Comprehensive Analysis of the Federal Columbia River Power System and Mainstem Effects of Upper Snake and Other Tributary Actions

U.S. Army Corps of Engineers
Bonneville Power Administration
U.S. Bureau of Reclamation

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TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
Action Agencies	U. S Department of the Interior Bureau of Reclamation (Reclamation), U.S. Army Corps of Engineers (Corps), and Bonneville Power Administration (BPA)
AFEP	Anadromous Fish Evaluation Program
AgWQMAP	Agricultural Water Quality Management Area Plans
Amsl	above mean sea level
APA	Administrative Procedures Act
AWS	auxiliary water supply
BA	Biological Assessment
bgs	behavioral guidance structure
BiOp	biological opinion
BLM	Bureau of Land Management
BMP	best management practice
BPA	Bonneville Power Administration
BRT	Biological Review Team
CBBTTAT	Clearwater Basin Bull Trout Technical Advisory Team
CBFWA	Columbia Basin Fish and Wildlife Authority
CBWTP	Columbia Basin Water Transactions Program
CCC	Civilian Conservation Corps
CCCD	Columbia County Conservation District
cfs	thousand cubic feet per second
COMPASS	Comprehensive Fish Passage Model
Corps	U.S. Army Corps of Engineers
CP	Conservation Practice
CR	Columbia River
CRE	Columbia River estuary
CREP	Conservation Reserve Enhancement Program
CRFMP	Columbia River Fish Management Plan
CRITFC	Columbia River Inter-Tribal Fish Commission
CTUIR	Confederation Tribes of the Umatilla Indian Reservation
CWA	Clean Water Act
DIS	direct in-river survival
DO	dissolved oxygen
DPS	Distinct Population Segment
Ecology	Washington State Department of Ecology
EDT	Ecosystem Diagnosis and Treatment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESBS	extended-length submerged bar screen
ESU	Evolutionarily Significant Unit
ETM	estuary turbidity maximum

FCRPS	Federal Columbia River Power System
FERC	U.S. Federal Energy Regulatory Commission
FLPMA	Federal Land Policy and Management Act
FPE	fish passage efficiency
FPOM	Fish Passage Operations and Maintenance Team
FPP	Fish Passage Plan
FR	Federal Register
FSA	Farm Service Agency
FWPCA	Federal Water Pollution Control Administration
FY	fiscal year
GBD	gas bubble disease
HCP	Habitat Conservation Plan
HCW	Habitat Conservation Workgroup
HGMP	Hatchery & Genetic Management Plan
HOF	hatchery-origin fish
HYDROSIM	Hydro Simulation Program
ICBEMP	Interior Columbia River Basin Ecosystem Management Project
IDEQ	Idaho Department of Environmental Quality
IFIM	Instream Flow Incremental Methodology
IOSC	Idaho Office of Species Conservation
IPC	Idaho Power Company
IPH	Idaho Power Company
IRDA	Interagency Restoration Database
ISRP	Independent Scientific Review Panel
JBS	juvenile bypass system
LCFRB	Lower Columbia Fish Recovery Board
LCR	Lower Columbia River
LCREP	Lower Columbia River Estuary Partnership
LSRCP	Lower Snake River Compensation Program
LWD	large woody debris
MAF	million acre-feet
MCMCP	Mid-Columbia Mainstem Conservation Plan
MCR	Middle Columbia River
mg/l	milligrams per liter
MGR	minimum gap runner
Mm	Millimeter
MMPA	Marine Mammal Protection Act
MOP	minimum operation pool
MPG	Major Population Group
MSA	Magnuson-Stevens Fishery Conservation and Management Act
msl	mean sea level
NEOH	Northeast Oregon Hatchery
NEPA	National Environmental Policy Act
NFH	National Fish Hatchery
NFMA	National Forest Management Act
NMFS	National Marine Fisheries Service

NO_2-N	Nitrite
NO_3-N	nitrate-nitrogen
NOAA	National Oceanic and Atmospheric Administration
NOF	natural-origin fish
NPCC	Northwest Power and Conservation Council
NPMP	Northern Pikeminnow Management Plan
NPMP	Northern Pikeminnow Management Program
NRCS	Natural Resources Conservation Service
NTU	nephelometric turbidity units
NWF	National Wildlife Federation
NWFP-ACS	Northwest Forest Plan – Aquatic Conservation Strategy
NWFSC	Northwest Fisheries Science Center
O&M	operations and maintenance
ODA	Oregon Department of Agriculture
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODS	overall direct survival
OHV	off-highway vehicle
OWRD	Oregon Water Resources Department
PA	Proposed Actions
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	primary constituent element
PDO	Pacific Decadal Oscillation
PH1	Bonneville Powerhouse I
PH2	Bonneville Powerhouse II
PIT	passive integrated transponder (tag)
PUD	public utility district
PVA	population viability analysis
PWG	Policy Work Group
QET	quasi-extinction threshold
R/S	recruits-per-spawner
Reclamation	U.S. Department of the Interior Bureau of Reclamation
RHCA	Riparian Habitat Conservation Area
RM	river mile
RM&E	research, monitoring, and evaluation
RMO	Riparian Management Objective
ROD	Record of Decision
RPA	Reasonable and Prudent Alternative
RSW	Removable spillway weir
Salmon PORT	Salmon Partners Ongoing Tracking System
SAR	smolt-to-adult return
SBNFTG	Southwest Basin Native Fish Technical Group
SCS	U.S. Soil Conservation Service
Settlement	Nez Perce Water Rights Settlement Agreement
SIS	Spillway Improvement Project
SR	spawner-recruit

SRSRB	Snake River Salmon Recovery Board
SRWRA	Snake River Water Rights Act of 2004
SSD	spatial structure and diversity
SSHIAP	Salmon and Steelhead Habitat Inventory and Assessment Project
TDG	total dissolved gas
TMDL	total maximum daily load
TP	total phosphorus
TRT	Technical Recovery Team
U.S.C.	United States Code
UCR	Upper Columbia River
USFS	U.S. Forest Service
USFWS	U. S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USRITAT	Upper Salmon River Interagency Technical Advisory Team
UWR	Upper Willamette River
VARQ	variable (VAR) outflow (Q)
VSP	Viable Salmonid Population
WDFW	Washington Department of Fish and Wild
WDNR	Washington Department of Natural Resources
WRIA	Water Resources Inventory Area
WSDOT	Washington State Department of Transportation
WSF	water supply forecast

Chapter 1
Introduction

TABLE OF CONTENTS

1.1 PURPOSE OF THE COMPREHENSIVE ANALYSIS

In this document, the Action Agencies--the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), U.S. Army Corps of Engineers (Corps), and Bonneville Power Administration (BPA)—combined and analyzed the effects of two separate actions on Endangered Species Act (ESA)-listed species in the lower Snake and Columbia rivers: (a) the operation and maintenance (O&M) of the Federal Columbia River Power System (FCRPS)[1]; and, (b) the operation and maintenance of the Reclamation's Upper Snake River projects.

In *American Rivers v. National Oceanic and Atmospheric Administration (NOAA) Fisheries*, the Court ordered that the analysis of effects occurring in the Upper Snake Biological Opinion (BiOp) remand be integrated with the analysis of effects for the remand of the 2004 FCRPS BiOp to ensure a "comprehensive analysis" of the effects of the two actions on the listed species and designated critical habitat. The Court also affirmed that the agencies were not required to address FCRPS and Upper Snake actions in one BiOp and allowed for separate consultations and separate BiOps. Because the Upper Snake River projects and the FCRPS are operated independently of one other, two separate BiOps will be prepared – one addressing the effects attributed to the operation of the FCRPS, and one that addresses the effects of the independent operation of 12 Upper Snake River projects. However, because both of these independent actions hydrologically influence flows in the Snake and Columbia rivers, it is reasonable to analyze these effects comprehensively.

FCRPS Consultation. The FCRPS Action Agencies have undergone ESA Section 7 consultation on the effects of the FCRPS[2] on listed salmon and steelhead since the early 1990s. The current FCRPS litigation began in 2001 when the National Wildlife Federation et al. (NWF) challenged the adequacy of the 2000 FCRPS BiOp. In 2003, the U.S. District Court of Oregon, found the 2000 FCRPS BiOp "arbitrary and capricious" and remanded to NOAA Fisheries (also called National Marine Fisheries Service or NMFS). NOAA Fisheries completed a revised FCRPS BiOp in November 2004.

The NWF challenged the 2004 FCRPS BiOp, and in October 2005, the Court ordered a remand of the 2004 FCRPS BiOp to make a jeopardy determination that complies with the ESA and address the legal flaws as follows:

1. correct its improper segregation of the elements of the proposed action NOAA Fisheries deems to be nondiscretionary;
2. correct its improper comparison, rather than aggregation, of the effects of the proposed action on the listed salmon and steelhead;
3. correct the flawed critical habitat determinations;
4. fix the inadequacy of the jeopardy determination in addressing the effects of the proposed action on both recovery and survival; and
5. correct past reliance on mitigation measures that are not reasonably certain to occur.

[1] The FCRPS comprises 14 Federal multipurpose hydroprojects. The 12 projects operated and maintained by the Corps are: Bonneville, The Dalles, John Day, McNary, Chief Joseph, Albeni Falls, Libby, Ice Harbor, Lower Monumental, Little Goose, Lower Granite, and Dworshak dams. Reclamation operates and maintains the following FCRPS projects: Hungry Horse Project and the Columbia Basin Project, which includes Grand Coulee Dam. The FCRPS consultation also includes the mainstem effects of other Reclamation projects in the Columbia Basin.
[2] The FCRPS projects addressed in these consultations were authorized by Congress for multiple purposes including flood control, navigation, irrigation, power generation, recreation, municipal water supply, fish and wildlife, and water quality.

In accordance with instructions from the Court, NOAA Fisheries and the FCRPS Action Agencies are collaborating with four States and seven Tribes to develop actions to include in the proposed action, clarify policy issues, and narrow areas of disagreement on scientific and technical information.

Upper Snake River Consultation. In November 2004, Reclamation initiated formal consultation under Section 7 of the ESA by submitting a biological assessment (BA) to NOAA Fisheries (Reclamation 2004). The BA described 12 separate actions involving operations and routine maintenance at 12 Reclamation projects located upstream of Idaho Power Company's (IPC's) Brownlee Reservoir, and evaluated the potential effects of those actions on ESA-listed endangered or threatened species and their designated critical habitat. The projects, collectively referred to as the Upper Snake projects, are Minidoka, Palisades, Michaud Flats, Ririe, Little Wood River, Boise, Lucky Peak, Mann Creek, Owyhee, Vale, Burnt River, and Baker.

Reclamation initiated consultation because the existing BiOp expired before the start of the 2005 irrigation season, and some components of the proposed actions differed from the actions consulted upon previously. Most notable was the development of the Nez Perce Water Rights Settlement that described the conditions for continued provision of salmon flow augmentation from the upper Snake River.

NOAA Fisheries issued its BiOp in March 2005 (2005 Upper Snake River BiOp) (NMFS 2005a). The 2005 Upper Snake River BiOp concluded that Reclamation's proposed actions were not likely to jeopardize the continued existence of 13 Columbia River Basin Evolutionarily Significant Units (ESUs) [or Distinct Population Segments (DPS), which is often used for steelhead] listed or proposed for listing, or to adversely modify or destroy designated critical habitat for three ESUs.

In 2005, American Rivers and others filed a suit alleging Administrative Procedures Act (APA) and ESA violations (*American Rivers v. NOAA Fisheries*). On May 23, 2006, the U.S. District Court of Oregon held that NOAA Fisheries' 2005 Upper Snake River BiOp was invalid because it used the same comparative jeopardy analysis used in the FCRPS BiOp. On September 26, 2006, the Court issued an order requiring the Federal defendants to produce a comprehensive analysis, which considers the combined effects of the Reclamation projects and the FCRPS operations on listed species.

The Federal agencies are working together to implement the Court's instructions in *American Rivers v. NOAA Fisheries,* and have developed this comprehensive analysis based on the best scientific and commercial data available to evaluate the effects of Reclamation's operation of the Upper Snake projects together with the effects of the operation of the FCRPS. This Comprehensive Analysis includes an evaluation of the effects of the:

1. FCRPS Proposed Reasonable and Prudent Alternative (RPA)
2. Upper Snake River Proposed Actions (PA)
3. environmental baseline
4. cumulative effects.

This analysis evaluates all of these effects, factoring in the status of the species, and applies the jeopardy framework described in memoranda prepared by Robert Lohn, NOAA Fisheries Regional Administrator, dated July 12, 2006, and September 11, 2006 (Lohn 2006a and 2006b).

In conducting the Comprehensive Analysis, the Action Agencies specifically addressed the Court's concerns as follows: (1) the analysis of the action makes no distinction between discretionary and nondiscretionary actions; (2) the effects of the action are considered within the context of other existing human activities that impact the listed species; (3) critical habitat is considered in the context of life cycles and migration patterns; any actions on which the Action Agencies rely to improve safe passage are reasonably certain to occur; (4) the jeopardy analysis expressly considers the prospects for recovery; and (5) for mitigation measures upon which they rely for benefits, the Action Agencies provide specific plans as well as a clear, definite commitment of resources; actions that the Action Agencies intend to take but that may seem less certain, were not included as quantitative benefits in the analysis.

1.2 GEOGRAPHIC AREA

The geographic area of this comprehensive analysis is consistent with the description of the FCRPS action area and the Upper Snake River project action area identified in the respective BAs.[3] Generally, the geographic scope addressed in this comprehensive analysis encompasses the areas that are hydrologically influenced by the operation of the Upper Snake River projects and the FCRPS projects including the:

- Snake River system including specified tributaries above IPC's Hells Canyon Complex, the Snake River from the tailrace of Hells Canyon Dam (the last of IPC's three Hells Canyon Complex dams), and the Clearwater River below Dworshak Dam to the confluence with the Columbia River; and
- Columbia River system from Libby and Hungry Horse dams in Montana, including specified tributaries down to and including the estuary and plume.

1.3 DURATION OF FCRPS AND UPPER SNAKE RIVER ACTIONS

In 2004, Congress passed the Snake River Water Rights Act of 2004 which implements the Nez Perce Water Rights Settlement Agreement. The Snake River Water Rights Act provides in pertinent part: "the Secretary of Interior and the other heads of Federal agencies with obligations under the Agreement shall execute and perform all actions, consistent with this Act, that are necessary to carry out the Agreement." See Snake River Water Rights Act § 4, Pub. L. No. 108-447, 2004 U.S.C.A. (118 stat. 2809, 3433). The Settlement in turn provides: "The term of this [Snake River Flow] component of the agreement shall be for a period of thirty (30) years with opportunity for renewal upon mutual agreement" (See Settlement Term Sheet at Section III.A and III.K, Nez Perce Tribe et al. 2004). Thus, as specified by Congress, the term of Reclamation's proposed actions and consultations on the Upper Snake River projects is 30 years, commencing in 2005 through 2034.

The provisions of the Snake River Flow component of the Nez Perce Water Rights Settlement form the foundation for the upper Snake proposed actions for this consultation. The Settlement provides a framework for administrative and legislative actions that make possible certain aspects of the proposed actions. For example, State protection of water provided for flow augmentation has been achieved through changes to Idaho State law enacted by the Idaho Legislature for the 30-year duration of the Snake River Flow component of the Settlement (through 2034). Similarly, Reclamation has secured a 30-year lease of 60,000 acre-feet of private natural flow water rights for flow augmentation, granted solely under the authorities of the State of Idaho, pursuant to the same Idaho statute.

The term of the FCRPS Proposed RPA is 10 years. The objective of the FCRPS consultation is to determine whether the 10-year program of actions will avoid jeopardy and adverse modification of critical habitat and whether it will result in a trend toward recovery for the ESUs and DPSs and the conservation values of primary constituent elements for designated critical habitat, including its future effects, beyond

[3] A detailed description of the FCRPS action area is in the FCRPS BA - Section 1.3. A detailed description of the Upper Snake River action area is in the Upper Snake River BA in Section 2.2.

the last year of the program's implementation. This Comprehensive Analysis evaluates the effects from the FCRPS activities occurring through 2017.

This Comprehensive Analysis contains a quantitative and qualitative analysis of the combined Upper Snake River PA and FCRPS Proposed RPA and considers various factors in addressing the risks of extinction and prospects for survival and recovery for listed salmon and steelhead through the year 2017 (a ten year period). Reclamation recognizes the temporal difference between the FCRPS Proposed RPA and the Upper Snake River PA and the resulting challenge of conducting a comprehensive analysis of both actions. Under existing case law, Reclamation is required to conduct an analysis that is coextensive with the 30-year action proposed in its 2007 Upper Snake River BA. In order to evaluate the effects of the Upper Snake River PA through the year 2034, Reclamation assumed that FCRPS operations would continue as proposed in the FCRPS BA (Corps 2007). Reclamation used modeled hydrologic data from MODSIM and HYDSIM to use as part of a qualitative analysis of the hydrologic effects of its Upper Snake River actions for the years 2017 through 2034 on listed anadromous fish. This qualitative analysis is contained in the 2007 Upper Snake River BA (Reclamation 2007, see Chapters 3 and 4).

Reclamation will review the Upper Snake River consultation in 2017 to determine whether a continuation of the PA is acceptable given the conditions of the various populations at the ESUs and DPSs at that time. This commitment ensures that if the FCRPS Proposed RPA changes after 2017, Reclamation will re-evaluate its analysis. Further, Reclamation and NOAA Fisheries will continually review the status of listed salmon and steelhead, Reclamation's performance, and other factors to determine whether the triggers specified in 50 CFR 406.16 require earlier reinitiation of consultation.

1.4 ORGANIZATION OF THE COMPREHENSIVE ANALYSIS

The Comprehensive Analysis presented in the following chapters includes supporting material that describes the Action Agencies' evaluation of the effects of the:

1. Proposed FCRPS RPA
2. Upper Snake River PA
3. Environmental Baseline
4. Cumulative Effects.

Discussion of the Environmental Baseline is in Chapter 2. Chapter 3 describes the general analytical approach and methodologies as well as details the numerical analysis for the Interior Columbia River Basin ESU/DPSs. This chapter is supported by Appendices A through E, which contain resource area (All-H) specific analytical information. Chapters 4 through 16 provide the detailed ESU/DPS specific biological analysis. Chapters 17 and 18 explain the Action Agencies' analysis of the Cumulative Effects and Other Federal Actions to Conserve Species, respectively. Chapter 19 contains the analysis of the effects of the proposed FCRPS RPA and the Upper Snake River PA on designated Critical Habitat. Chapter 20 contains references.

Chapter 2
Environmental Baseline

TABLE OF CONTENTS

2 ENVIRONMENTAL BASELINE

2.1 INTRODUCTION

The Comprehensive Analysis addresses the integrated analysis of effects of the Federal Columbia River Power System (FCRPS) Proposed Reasonable and Prudent Alternative (RPA) and the Upper Snake River Proposed Actions (PA) on the listed species and designated critical habitat. The “effects of the action” is defined as “the direct and indirect effects of an action on the species or 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. The environmental baseline includes the past and present impacts of all Federal, State or private actions and other human activities in the action areas, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process” (50 CFR § 402.02). In the following two paragraphs, the Action Agencies explain how the environmental baseline is incorporated into the biological analysis, its observations and conclusions.

The analytical approach employed in this Comprehensive Analysis considers the biological requirements for survival and recovery of the Endangered Species Act (ESA)-listed species in question, and evaluates whether the species are likely to survive and trend toward recovery after considering the combined effects of the FCRPS Proposed RPA and the Upper Snake River PA, the environmental baseline, and cumulative effects. It is a lifecycle survival analysis that necessarily considers all mortality factors affecting the listed species, as well as all actions that have an impact on the species’ survival, productivity, and population growth rates. In effect, the analysis makes no distinction between the Federal action, the environmental baseline, or cumulative effects. All impacts on the salmon or steelhead lifecycle are combined for the purposes of this analysis.

The quantitative analysis employed in this Comprehensive Analysis relies on commonly used and accepted biological metrics that measure lifecycle survival (also referred to as productivity, population growth rate, or abundance trend), as well as estimated extinction risk, under different modeling assumptions. Because the analysis proceeds from empirical estimates of average lifecycle survival over an historical period, *it captures all sources and causes of salmon mortality during that period.* The analysis then “adjusts” those average historical survival estimates to reflect current conditions—again, combining all sources of mortality as well as survival improvements into the analysis. Finally, it builds upon this estimate of current survival to incorporate the effects of the proposed RPA/PA combined with any anticipated effects of proposed Federal projects that have undergone Section 7 consultation and the effects of State and private actions that are reasonably certain to occur. Thus, the conclusions in this Comprehensive Analysis are based upon an analytical process that seeks to integrate all effects on the salmonid lifecycle into every step of the analysis.

2.2 BIOLOGICAL REQUIREMENTS AND ESSENTIAL HABITAT FEATURES

Detailed information used in this analysis on the status of the species and base and current status can be found in the introduction, key limiting factors, base status, and current status sections of Chapters 4 through 16 of this Comprehensive Analysis and Appendix A of the FCRPS BA.

The Action Agencies also referred to several other sources for baseline information. These sources included population-level datasets supplied by the Interior Columbia Basin Technical Recovery Team (TRT) (Cooney 2006), National Marine Fisheries Service (NMFS; also called National Oceanic and Atmospheric Administration [NOAA] Fisheries) recovery plans for salmon and steelhead in the Columbia

River Basin (2007 Reference File), the 2000 and 2004 FCRPS Biological Opinions (BiOps) (NMFS 2000, 2004), 2005 Upper Snake River BiOp (NMFS 2005a), and updated status of Federally listed Evolutionarily Significant Units (ESUs) of West Coast salmon and steelhead (NMFS 2005b).

2.3 FACTORS AFFECTING SPECIES

Salmon and steelhead have been adversely affected in the Columbia River Basin over the last century by many activities including human population growth, urbanization, introduction of exotic species, overfishing, development of cities and other land uses in the floodplains, water diversions for all purposes, dams, mining, farming, ranching, logging, hatchery production, predation, ocean conditions, and loss of habitat (Lackey et al. 2006). Factors affecting salmon and steelhead related to the FCRPS and Reclamation's projects are briefly discussed below; these effects were documented in detail previously (NMFS 2000, chapters 5 and 6; NMFS 2005a). This information and other factors were integrated into the analytical approach as described in Appendix B of this Comprehensive Analysis.

A description of recent improvements for salmon and steelhead can be found in Appendix A of the FCRPS BA. The system overhaul included structural and operational changes for fish passage at the mainstem dams; regulating flow to assist juvenile fish migration; spill operations to assist juvenile fish passage; transport of juvenile fish; control of predators; hatchery improvements; habitat improvements; harvest changes; development of performance standards; and research, monitoring, and evaluation (RM&E) to support adaptive management.

2.3.1 Hydrologic Effects

2.3.1.1 Streamflow Effects of FCRPS and Other Reclamation Project Operations

Hydropower and water management in the Columbia River Basin have impeded salmonid migrations, altered habitats, and increased predation on and competition faced by juvenile salmonids. The following descriptions are from NMFS (2004 and 2005a) unless otherwise indicated.

2.3.1.2 Flow Alterations

Changes in flow patterns and quantity can affect salmon migration and survival through both direct and indirect effects. Juvenile and adult migration behavior and travel rates are related to river flow and several other factors. Current flow depletions and estimated hydrologic conditions of the current FCRPS and Upper Snake River operations are reported in Appendix B of this Comprehensive Analysis.

Flow fluctuations may stimulate or delay juvenile migration or adult migration, thereby affecting the timing of juvenile arrival in the estuary and ocean or adult arrival at the spawning grounds. Flow also affects the availability of habitat for mainstem spawning and rearing stocks. Rapid diurnal flow fluctuations can disrupt mainstem spawners, leave redds dewatered, or strand juveniles.

As described in Appendix A of the FCRPS BA, many activities by the Action Agencies have reduced these adverse effects. The Action Agencies improved flow regulation for salmon migrations and acquired water for flow augmentation.

2.3.1.3 Water Quality

Flow regulation, reservoir construction, and other factors have increased average water temperatures beyond optimums for salmon in the lower Columbia River. Large mainstem storage reservoirs have decreased maximum summer temperatures in the lower Snake and Columbia rivers, but have increased the period of time when temperatures are higher than optimal for salmonids. High water temperatures can cause migrating adult salmon to stop or delay their migrations. Warm temperatures can also increase the susceptibility of fish to disease. There are many periods of the year, including months when salmon are present, that water temperatures remain within the acceptable range. Flow management and flow augmentation are also used to improve water temperatures, when appropriate (Appendix A of the FCRPS BA).

Flow regulation and reservoir construction also have increased water clarity, which can affect salmon through food availability and susceptibility to disease and predation. Water can become supersaturated with atmospheric gases, primarily nitrogen, when water is spilled over high dams. This can result in substantial stress, which can lead to mortality. Gas supersaturation poses the greatest risk for the salmon stocks in the Lower Columbia Domain, which must pass Bonneville Dam or transit the portion of the mainstem immediately downstream of Bonneville Dam. As described in Appendix A of the FCRPS BA, many actions have reduced harm to salmon and steelhead related to supersaturated gas; these actions include spill management for juvenile passage and construction of spill deflectors at Bonneville, John Day, McNary, Ice Harbor, Lower Monumental, and Lower Granite dams.

2.3.1.4 Altered Ecosystems

Modification of riverine habitat into impoundments has resulted in changes in habitat availability, migration patterns, feeding ecology, predation, and competition. For example, the Bonneville Dam impoundment has inundated some spawning habitat in the lower reaches of the upper Columbia Gorge tributaries. Downstream migration is slower through impoundments; upstream migration is faster. Food webs are different in the impoundments than in natural rivers. Predation is a major source of mortality, although the same may have been true in the predevelopment condition. Reservoir conditions (flow and temperature) may favor the growth of fish predators, including native northern pikeminnow and nonnative walleye and smallmouth bass. Appendix A of the FCRPS BA describes a host of actions implemented since 1994 designed to reduce some of these impacts.

2.3.1.5 Migration Barriers

Blocked Habitat

The construction of Grand Coulee Dam in 1939 blocked access to historical production areas for upper Columbia River spring Chinook salmon and steelhead (National Research Council 1996, cited in Interior Columbia Basin TRT 2003). Chief Joseph Dam, the reregulating dam for Grand Coulee and downstream of Grand Coulee, is also impassable. The Sanpoil, Spokane, Colville, Kettle, Pend Oreille, and Kootenai rivers each may have supported one or more populations of Chinook salmon and/or steelhead.

Before European contact, Snake River fall Chinook salmon are believed to have occupied the mainstem Snake River up to Shoshone Falls (Gilbert and Evermann 1894, cited in Interior Columbia Basin TRT 2003). In particular, the area downstream of Upper Salmon Falls, at river mile (RM) 578, was identified by Evermann (1896) as the "... largest and most important salmon spawning ground of which we know in Snake River." After loss of these upstream reaches with construction of Swan Falls Dam in 1901, the reach between Marsing, Idaho, and Swan Falls Dam (RM 349 to 424) is believed to have been the primary spawning and rearing area for Snake River fall Chinook salmon (Irving and Bjornn 1981; Haas 1965, cited in Interior Columbia Basin TRT 2003). However, construction of the Hells Canyon Dam Complex (1958 to 1967) cut off access to historical habitat upstream of RM 248. Additional fall Chinook salmon habitat was lost through inundation as a result of the construction of the lower mainstem Snake River dams (Groves and Chandler 1999). In addition to the loss of fall Chinook salmon habitat on the mainstem Snake River, the Hells Canyon Dam Complex cut off access to historical habitat in seven tributaries for spring/summer Chinook salmon and steelhead. The seven tributaries are the Boise, Burnt, Bruneau, Owyhee, Payette, Powder, and Weiser rivers. Black Canyon Dam, completed in 1924, blocked access to historical habitat for sockeye salmon in the Payette River above RM 38.7.

2.3.1.6 Juvenile Dam Passage

Smolts typically migrate near mid-channel in the upper water column where water velocities are greatest. Juvenile fish generally pass the Federal mainstem dams either through spillways, turbines, surface collectors or through screened juvenile bypass systems. Some fish are delayed in the forebays at some mainstem hydroelectric projects during daylight, reluctant to sound so they can either enter a turbine or find the intake to some of the juvenile bypass systems.

Juveniles may experience substantially different mortality rates depending on whether passage occurs via turbines, a bypass system, or spill. Turbines are typically the most hazardous route.[1] Mortality results from abrupt pressure changes in the turbines and from mechanical injury. Thus, spillways, surface collectors, and bypass systems are generally the safer routes of passage.

At many projects, current operations provide dedicated spill to facilitate dam passage by juveniles. Surface bypass systems have generally proven highly effective at safely guiding juvenile fish downstream through non-turbine passage routes. Appendix A to the FCRPS BA explains the many actions already implemented to improve juvenile salmon passage at dams, including spill improvements, addition of the Bonneville Corner Collector, and the addition of removable spillway weirs (RSWs) at Ice Harbor and Lower Granite dams. Current dam survivals are discussed in Appendix B of the FCRPS BA.

Juvenile bypass systems that divert fish from turbine intakes are now in place at almost all the Federal mainstem dams in the Columbia River system.[2] Most systems involve large submerged screens that project downward into the turbine intakes and deflect fish upward into a gatewell, where they pass through orifices into channels that run the length of the dam. The fish are then either routed back to the river below the dam or to the transport facilities at three of the four Snake River dams (Lower Granite, Little Goose, and Lower Monumental), and McNary Dam on the Columbia River. Appendix A to the FCRPS BA notes improvements to bypass systems and fish transportation.

Spillways are generally considered to be one of the safest passage routes for fish passing the Federal mainstem dams (NMFS 2005c). However, studies have shown that survival through spill may vary depending on the dam, level of spill, spill patterns, fish size and stock specific, and due to environmental conditions. (e.g., at Bonneville Dam in 2004, daytime spill survival for subyearling fish was 87 percent, while at other times spillway survival was 98 percent. Further explanation of spillway passage and improvements in spillways is contained in Appendix A to the FCRPS BA.

Specific seasonal releases of water from the dams, called flow augmentation, are meant to aid salmon migration. Water stored in several FCRPS dams in the upper Columbia River and Snake River basins is used to augment flows when juveniles are moving through the system. Water stored during winter storms is released in the spring and summer months to improve flows (and in some cases, water temperatures) in the lower Snake and Columbia rivers.

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[1] In conventional Kaplan turbines, fish may be injured or killed by mechanical, pressure, or shear related affects in passage through a turbine (Electric Power and Research Institute 1987). Recent turbine designs are intended to reduce the effects associated with mechanical or pressure related injuring to fish. Chelan Public Utility District (PUD) therefore recently replaced all of the units at Rocky Reach Dam with “reduced gap” turbines (i.e., smaller spaces between the turbine blades and the walls of the housing and at the hub). The Corps is upgrading turbine units at Bonneville Powerhouse 1 (PH1) with minimum gap runners (MGRs), which has been shown to reduce injuries on juvenile fish passing through the turbines.

[2] Screened bypass systems are operational at Bonneville PH1 and second powerhouse (PH2), John Day, McNary, Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams. For the Federal mainstem dams, only The Dalles Dam does not have a screened juvenile bypass system, as it relies on a surface collector and spill as the primary routes for juvenile passage.

In combination, actions for fish, as indicated in Appendix A of the FCRPS BA, have resulted in improved juvenile salmon survival past the dams. For Snake River juveniles, system survival is now equivalent to what it was in the 1960s, when only four Federal dams were in place on the Columbia and Snake rivers.

A more comprehensive analysis of juvenile and adult direct and indirect effects of passage through the mainstem dams can be found in the two NMFS technical memorandums (NMFS 2005c,d).

2.3.1.7 Adult Dam Passage

Fish passage in the form of fish ladders is provided at the eight mainstem FCRPS projects in the lower Snake and lower Columbia rivers and the five mainstem U.S. Federal Energy Regulatory Commission (FERC)-licensed projects in the Mid-Columbia River reach. In general, adult passage facilities are highly effective. Nonetheless, salmon may have difficulty finding ladder entrances, and fish also may fall back through the spillway or turbines, either voluntarily (like steelhead that often "overshoot" their natal stream), or involuntarily, after exiting the fish ladder.

Appendix A to the FCRPS BA documents improvements at the mainstem dams to support adult migration. Adult survival past the dams is good for all listed species.

2.3.2 Habitat Effects

The quality and quantity of habitat for salmon and steelhead have declined during much of the past 150 years. For at least the past decade, substantial habitat improvement efforts have been under way throughout the Columbia River Basin. A compilation of habitat and primary constituent element status is noted in the 2007 Reference File. Appendix A to the FCRPS BA reports improvements in habitat related to past Action Agencies' work. In addition, the States of Washington, Oregon, and Idaho and other entities have implemented habitat improvement projects throughout the Columbia River Basin.

2.3.3 Hatchery Effects

The Comprehensive Analysis assumes that average hatchery impacts on listed fish during a 20-year base period approximately spanning brood years 1980 to 1999 would continue into the future (except where specifically noted in the analysis). The hatchery programs that the Action Agencies have included as part of the programmatic consultation are listed in Attachment B.2.3-3 of the FCRPS BA. Most of the FCRPS mitigation hatchery programs (Lower Snake River Compensation Plan, Grand Coulee Dam mitigation, and Dworshak and John Day mitigation) were in operation during this entire 20-year period and continue to operate today.

Artificial propagation programs authorized by Congress under the Lower Snake River Compensation Plan are included in the environmental baseline. The artificial propagation facilitates under this program were originally authorized to help mitigate for the construction of the four Federal lower Snake River hydroelectric dams.

All Federal and non-Federal artificial propagation programs in the Columbia River Basin above Priest Rapids Dam are included in the environmental baseline. The current Section 7 BiOp for hatchery operations associated with unlisted salmon species (for Federally funded programs) and Permit 1347 (for State-operated programs) both expire October 22, 2013. ESA permits [1396, U.S. Fish and Wildlife Service (USFWS) and 1412, Confederated Tribes of the Colville Reservation] associated with listed steelhead are in place through October 2, 2008, and permit 1395 [issued to the Washington Department of Fish and Wildlife (WDFW)] is in place through October 2, 2013. ESA permit 1300, issued to the

USFWS to propagate listed spring Chinook salmon, is in place through December 31, 2007, and permit 1196, issued to WDFW, expires January 20, 2014.

For more than 100 years, hatcheries in the Pacific Northwest have been used primarily to produce fish for harvest and to replace natural production lost to dam construction and other development. They have also been used to sustain naturally produced salmonid populations (e.g., Redfish Lake sockeye salmon).

A large proportion of salmonids returning to the region are first-generation hatchery-origin fish. For example, 80 percent of upper Columbia River steelhead, 50 percent of upper Columbia River spring Chinook salmon, 85 percent of Snake River steelhead, 60 percent of Snake River fall Chinook salmon, and 80 percent of Snake River spring/summer Chinook salmon originated in hatcheries (Federal Caucus 2005). Because hatcheries have traditionally focused on providing fish for harvest, it is only recently that the adverse effects of hatcheries on natural populations have been demonstrated. When appropriate, hatcheries can also be used as a "safety-net" for listed species. NMFS has described the effects of Columbia River Basin artificial propagation programs on ESA-listed stocks in numerous documents, including NMFS (2003), NMFS (2004), and the recent updated status review (NMFS 2005b).

The role hatcheries play in the Columbia River Basin is being redefined by NMFS through its final proposed hatchery ESA listing policy, development of environmental impact statements, hatchery reform efforts, and recovery planning efforts. These efforts will focus on maintaining and improving ESU viability. Research designed to clarify interactions between natural and hatchery fish and to quantify the effects of artificial propagation on natural fish will play a pivotal role in informing these efforts. The final facet of these initiatives is to use hatcheries to create fishing opportunities that are benign to listed populations (e.g., terminal area fisheries). Improvements to hatchery operations that benefit listed salmon are documented in Appendix A to the FCRPS BA.

2.3.4 Harvest Effects

This Comprehensive Analysis assumes that average harvest impacts on listed fish during a 20-year base period approximately spanning brood years 1980 to 1999 would continue into the future.

Treaty Indian fishing rights in the Columbia River Basin are under the continuing jurisdiction of the U.S. District Court of Oregon in *U.S. v. Oregon*, No. 68-513 (D. Or., continuing jurisdiction case filed 1968). The parties to *U.S. v. Oregon* are the United States acting through the Department of the Interior (USFWS and Bureau of Indian Affairs) and Department of Commerce (NMFS [also called NOAA Fisheries]); the Warm Springs, Umatilla, Nez Perce, Yakama, and Shoshone-Bannock Tribes; and the States of Oregon, Washington, and Idaho.

Starting in 1977, Tribal and State fisheries subject to *U.S. v. Oregon* have been regulated pursuant to a series of court orders reflecting court-approved settlement agreements among the parties. The last long-term agreement, known as the Columbia River Fishery Management Plan (CRFMP), was adopted and approved by the Court in 1988 and expired in 1999. At the Court's direction and under its supervision, the parties are currently in the process of negotiating a new long-term agreement.

During the past 10 years, harvest has been managed pursuant to the CRFMP and successor agreements that contain restraints on the fisheries necessitated by the ESA listings of some of the ESUs. As a result, NMFS has conducted ESA Section 7 consultations and issued no-jeopardy opinions covering these agreements and their impact on ESA-listed species.

2.4 ALREADY COMPLETED SECTION 7 CONSULTATIONS

This consultation includes the Columbia River mainstem effects of the following Reclamation projects that have already undergone Section 7 consultation for tributary effects: Crooked River, Deschutes, Wapinitia, and Umatilla projects.

The Action Agencies reviewed materials provided by NMFS on already completed ESA Section 7 consultations in the Columbia River Basin since November 30, 2004. The results of this effort are summarized briefly in Chapters 4 through 14 (sections titled: Other Federal Actions That Have Completed ESA Consultation). NMFS reported completed consultations on habitat actions that benefit salmon, steelhead, or other species throughout many of the Columbia River tributaries. The lists from NMFS also included actions not directed toward benefiting fish, such as bridge repairs, fire-suppression activities, and other activities.

Chapter 3
Analytical Approach

TABLE OF CONTENTS

LIST OF TABLES

3.1 EFFECTS ANALYSIS: POPULATION METRICS AND ANALYTICAL FRAMEWORK

3.1.1 Introduction

This chapter describes the analytical approach and population metrics used to assess the status of the Evolutionarily Significant Units (ESUs) of salmon [or the term Distinct Population Segments (DPSs), which is often used for steelhead] in the Interior Columbia River Basin listed as threatened or endangered under the Endangered Species Act (ESA). For the most part, adequate information is available to quantitatively estimate abundance and productivity for populations in the Interior Columbia River Basin.

Where information is generally available for populations within an ESU, but data are lacking for a limited number of populations in the ESU, the analysis assumes that the populations for which data are available are reasonably representative of the populations lacking such data. For ESUs where sufficient population-level information is lacking for most populations, the quantitative analytic approach described in this chapter is not used. The analysis for those ESUs is necessarily qualitative. This is the case, to a significant degree, for the Snake River Steelhead DPS in the Interior Columbia River Basin, where Interior Columbia Basin Technical Recovery Team (TRT) estimates for "average" A-run and B-run populations are relied upon, but may not be representative of the status of specific populations. It is entirely the case for all of the listed ESUs in the lower Columbia River and Willamette River basin. For those ESUs , the analysis relies on base period information supplied by National Marine Fisheries Service (NMFS, also known as National Oceanic and Atmospheric Administration [NOAA] Fisheries) Biological Review Team (BRT), the Willamette-Lower Columbia TRT, and local recovery boards. Estimates of current and prospective status for these populations and ESUs are almost entirely qualitative, based upon best professional judgment.

The analytical approach described in this chapter considers the biological requirements for survival and recovery of the listed species, and evaluates whether the species are likely to survive and be placed on a trend toward recovery after considering the effects of the Federal Columbia River Power System (FCRPS) Proposed Reasonable and Prudent Alternative (RPA) and the Upper Snake River Proposed Actions (PA) aggregated with the environmental baseline and cumulative effects. As such, it is a lifecycle survival analysis that necessarily considers all mortality factors affecting the listed species, as well as all actions that have an impact on the species' survival, productivity, and population growth rates.

This chapter includes a description of the step-wise process for estimating how population metrics indicative of lifecycle survival would change over time based on:

1. hind casting the effects of recent actions or changes that have been implemented to improve survival relative to the base period used for our assessments (generally the 20-year period from about 1980 to 2000); and

2. implementation of those future actions proposed to be implemented by the Action Agencies, aggregated with other changes that have undergone ESA Section 7 consultation and/or are reasonably certain to occur.

These actions include both operational and configuration changes designed to:

- improve juvenile survival past dams and through the reservoirs of the FCRPS,
- improve tributary habitat conditions,

- improve estuary habitat conditions,
- decrease avian and piscivorous predation, and
- improve hatchery operations.

In the case of prospective improvements attributed to tributary habitat improvements, these were divided into those planned for the near term (2007 to 2009) and those for the long term (2010 to 2017). For the purposes of this analysis, the Action Agencies relied upon datasets provided by the Interior Columbia Basin TRT (Matheson 2006; Cooney and Matheson 2006).

Subsequent sections of this chapter describe the:

- relationship between the Action Agencies' analytic approach and NMFS' proposed jeopardy standard,
- metrics used in this analysis,
- methods used to estimate extinction probabilities,
- method used to estimate survival improvements related to certain categories of hatchery reform,
- treatment of statistical uncertainty, and
- multiple quasi-extinction thresholds used for extinction modeling purposes.

3.1.2 Jeopardy Analysis and Metrics

In two recent memoranda (Lohn 2006a, b), NMFS described the framework it intends to use in its Biological Opinion (BiOp) for the FCRPS and Upper Snake River. These memoranda address, among other topics, the general analytical framework for determining current and future population status, a strategy for judging the benefits of reduced risk associated with changes in the All Hs (hydro, habitat, hatchery, and harvest), the definition and application of a jeopardy standard, and a list of biological metrics of population status that can be used in the jeopardy determination and for judging progress toward recovery. The Action Agencies' biological analysis seeks to conform to the approach described in the NMFS memoranda.

NMFS has indicated that the jeopardy determination will address both the survival and recovery of the listed species. While it is obvious that a species must survive to avoid jeopardy, the recovery consideration requires further explanation. As contemplated by NMFS, the recovery test will need to demonstrate a "trend toward recovery" based on the "the expected effectiveness of the mitigation measures in reducing obstacles to recovery…" (Lohn 2006b).

NMFS has indicated it will look at multiple biological metrics to assess the status of listed populations in the context of its jeopardy analysis (Lohn 2006b). NMFS logically argues that no one metric by itself is adequate to render a jeopardy determination. Any individual metric is sensitive to different assumptions and measures different aspects of a species' status. The metric that NMFS suggested as a primary (but not the only) indicator of the survival component of the jeopardy analysis is modeled risk of quasi-extinction. The metrics identified for the recovery component include cohort replacement rate or recruits-per-spawner (R/S) productivity, median annual population growth rate or lambda (λ), and the log-transformed abundance trends of natural-origin spawners. All of these metrics can provide valuable insight into the status of the population, but each has inherent limitations and biases that need to be considered. All are highly dependent on the quality of data that are used in the calculations. All of the population level metrics are estimated using the same datasets, which were supplied by the Interior Columbia Basin TRT.

This jeopardy construct effectively establishes a framework in which selected biological metrics are potentially appropriate for one or both of the analyses (i.e., survival and recovery). For example, estimating risk of extinction over a particular time horizon (i.e., a population viability analysis [PVA]) logically addresses the question of survival, but it is not the only population metric relevant to survival. Productivity metrics such as R/S or median population growth rate are also important indicators of survival potential. Recent abundance and abundance trends are also significant to an analysis of this kind.

Similarly, although progress toward recovery can be gauged using such metrics as R/S, median population growth rate, and general trend analyses, the results of a PVA are also relevant. That said, in the sections that follow, the metrics are presented in the context of the survival or the recovery standard, with the understanding that the distinction is not black and white.

An important caveat to note in the use of all of these metrics for assessing population status is that they are estimates and not absolute values; each has an associated confidence interval that is explicitly acknowledged. Data underpinning these estimates, although considered the best available, were collected by a variety of different agencies (and individuals), using protocols that evolved and changed over time. These metrics are best viewed as broad indicators of population status and expected trends over time. A more thorough discussion on this subject can be found below. Estimates of these parameters for selected salmon and steelhead stocks in the Interior Columbia River Basin are presented in Attachments A-1 through A-6 to Appendix A.

The following is a brief description of each of these metrics as currently applied to salmon populations in the Columbia River Basin, and a discussion of some generally acknowledged strengths and limitations of each.

3.1.2.1 Survival Component of the Jeopardy Analysis

NMFS has indicated that it will consider the following metrics and qualitative biological information in assessing the survival component of the jeopardy analysis.

- A 24-year quasi-extinction risk analysis (quasi-extinction = <50 spawners for each of four consecutive years);
- Recent trends in abundance and productivity (trends are stable or showing improvement);
- The degree to which safety-net and/or supplementation hatchery programs meet program objectives;
- The degree to which actions targeted at limiting factors and threats are anticipated to generate biological benefits in the short term have been implemented; and
- The effectiveness of monitoring, performance standards, adaptive management, and governance in addressing short-term threats to an ESU.

For the purposes of this biological analysis, no single model or indicator is relied upon as a “bright-line” test. Survival determinations are based on the entire spectrum of quantitative and qualitative information available.

3.1.2.2 Extinction Probability

Population Viability Analysis is used to estimate the likelihood (expressed as a percentage) that a population will persist over a selected time horizon. A commonly used standard in conservation biology for a negligible risk of extinction is less than 5 percent risk of extinction in 100 years. This is used in some instances as a biological listing and/or delisting standard under the ESA. For the purpose of a jeopardy analysis, NMFS has indicated that it will consider 24-year quasi-extinction risk, with quasi-extinction defined as 50 or fewer spawners in each of four consecutive years. It is the Action Agencies' intent to model extinction probabilities at a variety of extinction thresholds to provide a firmer base for our determinations. A more detailed description of the modeling method used to develop these estimates is presented in Appendix A, and results of these estimates are presented in Attachments A-1 through A-6 to Appendix A.

Key aspects of this analysis that affect the ultimate utility of the estimate as an indicator of survival are the choices of the time horizon, and the definition of quasi-extinction. With regard to the time horizon, 24 years was selected rather than a more traditional 100-year period because 1) the high uncertainty typically associated with the longer 100-year time horizon, and 2) the shorter time horizon affords the potential to further modify actions in the near term through an adaptive management process (if monitoring and evaluation indicate a need for further action to avoid longer term risk).

The selection of a quasi-extinction threshold (QET) = 50 is largely a policy choice that sets a high bar for meeting a criterion of less than 5 percent risk. Because the use of this modeling threshold may overstate the risk to small populations that have persisted for decades at low abundance (i.e., average annual returns of 20 to 100 adults), the Action Agencies consider results of a range of sensitivities using QETs of 1, 10, 30, and 50 fish.

A more detailed discussion of the rationale for the range of QET assumptions used in this modeling exercise can be found in Appendix A.

3.1.2.3 Viable Salmonid Population Characteristics and Other Considerations

The primary quantitative considerations in this biological analysis are abundance and productivity. However, conserving and rebuilding sustainable salmonid populations involves more than meeting abundance and productivity criteria. Accordingly, NMFS has developed a conceptual framework defining a Viable Salmonid Population (VSP) (McElhany et al. 2000). In this framework there is an explicit consideration of four key population characteristic or parameters for evaluating population viability status: abundance, productivity (or population growth rate), biological diversity, and population spatial structure.

Based on the current understanding of population attributes that lead to sustainability, the VSP construct is central to the goal of ESA recovery, and warrants consideration in a jeopardy determination. However, it must also be stressed that the ability to significantly improve either a species' biological diversity or its spatial structure and distribution is limited within the timeframe of the Action Agencies' Proposed RPA. That said, this biological analysis is informed by consideration of the VSP parameters and VSP risk ratings developed by the relevant TRTs. More discussion on this subject can be found in Chapters 4-16 of this Comprehensive Analysis.

In addition to the various VSP parameters, other considerations for judging population status relative to the survival component of the jeopardy standard are largely of a qualitative nature. These include the degree to which:

1. hatchery supplementation programs mitigate risk;
2. limiting factors are identified and addressed in the short term; and
3. the existence of a rigorous monitoring and evaluation program to closely track population status.

Although hatchery programs have been identified as a major source of risk to natural salmon populations (primarily by reducing biodiversity and fitness), this criticism is largely the result of poorly conceived and managed programs in the past. Whereas hatcheries were historically dedicated to the mass production of fish for mitigation for habitat loss and dam construction (largely for the purposes of harvest), today's hatcheries can potentially play a significant role in the conservation and rebuilding of species. Recent advances in understanding the importance of using locally-adapted broodstocks in supplementation programs, and implementing genetic management plans to optimize genetic and life history diversity mean that a well-designed supplementation program can provide both a hedge against near-term extinction risk, while buying time to address the underlying causes of poor population productivity.

An exception to the general qualitative approach for considering hatchery effects applies in cases where improvements in hatchery management have resulted in either significant reductions in straying of hatchery fish derived from non-native broodstock or where broodstock management protocols for intentionally supplemented populations are substantially improved. In both instances, the Action Agencies' believe it is possible to arrive at a quantitative estimate of the resulting productivity improvement in the naturally spawning population. The methods employed in this analysis are described in Appendix A.

Another qualitative consideration in evaluating short-term survival is the degree to which actions targeted at limiting factors and threats are expected to produce biological benefits. A high degree of confidence would logically be expected if, for example, the action(s) had been employed in several similar situations and monitoring and evaluation had documented its effectiveness. The highest level of confidence would be afforded to those actions or approaches whose effectiveness has been documented in the peer-reviewed literature.

A key factor in minimizing the risk of extinction is the implementation of a comprehensive monitoring and evaluation program that can serve to quickly identify rapidly declining populations. Although identifying a population in steep decline is an important step, it is perhaps equally important to have in place an adaptive management plan that includes contingency plans for implementing aggressive action on short notice. Such actions could include implementation of a captive rearing or captive broodstock program, emergency harvest closure, and site-specific actions to open blocked assess to spawning and rearing habitat.

3.1.2.4 Recovery Component of the Jeopardy Determination

NMFS has indicated that it will consider the following metrics and qualitative biological information in assessing the recovery component of the jeopardy analysis.

- 10- and 20-year geometric means of natural R/S; a "trend towards recovery" generally would be indicated if this metric is estimated to be greater than 1.0.
- 12- to 20-year λ, based on 4-year running sums and Dennis-Holmes diffusion approximation method; a "trend towards recovery" would be indicated if this metric is estimated to be greater than 1.0.
- Regression of log-transformed natural spawners (+1) from 1990-present and from all available years to present; a "trend towards recovery" would be indicated if this metric is estimated to be greater than 1.0.
- Life stage survival information (e.g., juvenile reach survival estimates), as indicators of improvement in limiting factors and threats.

The Action Agencies' biological analysis primarily relies upon longer term productivity, λ, and trend estimates consistent with the principle that a longer time series provides better estimates – estimates that are less likely to be unduly influenced by shorter term climate conditions and other phenomena.

On another subject: some commenters have stated that a population growth rate or productivity estimate only slightly greater than 1.0 is not sufficiently high to be considered indicative of a trend towards recovery for populations presently at low levels of abundance. One commenter has indicated that population growth rate at low densities should be closer to 3.0 in order to avoid jeopardizing a population's prospects for recovery.

There is a clear distinction between the relatively brief periods of very high productivity sometimes observed at low levels of abundance and measures of long-term average productivity. This biological analysis considers estimates of long-term average growth rates (or productivity) and the survival improvements it would take (all other things being equal) to change a long-term average growth rate from <1.0 to >1.0. A population with an average long-term population growth rate >1.0 is, by definition, a population whose size is increasing, not decreasing. A population that persists with an average growth rate >1.0 over an extended period of time will eventually recover. It is, in short, on a trend towards recovery.

Put another way, reviewing the available data for Columbia River Basin salmon and steelhead populations, many populations can be found that have demonstrated high productivity (3.0 or greater) during a limited number of years when abundance was very low (and when environmental conditions, particularly ocean conditions, were likely very good). As abundance increases, productivity will generally decline and should eventually stabilize at average productivity of about 1.0.

A period of 20 years (the period that was generally used in this analysis for average productivity estimates) will include a range of abundances and productivities. The average productivity estimate for those years is, in all cases, much lower than the productivity that might have been observed during a limited number of years when abundance was very low.

A population growth rate of 3.0 would be considered an exceptionally high growth rate that one might see at very low abundance levels. A population "on a trend towards recovery" should generally exhibit higher productivity at low abundance. But as the population grows, its productivity can be expected to quickly decline. Average productivity of 3.0 is not sustainable, nor is it found in nature (e.g., a salmon population cannot triple in size each generation for very long).

The standard described in the NMFS memos (Lohn 2006a,b) is average population growth rates (or productivities) greater than 1.0 resulting from the effects of the Proposed RPA aggregated with cumulative effects and the environmental baseline. The notion that it is necessary to achieve average longer-term productivities of 3.0 in order to avoid jeopardizing a species' chances for recovery is unfounded.

3.1.2.5 Recruit/Spawner Models and the Influence of Hatchery-Origin Spawners

NMFS has indicated it will consider 10- and 20-year geometric means of natural R/S in judging whether a population is "trending toward recovery" and also in evaluating potential benefits of changes associated with a conservation measure or a RPA. As noted above, this analysis relies primarily upon longer term estimates of productivity.

A major strength of a R/S estimate is that it is a measure of productivity that directly reflects the ability of a population to sustain itself. A R/S estimate simply reflects the rate at which spawning adults in one generation are replaced by spawning adults in the next generation. A R/S value < 1.0 indicates the population is not replacing itself. If this pattern continues over a sufficient period of time, the population will become extinct. Conversely, R/S >1.0 indicates the population is more than replacing itself; R/S = 1.0 means the population is exactly replacing itself.

Estimating R/S requires a time series of data on adult returns. The unit can be either a demographically independent population, some logical grouping of populations, or in the case of a listed salmon stock, an ESU. It also requires information on the average age structure of the population, and when available, it is highly desirable to have information on the fraction of the naturally spawning population that are hatchery-origin spawners.

For the purposes of estimating R/S productivity, hatchery-origin fish spawning naturally are counted as spawners, but not recruits. Therefore, a population's measured R/S productivity will be depressed by poorly adapted hatchery-origin spawners with relatively low productivity. Conversely, significant improvements to the productivity of hatchery-origin fish used to supplement a natural population will improve overall population productivity. A method used in this Comprehensive Analysis to estimate these improvements is described later in this chapter.

R/S values are typically reported as the geometric mean of productivity estimates for a historical period. In this Comprehensive Analysis, the Action Agencies are primarily using 20-year geomeans derived from a time series of data roughly spanning the brood years from 1980 to 2000 (or the most recent brood year for which complete adult return information is available). The Action Agencies' estimates of R/S values are shown for selected salmon and steelhead stocks in Attachments A-1 through A-6 to Appendix A.

3.1.2.6 Median Population Growth Rate or Lambda (λ)

Population growth rate (λ) or median annual population growth rate was the primary metric relied upon in the 2000 FCRPS BiOp. A $\lambda = 1.0$ means that a population is neither growing nor declining, on average, across a given time period; whereas a $\lambda = 0.9$ means that the population is declining at a rate of 10 percent annually—a trend that is obviously not sustainable in the long term. Conversely, a $\lambda = 1.1$ indicates a population is increasing 10 percent each year, a circumstance that likewise cannot continue *ad infinitum* since all habitats have an upper limit or carrying capacity.

NMFS has indicated it would consider 12- and 20-year λ estimates in judging a "trend toward recovery." A λ greater than 1.0 would be considered to indicate such a positive trend. For the purposes of this analysis, the Action Agencies used λ estimates developed by the Interior Columbia Basin TRT. The TRT appears to be using a simplified λ method that differs from the method used in the 2000 FCRPS BiOp. In effect, these λ values count hatchery-origin fish in the spawning population as though they are recruits – the progeny of naturally spawning fish in the previous generation. The λ estimates used in this analysis, therefore, tend to overstate population growth rates for populations with significant numbers of hatchery-origin fish in the spawning population. These λ estimates are, on the other hand, acceptable measures of median annual population growth for populations that are not supplemented by hatchery fish.

Lambda is estimated using the first and last four-year running sums of a time series of naturally spawning adults, ignoring the intermediate observations. As such, λ is very sensitive to the starting and ending points chosen for the estimate.

3.1.2.7 Population Trend Estimation

The method the Action Agencies used is taken from the draft report of the West Coast Salmon BRT (NMFS 2003). In conducting population status reviews, the BRT calculated trends using the slope of a line fit to a (log transformed) abundance index (e.g., redd counts, spawner counts, dam counts) versus time. Trend is reported as the exponential function of the slope; a value > 1.0 indicates the population is growing, a value of 1.0 indicates the population is stable (i.e., replacing itself), and a value of < 1.0 indicates the population is declining in abundance over the time period selected. Two alternative time periods were considered: 1980 to present and 1990 to present. The present is considered to be the most recent year in the Interior Columbia Basin TRT datasets used for this analysis.

One of the more attractive features of using trend analysis to assess population status is its simplicity. However, trend is influenced to an unknown degree by the progeny of hatchery-origin spawners in previous generations. Therefore, it should be used cautiously where significant numbers of hatchery fish are present in the spawning population. A more complete discussion can be found in the section below discussing uncertainty. Results of this trend analysis for selected salmon and steelhead stocks are shown in Attachments A-1 through A-6 of Appendix A.

3.1.2.8 Other Considerations

Other considerations in determining whether a population is trending toward recovery include empirical data on the life stage survival such as juvenile reach travel survival estimates, adult passage efficiency/conversion rates, and smolt-to-adult return (SARs) rates. These are particularly relevant where they can be linked to limiting factors and threats, and the empirical data indicate that conditions (and survival) are changing.

Adult passage efficiency (and by extension survival) is readily estimated from dam counts of returning adults that are collected by the Corps. Current information on SARs of many Columbia River populations can be estimated from the rapidly expanding passive integrated transponder (PIT)-tag database. Such estimates are regularly made available by the Northwest Fisheries Science Center (NWFSC), the University of Washington Columbia Basin Research, and the Fish Passage Center.

Taken together these kinds of life stage-specific survival estimates are important ways to track population responses to changes/improvements in fish passage conditions. When considered over the long term, they can provide solid evidence of the effectiveness of improvements in the FCRPS.

3.1.3 Analytical Framework

As noted in the introduction to this chapter, the general analytical strategy for assessing population status for populations and ESUs with adequate data to support such an analytic approach is a step-wise adjustment of population-level metrics from a historical base period to current conditions, and from current conditions to expected future status. This approach is modeled upon the analytic approach used by NMFS in the 2000 FCRPS BiOp. It is also virtually identical in its step-wise approach and the time periods selected to the approach used by the Interior Columbia Basin TRT in its Interim Gaps Report (Interior Columbia Basin TRT 2006).

The quantitative analysis employed in this Comprehensive Analysis relies on commonly used and accepted biological metrics that measure lifecycle survival, as well as estimated extinction risk under different modeling assumptions. Since the analysis proceeds from empirical estimates of average lifecycle survival over an historical period, it captures all sources and causes of salmon mortality during that period. The analysis then “adjusts” those average historical survival estimates to reflect current conditions – again, aggregating all sources of mortality as well as survival improvements into the analysis. Finally, it builds upon this aggregated estimate of current survival to incorporate the effects of the Proposed RPA combined with any anticipated effects of proposed Federal projects that have received ESA Section 7 consultation and the effects of State and private actions that are reasonably certain to occur. Thus, the analytical process integrates all effects on the salmonid lifecycle into every step of the analysis.

In this analytical construct, the base status is defined as the average status of the population based on the quantitative survival and recovery metrics estimated from a time series of abundance data beginning in about 1980 for most populations. In the case of trend estimates, the Action Agencies relied on two periods: 1980 to the most recent observations, and 1990 to the most recent observations. The adjustment from base-to-current status is an attempt to estimate *current* survival, as opposed to the average survival over a historical period. Finally, the Action Agencies make a current-to-prospective adjustment to estimate the future status of the population based on adjustment of the survival and recovery metrics for expected improvements associated with the Proposed RPA.

3.1.3.1 Key Assumptions

In this analysis, the Action Agencies assumed that recent improvements in survival (base-to-current) will continue into the future. Furthermore, the estimated survival improvements in the analysis do not incorporate density dependence (except in the case of the extinction probability modeling). Given the relatively low abundance in recent times for most of these populations, density dependence is unlikely to be a significant factor within the timeframe of the actions considered in this Comprehensive Analysis.

The Action Agencies assumed that survival changes are instantaneous, which will not necessarily be the case for certain actions. For example, some actions to improve tributary habitat or hatchery practices could take years or even decades for their beneficial effects to be fully realized. However, in the case of tributary habitat actions, this analysis attempts to quantify only the survival improvements that would be expected within the 10-year period of a BiOp. Finally, the Action Agencies assumed that future ocean and climate conditions will approximate the average conditions that prevailed during the 20-year base period used for the status assessments. For most populations, that period is about equivalent to the "recent" ocean period used by the Interior Columbia Basin TRT in its analyses. This period was characterized by relatively poor ocean conditions that presumably contributed to poor early ocean survival of salmonids.

The Interior Columbia Basin TRT's "pessimistic" ocean condition scenario results in survivals that are about 15 percent lower for Snake River Spring/Summer Chinook Salmon than the "recent' ocean conditions scenario, and about 36 percent lower for Upper Columbia Spring Chinook Salmon. Alternatively, TRT's "historical" ocean conditions scenario results in survivals that are about 39 percent higher for both Snake River Spring/Summer Salmon and Upper Columbia Spring Chinook Salmon (Interior Columbia Basin TRT and Zabel 2006). This subject is treated at greater length in the discussion of the effects of potential climate change in Appendix H.

3.1.3.2 Comparison to the Remand Collaboration's Conceptual Framework

The FCRPS BiOp Remand's Collaboration Process among the sovereigns developed a Conceptual Framework approach intended to help the Action Agencies develop their Proposed RPA. The Framework approach attempted to estimate the relative magnitude of mortality factors affecting Interior Columbia River Basin salmonid populations. That assessment was intended to define the FCRPS's "relative expectation…for recovery" (Framework Work Group 2006).

The Remand Collaboration's Framework working group developed high and low mortality estimates for all sources of mortality, including the FCRPS. These were first estimated as proportional changes in survival attributable to different mortality factors, which were then translated into relative impacts normalized to 1.0. Relative impacts were developed according to different assumptions regarding latent mortality attributable to the hydrosystem and tribal harvest impacts (Framework Work Group 2006)

The Conceptual Framework anticipated using the survival "gaps" estimated by the Interior Columbia Basin TRT as being needed to achieve long-term recovery/viability along with the Framework Work

Group's estimates of relative impacts for apportioning mitigation responsibility among the various sources of human-caused mortality. This biological analysis includes a comparison with the Conceptual Framework approach.

The Collaboration's Policy Working Group (PWG) did not determine where in the range of relative impacts described above the Action Agencies' Proposed RPA should be assessed. The range of "gaps" that the Framework approach would expect the FCRPS to fill was reviewed and the Action Agencies assessed whether the total survival improvements estimated in this biological analysis would "fill" those gaps at the high and low ends of the range. The equation used for this purpose was simple:

(1) $$Gap_{FCRPS}=Gap_{ICTRT}\hat{\ }RI_{FCRPS}$$

where Gap_{FCRPS} is the lifecycle survival improvement that the Conceptual Framework approach, as applied in this biological analysis, would allocate to the FCRPS, Gap_{ICTRT} is the Interior Columbia Basin TRT's gap for "recent" ocean and "base hydro" conditions at the 5 percent risk level (Interior Columbia Basin TRT 2006), and RI_{FCRPS} is the Framework group's relative impact associated with the FCRPS at the high or low end of the range. The Framework comparison for Interior Columbia River Basin ESUs can be found in Chapters 4 to 16.

The Conceptual Framework was intended, among other things, to "provide a clear and complementary link to ongoing recovery planning efforts" (Framework Work Group 2006). As such, it can be understood to represent the Collaboration parties' view of the appropriate contribution of the FCRPS toward long-term recovery of the listed ESUs in the Interior Columbia River Basin. Therefore, it provides another "metric" for use in considering the impacts of the Proposed RPA on a listed species' prospects for recovery.

3.1.3.3 Assessment of Major Population Group and ESU-level Status

As noted, estimated changes in both survival and recovery metrics were made in a step-wise fashion taking in to account recently implemented or planned changes in hydropower operations and configuration, upper Snake River flow augmentation, improvements in tributary habitat (short- and long-term), improvements in estuarine habitat/survival, and reduced avian predation, and changes in hatchery and harvest management. The first adjustment was the base-to-current step, and the second adjustment was the current-to-prospective adjustment. The final stage in the analysis estimates the expected future status of individual populations within an ESU. These individual population estimates then inform a qualitative assessment of the likely future status of the major population groups (MPGs), if any, and the ESU. This qualitative assessment considers other VSP factors such as spatial structure, life history patterns and genetic diversity, as well as recommendations of the relevant Interior Columbia Basin TRTs and recovery planning boards. More detail can be found in the individual ESU narratives in Chapters 4 through 16 of this Comprehensive Analysis.

3.1.4 Methods

As indicated, the survival and recovery metrics used in the analysis are, in effect, averages across a historical period. For the recovery metrics (R/S productivity, λ, and abundance trend), gaps are calculated based on data collected over a historical period. Gaps are simply the survival improvements needed to achieve the "trending toward recovery" criterion. The common currency of the analysis is the gap, or density-independent lifecycle survival improvement, expressed as a multiplier. A gap of 1.20 indicates that a 20 percent improvement in lifecycle survival (or recruit-per-spawner productivity) is needed to achieve the criterion.

For R/S productivity, therefore, the method for calculating the gap is quite simple. The survival improvement needed to achieve R/S=1.0 is simply 1.0 divided by the historical average R/S, or

(1) $1/P_h$

where P_h represents the geometric mean of R/S productivity over the historical base period. A value less than 1.0 indicates that no further improvement is needed to achieve R/S>1.0. As such, the gap represents the multiplier necessary to achieve the target productivity.

Since λ and trend are both measures of annual population growth (as opposed to a measure of lifecycle survival), it is necessary to use the following equation to calculate a needed change in lifecycle survival based on an estimate of annual population growth. For the purposes of these estimates, we use an approximation of the mean generation time for Chinook salmon and steelhead populations of 4.5 years.

(2) $r_s = r_\lambda^{\text{mean generation time}}$

where the λ gap, r_λ, is the multiplier of median annual population growth (λ) needed to achieve the criterion of λ=1.0 (calculated as 1/λ), and the survival gap, r_s, is the corresponding multiplier of lifecycle survival needed to achieve the λ criterion. A gap value less than 1.0 means that no further improvement is needed to achieve λ>=1.0. Because abundance trend estimates also represent annual time steps, the same mathematical approach applies to the trend estimates and resulting trend gaps in this Comprehensive Analysis.

The analysis then reduces gaps according to the equation

(3) Gap/S_p

where Gap is the gap expressed as a multiplier and S_p is the product of the survival changes in the various All Hs estimated to result from actions either already implemented (in the base-to-current adjustment) or actions expected to be implemented as part of the Proposed RPA (in the current-to-prospective adjustment).

Finally, the gap that results after considering the prospective effects of the Proposed RPA (the current-to-prospective adjustment) is converted to an estimate of future R/S productivity, λ or trend. The gap in this case could be greater or less than 1.0. If the final gap is less than 1.0, the estimated future metric will be greater than 1.0.

3.2 BENEFITS METHODOLOGY BY H AND PREDATION MANAGEMENT

The following sections provide an overview of the methodology used to estimate the benefits for the following action areas: hydro, habitat (tributary and estuary), hatchery, harvest, and predation management.

3.2.1 Hydropower

3.2.1.1 Introduction

Many of the survival parameters in existing biological models utilize the amount and timing of flow in the Snake and Columbia rivers. Two different flow models were used to complete the hydrologic analysis for the comprehensive analysis. One model was used for the upper Snake River above Brownlee Reservoir, and the other was used for the remainder of the Snake and Columbia River basins. Reclamation's MODSIM hydrology model (2007 version) was used to estimate the hydrologic effects and inflows to Brownlee Reservoir resulting from operation and the existence of the upper Snake River projects and all private diversions and depletions. The model takes into account all Reclamation operations (storage of water, release from storage, diversion for irrigation or other purposes, delivery for flow augmentation, pumping of ground water, and project return flows), private activities (private storage dams, diversions of private water rights into private canals, private pumping of ground and surface water, and return flows), and variable weather conditions.

The Brownlee Reservoir inflows developed by MODSIM were then incorporated as input into BPA's HYDSIM model. Hydro Simulator Program (HYDROSIM, also known as HYDSIM), which is used for the lower Snake and Columbia rivers, was developed by BPA in the 1990s, and is used to calculate flows for the various scenarios of flow operations being considered.

For simulations of flow, the HYDROSIM model utilizes flow broken into 14 periods per year, with April and August each divided into two periods. It considers available water, desired flow at certain times, rule curves for each of the reservoirs, irrigation demands, and projected power demand. In short, HYDSIM analyzes all effects due to the current level of development.

Using historical flow data, MODSIM and HYDROSIM can be used to project how flow would pass through the upper Snake, lower Snake, and Columbia River systems, respectively, if the volume and timing of water available were the same as a specific historical water flow year. For example, the models can be used to project how flows would be distributed through any one of the periods (14 for HYDSIM and 12 for MODSIM) for multiple locations in the system for a selected high-, medium-, or low-flow year. The models can estimate what flow would be occur due to modeled change in operations at different projects.

As previously mentioned, the output of the MODSIM model, which is inflow to Brownlee Reservoir, is used as one of the inputs to the HYDSIM model. The output of HYDSIM is then used for survival models of fish passage that utilize flow as one of the parameters. The overall results of the hydroreg modeling are presented in Appendix B.

Prior to construction of the FCRPS, downstream survival of juvenile fish was not well quantified. However, it is without question that some level of natural downstream mortality occurred. With the FCRPS in place, the mortality levels are assumed to be above that which might have naturally occurred due to both the existence and operation of the hydropower projects. While the Action Agencies have been able to demonstrate causative factors of mortality within the FCRPS, they do not believe that it is presently possible to definitively separate the overall differences between natural and hydrosystem-related mortality.

The proposed hydro actions are expected to change the current levels of mortality due to the existence and operations of the projects. Because of the difficulty of separating the factors for mortality, the following base, current and prospective analyses aggregate the three primary sources of mortality including the natural, operational, and existence.

3.2.1.2 Overall Analysis

In developing the overall analysis of the effects of the proposed hydro actions on listed anadromous fish, the Action Agencies relied on model outputs and previous analyses for assessing the effectiveness of the hydro actions. The analysis incorporated an ESU-by-ESU analysis for three primary time periods of hydrosystem existence, the base (corresponding to the general conditions that were experienced by juveniles during the 1980 to 2001 outmigrations), current, and prospective conditions, with results reported as an average across all water years.

The analysis began with baseline survival estimates primarily provided by the TRT or other relevant sources, with consideration of estimates for key parameters (i.e., direct in-river survival, percent transported). Next, the effects that have already occurred (current) and a range of effects that might occur (prospective) from operation and configuration changes to the hydrosystem were estimated.

For the prospective effects, changes provided in the Proposed RPA were based on best professional judgment. However, at times, these estimates encompassed the upper end of the range of those effects. These estimates were then input into the Comprehensive Fish Passage (COMPASS) model, yielding an output of potential direct in-river survival (see Appendix B). From this, an overall direct survival estimate to the Bonneville Dam tailrace was calculated, which included transport survival and effects from Mid-Columbia Public Utility District (PUD) dams for the applicable ESUs. Finally, SARs were estimated for both in-river and transported juveniles (Scheurell and Zabel hypothesis) and an overall SAR was estimated (see Appendix B).

The COMPASS model results were used to estimate survival under the Proposed RPA to quantify the level of incidental take and to comparatively assess the relative effects of survival change of the current operations to base operations, and prospective operations to current operations. For the biological analysis for upper Columbia River ESUs, these effects were aggregated with the observed (base-to-current) or expected (current-to-prospective) survival improvements that are resulting from actions taken to improve juvenile survival through the mid-Columbia PUD dams as a result of settlement agreements and BiOps. The overall results of the COMPASS modeling and the effects of system survival are presented in Appendix B.

Currently, the Action Agencies do not have the ability to complete COMPASS modeling for Snake River fall Chinook or sockeye salmon due to their complex life history attributes or general lack of information for input into the model. Therefore, hydropower improvement actions at the projects were not quantified as to their improvements for either ESU. It is anticipated that hydro actions to assist other upper river ESUs will also likely improve lifecycle survival for Snake River fall Chinook salmon and sockeye salmon.

For the lower Columbia and Willamette populations, most occur downstream of Bonneville Dam and currently little information is available to assess relative effects of prospective actions associated with fish passage. Also, it is not possible at this time to assess comparative improvements as, no COMPASS model is available for these ESUs. However, some hydro effects were assessed based on improvements at Bonneville Dam for those portions of the ESU whose populations originate upstream of the dam or that spawn in close proximity. These include lower Columbia River Chinook salmon, steelhead, coho salmon, and chum salmon (see Chapters 11 through 14).

3.2.1.3 Analysis by ESU

The ESU-by-ESU hydro effects analysis for the interior Columbia Basin ESUs is outlined in Table 3-1. Snake River Steelhead and Spring/Summer Chinook Salmon were aggregated across the entire ESU because in-river hydrosystem improvements were expected to affect populations similarly.

Table 3-1. ESU-by-ESU Analysis Matrix

ESU (or DPS)	Hydro Analysis	Rationale
Snake River Spring//Summer Chinook Salmon	Aggregated for ESU	Similar FCRPS experience
Snake River Steelhead	Aggregated for DPS	Similar FCRPS experience
Upper Columbia River Chinook Salmon	Independent by population	Different downstream migration experience
Upper Columbia River Steelhead	Independent by population	Different downstream migration experience
Mid-Columbia River Steelhead	Aggregated by entry point into FCRPS	Notably different FCRPS experience
Lower Columbia River Chinook Salmon, Steelhead, and Coho Salmon	Portion of ESU originating above Bonneville Dam	Assessment based on anticipated fish passage improvements at Bonneville Dam

For Upper Columbia River Chinook Salmon and Steelhead, although they are assumed to experience similar conditions through the FCRPS, different effects are experienced upstream of the FCRPS (in that they migrate past a different number of dams and reservoirs). Therefore, they are reported on separately as three primary populations (Methow and Okanogan populations combined).

For Mid-Columbia River Steelhead, because this DPS inhabits tributaries that enter the Columbia River between Bonneville Dam and McNary reservoir, the effects of the FCRPS experienced by this DPS are notably different from one population to the next. Therefore, these populations were analyzed by aggregating them according to which hydropower pool they initially entered on their downstream migration. Thus, the analysis for Mid-Columbia Steelhead examined the Yakima/Walla Walla aggregate, Umatilla/John Day aggregate, Deschutes River, and Bonneville pool tributaries aggregate as distinct groups.

The data are more robust for Snake River migrants traveling through the lower Columbia River in comparison to the upper Columbia River populations. Therefore, the assumption was made that the effects of hydrosystem actions in the lower Columbia River would be consistent for both upper Columbia River and Snake River ESUs. However, empirical data were used to provide separate estimates of passage timing at McNary Dam because upper Columbia River fish generally arrive at this project many days later than Snake River fish.

Base Condition

For the five modeled interior ESUs of Chinook and steelhead, base conditions for direct in-river survival (DIS) were taken from Interior Columbia Basin TRT estimates (largely for average survival rates and transport rates) for the 1980 to 2001 juvenile migrations, which used both empirical and interpolated information. For the Mid-Columbia River Steelhead DPS, the base condition for DIS was empirically derived by calculating in-river survival of Snake River steelhead from Lower Granite to Bonneville, which was 26.5 percent. From this estimate, a per-project survival estimate of 84.7 percent was derived. This was then applied on a project-by-project basis to determine the survival of fish encountering from one to four projects (Appendix B).

Current Condition

The current condition was developed via COMPASS modeling (Appendix B) using the 2006 hydropower configuration (i.e., implementation structural measures from the 2000/2004 FCRPS BiOps), and the operation plan that was described in the 2004 BiOp.

Prospective Condition

For the prospective condition, information developed in the Remand Collaboration Process was considered when developing the Proposed RPA for both operation and configuration changes.

Changes to the operational scenarios for water management and transportation were considered and the Action Agencies included these in the Proposed RPA. The changes in operations, including level of spill, initiation of transport, and other factors were analyzed in the COMPASS model and subsequent changes in survival were calculated (Appendix B).

With respect to configuration changes, the Proposed RPA included the prospective construction and operation of surface passage, spillway improvements, and other changes. The Action Agencies estimated the ranges of potential effects for each of these changes, and discussed and modified them with input from NMFS technical staff. From the range of estimates, a point estimate of the most likely to occur was generated based on best professional judgment for each action. This information was then shared with State and Tribal co- managers working in the Anadromous Fish Evaluation Program (AFEP) process and provided in the December 20, 2006 Proposed Action draft to the PWG.

The best professional judgment of the effects for route specific survivals were included in the prospective COMPASS model (often including the upper end of the range), with the assumption that all of the configuration elements would be in place by 2017. Changes associated with structural configuration actions (e.g., surface passage) were reflected as changes in fish travel time, resulting in changes in the timing of the arrival of fish arrive in the estuary (consistent with the estuary arrival time hypothesis).

After the potential operation and configuration survival changes were input into the model, the analysis was run with both the current condition (2006 configuration/2004 operations) and the full complement of proposed actions (2017) in place for the 50-year water record (1929 to 1978).

3.2.1.4 Effects Description

The effects examined are reported step-wise in Appendix B to provide a thorough explanation of how the analysis was conducted.

3.2.2 Habitat

The methodology and benefits of tributary and estuary habitat actions are summarized in the following sections.

3.2.2.1 Tributary

Tributary Habitat Benefits—Methodology and Results

The Action Agencies estimated survival benefits attributable to tributary habitat actions that are or will be implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies. These actions are described in the Tributary Habitat Action [see Appendix B.2.2 to the FCRPS Biological Assessment (BA) document].

Survival improvement estimates were made for actions completed from 2000 to 2006 and planned for 2007 to 2009. Survival improvement estimates, described in Appendix C, correspond with values for the base-to-current (2000 to 2006) and the current-to- prospective (2007 to 2017) periods represented in the biological analysis.

To compile these estimates, the Action Agencies used information and methods produced in conjunction with the tributary Remand Collaboration Habitat Conservation Workgroup (HCW) Process. The Remand

Collaboration HCW was charged by the PWG to evaluate the method used in Appendix E of the 2004 BiOp. The Habitat Workgroup ultimately decided to update the Appendix E Method. The Action Agencies applied two main approaches to use data and information from the Remand Collaboration Habitat Workgroup to produce survival estimates for salmon and steelhead populations. Further detail on the procedures and components utilized are presented in Appendix C.

3.2.2.2 Estuary

The details of the Proposed RPA and how benefits were determined are presented in Appendix D. The following sections summarize the methods used to estimate survival benefits resulting from improvements to estuarine habitat. A more detailed report outlining this evaluation process is provided in PC Trask Associates (2007) (see Appendix D, Attachment D-1).

Methodology

The evaluation of Federal projects was accomplished in two distinct steps. These steps are summarized below and discussed in more detail in Appendix D, Attachment D-1.

1. The first step involved scoring projects using the Lower Columbia River Estuary Partnership's (LCREP) *Criteria for Identifying and Prioritizing Habitat Protection and Restoration Projects on the Lower Columbia River and Estuary* (see Attachment B.2.2-3 to Appendix B in the FCRPS Biological Assessment). Each Federal project was examined in terms of two types of criteria from the LCREP: certainty of success and potential benefits.
2. The second step involved linking specific Federal projects to recovery "actions" (broader types of actions) identified in NMFS' draft *Columbia River Estuary Recovery Plan Module* (NMFS 2006a) and evaluating their contribution to implementation of that action across (or throughout) the estuary. Contribution to implementation was evaluated using survival improvement targets from the *Estuary Recovery Plan Module* to determine the level of benefit that could be gained from different actions.

Given the level of understanding of the estuary at this time, survival benefits were analyzed for ocean and stream-type life history and not at the population level. The benefits evaluation of projects and associated actions utilized two numerical survival improvement targets for each action—one for ocean-type juveniles and one for stream- types. These targets express the proportion of improvement in salmonid survival that a given recovery action might accomplish. Ocean-type juveniles, such as Snake River Fall Chinook Salmon, are more likely than stream-types to benefit from the off-channel habitat improvements that most estuary projects would create.

Survival Benefits

The survival benefits associated with the specific actions above were determined by ESU. A more detailed report outlining this evaluation process is provided in PC Trask Associates (2007) (see Appendix D, Attachment D-1).

3.2.3 Hatcheries

Hatchery programs may have negative effects on the viability of natural salmon and steelhead populations. Improving overall management including the use of best management practices (BMPs) and a site specific additional actions are intended to eliminated or reduce negative effects to these native stocks. Some hatchery programs have been identified as have major adverse effects to native listed stocks and specific actions have been or will be directed at these sites where the FCRPS can have influence on these sites.

The Hatchery/Harvest Workgroup reported to the Remand Collaboration PWG that it was not able to quantify benefits of the hatchery actions developed for the Remand Collaboration Hatchery/Harvest (Hatchery/Harvest) Workgroup's "Coarse Screen" list. Instead, individual Hatchery/Harvest Workgroup participants assigned a qualitative "High," "Medium," or "Low" value, based on their best professional judgment, to the expected benefits of the actions during and after the period of the BiOp. Hatchery/ Harvest Workgroup members also indicated which population viability parameters (i.e., abundance, productivity, spatial structure, and diversity) would be positively affected by the action. These values, whenever available, were used in the Action Agencies benefits summary tables and considered qualitatively in the Action Agencies' biological analysis. Furthermore, for certain populations it was possible to quantitatively estimate the survival improvements that resulted from past or prospective hatchery reforms, specifically reforms involving significant improvements in broodstock management protocols. More detail on the methods used for these estimates can be found in Appendix E. The explanations of where and how this method was used can be found in Chapters 6 and 9 of this Comprehensive Analysis.

More detail on the Proposed RPA and benefits is presented in Appendix B.2.3 to the FCRPS BA document.

3.2.4 Harvest

Estimates of survival changes associated with past changes in harvest management were supplied by Anthony Nigro of the Oregon Department of Fish and Wildlife (ODFW) on behalf of an *ad hoc* technical workgroup representing certain of the parties in the *U.S. v. Oregon* process (Nigro 2007). The spreadsheets supplied by the workgroup are included in Appendix G. These estimates were used in the base-to-current adjustment of the analyses for Snake River Spring/Summer Chinook Salmon, Upper Columbia Spring Chinook, Snake River Steelhead, Upper Columbia Steelhead, and Mid-Columbia Steelhead populations.

3.2.5 Predation

Introduction

In developing the overall analysis of the effects of the proposed predation management action on listed anadromous fish, the Action Agencies relied on information generated from recent analyses for assessing the effectiveness from pikeminnow and tern relocation actions (see Appendix F).

Piscivorous Predation

The first critical assessment of the magnitude of predation on juvenile salmonids by resident fishes in the Columbia River was conducted from 1983 to 1986. Rieman et al. (1991) used rigorous estimates of predator population sizes (Beamesderfer and Rieman 1991) and individual consumption rates (Vigg et al 1991) to demonstrate that mean annual loss of juvenile salmonids to predators was equivalent to mortality associated with dam passage, and that northern pikeminnow accounted for 78 percent of estimated loss of juvenile salmonids. Beamesderfer et al. (1996) estimated that approximately 16.4 million emigrating juvenile salmonids were consumed by northern pikeminnow annually in the Columbia and Snake rivers prior to the Northern Pikeminnow Management Program (NPMP). When compared to the estimated 200 million juvenile salmonids produced in these combined river systems, the northern pikeminnow are thus believed to have consumed approximately 8 percent of all downstream migrants.

These studies and others added greatly to our knowledge of piscivorous predation in the Columbia River Basin and also provided a scientific basis for the NPMP. Rieman and Beamesderfer (1990) found that relatively low annual exploitation rates (10 to 20 percent) applied to northern pikeminnow populations could, in principle, result in a reduction of approximately 50 percent on the total consumption of juvenile salmonids by northern pikeminnow.

Since 1990, large-scale agency-sponsored fisheries have been implemented in the Columbia and Snake rivers to harvest northern pikeminnow of target size. Biological evaluation of the NPMP through 1999 indicate that predation on juvenile salmonids by northern pikeminnow has decreased 25 percent since fishery implementation began (Friesen and Ward 1999). This means that 2 to 4 million juvenile salmon annually survive that would otherwise have been eaten by this predator. The benefits of pikeminnow removals affect all ESA-listed and non-listed yearling and sub-yearling salmonids that use the mainstem Columbia and Snake rivers as outmigration corridors.

In 2006, the Action Agencies continued implementing a general increase in the reward structure started in the summer of 2004. Average exploitation rates (the percentage of the targeted size fish annually removed) in the NPMP, notwithstanding the increased incentives in 2001 and in 2004 to 2005, have averaged approximately 11 percent for the last 16 years.

The observed exploitation rate on northern pikeminnow since increasing the monetary incentives has averaged 18 percent, an improvement of more than 50 percent. Program evaluators are modeling estimates of the increased exploitation rate's additional effect on reduction in predator mortality. Preliminary estimates place the reduction in pikeminnow predation at 42 percent (personal communication, Tucker Jones, ODFW, technical memorandum, March 5, 2007). This increase above the baseline 25 percent estimated by Friesen and Ward (1999) is above and beyond the base benefits assumed by previous analyses. Therefore, the marginal benefit of any increase in exploitation rate resulting from increases in program incentives should be separate and above base-to-current period benefits.

The juvenile salmon survival benefits associated with an increased incentive program can be estimated by modeling the additional removals consistent with the general assumptions and model parameters used in evaluating and estimating the cumulative benefits of the NPMP to date. The general approach employed by NPMP analysts involves applying an appropriate northern pikeminnow consumption rate on juvenile salmonids (temporally and spatially) to the number of additional northern pikeminnow removed (temporally and spatially) to determine "number of smolts" not eaten. This provides an indication of potential incremental benefit of increased removals, assuming no significant inter-or intra-specific compensation.

Caspian Tern Predation

Caspian tern population estimates were derived and where necessary, interpolated, from known data. Research data collected by D. Roby (U.S. Geological Survey/Oregon State University) and associates formed the basis for these analyses. Collis et al. (1998) had documented population estimates for the Columbia River estuary Caspian tern colony for 1984, 1986, 1987, and 1991 from Corps and U.S. Fish and Wildlife Service (USFWS) biologists. Research data for 1997 to 2006 (Collis 2007) provided Caspian tern population estimates for that time period. Population estimates for the years when data were unavailable were interpolated from estimates for the years that encompassed the time period.

Total juvenile salmonid consumption by Caspian terns is based upon research results for the period 1997 to 2006. Estimates of annual smolt consumption were calculated using a bioenergetics modeling approach (see Roby et al. 2003 for a detailed description of model construction and input variables). The annual consumption estimates from 1997 to 2006 were compiled by the researchers and forwarded to Portland District, Corps for utilization in preparation of these estimates. These data were derived from a Don Lyons e-mail (Lyons 2007) for the years research occurred. To calculate total juvenile salmonid consumption for years prior to 1997, these data were separated by island (e.g., Rice and East Sand islands). For each island, the number of juvenile salmonids consumed per tern per year was determined. Thus, for East Sand Island, data from 1999 to 2006 were evaluated to determine the average number of juvenile salmonids consumed per tern per year. For Rice Island, the average was calculated for 1997 to 2000. These averages were then multiplied by the estimated tern population at Rice or East Sand for the years prior to 1997 to generate total juvenile salmonids consumed for this period. .

A similar process to juvenile salmonid consumption estimates for years prior to 1997 was used to calculate the number of Chinook salmon subyearling, Chinook salmon yearling, steelhead, and coho salmon consumed by terns per year at either East Sand or Rice Island. Juvenile salmonid consumption data, broken into the four "species" categories (Lyons 2007) were grouped by island and the average percent composition for each island was then multiplied by the estimated juvenile salmonid composition (total) for the respective islands to provide a "species" breakdown.

Juvenile Salmonid Survival

The Action Agencies' analysis of tern predation on juvenile salmon and steelhead survival in the estuary divides the tern predation effects into three time periods:

1. Baseline covers 1980 to 2001;
2. Current condition includes 2002 to 2006; and
3. Prospective (a future tern population level which is based on the future population objective or 3,125 breeding pairs established in the Caspian Tern Environmental Impact Statement [EIS]).

To estimate the effects of tern predation on juvenile salmonid survival, the Action Agencies used estimates of the number of juvenile salmonids consumed, divided by the number of juvenile salmonids estimated to arrive at Tongue Point (Fish Passage Center hatchery release, transportation, and in-river migrant estimates for 1987 to 1999; NMFS 1999 to 2006).

Estimates prior to pre-1987 were not available. Therefore, 1987 to 1999 smolt numbers for each species were averaged and extrapolated to those years. The average consumption rates per breeding pair were estimated and that rate was extrapolated to the future estimates of the tern population. For the baseline, the Action Agencies used the average tern numbers and consumption rates from 1980 to 2001. For the current condition, the average tern numbers and consumption rate from 2002 to 2006 were used. To estimate the consumption rates for the prospective condition, the Action Agencies calculated the 2002 to 2006 average proportion of smolts consumed per breeding pair, and expanded it to the future tern population objective of 3,125 breeding pairs.

Baseline to Current and Prospective Survival Changes:
Relative survival changes resulting from the relocation of terns to East Sand Island (baseline-to-current) and additional benefits that would be expected for the future reduced tern population objective in the tern EIS (prospective). Relative survival changes for the baseline-to-current condition are calculated by dividing the estimated absolute survival of the current condition by the estimated absolute survival of the baseline condition (1-current consumption)/(1- baseline consumption). It is assumed that these relative survival rates, which are based on the entire Columbia River Basin run for each species and rearing type, are the same as they would be for the respective ESUs. For example, the 1.007 relative survival rate for all subyearling Chinook under the prospective scenario would be same as that for the Snake River Fall Chinook Salmon ESU. Estimates of juvenile salmonids at Tongue Point prior to 2000 assume that there is no mortality between Bonneville Dam and Tongue Point. The Action Agencies also assumed that

juvenile chum and Snake River sockeye salmon consumption by terns is not substantial enough for there to be a survival benefit from the proposed tern population reduction (Collis et al. 2002).

Chapter 4
Snake River Fall Chinook Salmon
Evolutionarily Significant Unit

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

4.1 INTRODUCTION

This chapter briefly summarizes the current biological analysis developed for this Evolutionarily Significant Unit (ESU). Summary data for this ESU are presented in Table 4-1. The geographic extent of the ESU is shown in Figure 4-1.

Table 4-1. ESU Description and Major Population Groups (MPGs)

ESU Description[1]	
Threatened	Listed under ESA in 1992; reaffirmed in 2005
1 current major population group	1 current population
Hatchery programs included in ESU	Lyons Ferry, Fall Chinook Acclimation Ponds, Nez Perce Tribal Hatchery, Oxbow Hatchery
Major Population Group	**Population**
Snake River Mainstem	Lower Snake River Mainstem

[1/] 70 FR 37160; Interior Columbia Basin Technical Recovery Team (TRT) 2003, 2005

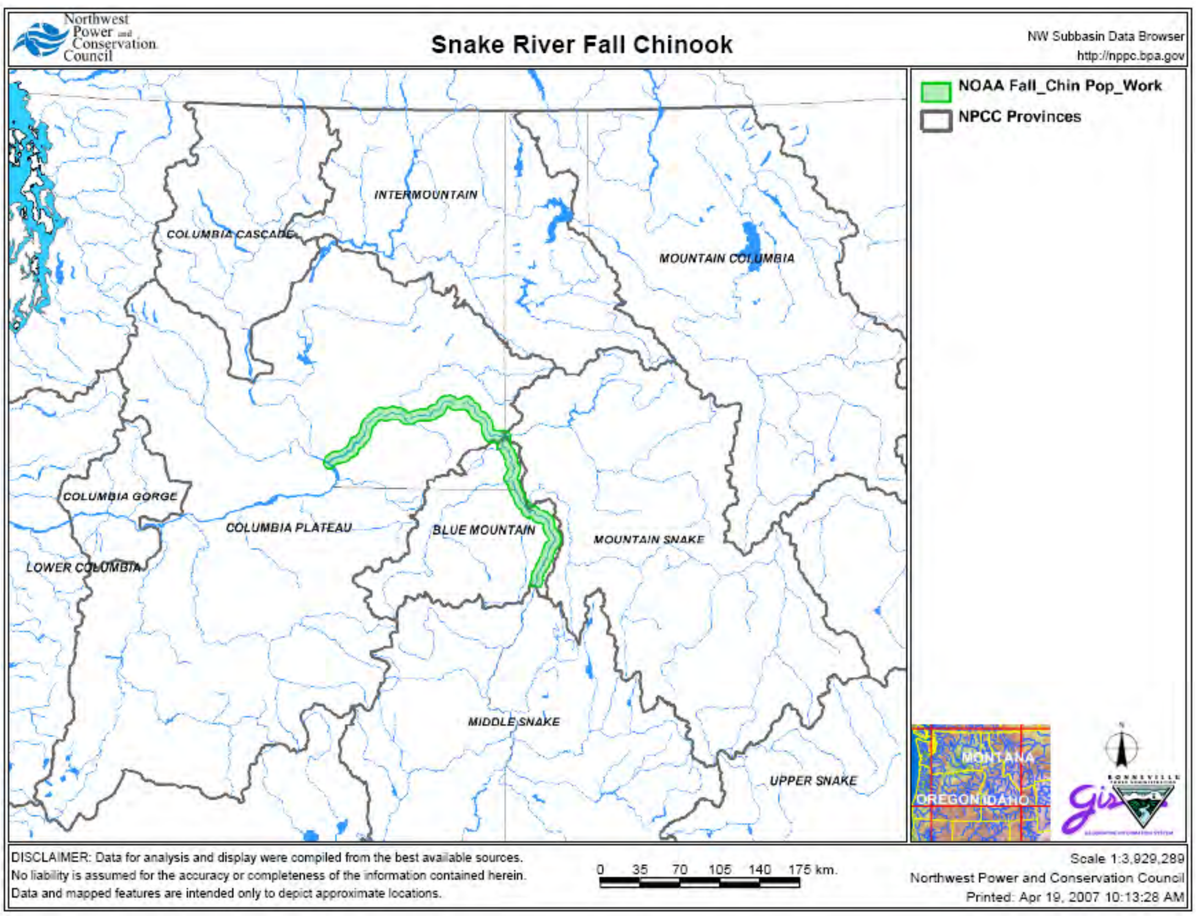

Figure 4-1. Snake River Fall Chinook Salmon ESU

This chapter is organized into five sections. Section 4.1 provides an overview of the ESU and the factors limiting its viability. Section 4.2 summarizes population-level status information during the 20-year base period used for this analysis. Section 4.3 provides the analysis of the current status and provides estimates of the “gaps,” or needed lifecycle survival improvements for individual populations to meet certain biological criteria. It summarizes the improvements made to the hydrosystem and in other Hs (habitat, hatcheries, and harvest) since about 2000 and estimates the salmonid survival benefits associated with those improvements. Section 4.4 describes the actions proposed to be implemented into the future, and Section 4.5 estimates their effects on salmonid survival when aggregated with the environmental baseline and cumulative effects.

Almost all of the metrics used in this analysis are estimates for individual populations within the ESU. The Endangered Species Act (ESA) is concerned with the status of a species, either Distinct Population Segments (DPS, which is an equivalent term often used for steelhead) or ESUs. Individual populations and major population groups (where they exist) obviously contribute to ESU status. However, the status of the ESU is not wholly dependent upon the status of any of the ESU’s individual components.

The Snake River Fall Chinook ESU is composed of a single population that spawns and rears in the mainstem Snake River and tributaries, from the confluence of the Snake and Columbia rivers in the Tri-Cities area of Washington State to the tailrace of Hell Canyon Dam in Idaho. Snake River fall Chinook salmon do not occur in the upper Snake River Basin above Hells Canyon Dam, although historically they migrated up the Snake River to Shoshone Falls and some of the larger tributaries. Approximately 370 miles of mainstem habitat has been lost between Hells Canyon Dam and Shoshone Falls. Construction of Swan Falls Dam denied fall Chinook salmon access to upstream spawning areas downstream from upper Salmon Falls; these fish then reportedly used an area of the Snake River near Marsing, Idaho (Evermann 1896 cited in Interior Columbia Basin TRT 2003). Construction of Idaho Power’s Hells Canyon Complex further reduced Snake River spawning and rearing habitat available for fall Chinook salmon. Additional life history information for fall Chinook salmon can be found in Waples et al. (1991), Myers et al. (1998), Healey (1991), and Bjornn and Reiser (1991). Based on life history and genetic differences, Fall-Run Chinook Salmon in the Snake River are distinct from the Spring/Summer-Run in the Snake River Basin (Waples et al. 1991). Snake River Fall Chinook Salmon are also considered separately from those assigned to the upper Columbia River Summer and Fall Run ESU because of considerable differences in habitat characteristics and adult ocean distribution and less definitive, but still significant, genetic differences. There is, however, some concern that recent introgression from Columbia River hatchery strays is causing the Snake River population to lose the qualities that made it distinct for ESA purposes.

Historical abundance of this ESU is estimated to have been 400,000 to 500,000 fish. By the late 1930s and 1940s, as a result of a combination of heavy fishing pressure since the 1890s and the blocking of 150 miles of important habitat by the construction of Swan Falls Dam in 1901, abundance was estimated at 72,000. After completion of the Hells Canyon Complex and inundation of Snake River mainstem spawning habitat, only 10 to 15 percent of the former range of Fall Chinook Salmon remains; the remaining area is the least productive area historically occupied by this ESU.

Unlike the other ESA-listed Chinook salmon ESUs in the Interior Columbia River Basin, this ESU historically exhibited primarily an ocean-type life history, with fish rearing only briefly in their natal area, outmigrating as subyearlings, and returning to spawn in September and October. However, recent research shows that a relatively high proportion of returning adult Snake River Fall Chinook salmon have adapted to a yearling life history. It is not fully understood whether this is a recent or recently discovered change. These juveniles spend their first winter in one or more reservoirs and migrate to the ocean as yearlings. This relatively novel life history pattern for ocean-type Chinook salmon may be fostered by mainstem flow and temperature conditions. Fall Chinook salmon in general spawn in mainstem rivers at relatively low elevations and appear to be able to adapt to modified habitat relatively quickly, as occurred after the removal of the Lewiston Dam in 1974.

Idaho Power conducted extensive research on fall Chinook salmon in the Snake River downstream from Hells Canyon Dam to Asotin, Washington (Groves and Chandler 2001). Idaho Power developed criteria for parameters for migration, rearing, and spawning. They reported the following:

- Optimal water temperature for migrating adult fall Chinook salmon is between 8 and 15°C (range: 1 to 8°C and 15 to 21°C);
- Optimal water temperature for spawning fall Chinook salmon is between 10 and 15°C (range: 5 to 10°C and 15 to 16°C);
- Optimal water temperature for rearing fall Chinook salmon is between 10 and 15°C (range: 1 to 10°C and 15 to 21°C);
- Optimal water temperature for migrating juvenile fall Chinook salmon is between 8 and 15°C (range: 1 to 8°C and 15 to 21°C); and
- Optimal dissolved oxygen levels need to be greater than 76 percent saturation at water temperatures of 16°C or lower.

Requirements for spawning fall Chinook salmon include water depths between 0.2 and 6.5 m; mean water column velocities between 0.6 and 1.7 m/s, and substrate size between a 2.6- and 15.0-centimeter (cm)-long axis length.

Requirements for rearing fall Chinook salmon include areas within littoral zone to depths of 1.5 m, with substrates of less than a 22.5-cm-long axis length, mean water column velocities less than 0.4 m/s, and lateral shoreline slopes less than 40 percent (Groves and Chandler 2001).

In the Snake River downstream from the Hells Canyon Complex to Asotin (RM 247.0 to approximately RM 148.4), fall Chinook salmon generally initiate spawning as water temperatures drop below 16°C and terminate spawning as temperatures drop to 7°C (Groves 2001). However, this varies annually and initiation of spawning has been delayed until water temperatures were as low as 12°C and infrequently began when temperatures were as high as 17°C (Groves 2001).

Hatcheries have played a major role in the production of Snake River Fall Chinook Salmon since the early 1980s (Busack 1991). There are three hatchery populations that are considered part of this ESU: Lyons Ferry, Nez Perce Tribal, and Oxbow hatcheries (Federal Register 70, #123). The Federal Columbia River Power System (FCRPS) funded Lyons Ferry Hatchery, a mitigation program for construction of the lower Snake River dams, began operating in the early 1980s, and the Bonneville Power Administration (BPA) funded Nez Perce Hatchery Program for dam mitigation began in the late 1990s. Over the past 10 years, hatchery contribution to Snake River escapement has been estimated at nearly 60 percent. Because artificial propagation of Snake River Fall Chinook Salmon is a relatively recent contributor to production, it is believed that the cumulative genetic changes associated with it may be limited. Presently, natural-origin fish are incorporated into the brood stock each year, which should reduce divergence from the natural population. Also the release of yearling smolts has been curtailed in recent years. The greater emphasis on the release of subyearling fish is expected to minimize the differences in mortality patterns between hatchery and wild populations that can lead to genetic change (Waples 1999). (See NMFS 1999 for further discussion of the Snake River Fall Chinook Salmon supplementation program.)

The National Marine Fisheries Service (NMFS, also called National Oceanic and Atmospheric Administration [NOAA] Fisheries), in its 2004 Biological Opinion (BiOp), concluded that the artificial propagation programs have provided benefits to the ESU in terms of abundance, spatial distribution, and diversity in recent years, although the contribution of these programs to overall ESU productivity is uncertain and the artificial propagation programs are not sufficient to substantially reduce the long-term risk of extinction. Depending upon the assumptions made about the likelihood of the progeny of hatchery fish returning as productive adults, long- and short-term trends in productivity are at or above replacement. Thus, NMFS proposed to retain the current listing of this species as threatened (i.e., likely to become an endangered species within the foreseeable future) even though it is not likely to go extinct in the near future. Actions under the 2000 FCRPS BiOp and improvements in hatchery practices have provided some encouraging signs in addressing the factors for decline. The quality of data available to managers is considered to be moderate for juveniles in the mainstem, poor for juveniles in the tributaries, and moderate-poor for adults. Natural mortality of these fish throughout their lifecycle is 90 to 95 percent. The amount of human impact relates to several factors: hydropower (hydro), habitat, hatcheries, harvest, and predation.

Snake River Fall Chinook Salmon are similar in life history and appearance to the unlisted “upriver bright” fall Chinook salmon, which include several large, healthy populations of hatchery- and naturally-produced fish in the Hanford Reach of the Columbia River. Because Snake River fish mix with these other populations in the Columbia River, as well as with healthy stocks of Alaska Chinook salmon in the ocean, they are heavily harvested in ocean, mixed-stock treaty Tribal and non-Tribal fisheries. The harvest rate of Snake River Fall Chinook Salmon averaged approximately 65 percent from 1980 to 1995; however, current agreement under the Columbia River Compact limits harvest to 54 percent or less. The 2000 to 2003 harvest rates have averaged 44 percent.

A transportation program to barge fall Chinook salmon smolts (as well as for spring/summer Chinook and steelhead) past the Snake and Columbia river dams was initiated in 1968. At the time this program was implemented a comprehensive evaluation of the effects of transportation on lifecycle survival was put into place for the spring-migrating fish. However, this was not the case for the summer-migrating fall Chinook salmon subyearling migrants. Although widely believed at the time to be an important tool for enhancing survival, the small size of this population made rigorous scientific evaluation of potential benefits of the program for the most part impossible. More recently, questions about delayed mortality have created uncertainty about these putative benefits. In addition, the recent findings regarding the existence of a reservoir life history and the propensity for some portion of each brood year to remain in the river an additional year before migrating adds even more uncertainty to the mix. Clearly, a summer transportation program would have dubious benefit for a smolt that would “naturally” migrate the following year and enter the ocean at age one in the spring, and may even be harmful. Indeed, there are many uncertainties regarding the life of Snake River Fall Chinook Salmon and the efficacy of smolt transportation as a tool to increase survival.

Human impacts and current limiting factors for this ESU come from multiple sources: hydro passage, habitat degradation, hatchery effects, fishery management and harvest decisions, predation, and other sources.

4.1.1 Key Limiting Factors

Salmon and steelhead have been adversely affected over the last century by many activities including human population growth, introduction of exotic species, over fishing, developments of cities and other land uses in the floodplains, water diversions for all purposes, dams, mining, farming, ranching, logging, hatchery production, predation, ocean conditions, loss of habitat and other causes (Lackey et al. 2006).

Current key limiting factors for this ESU identified by NMFS in the ESU Overviews for the Remand Collaboration Process (NMFS 2005e) are summarized in Table 4-2.

Table 4-2. Key Limiting Factors

Mainstem Hydro	Snake River Fall Chinook Salmon migrate through 8 mainstem Columbia and Snake river dams as juveniles or are transported in barges. Estimates of current in-river juvenile mortality average 83 percent. Hells Canyon and other upstream dams limit spawning and rearing capacity by blocking access to habitat and alter historical temperature profile, gravel recruitment, and hydrograph in the remaining habitat. According to the Step 4 report, the estimated portion of the human impact attributable to the FCRPS dams (compared to natural river estimates) is 57 to 61 percent. If the latent mortality hypothesis is omitted, the human impact associated with the hydro system is 35 percent. Hydro impacts include volume, timing, and quality of flows that enter the FCRPS action area, including flows from the Snake River at the toe of Hells Canyon Dam, which are impacted by the operation of Reclamation's upper Snake River projects as well as non-Federal irrigation projects in the upper Snake River. Other hydrosystem impacts within the action area include the mainstem effects of Reclamation's other projects within the Columbia River Basin and many non-Federal irrigation projects within the Columbia River Basin.
Predation	Predation has been noted as a factor limiting survival at mainstem hydro facilities and in the Columbia estuary. The portion of Snake River Fall Chinook Salmon that exhibit a yearling life history and overwinter may be susceptible to higher predation rates, but when they resume their migration the larger size they have achieved may help them avoid many of the predators that traditionally prey on fall Chinook salmon subyearlings.
Harvest	The combined ocean and freshwater harvest rate has been between 35 to 45 percent for the last 6 years. According to the Step 4 report, the estimated portion of the human impact attributable to combined Tribal and non-Tribal harvest effects is 51 to 54 percent. If the latent mortality hypothesis is omitted, the range associated with the combined harvest impacts is 11 to 20 percent.
Hatcheries	Out-of-basin hatchery fish, primarily from the Umatilla Hatchery, stray into this area to spawn. In addition, it appears that supplementation programs have increased the number of natural spawners from several hundred to several thousand; continued operation could be managed to minimize risk to the natural component of the ESU. According to the Step 4 report, the estimated portion of the human impact attributable to hatchery effects is 4 percent. If the latent mortality hypothesis is omitted, the human impact associated with the hatchery system is 1 percent.
Estuary	The condition of the estuary is especially important to Snake River Fall Chinook Salmon that exhibit a yearling life history and over-winter below Bonneville Dam. Quantity and quality of habitat, predation, toxins, and the plume are potential limiting factors.
Habitat	Habitat quality in currently accessible areas is strongly affected by water management upstream of these areas. Construction of the Hells Canyon Complex blocked access to 97 percent of suitable spawning habitat previously available to fall Chinook salmon (Battelle 2000). Water quality in the upper Snake River plain is degraded compared to historical conditions. The dams act as a settling pond, so that while temperature and pollution are still an issue, the river below the dam does support fall Chinook salmon. Degraded estuary habitat affects subyearling juvenile rearing and the physiological transition from fresh water to salt water. According to the Step 4 report, the estimated portion of the human impact attributable to combined habitat effects in the tributaries and the estuary is 21 to 23 percent. If the latent mortality hypothesis is omitted, the human impact associated with habitat degradation is 13 percent.

4.2 BASE STATUS

4.2.1 ESU Abundance and Trends

The 10-year geometric mean abundance of Snake River Fall Chinook Salmon is 1,273 natural-origin spawners. The 5-year geomean abundance is 2,958 natural-origin spawners, which exceeds the interim recovery target for this ESU. Both 1980-recent and 1990-recent abundance trends for natural-origin spawners are greater than 1.0, indicating a growing population over those periods. Adult return numbers have declined since their recent peaks. However, this analysis focuses on longer-term trends consistent with the principle that a longer time series provides better estimates (see, for example, Dennis et al. 1991).

ESU abundance and a rolling 5-year geometric mean of abundance are shown relative to the NMFS interim recovery target in Figure 4-2.

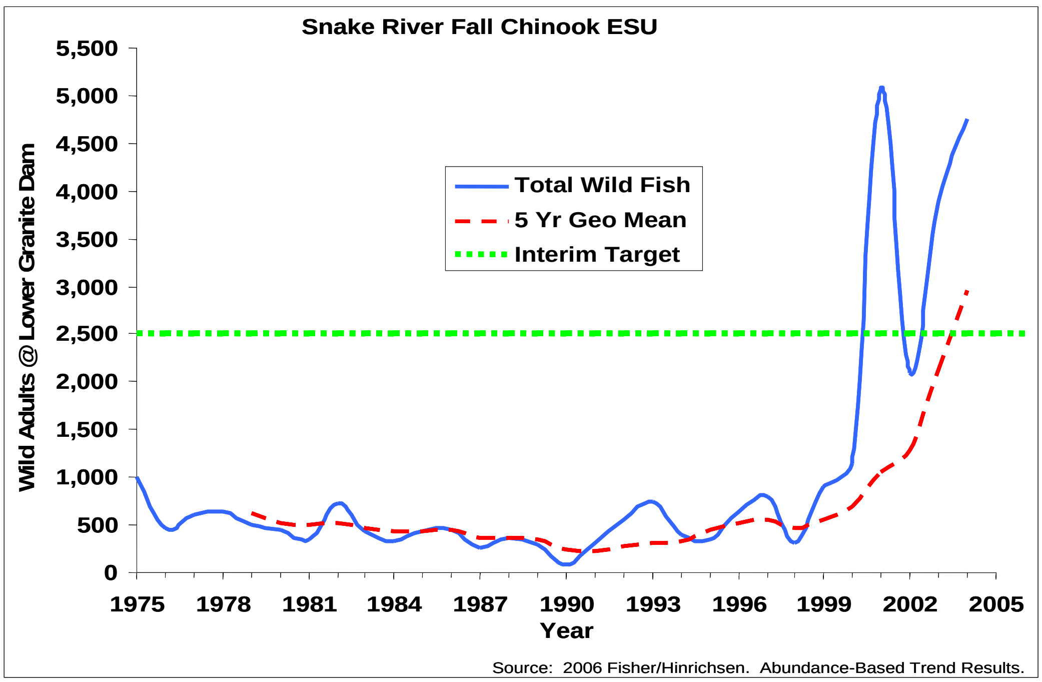

Figure 4-2. Snake River Fall Chinook Salmon Abundance Trends

4.2.2 Extinction Probabilities, Recruit-per-Spawner Productivity, and Lambda

Base productivity and survival metrics for the single population comprising this ESU are summarized in Table 4-3. Productivity, as reflected by estimates of recruits-per-spawner (R/S), is < 1.0 if estimated from the full 20-year time series of data, but is > 1.0 if estimated from the most recent 10-year period (0.82 and 1.24, respectively). It is not possible to model hydrosystem survival improvements for this ESU due to life history uncertainties. Therefore, this biological assessment uses the 10-year R/S productivity value as its base case in the view that the 10-year R/S value best represents current survivals resulting from significant hydrosystem improvements over the past decade. The 10-year R/S value is 1.24, indicating a trend toward recovery for this ESU. A trend toward recovery is also indicated by the 20- and 10-year estimates of median population growth rate (λ), which average 1.14 and 1.31, respectively, as well as both 20-and 10-year trend estimates of 1.09 and 1.25, respectively. The 24-year extinction risk estimates are low (< 5 percent) at all quasi-extinction thresholds (QETs). In this analysis, a metric of 1.0 reflects no

Table 4-3. Base Status Metrics

Population	20-year R/S	10-year R/S	20-year λ	12-year λ	1980-current Trend	1990-current Trend	Ext. Risk QET= 1	Ext. Risk QET= 50
Lower Mainstem	0.82	1.24	1.14	1.31	1.09	1.25	0.00	0.01

Note: For R/S, lambda and trend, a value >1.0 indicates a growing population. Extinction probabilities are expressed as percentages, e.g., a value of 0.01 indicates a 1 percent risk of extinction within 24 years.

gap. A number below 1.0 reflects a positive condition, while a number above 1.0 reflects a gap. For example, a gap of 1.2 indicates that 20 percent productivity is needed in the future.

Based on consideration of these metrics, the survival gaps that need to be closed to achieve the survival and recovery criteria before recent and prospective actions are taken into account are summarized in Table 4-4. The only metric suggesting a need for lifecycle improvement is the 20-year R/S estimate where a 22 percent increase in survival would bring it in line with a survival and trending toward recovery criterion of 1.0.

Table 4-4. Base Status Gaps

Population	20-year R/S Gap	10-year R/S Gap	20-year λ Gap	Long-term Trend Gap	Ext. Risk Gap QET = 1	Ext. Risk Gap QET = 50
Lower Mainstem	1.22	0.81	0.56	0.37	0.00	0.00

Note: Gaps are expressed as multipliers. For example, a 1.10 gap indicates a 10 % improvement is necessary to close gap. If gap is ≤ 1.0, no further improvement is necessary to close gap.

4.2.3 Spatial Structure and Biological Diversity

Conserving and rebuilding sustainable salmonid populations involves more than meeting abundance and productivity criteria. Accordingly, NMFS has developed a conceptual framework defining a Viable Salmonid Population (VSP) (McElhany et al. 2000). In this framework there is an explicit consideration of four key population characteristic or parameters for evaluating population viability status: abundance, productivity (or population growth rate), biological diversity, and population spatial structure. The reason that certain other parameters such as habitat characteristics and ecological interactions were not included among the key parameters is that their effects on populations are implicitly expressed in the four key parameters. Based on the current understanding of population attributes that lead to sustainability, the VSP construct is central to the goal of ESA recovery, and warrants consideration in a jeopardy determination.

Spatial Structure – Spatial structure, as the term suggests, refers to the geographic distribution of individuals in a population unit and the processes that generate that distribution. Distributed populations that interact genetically are often referred to as a metapopulation. Although the spatial distribution of a population, and thus its metapopulation structure, is influenced by many factors, none are perhaps as important as the quantity, quality, and distribution of habitat. One way to think about the importance or value of a broad geospatial distribution is that a population is less likely to go extinct from a localized catastrophic event or localized environmental perturbations.

Biological Diversity – Biological diversity within and among populations of salmonids is generally considered important for three reasons. First, diversity of life history patterns is associated with a use of a wider array of habitats. Second, diversity protects a species against short-term spatial and temporal changes in the environment. And third, genetic diversity is the so-called raw material for adapting to long-term environmental change. The latter two are often described as nature's way of hedging its bets –

a mechanism for dealing with the inevitable fluctuations in environmental conditions – long and short term. With respect to diversity, more is better from an extinction-risk perspective.

The Snake River Fall Chinook Salmon ESU consists of a single Major Population Group (MPG) and a single population that the Interior Columbia Basin Technical Recovery Team (TRT) has designated as "at high risk" for spatial structure and diversity (SSD). The loss of access to some 70-plus percent of its historical habitat after construction of the Hells Canyon Complex and the current existence of a single population are the primary factors for this high-risk status. However, the increasing abundance and productivity of this ESU are positive factors that help offset this risk. Additional contributors to reducing this risk, and in particular the risk to the biological diversity and uniqueness of this ESU, have been the systematic efforts of fishery managers to minimize the introduction of outside hatchery strays. These efforts have included the removal of marked hatchery fish at the Lower Granite Dam adult trap, and modifications to the Umatilla program to increase homing fidelity to the Umatilla River. The results of these changes have been biologically significant. Prior to 1998/1999 NMFS status reviews, the 5-year average contribution of outside stocks to the escapement over Lower Granite Dam exceeded 26 percent. More recently, the 1997 to 2011 5-year average was reduced to 12 percent, with the 2001 proportion just over 8 percent.

4.3 BIOLOGICAL ANALYSIS OF ACTIONS: RECRUITS-PER-SPAWNER, LAMBDA, AND TRENDS WITH CURRENT AND PROSPECTIVE ADJUSTMENTS

The Base Status is the historical status of the ESU, defined as the status of the population based on the *average* of quantitative survival metrics estimated from a time series of abundance data beginning in about 1980. For the most part, longer-term averages (generally 20 years) were used where they were available. In the biological analysis, this is the starting point, shown in the tables above.

The next step is Current Status, an adjustment of the initial base estimates to reflect our best estimate of current survivals, as opposed to an average of survivals that prevailed over a period in the past. This would obviously include recent improvements already implemented but not fully reflected in the base conditions. Current Status is defined as "estimated survival metrics adjusted for recently implemented changes in hydropower configuration and operations, hatchery operations, tributary and estuarine habitat improvements, and reduced avian predation." These are actions that have recently been implemented, but their effects are not reflected in the time series of survival data that for the most part started in 1980.

The final step is Prospective Status, which adjusts Current to Prospective Status based on the estimated effects of future actions. The current-to-prospective adjustment is simply an adjustment of the current survival estimates to reflect survival improvements expected from the hydro, habitat, and hatchery changes included in the Proposed RPA, and in particular those that are expected to be implemented in the period 2007 to 2017.

This analysis assumes that future ocean and climate conditions will approximate the average conditions that prevailed during the 20-year base period used for our status assessments. For most populations, that period is about equivalent to the "recent" ocean period used by the Interior Columbia Basin TRT in its analyses. This period was characterized by relatively poor ocean conditions that presumably contributed to poor early ocean survival of salmonids. To illustrate, the Interior Columbia Basin TRT's "pessimistic" ocean condition scenario results in survivals that are about 15 percent lower for Snake River Spring/Summer Chinook Salmon than the "recent" ocean conditions scenario, and about 36 percent lower for Upper Columbia Spring Chinook Salmon. Alternatively, the TRT's "historical" ocean conditions scenario results in survivals that are about 39 percent higher for both Snake River Spring/Summer and

Upper Columbia Spring Chinook Salmon (Interior Columbia Basin TRT and Zabel 2006). This subject is treated at greater length in the discussion of the effects of potential climate change in Appendix H.

The analysis of status assumes a certain amount of annual take of natural adult fish based on recent harvest levels.

4.3.1 Current Status Analysis

Over the current period (2000 to 2006) the Action Agencies implemented multiple actions to improve fish survival relative to the base period prior to 2000. The percentage changes in lifecycle survival used in the base-to-current adjustments for the Lower Mainstem Snake River Fall Chinook Salmon population are summarized in Table 4-5. These actions are described in the following sections.

Table 4-5. Estimated Survival Improvements Used in the Base-to-Current Adjustment

Population	Hydro	Habitat (tributary)	Habitat (estuary)	Avian predation	Hatchery
Lower Mainstem	N/A	N/A	0.7%	2.1%	N/A

4.3.1.1 Hydropower Survival Improvements

As noted, it is not possible at this time to model hydrosystem survival improvements for this ESU due to life history uncertainties. Therefore, lifecycle survival improvements attributable to hydrosystem improvements are not estimated. As an alternative, the 10 year recruit-per-spawner estimate is used as a surrogate for the base-to-current adjusted R/S value.

4.3.1.2 Tributary Habitat Survival Improvements

Snake River Fall Chinook Salmon spawn in the mainstem and would not directly benefit from tributary habitat improvements.

4.3.1.3 Estuary Habitat Survival Improvements

The estimated survival benefit for Snake River Fall Chinook Salmon (ocean-type life history) associated with the specific actions discussed above is 0.7 percent. Action Agencies implemented habitat actions through 21 estuary habitat projects. Unrestricted fish passage and access to approximately 3 miles of quality habitat was provided via these specific actions[1]:

- Replaced three culverts with full-spanning bridges;
- Provided approximately 10 miles of improved tidal channel connectivity by installing a tide gate retrofit;
- Acquired approximately 473 acres of off-channel and riparian habitats;
- Restored and created 90 acres of marsh and tidal sloughs and approximately 100 acres of riparian forests;
- Protected approximately 55 acres of high-quality riparian and floodplain habitat;
- Restored and preserved approximately 154 acres of off-channel habitat;
- Protected 80 acres of high-value off-channel forested wetland habitat;

[1] A more thorough report detailing this evaluation process is: *Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary* (PC Trask & Associates 2007), which is included in Appendix D, Attachment D-1.

- Restored approximately 96 acres of tidal wetlands habitat by replacing undersized culvert that limited fish access;
- Conserved 155 acres of forested riparian and upland habitat;
- Provided partial tidal channel reconnection by tide gate retrofit (acreage unknown at this time);
- Provided integrated pest management (purple loosestrife);
- Reconnected and restored 183 acres of historical floodplain by dike removal;
- Restored 25 acres of historical floodplain by breaching a dike;
- Provided fish passage access to 6 miles of stream habitat by removal of two culverts and replacement with bridges;
- Restored 310 acres of native hardwood riparian forest, 200 acres of seasonally wet slough and 155 acres of degraded riparian habitats; increased circulation in approximately 92 acres of backwater and side-channel habitat by tide gate retrofit;
- Improved embayment circulation for 335-plus acres of marsh/swamp and shallow-water and flats habitat; and
- Preserved 35 acres of historical wetland habitat.

4.3.1.4 Predation Management Survival Improvements

Avian Predation

The estimated survival increase for Snake River Fall Chinook Salmon from the baseline-to-current condition is 2.1 percent. This estimate errs strongly on the conservative side because averaging tern consumption of juvenile salmonids across the 20-year base period downplays the actual change in survival that resulted from relocating terns from Rice Island to East Sand Island in 1999. In 1999 tern consumption of juvenile salmonids was at its peak with an estimated 13,790,000 smolts consumed, compared to 8,210,000 in 2000 after relocation.

Piscivorous Predation

The ongoing Northern Pikeminnow Management Program (NPMP) has been responsible for reducing predation-related juvenile salmonid mortality since 1990. The improvement in lifecycle survival attributed to the NPMP is estimated at 2 percent for migrating juvenile salmonids (Friesen and Ward 1999). The northern pikeminnow has been responsible for approximately 8 percent predation-related mortality of juvenile salmonid migrants in the Columbia River Basin in the absence of the NPMP (2000 FCRPS BiOp at 9-106). The ongoing NPMP is already accounted for in the estimation of survival improvements modeled within the reservoir mortality life stage because the modeling estimates are calibrated to empirical reach survival estimates that included the ongoing program.

4.3.1.5 Hatchery Management Survival Improvements

Straying of out-of-basin hatchery fall Chinook salmon into the Snake River has been a problem for several decades. In 1989, for example, an estimated 40 percent of the adults used for broodstock at Lyons Ferry Hatchery were out-of-basin hatchery strays. In the last decade, however, returns of Snake River-origin fall Chinook salmon have increased disproportionately to outside hatchery strays. Prior to the 1998 to 1999 NMFS status reviews, the 5-year average contribution of outside stocks to the escapement over Lower Granite Dam exceeded 26.2 percent. The most recent 5-year average (1977 to 2001) was 12.4 percent, with the contribution in 2001 being just over 8 percent. The drop in relative contribution by outside stocks reflects the disproportionate increase in returns of the Lyons Ferry Hatchery component, the systematic removal of marked hatchery fish at the Lower Granite Dam trap, and modifications to the Umatilla program to increase homing of fall-run Chinook salmon release groups intended to return to the Umatilla River (NMFS 2005b). The Lower Granite Dam adult trap improvements completed in 2007 will enable trapping of more natural-origin broodstock to improve broodstock management in the Lyons Ferry and Nez Perce Tribal Hatchery fall Chinook salmon programs. The improved trap will also facilitate the trapping and removal of more non-ESU hatchery strays, preventing them from passing above Lower Granite Dam and possibly breeding with ESU fish.

2000 to 2006

BPA funded the development of Hatchery Genetic Management Plans (HGMPs) for all Federally funded hatchery programs in this ESU. No survival improvements from these planning processes are estimated for the 2000 to 2006 time period, although low benefits are expected as NMFS uses the HGMPs in its hatchery program ESA Section 7 consultations. Other BPA-funded hatchery actions implemented with benefits for this ESU in 2000 to 2006 include:

- Three fall Chinook salmon acclimation programs and the fall Chinook salmon production program at Nez Perce Tribal Hatchery increase fish spawning naturally and improve spatial structure. These programs are important to sustaining and preventing extirpation of the ESU and provide high benefits for abundance, productivity, and genetic diversity.
- Installation, operation, and maintenance of the Lower Granite Dam adult salmon and steelhead trap improvements with benefits accruing for this ESU beginning in 2007.

4.3.2 Current Status Gaps

Over the current period (2000 to 2006) the Action Agencies implemented multiple actions to improve fish survival relative to the base period prior to 2000. The percentage improvements in lifecycle survival used in the base-to-current adjustments for fall Chinook salmon are summarized in Table 4-6.

Table 4-6. Current Status: Adjusted Gaps after Base-to-Current Adjustment

Population	Adjusted 10-year R/S Gap	Adjusted 20-year λ Gap	Adjusted Long-term Trend Gap	Adjusted Ext. Risk Gap QET = 1	Adjusted Ext. Risk Gap QET = 50
Lower Mainstem	0.78	0.54	0.36	0.00	0.00

Note: Gaps are expressed as multipliers. For example, a 1.10 gap indicates a 10% improvement is necessary to close gap. If gap is ≤ 1.0, no further improvement is necessary to close gap.

4.3.3 Prospective Status Analysis

As noted above the prospective status is the projected status of the population based on adjustment of the survival metrics for expected improvements associated with the Proposed RPA. As was the case for the base-to-current adjustment, the improvements for the current-to-prospective are divided into the categories of those expected from changes in hydropower operations and configuration (including Upper Snake River flow augmentation), changes in tributary habitat conditions attributable to actions implemented in the periods 2007 to 2009 and 2010 to 2017, changes in estuarine habitat, reduced impacts of avian predation, and improved hatchery operations.

Hydro benefits were not calculated for the current or prospective survival analysis for fall Chinook salmon. The current Comprehensive Fish Passage (COMPASS) model is not yet capable of estimating survival due to the complex life histories exhibited by fall Chinook salmon. However, significant configuration and operation actions have occurred in recent years and are projected to continue into the future. The key unknown is the effect of recent actions to leave more fish in-river (RSW and spill) compared to past operations that primarily relied on transport. This is a key uncertainty being addressed in Research, Monitoring, and Evaluation.

The prospective status is projected based expected survival improvements associated with actions in 2007 to 2017. Over this period the Action Agencies will implement multiple actions to improve fish survival relative to the current period. The percentage changes in lifecycle survival used in current-to-prospective adjustments are summarized in Table 4-7. Actions are summarized below.

Table 4-7. Estimated Improvements in Survival Used in the Current-to-Prospective Adjustment

Population	Hydro	2007-17 Habitat	Habitat (estuary)	Avian predation	Pikeminnow predation	Hatchery
Lower Mainstem	N/A	N/A	9.0%	0.7%	1.0%	N/A

Note: FCRPS impacts are based on river flows that enter the FCRPS action area, including those that enter the Snake River at the toe of Hells Canyon Dam, which are affected by the operation of Reclamation’s upper Snake Projects.

4.3.3.1 Hydropower Survival Improvements

The Action Agencies have formulated a broad array of hydropower actions to further increase the survival of this ESU during migration through the hydrosystem. Specific survival benefits for each action were derived using best professional judgment and are based on a per-project basis. However, due to the life history complexity, it is not possible to generate COMPASS survival estimates at this time. The configuration and operational improvement actions that contribute to these survival increases are organized into strategies. Specific actions contained within these strategies are listed in the Hydrosystem Action Summary. These strategies include:

1. Operate the FCRPS to more closely approximate the shape of the natural hydrograph and to improve juvenile and adult fish survival;
2. Modify Columbia and Snake river dams to facilitate safe passage;
3. Implement operational improvements at Columbia and Snake river dams;
4. Operate and maintain juvenile and adult fish passage facilities; and
5. Continue to evaluate the best passage management strategy for fall Chinook salmon (i.e., transport vs. in-river).

Changes in the timing of Upper Snake River flow augmentation, as described in Reclamation’s Upper Snake River Biological Assessment (BA), are also expected to improve conditions for survival.

4.3.3.2 Tributary Habitat Survival Improvements

The Action Agencies are not proposing tributary habitat improvements for Snake River Fall Chinook Salmon.

4.3.3.3 Estuary Tributary Habitat Survival Improvements

2007 to 2009

The estimated survival benefit for Snake River Fall Chinook Salmon (ocean-type life history) associated with the specific actions described below is 2.3 percent. The Action Agencies’ estimated benefit for 2007 is based on actions that are or will be underway in the very near-term. For 2008 and 2009, the Action

Agencies' estimated benefit is based on the increased funding level described in the FCRPS BA.[2] The Action Agencies are or will be implementing multiple habitat actions through approximately 35 estuary habitat projects. Specific estuary habitat actions:

- Restore partial tidal influence and access to several acres (exact amount unknown at this time) by a tide gate retrofit; improve hydrologic flushing and salmonid access to a lake (Sturgeon Lake is approximately 3,200 acres);
- Acquire and protect 40 acres of critical floodplain habitat and 40 acres of riparian forest restoration;
- Install six to eight engineered log-jams that will help to slow flood flows, reduce erosion, contribute to sediment storage, enhance fish habitat, and contribute wood into the project area;
- Acquire and restore floodplain connectivity to 380 acres of off-channel rearing habitat for juveniles;
- Install fish-friendly tide gates to increase tidal flushing and fisheries access to approximately 110 acres;
- Plant riparian vegetation on up to 210 acres;
- Re-establish hydrologic connectivity to reclaim and improve floodplain wetland functions, increase off-channel rearing and refuge habitat on 5 acres, plant native vegetation along shoreline, and reconstruct slough channels on 2.5 acres of annually inundated off-channel habitat;
- Breach a dike and re-establish flow to portion of original channel, plant vegetation on 50 acres, remove invasive weeds on 180 acres, plant wetland scrub shrub on 45 acres, and control and remove invasive wetland plants on 45 acres as part of a long-term 1,500-acre restoration effort;
- Retrofit a tide gate (acreage unknown at this time); protect and restore approximately 5 to 10 acres of emergent wetland and riparian forest habitats;
- Reconnect 45 acres of floodplain by tide gate removal;
- Acquire 45 acres of floodplain with future dike removal;
- Reconnect 50 acres of floodplain;
- Acquire 320 acres of tidelands and 119 acres of riparian/upland forest; and
- Restore 30 acres of riparian habitat.

There are be approximately 15 to 20 additional projects and associated actions similar to actions listed above that are undergoing scoping and sponsor development (the number of projects and associated actions is based on the increased funding level for 2008 to 2009 described in the FCRPS BA).

2010 to 2017

The survival benefit for Snake River Fall Chinook Salmon (ocean-type life history) associated with these actions is 6.7 percent. The Action Agencies' estimated benefits for 2010 to 2017 are based on the increased funding level described in the BA. However, the level of effort in this time period may increase depending on the outcome of a General Investigation study of Ecosystem Restoration opportunities,

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[2] A more thorough report detailing this evaluation process is: *Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary* (PC Trask & Associates 2007), which is included in Appendix D, Attachment D-1.

depending on Congressional appropriations, future funding scenarios, and results of actions. Specific projects have yet to be identified, but actions for this period will be similar in nature to actions implemented in previous periods discussed above. Actions will include protection and restoration of riparian areas, protection of remaining high-quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, and reduction of noxious weeds.

4.3.3.4 Predation Management Survival Improvements

Avian Predation

The estimated increase in Snake River Fall Chinook Salmon survival from the current to future condition is 0.7 percent, and this benefit is carried out to 2017 and beyond. This improvement is expected to result through the reduction in estuary tern nesting habitat, and subsequent relocation of terns to outside the Columbia Basin.

Piscivorous Predation

The percentage improvement in lifecycle survival attributable to the proposed continuation of the increase in incentives in the NPMP and resultant marginal increase in observed exploitation rate is estimated at 1 percent total from 2007 to 2017. This estimate was derived based on the difference between the estimated benefits from the base NPMP (defined as the period 1990 to 2003) and estimated survival benefits under the increased incentive program (defined as the period of 2004 to present). This rate would generally apply to all juvenile salmonids.

4.3.3.5 Hatchery Management Survival Improvements

2007 to 2017

The Action Agencies will:

- Continue to fund the three fall Chinook salmon acclimation programs and the fall Chinook salmon production program at Nez Perce Tribal Hatchery to increase fish spawning naturally and improve spatial structure. These programs are important to sustain and prevent extirpation of the ESU and provide high benefits for abundance, productivity, and genetic diversity;
- Continue to fund the operation and maintenance of the Lower Granite Dam adult salmon and steelhead trapping facility; and
- Further expand the Lower Granite Dam adult salmon and steelhead trapping facility to enable collection of more natural-origin broodstock, trapping and removal of more out-of-basin stray fall Chinook salmon, and improved run reconstruction and research data collection. These actions will provide low to medium benefits for abundance, productivity, and genetic diversity of the ESU.

4.3.4 Prospective Status

Comprehensive analyses of the changes in lifecycle survival resulting from the proposed actions and analysis of how they will change the survival metrics indicate that the Snake River Fall Chinook Salmon ESU will survive in the near-term. Based on the estimated remaining gaps summarized in Table 4-8, the single population comprising the Snake River Fall Chinook Salmon requires no additional improvements in lifecycle survival to achieve the survival and trending toward recovery criteria. Based on the productivity metrics used in this analysis, the population is growing and will likely continue to do so until its remaining habitat is fully seeded.

Table 4-8. Estimated Future Status with Proposed RPA

Population	Prospective 10-year R/S	Prospective 20-year λ	Prospective Long-Term Trend	Prospective Risk Gap QET = 1	Prospective Risk Gap QET = 50
Lower Mainstem	1.41	1.17	1.29	0.00	0.00

Note: Future productivity values represent estimates of future R/S, lambda and trend after consideration of the effects of the Proposed RPA. For R/S, lambda and trend a value >1.0 indicates a growing population. A risk gap of 0.00 indicates a <5 percent risk criterion has been exceeded.

4.3.5 Remand Conceptual Framework Analysis

The FCRPS BiOp Remand Collaboration among the sovereigns developed a Conceptual Framework approach intended to help the Action Agencies develop their proposed action. The Framework approach attempted to estimate the relative magnitude of mortality factors affecting Interior Columbia Basin salmonid populations. That assessment was intended to define the FCRPS's "relative expectation…for recovery" (FCRPS 2006). The collaboration's Framework working group developed high and low mortality estimates for all sources of mortality, including the FCRPS. The collaboration's Policy Working Group has not determined where in that range the Action Agencies' Proposed RPA should be assessed. The range of "gaps" that the Framework approach would expect the FCRPS to fill was reviewed and the Action Agencies assessed whether the total survival improvements estimated in this biological analysis would "fill" those gaps. For the purposes of this comparison, the Interior Columbia Basin TRT gaps were used for "recent" ocean and "base hydro" conditions (corresponding to the base period used for R/S productivity estimation), and the TRT's 5 percent risk level.

The Interior Columbia Basin TRT gap for the 1990 to1999 period was used to correspond to the 10-year geomean R/S productivity estimate. The Conceptual Framework was intended, among other things, to "provide a clear and complementary link to ongoing recovery planning efforts" (FCRPS 2006). As such, it can be understood to represent the collaboration parties' view of the appropriate contribution of the FCRPS toward long-term recovery of the listed ESUs in the Interior Columbia River Basin. Therefore it provides another "metric" for use in considering the impacts of the Proposed RPA on a listed species' prospects for recovery. The results of that analysis are displayed in Table 4-9.

The Proposed RPA (without considering either improvement in the environmental baseline or other actions reasonably certain to occur) leaves a 1 percent gap at the low end of the Framework range and a 10 percent gap at the high end. However, considering a reasonable qualitative assessment of likely hydrosystem survival improvements, it seems reasonable to suppose that Framework gaps would be filled at the high and low ends of the range.

Table 4-9. Gap Calculations from the Conceptual Framework

MPG	TRT Gap	FCRPS Relative Impact (high)	FCRPS Relative Impact (low)	TRT Gap (high hydro)	TRT Gap (low hydro)	Total Survival Change	Remaining Framework Gap (high)	Remaining Framework Gap (low)
Lower Mainstem (1977-1999)	1.47	0.57	0.35	1.25	1.14	1.13	1.10	1.01
Lower Mainstem (1990-1999)	1.38	0.57	0.35	1.20	1.12	1.13	1.06	0.99

Note: Interior Columbia Basin TRT gaps are expressed as multipliers. Gaps are for 5 percent risk, recent ocean/base hydro conditions. A "remaining" gap value <1.0 indicates that no further improvement is necessary. Total survival changes combine all estimated survival improvements for the base-to-current and current-to-prospective adjustment.

4.4 ADDITIONAL ACTIONS TO BENEFIT THE ESU

4.4.1 Other Reasonably Certain to Occur Actions[3]

This analysis does not include analysis of non-Federal actions that are reasonable certain to occur, developed as part of the Remand Collaboration.

4.4.2 Other Future Federal Actions with Completed Section 7 Consultation

NMFS searched its Public Consultation Tracking Database (PCTS) for Federal actions that had completed Section 7 consultation since November 30, 2004, that could be used to adjust the status of the lower mainstem Snake River population between the base and current periods. These included several consultations with the Corps on its Clean Water Act Section 404 permitting process (maintenance dredging of a barge slip at or near the mouth of the Snake River, construction of a new floating dock at the Port of Clarkston, Washington, and installation of a new boat launch at Wawawai Landing, Washington). NMFS also completed a consultation with BPA on replacing a wood pole transmission line north of Lewiston, Idaho.[4]

4.5 OBSERVATIONS

After considering recently implemented actions and the likely effects of the Proposed RPA, all three metrics of productivity (recruit-per-spawner, λ, and long-term trends) are expected to be greater than 1.0, indicating that this population will replace itself and grow. Moreover, extinction risk for this population is negligible.

4.6 CONCLUSION

All three metrics of productivity (recruit-per-spawner, λ, and long-term trends) indicate that this population is replacing itself and growing. Moreover, extinction risk for this population is negligible. Although this population will never return to historic abundance because of the loss of habitat from the construction of the privately owned Hells Canyon Complex of dams in the late 1950s, it is expected that this population will continue to grow until the currently available habitat is fully utilized. As noted above, abundance over the most recent 5-year period in the Interior Columbia Basin TRT dataset exceeds the interim recovery target for this ESU. The Action Agencies have worked with the States and Tribes through the Remand Collaboration Process and other forums to identify actions intended to address the needs of listed salmon and steelhead as determined by quantitative and qualitative biological analyses. Acknowledging that NMFS will review the actions and the effects analyses contained herein to make a final jeopardy determination in the forthcoming biological opinions, the Action Agencies are making the following conclusions. Based on our assessment of the FCRPS and Upper Snake River actions and analysis of effects, considering the present and future human and natural context, the Action Agencies conclude that the net effects of the proposed actions, including the existence and operations of the dams with the proposed mitigation, meet or exceed the objectives of doing no harm and contributing to recovery with respect to this ESU.

[3] Many of the actions listed above have a cost-share component with a variety of other Federal funding sources and therefore may be properly described as contributing to the status of the environmental baseline rather than cumulative effects.
[4] No quantitative adjustments were made based on these data.

Chapter 5
Snake River Spring and Summer Chinook Salmon Evolutionarily Significant Unit

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

5.1 INTRODUCTION

This chapter briefly summarizes the current biological analysis developed for this Evolutionarily Significant Unit (ESU). Summary data for the ESU are presented in Table 5-1. The geographic extent of the ESU is shown in Figure 5-1.

Table 5-1. ESU Description and Major Population Groups (MPGs)

ESU Description	
Threatened	Listed under Endangered Species Act (ESA) in 1992; reaffirmed 2005
5 current major population groups	28 current populations (1 to 9 populations per Major Population Group [MPG])
Hatchery programs included in ESU	Conventional and captive broodstock programs: Tucannon, Lostine River, Catherine Creek, Upper Grande Ronde, Lookingglass, Imnaha River, Big Sheep Creek, South Fork Salmon River, Johnson Creek, Lemhi, East Fork Salmon River, West Fork Yankee Fork, Sawtooth, McCall, and Pahsimeroi
Major Population Groups	**Populations**
Grande Ronde/Imnaha	Catherine Creek
	Grande Ronde River upper mainstem
	Imnaha River mainstem
	Lostine River/Wallowa River
	Minam River
	Wenaha River
Lower Snake	Tucannon River
Middle Fork Salmon River	Bear Valley Creek
	Big Creek
	Camas Creek
	Chamberlain Creek
	Loon Creek
	Marsh Creek
	Middle Fork Salmon River above Indian Creek
	Middle Fork Salmon River below Indian Creek
	Sulphur Creek
South Fork Salmon River	East Fork South Fork Salmon River
	Little Salmon River
	Secesh River
	South Fork Salmon River mainstem
Major Population Groups	**Populations**
Upper Salmon River	East Fork Salmon River
	Lemhi River
	North Fork Salmon River
	Pahsimeroi River
	Salmon River lower mainstem below Redfish Lake
	Salmon River upper mainstem above Redfish Lake
	Valley Creek
	Yankee Fork

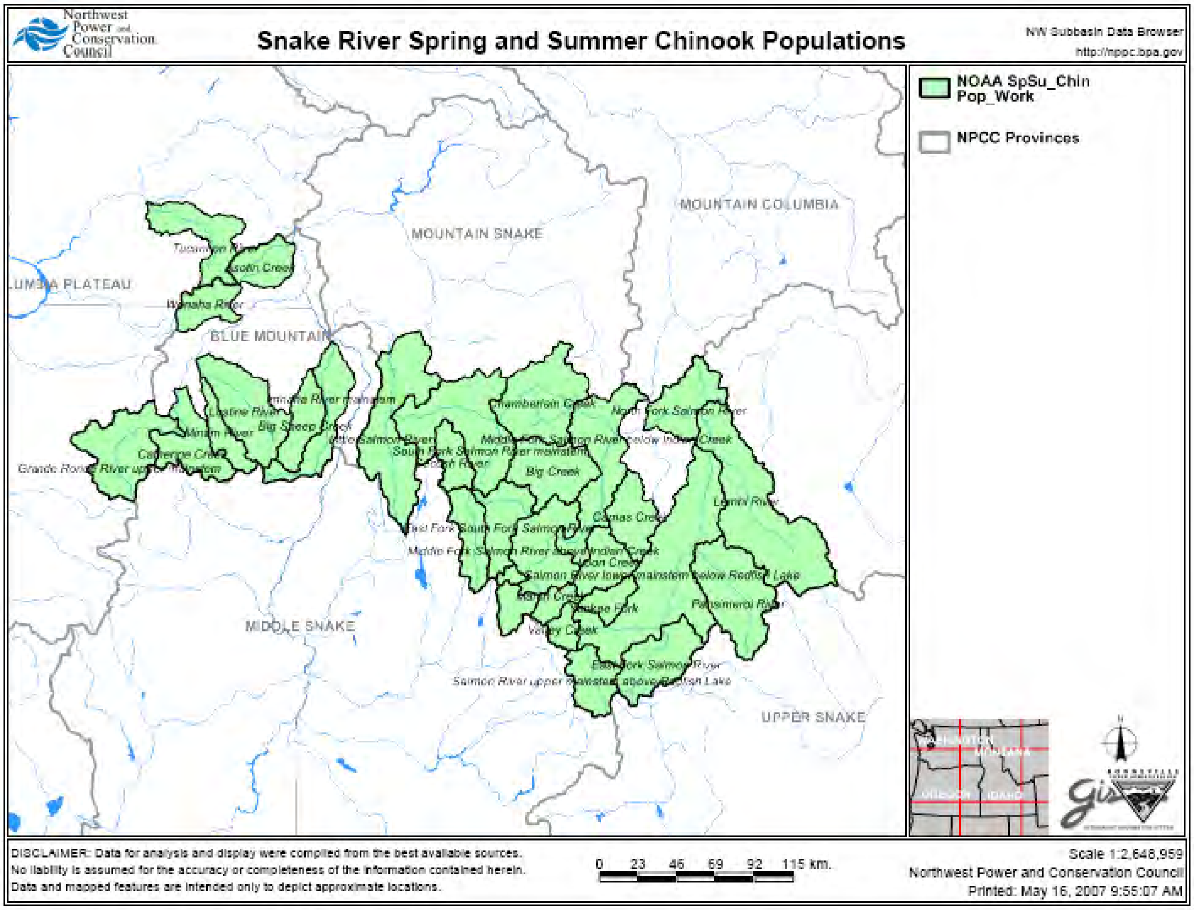

Figure 5-1. Snake River Spring and Summer Chinook Salmon ESU

This chapter is organized into five sections. Section 5.1 provides an overview of the ESU and the factors limiting its viability. Section 5.2 summarizes population-level status information during the 20-year base period used for this analysis. Section 5.3 provides the analysis of the current status and provides estimates of the "gaps," or needed lifecycle survival improvements for individual populations to meet certain biological criteria. It summarizes the improvements made to the hydrosystem and in other Hs (habitat, hatcheries, and harvest) since about 2000 and estimates the salmonid survival benefits associated with those improvements. Section 5.4 describes the actions proposed to be implemented into the future, and Section 5.5 estimates their effects on salmonid survival when aggregated with the environmental baseline and cumulative effects.

Almost all of the metrics used in this analysis are estimates for individual populations within the ESU. The ESA is concerned with the status of a species, either the Distinct Population Segments (DPS, which is an equivalent term often used for steelhead) or ESUs. Individual populations and major population groups (where they exist) obviously contribute to ESU status. However, the status of the ESU is not wholly dependent upon the status of any of the ESU's individual components.

The Snake River Spring and Summer Chinook Salmon ESU is composed of multiple populations that spawn and rear in the tributaries of the Snake River between the confluence of the Snake and Columbia rivers and the Hells Canyon Dam. The Interior Columbia Basin Technical Recovery Team (TRT) has identified 28 existing populations and four functionally extirpated populations for this ESU. These populations are organized into five major population groups: Lower Snake, Grande Ronde/Imnaha, South

Fork Salmon River, Middle Fork Salmon River, and Upper Salmon. They are all considered stream-type, typically migrating to the ocean as yearlings after a year in fresh water, returning to freshwater during spring and summer after 2 or 3 years in the ocean, and spawning in late summer. Adults are migrating upstream and juveniles are migrating downstream while Reclamation is storing, releasing, and diverting water. Spawning areas are the mid to upper reaches of most accessible tributaries. The ESU includes current returns to the Tucannon River, the Grande Ronde River system, the Imnaha River, and the Salmon River. The TRT has defined a hierarchical population structure for this ESU composed of 32 demographically independent populations, four of which are considered functionally extirpated. These populations are organized into five major population groups: Lower Snake, Grande Ronde/Imnaha, South Fork Salmon River, Middle Fork Salmon River, and Upper Salmon. This ESU was listed as threatened on April 22, 1992, and reaffirmed as threatened on June 28, 2005.

The total annual production of natural Spring and Summer Chinook Salmon from the Snake River was likely in excess of 1.5 million fish during the late 1800s. The Salmon River alone produced up to 45 percent of all Columbia River Spring and Summer Chinook. Since then, Snake River Spring and Summer Chinook have suffered dramatic declines as a result of intensive commercial harvest, loss of habitat, and/or degradation of habitat caused by logging, grazing, mining, irrigation diversions, and early barrier dams. The declines continued with the construction of the hydropower system on the Snake and Columbia rivers, including four Federal dams on the Snake River and the Idaho Power Company's three-dam Hells Canyon Complex, which was constructed without fish passage.

Another major impact on salmon numbers and productivity occurred during the mid-1970s. A "cool" Pacific Decadal Oscillation (PDO) regime in the North Pacific Ocean shifted to a warm regime that lasted at least through the mid-1990s. A cool regime is strongly correlated with enhanced ocean productivity off the West Coast of the United States (and improved Columbia River Basin salmon survival); a warm PDO regime is correlated with poor ocean productivity off the West Coast of the United States (and poor Columbia River Basin salmon survival) (Peterson et al. 2006). The combination of harvest rates during the 1960s and early 1970s that exceeded 60 percent of the total run in some years, the construction of major Federal and private hydropower projects in the Snake River Basin during the 1950s and into the early 1970s, and the regime shift in the Pacific Ocean in the mid-1970s contributed to a steep decline in numbers of salmon returning to the Snake River Basin to spawn. Since hitting a trough in the early 1990s, Snake River Spring and Summer Chinook Salmon numbers have increased significantly (see Figure 5-2).

Spring and Summer-Run Chinook Salmon are produced at a number of artificial production facilities in the Snake River Basin. Much of the production was begun under the Lower Snake River Compensation Plan. Historically, a number of hatchery programs used broodstock originating from outside the Snake River Basin. Broodstock from the Carson National Fish Hatchery were used to supplement populations in Catherine Creek and the Grande Ronde River during the 1980s and into the 1990s. This practice was phased out in the 1990s due to concerns about high stray rates and the negative effects non-native, domesticated broodstock could have on wild populations. Concerns were raised in the 1998 status review (Myers et al. 1998) regarding the use of Rapid River hatchery stock reared at the Lookingglass hatchery in the Grande Ronde River Basin. The Rapid River hatchery stock was originally developed from broodstock collected from Spring-run Chinook returns to historical production areas above the Hells Canyon Dam complex. Use of Rapid River stock was similarly phased out in the late 1990s.

In-river harvest of Snake River Spring and Summer Chinook Salmon is managed under the Columbia River Fishery Compact on a sliding scale of 5.5 to 17 percent. The average 2000-2004 harvest averaged 10.7 percent. Harvest occurs both in a commercial and recreational fishery in the lower Columbia River, and in a tribal fishery in Zone 6. Based on the rare observation of tagged fish in mixed stock ocean fisheries it is generally believed that ocean harvest contributes little to harvest mortality. The TRT considers all extant populations in this ESU to be at high risk for abundance and productivity and from low to high risk for spatial structure and genetic diversity.

Human impacts and current limiting factors for this ESU come from multiple sources: hydro passage, habitat degradation, hatchery effects, fishery management and harvest decisions, predation, and other sources.

5.1.1 Key Limiting Factors

Salmon and steelhead have been adversely affected over the last century by many activities including human population growth, introduction of exotic species, over fishing, developments of cities and other land uses in the floodplains, water diversions for all purposes, dams, mining, farming, ranching, logging, hatchery production, predation, ocean conditions, loss of habitat and other causes (Lackey et al. 2006). Current key limiting factors for this ESU identified by the National Marine Fisheries Service (NMFS, also called National Oceanic and Atmospheric Administration [NOAA] Fisheries) in the ESU Overviews for the Remand Collaboration (NMFS 2005e) are summarized in Table 5-2.

Table 5-2. Key Limiting Factors

Hydro	The direct in-river survival rate for smolts passing through the Federal Columbia River Power System (FCRPS) is currently about 50 percent. According to the Step 4 report, the estimated portion of the human impact attributable to the FCRPS dams (compared to natural river estimates) is 74 to 95 percent. Several hypotheses attributing additional or latent mortality to hydrosystem passage have been formulated and are currently under independent scientific review. Latent mortality is defined as any mortality expressed in a life stage subsequent to where a direct effect occurs (e.g., stress due to poor rearing habitat results in additional mortality during downstream migration). If latent mortality is omitted, the range associated with the hydro system is 38 to 43 percent. Hydro impacts include volume, timing, and quality of flows that enter the geographic area, including flows from the Snake River at the toe of Hells Canyon Dam, which are impacted by the operation of Reclamation's upper Snake River projects as well as non-Federal irrigation projects in the upper Snake River. Other hydrosystem impacts within the geographic area include the mainstem effects of Reclamation's other projects within the Columbia River Basin and many non-Federal irrigation projects within the Columbia River Basin.
Predation	Predation has been noted as a factor limiting fish survival at mainstem hydro facilities and in the Columbia estuary.
Harvest	Current harvest rates (almost exclusively in mainstem Columbia River fisheries) average about 8 percent, though harvest rates since the adoption of a new management regime in 2001 have been higher, averaging about 11 percent. The current 3-year in-river harvest agreement allows for harvest between 5.5 percent and 17 percent, depending upon run strength. According to the Step 4 report, the estimated portion of the human impact attributable to combined Tribal and non-Tribal harvest effects is 37 to 69 percent. If latent mortality is omitted, the range associated with the combined harvest impacts is 14 to 15 percent.

Table 5-2. Key Limiting Factors

Estuary	Predation, levels of toxic substances, and habitat conditions in the plume are potential limiting factors.
Hatcheries	Eleven Spring and Summer Chinook Salmon hatchery programs operate within the ESU: 10 of these currently operate with appropriate conservation practices and are not considered a major limiting factor for naturally spawning Spring and Summer Chinook Salmon; Rapid River Hatchery is operated as an isolated program that may not have a large effect on natural populations. The recovery goal contemplates a transition from hatchery to natural production as natural fish recover. According to the Step 4 report, the estimated portion of the human impact attributable to hatchery effects is 6 to 11 percent. If latent mortality is omitted, the human impact associated with the hatchery system is 1 percent.
Habitat	Eleven of the Snake River Spring and Summer Chinook Salmon natural populations spawn in wilderness, where habitat is in good to excellent condition, but their survival and productivity are still very low. For others, habitat is degraded in the lower tributaries, where the fish – both juveniles and adults – need cold, clean water, in varying amounts and flow rates at different life stages. Reduced vegetation on the hills and in the riparian corridor, combined with summer temperatures, increases water temperature. In addition to current limiting factors and threats, we need to consider the threat of additional loss of habitat resulting from future development, and the adequacy of regulatory mechanisms to address these threats. According to the Step 4 report, the estimated portion of the human impact attributable to combined habitat effects in the tributaries and the estuary is 33 to 62 percent. If latent mortality is omitted, the human impact associated with habitat degradation is 15 to 16 percent.

5.2 BASE STATUS

This section summarizes the average status of this ESU during the base period, which for most populations is a 20-year period beginning in brood year 1979, 1980, or 1981, depending on the population. All of the analysis in this chapter relies on datasets supplied by the Interior Columbia Basin TRT. Those datasets do not include adult return information for the last 1 to 3 years, depending on the population.

5.2.1 ESU Abundance and Trends

Geometric mean abundance since the late 1990s has substantially increased for the ESU as a whole. Geomean abundance of natural-origin fish for the 2001 to 2005 period was 25,957 compared to 4,840 for the 1996 to 2000 period, a 436 percent improvement (all abundance trend information from Fisher and Hinrichsen [2006]). The interim recovery abundance level identified by NMFS for the ESU as a whole is 41,900 (Lohn 2002). The sum of the TRT's minimum abundance thresholds for all populations in this ESU is 26,500 (Interior Columbia Basin TRT 2006).

The ESU-level abundance trend of natural-origin spawners for 1990 to 2005 indicates an increasing population over that time. (The slope of the trend line for the ESU as a whole is 1.10 for this period.) Even the 1980 to 2005 ESU-level trend indicates positive growth (trend line slope of 1.02 for the entire ESU). All populations in the ESU show increasing or steady population growth trends in the 1990-recent period though many populations show declines when the longer 1980-recent period is analyzed.

Adult return numbers have recently declined from their peaks in 2001 and the years immediately following. However, this analysis focuses on longer-term trends consistent with the principle that a longer time series provides better estimates.

Abundance and a rolling 5-year geometric mean of abundance for the ESU compared to the NMFS ESU interim recovery target are shown in Figure 5-2.

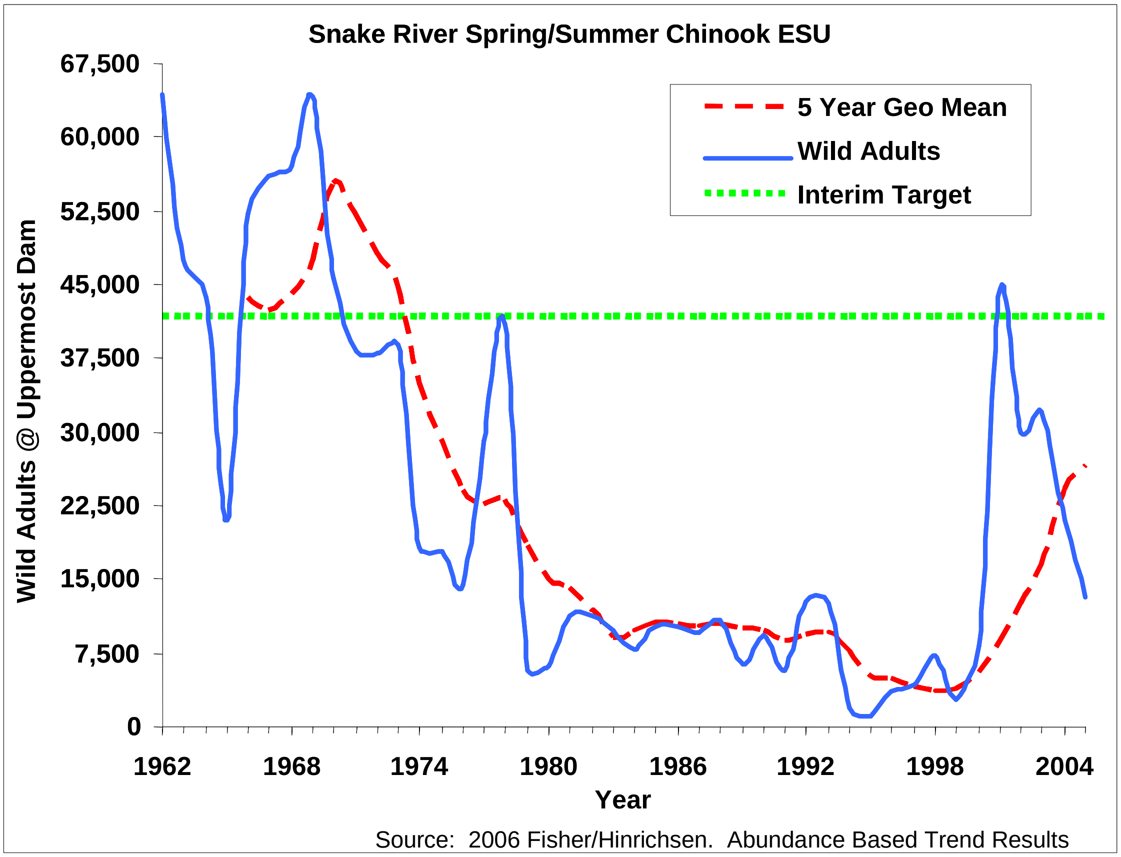

Figure 5-2. Snake River Spring Summer Chinook Abundance Trends

5.2.2 Extinction Probability/Risk

Results of extinction risk modeling are summarized in Table 5-3. Extinction probability estimates were developed for populations in this ESU using the Beverton-Holt production function, which was fit to spawner-recruit data from brood years 1978 to the present. The estimated Beverton-Holt function was used to project populations over a 24-year time horizon to estimate extinction probability. Alternative quasi-extinction thresholds (QETs) of 1, 10, 30, and 50 spawners were used in the analysis. In the modeling, extinction was assumed to occur when spawners fell below the QET for 4 years running. Reproductive failure was assumed to occur in any year in which spawner numbers fell below 10, except in the case of QET=1, where reproductive failure was assumed when spawners fell below 2.[1]

This modeling approach examined extinction risk first without future hatchery supplementation of the populations (Table 5-3), and then with future supplementation, the more likely prospect for some

[1] Reproductive failure is the assumption that zero progeny are produced in any year where spawner numbers fall below the identified threshold.

Table 5-3. Extinction Probability Results Assuming No Future Supplementation

MPG	Population	Ext. Risk QET = 1	Ext. Risk QET = 10	Ext. Risk QET = 30	Ext. Risk QET = 50
Lower Snake	Tucannon	0.00	0.02	0.06	0.10
Grande Ronde/ Imnaha	Catherine Cr.	0.12	0.29	0.42	0.51
	Lostine R.	0.00	0.03	0.10	0.19
	Minam R.	0.00	0.00	0.02	0.05
	Imnaha R.	0.00	0.01	0.04	0.09
	Wenaha R.	0.00	0.05	0.15	0.25
	Upper GR R.	0.00	0.08	0.40	0.68
S. Fork Salmon R.	South Fork	0.00	0.00	0.00	0.00
	Secesh R.	0.00	0.00	0.01	0.03
	E. Fork S. Fork.	0.00	0.00	0.00	0.01
Middle Fork Salmon R.	Big Cr.	0.00	0.04	0.23	0.43
	Bear Valley Cr.	0.00	0.00	0.04	0.09
	Marsh Cr.	0.02	0.15	0.38	0.55
	Sulphur Cr.	0.00	0.13	0.44	0.68
	Camas Cr.	N/A	N/A	N/A	N/A
	Loon Cr.	N/A	N/A	N/A	N/A
	Chamberlain Cr.	N/A	N/A	N/A	N/A
	Lower Mid. Fork	N/A	N/A	N/A	N/A
Upper Salmon	Lemhi R.	N/A	N/A	N/A	N/A
	Valley Cr.	0.00	0.09	0.46	0.72
	Yankee Fork	N/A	N/A	N/A	N/A
	Upper Salmon	0.00	0.00	0.00	0.01
	N.F. Salmon	N/A	N/A	N/A	N/A
	Lower Salmon	0.00	0.00	0.05	0.19
	E. Fork Salmon	0.00	0.00	0.04	0.13
	Pahsimeroi	N/A	N/A	N/A	N/A

Note:
A risk level of 0.11 indicates an 11 percent risk of extinction, assuming that spawner abundance below the QET for 4 years running results in extinction.

populations (Table 5-4). It is expected that supplementation will continue for a number of the populations in this ESU for the foreseeable future, in part to support the ESU and in part to support harvest opportunity. For that reason, we have also modeled extinction probabilities assuming continued supplementation at the average levels seen over the most recent 10 years. While modeling shows that supplementation provides a hedge against short-term extinction, we acknowledge that longer-term supplementation must be carefully managed to control risks to viability. Supplementation is a strategy to support, not substitute for, self-sustaining natural populations.

Without future supplementation, base case extinction probability results indicate moderate to high probabilities of extinction for 75 percent of the modeled populations in this ESU, assuming QET=50. At QET=1 (“absolute” extinction as used in the 2000 FCRPS Biological Opinion [BiOp]), only one population has a greater than 5 percent probability of extinction.

Table 5-4. Extinction Probability Results Assuming Future Supplementation

Population	Ext. Risk QET = 1	Ext. Risk QET = 10	Ext. Risk QET = 30	Ext. Risk QET = 50
Lostine River Chinook Salmon	0.00	0.00	0.00	0.00
Grande Ronde Upper Mainstem Chinook Salmon	0.00	0.00	0.01	0.06
Catherine Creek Chinook Salmon	0.00	0.00	0.07	0.24
Imnaha River Chinook Salmon	0.00	0.00	0.00	0.00

Note:
Future supplementation levels were assumed to be equal to the average of 1996-present. Hatchery effectiveness of .2 pre-1998 and .5 post-1998. A time horizon of 24 years. A risk level of 0.11 indicates an 11 percent risk of extinction, assuming that spawner abundance below the QET for 4 years running results in extinction.

Results at other QETs are displayed in Table 5-3. However, with the more likely scenario of future supplementation, the extinction risk is low for most of the modeled populations.

It also should be noted that these extinction probability results assume continued harvest at the average levels that prevailed during the base period. If a population were truly going extinct, these harvest levels might not be expected to continue, at least for natural-origin spawners, until natural fish numbers increased. Assuming future harvest reductions relative to the base period would reduce extinction probabilities.

Table 5-4 summarizes extinction risk under the assumption of continued supplementation. As expected, near-term extinction probabilities decline for those populations where hatchery supplementation is assumed to continue. Note that populations in the Middle Fork Salmon major population group (MPG) with high extinction probabilities at some QETs are not presently supplemented and are not likely to be supplemented in the future. Further discussion of extinction probability results for these populations can be found below.

5.2.3 Recruit-per-Spawner Productivity, Lambda, and Trends

Base status metrics of productivity and trend are summarized in Table 5-5. This provides a historical snapshot of the ESU since before listing until the present. Recruit-per-spawner productivity (R/S) counts hatchery fish as spawners, but not recruits, with implications discussed below. Lambda, or median annual population growth rate (the metric relied on for the 2000 FCRPS BiOp), integrates both the hatchery and natural component of the ESU. Abundance trends are the slope of the regression of log-transformed natural-origin spawner counts versus time. The trend is shown only for natural-origin spawners, though hatchery supplementation likely influences this metric, as well. Values greater than 1.0 indicate a population that is increasing over time.

The time series of data used to develop these estimates were the same as those used by the Interior Columbia Basin TRT. R/S and lambda are calculated over 20-year and 10-year periods beginning in brood years 1979, 1980, or 1981, depending on the population. In the case of the Pahsimeroi, we use an 11-year dataset beginning in brood year 1990 (see discussion of the Pahsimeroi population below).

Table 5-5. Base Status Metrics

MPG	Population	20 year R/S	10 year R/S	20 year λ	12 year λ	1980-current Trend	1990-current Trend
Lower Snake	Tucannon	0.76	0.67	1.00	1.03	0.89	0.96
Grande Ronde/	Catherine Cr.	0.38	1.21	0.97	1.06	0.93	1.22
Imnaha	Lostine R.	0.72	1.49	1.05	1.05	1.01	1.16
	Minam R.	0.80	1.28	1.05	1.02	1.02	1.12
	Imnaha R.	0.60	0.80	1.05	1.13	0.98	1.10
	Wenaha R.	0.66	1.29	1.10	1.05	1.04	1.20
	Upper GR R.	0.32	0.63	N/A	N/A	0.93	1.00
S. Fork Salmon R.	South Fork	0.87	0.65	1.11	1.06	1.05	1.09
	Secesh R.	1.04	0.95	1.07	1.09	1.02	1.12
	E. Fork S. Fork.	0.98	0.65	1.08	1.06	1.03	1.03
Middle Fork	Big Cr.	1.23	1.27	1.09	1.07	1.02	1.14
Salmon R.	Bear Valley Cr.	1.36	1.33	1.10	1.05	1.05	1.16
	Marsh Cr.	0.98	0.73	1.08	1.04	1.00	1.11
	Sulphur Cr.	0.89	0.44	1.05	0.95	1.01	1.00
	Camas Cr.	0.89	1.23	1.04	1.08	0.98	1.22
	Loon Cr.	1.21	1.54	N/A	N/A	1.06	1.34
	Chamberlain Cr.	N/A	N/A	N/A	N/A	N/A	N/A
	Lower Mid. Fork	N/A	N/A	N/A	N/A	N/A	N/A
Upper Salmon	Lemhi R.	1.09	1.61	1.02	1.02	0.98	1.12
	Valley Cr.	1.08	1.41	N/A	N/A	1.02	1.20
	Yankee Fork	0.68	0.55	N/A	N/A	1.03	1.12
	Upper Salmon	1.50	1.90	1.06	1.07	1.01	1.11
	N.F. Salmon	N/A	N/A	N/A	N/A	N/A	N/A
	Lower Salmon	1.23	2.14	1.02	1.07	1.00	1.11
	E. Fork Salmon	1.17	2.31	1.04	1.07	1.01	1.17
	Pahsimeroi	0.39	0.90	1.08	1.15	1.38	1.34

Note:
For R/S, lambda, and trend, a value >1.0 indicates a growing population; a value <1.0 indicates a declining population.

Base period R/S productivity is less than 1.0 for about one-half of the extant populations in this ESU, indicating a declining trend over the period used for the analysis. In contrast, only one of the 17 populations with adequate data had a 20-year lambda estimate of < 1.0 (Catherine Creek). In the case of long-term trend (1980 to present), estimates < 1.0 were evident for six of 20 populations.

The Action Agencies used the lambda calculations provided by the Interior Columbia Basin TRT. Lambda, as currently calculated by the TRT, tends to overstate annual population growth rates for populations with significant numbers of hatchery-origin fish in the spawning population. Therefore, we place less emphasis on lambda estimates for these populations. Lambda is, on the other hand, an acceptable measure of median annual population growth for populations that are not supplemented by hatchery fish. Twenty- year lambda estimates are greater than 1.0 for all non-supplemented populations in this ESU, indicating growing populations over that time period.

Based on consideration of these metrics, the survival gaps needed to achieve the survival criteria, before recent and prospective actions are taken into account, are summarized in Table 5-6. Note that in this analysis, a metric of 1.0 reflects no gap. A number below 1.0 reflects a positive condition, while a

Table 5-6. Base Status Gaps

MPG	Population	20-year R/S Gap	20-year λ Gap	Long-term Trend Gap	Ext. Risk Gap QET = 1	Ext. Risk Gap QET = 10	Ext. Risk Gap QET = 30	Ext. Risk Gap QET = 50
Lower Snake	Tucannon	1.32	1.00	1.69	0.42	0.74	1.09	1.35
Grande Ronde/ Imnaha	Catherine Cr.	2.63	1.15	1.39	1.41	2.43	3.44	4.13
	Lostine R.	1.39	0.80	0.96	0.48	0.86	1.27	1.61
	Minam R.	1.25	0.80	0.77	0.27	0.51	0.80	1.05
	Imnaha R.	1.67	0.80	1.10	0.43	0.71	0.99	1.21
	Wenaha R.	1.52	0.65	0.84	0.57	0.96	1.39	1.72
	Upper GR R.	3.13	N/A	1.39	0.54	1.12	1.86	2.57
S. Fork Salmon R.	South Fork	1.15	0.63	0.80	0.16	0.27	0.36	0.44
	Secesh R.	0.96	0.74	0.91	0.39	0.62	0.78	0.88
	E. Fork S. Fork.	1.02	0.71	0.88	0.33	0.53	0.65	0.75
Middle Fork Salmon R.	Big Cr.	0.81	0.68	0.92	0.43	0.97	1.79	2.69
	Bear Valley Cr.	0.74	0.65	0.80	0.26	0.52	0.89	1.24
	Marsh Cr.	1.02	0.71	1.00	0.73	1.57	2.77	4.00
	Sulphur Cr.	1.12	0.80	0.96	0.39	1.58	3.81	6.09
	Camas Cr.	1.12	0.84	1.05	N/A	N/A	N/A	N/A
	Loon Cr.	0.83	N/A	0.74	N/A	N/A	N/A	N/A
	Chamberlain Cr.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Lower Mid. Fork	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Upper Salmon	Lemhi R.	0.92	0.91	1.10	N/A	N/A	N/A	N/A
	Valley Cr.	0.93	N/A	0.92	0.32	1.21	3.09	5.01
	Yankee Fork	1.47	N/A	0.88	N/A	N/A	N/A	N/A
	Upper Salmon	0.67	0.77	1.15	0.09	0.22	0.43	0.64
	N.F. Salmon	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Lower Salmon	0.81	0.91	1.00	0.13	0.42	0.99	1.58
	E. Fork Salmon	0.86	0.84	N/A	0.11	0.39	0.95	1.55
	Pahsimeroi	1.11	0.71	0.27	N/A	N/A	N/A	N/A

Note:
Gaps are expressed as multipliers. A gap of 1.32 indicates that a 32 percent survival improvement is needed to meet the criterion. A gap less than 1 indicates no further improvement is needed.

number above 1.0 reflects a gap. For example, a gap of 1.2 indicates that 20 percent productivity is needed in the future.

5.2.4 Spatial Structure and Biological Diversity

Conserving and rebuilding sustainable salmonid populations involves more than meeting abundance and productivity criteria. Accordingly, NMFS has developed a conceptual framework defining a Viable Salmonid Population (VSP) (McElhany et al. 2000). In this framework there is an explicit consideration of four key population characteristic or parameters for evaluating population viability status: abundance, productivity (or population growth rate), biological diversity, and population spatial structure. The reason that certain other parameters, such as habitat characteristics and ecological interactions, were not included among the key parameters is that their effects on populations are implicitly expressed in the four key parameters. Based on the current understanding of population attributes that lead to sustainability, the VSP construct is central to the goal of ESA recovery, and warrants consideration in a jeopardy determination. However, it must also be stressed that the ability to significantly improve either a species' biological diversity or its spatial structure and distribution is limited within the timeframe of the Action Agencies' Proposed Reasonable and Prudent Alternative (RPA).

Spatial Structure – Spatial structure, as the term suggests, refers to the geographic distribution of individuals in a population unit and the processes that generate that distribution. Distributed populations that interact genetically are often referred to as metapopulation. Although the spatial distribution of a population, and thus its metapopulation structure, is influenced by many factors, none are perhaps as important as the quantity, quality, and distribution of habitat. One way to think about the importance or value of a broad geospatial distribution is that a population is less likely to go extinct from a localized catastrophic event or localized environmental perturbations.

Biological Diversity – Biological diversity within and among populations of salmonids is generally considered important for three reasons. First, diversity of life history patterns is associated with a use of a wider array of habitats. Second, diversity protects a species against short-term spatial and temporal changes in the environment. Third, genetic diversity is the so-called raw material for adapting to long-term environmental change. The latter two are often described as nature's way of hedging its bets – a mechanism for dealing with the inevitable fluctuations in environmental conditions – long and short term. With respect to diversity, more is better from an extinction-risk perspective.

The Snake River Spring and Summer Chinook Salmon ESU consists of 29 extant populations in five MPGs. With the exception of the Lower Snake River MPG, each of the MPGs is comprised of four or more populations. Based on their Spatial Structure and Diversity (SSD) analyses and rating of 23 of the populations for which sufficient information was available, the TRT assigned a high risk to 6 populations, a moderate risk to 11 populations, and a low risk to 6 populations. With exception of the Lower Snake River MPG, with its single extant population (Tucannon River), all MPGs contained populations with a mix of risk ratings. Considering the wide geographic distribution of this ESU, the diversity of habitats utilized, and the preponderance of populations in the moderate SSD risk category, we conclude that this ESU is currently at no greater than moderate risk for SSD, and that this status will likely improve as a result of the recently implemented and proposed changes in the FCRPS, including improvements to the volume and reliability of flow augmentation from the Bureau of Reclamation's upper Snake projects achieved in the Nez Perce Water Rights Settlement. Particularly significant will be the continuing improvements in hatchery management and the resulting reduction in negative effects from hatchery- and natural-origin fish.

5.3 BIOLOGICAL ANALYSIS OF ACTIONS: RECRUITS-PER-SPAWNER, LAMBDA, AND TRENDS WITH CURRENT AND PROSPECTIVE ADJUSTMENTS

The Base Status is the historical status of the ESU, defined as the status of the population based on the average of quantitative survival metrics estimated from a time series of abundance data beginning in about 1980. For the most part, longer-term averages (generally 20 years) were used where they were available. In the biological analysis, this is the starting point, shown in the tables above.

The next step is Current Status, an adjustment of the initial base estimates to reflect our best estimate of current survivals, as opposed to an average of survivals that prevailed over a period in the past. This would obviously include recent improvements already implemented but not fully reflected in the Base conditions. Current Status is defined as “estimated survival metrics adjusted for recently implemented changes in hydropower configuration and operations, hatchery operations, tributary and estuarine habitat improvements, and reduced avian predation.” These are actions that have recently been implemented, but their effects are not reflected in the time series of survival data that for the most part started in 1980.

The final step is Prospective Status, which adjusts Current-to-Prospective Status based on the estimated effects of future actions. The current-to-prospective adjustment is simply an adjustment of the current survival estimates to reflect survival improvements expected from the hydro, habitat, and hatchery changes included in the Proposed RPA, and in particular those that are expected to be implemented in the period 2007 to 2017. Refer to Section 1.3 of this Comprehensive Analysis for a discussion of Reclamation’s qualitative analysis for the years 2017 through 2034.

This analysis assumes that future ocean and climate conditions will approximate the average conditions that prevailed during the 20-year base period used for our status assessments. For most populations, that period is about equivalent to the “recent” ocean period used by the Interior Columbia Basin TRT in its analyses. This period was characterized by relatively poor ocean conditions that presumably contributed to poor early ocean survival of salmonids. The TRT’s “pessimistic” ocean condition scenario results in survivals that are about 15 percent lower for Snake River Spring and Summer Chinook Salmon than the “recent’ ocean conditions scenario, and about 36 percent lower for Upper Columbia Spring Chinook Salmon. Alternatively, TRT’s “historical” ocean conditions scenario results in survivals that are about 39 percent higher for both Snake River Spring and Summer Salmon and Upper Columbia Spring Chinook Salmon (Interior Columbia Basin TRT and Zabel 2006). This subject is treated at greater length in the discussion of the effects of potential climate change in Appendix H.

The analysis of status assumes a certain amount of annual take of natural adult fish based on recent harvest levels.

5.3.1 Current Status Analysis

Over the Current period (2000 to 2006) the Action Agencies implemented multiple actions to improve fish survival relative to the base period prior to 2000. The percentage changes in life cycle survival used in the base-to-current adjustments for the Snake River Spring and Summer Chinook Salmon ESU are summarized in Table 5-7. Actions are described in summary below.

Table 5-7. Estimated Survival Improvements Used in the Base-to-Current Adjustment

MPG	Population	Hydro	Habitat (tributary)	Habitat (estuary)	Avian predation	Hatchery	Harvest
Lower Snake	Tucannon	22.5%	3.5%	0.3%	-0.4%		4.0%
Grande Ronde/ Imnaha	Catherine Cr.	22.5%	4.0%	0.3%	-0.4%	28.0%	4.0%
	Lostine R.	22.5%	1.0%	0.3%	-0.4%	7.0%	4.0%
	Minam R.	22.5%		0.3%	-0.4%	22.0%	4.0%
	Imnaha R.	22.5%	1.0%	0.3%	-0.4%		4.0%
	Wenaha R.	22.5%		0.3%	-0.4%	39.0%	4.0%
	Upper GR R.	22.5%	4.0%	0.3%	-0.4%	32.0%	4.0%
S. Fork Salmon R.	South Fork	22.5%		0.3%	-0.4%		4.0%
	Secesh R.	22.5%		0.3%	-0.4%		4.0%
	E. Fork S. Fork.	22.5%		0.3%	-0.4%		4.0%
Middle Fork Salmon R.	Big Cr.	22.5%		0.3%	-0.4%		4.0%
	Bear Valley Cr.	22.5%		0.3%	-0.4%		4.0%
	Marsh Cr.	22.5%		0.3%	-0.4%		4.0%
	Sulphur Cr.	22.5%		0.3%	-0.4%		4.0%
	Camas Cr.	22.5%		0.3%	-0.4%		4.0%
	Loon Cr.	22.5%		0.3%	-0.4%		4.0%
	Chamberlain Cr.	22.5%		0.3%	-0.4%		4.0%
	Lower Mid. Fork	22.5%		0.3%	-0.4%		4.0%
Upper Salmon	Lemhi R.	22.5%	0.5%	0.3%	-0.4%		4.0%
	Valley Cr.	22.5%	0.5%	0.3%	-0.4%		4.0%
	Yankee Fork	22.5%		0.3%	-0.4%		4.0%
	Upper Salmon	22.5%	0.5%	0.3%	-0.4%		4.0%
	N.F. Salmon	22.5%		0.3%	-0.4%		4.0%
	Lower Salmon	22.5%	0.5%	0.3%	-0.4%		4.0%
	E. Fork Salmon	22.5%	0.5%	0.3%	-0.4%		4.0%
	Pahsimeroi	22.5%	0.5%	0.3%	-0.4%		4.0%

Notes:
Harvest adjustments represent estimated harvest decreases between the base and current periods. Estimates supplied by A. Nigro (Oregon Department of Fish and Wildlife) on behalf of an ad hoc *US v. OR* technical workgroup (Nigro 2007).

5.3.1.1 Hydropower Survival Improvements

Several hydropower configuration and operational and maintenance improvements to fish passage facilities and other project areas were implemented in 2000 to 2006 and are estimated to have resulted in a 22.5 percent increase in survival over the baseline for all populations in this ESU (Table 5-7). This survival increase was estimated with Comprehensive Fish Passage (COMPASS) using the 2006 hydrosystem configuration operating under the 2004 BiOp-specified operation for each dam. Specific configuration and operation improvements included in this estimate are:

- Bonneville Powerhouse I (PH1) minimum gap runner (MGR) installations;

- Bonneville Powerhouse II (PH2) corner collector installation;
- Bonneville PH2 fish guidance efficiency improvements;
- Bonneville spill operation improvements;
- Bonneville PH1 juvenile bypass system (JBS) screen removal;
- Bonneville PH2 operation as first priority;
- The Dalles spill wall construction;
- The Dalles spill pattern improvements;
- The Dalles adult collection channel improvements;
- The Dalles sluiceway operation improvements;
- John Day spill operation improvements;
- John Day South Fish Ladder improvements;
- McNary spill operation improvements;
- McNary end spillbay deflectors and hoists;
- McNary full flow juvenile passive induced transponder (PIT)-tag detection;
- McNary juvenile transport facility bypass piping improvements;
- McNary spare extended submerged bar screen (ESBS);
- McNary improved juvenile bypass dewatering screens;
- McNary overhauling auxiliary water supply (AWS) pumps;
- McNary upgrading of adult fish ladders tilting weir controls;
- Ice Harbor removable spillway weir (RSW) installation and spill operation improvements;
- Ice Harbor full flow juvenile PIT-tag detection;
- Ice Harbor AWS improvements north shore adult fishway;
- Ice Harbor replaced adult fishway entrance weirs;
- Ice Harbor new bulkhead system for maintenance of south shore AWS pumps;
- Ice Harbor upgraded AWS hydraulic systems;
- Lower Monumental end spillbay deflectors, parapet walls, and stilling basin repair;
- Lower Monumental spill operations improvements;
- Lower Monumental juvenile fish separator improvement;
- Lower Monumental fish barge loading improvements;
- Lower Monumental rehabbed adult fish pumps;
- Lower Monumental replaced north shore adult fish counting station;
- Little Goose spill operations improvements;
- Little Goose ESBS improvements;
- Lower Granite RSW installation;

- Lower Granite ESBS improvements;
- Lower Granite modifications to adult transition pool to improve adult passage;
- Improved total dissolved gas monitoring program and equipment; and
- Delayed/staggered start of juvenile fish transportation program.

5.3.1.2 Tributary Habitat Survival Improvements

Bonneville Power Administration (BPA) and Reclamation implemented actions to address limiting factors for a number of populations in this ESU. BPA's annual expenditures for habitat projects in subbasins used by Snake River ESUs averaged about $5.4 million for the 2001 to 2006 time frame. Reclamation spent over $6 million to provide technical support for habitat projects in this period. Some of these actions provided benefits with immediate survival improvements and some will result in long-term benefits with survival improvements accruing into the future. During this time period the Action Agencies, in coordination with multiple partners:

- Increased streamflow through water acquisitions;
- Addressed entrainment by installing or improving fish screens;
- Increased fish passage and access by removing passage barriers;
- Improved channel habitat complexity and conditions; and
- Improved water quality and habitat conditions by protecting and enhancing riparian areas.

Survival improvements estimated to result from tributary habitat actions implemented by the Action Agencies in this time period are shown in Table 5-7. The percentages indicate the incremental survival improvement estimated to accrue by 2006 from the suite of implemented actions. Survival improvements were estimated as described in Appendix C, Attachment C-1.

Additional detail of habitat actions implemented by BPA and Reclamation in the 2000 to 2006 time frame is available in the Action Agencies' Annual Progress Reports located at www.salmonrecovery.gov.

5.3.1.3 Estuary Habitat Survival Improvements

Survival benefit for Snake River Spring and Summer Chinook Salmon (stream-type life history) associated with the specific actions discussed below was 0.3 percent. Action Agencies implemented habitat actions through 21 estuary habitat projects. Unrestricted fish passage and approximately 3 miles of access to quality habitat was provided by the following specific actions:[2]

- Replaced 3 culverts with full-spanning bridges;
- Provided approximately 10 miles of improved tidal channel connectivity by installing a tide gate retrofit;
- Acquired approximately 473 acres of off-channel and riparian habitats;
- Restored and created 90 acres of marsh and tidal sloughs and approximately 100 acres of riparian forests;

[2] A more thorough report detailing this evaluation process is: *Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary* (PC Trask & Associates 2007), which is included as Appendix D to this document.

- Protected approximately 55 acres of high-quality riparian and floodplain habitat;
- Restored and preserved approximately 154 acres of off-channel habitat;
- Protected 80 acres of high-value off-channel forested wetland habitat;
- Restored approximately 96 acres of tidal wetlands habitat by replacing undersized culvert that limited fish access;
- Conserved 155 acres of forested riparian and upland habitat;
- Provided partial tidal channel reconnection by tide gate retrofit (acreage unknown at this time);
- Provided integrated pest management (purple loosestrife);
- Reconnected and restored 183 acres of historical floodplain by dike removal;
- Restored 25 acres of historical floodplain by breaching a dike;
- Provided fish passage access to 6 miles of stream habitat by removal of two culverts and replacement with bridges;
- Restored 310 acres of native hardwood riparian forest, 200 acres of seasonally wet slough, and 155 acres of degraded riparian habitats;
- Increased circulation in approximately 92 acres of backwater and side-channel habitat by tide gate retrofit;
- Improved embayment circulation for 335-plus acres of marsh/swamp and shallow-water and flats habitat; and
- Preserved 35 acres of historical wetland habitat.

5.3.1.4 Predation Management Survival Improvements

Avian Predation

The estimated change from baseline to current survival of Upper Columbia River Spring Chinook Salmon can be found in Table 5-7. This reflects a reduction in survival from the base-to-current condition, because the tern population was increasing relative to the base period. Averaging tern consumption of juvenile salmonids across the 20-year base period downplays the actual change in survival that resulted from relocating terns from Rice Island to East Sand Island in 1999. In 1999 tern consumption of juvenile salmonids was at its peak with an estimated 13,790,000 smolts consumed, compared to 8,210,000 in 2000 after relocation.

Piscivorous Predation

The ongoing Northern Pikeminnow Management Program (NPMP) has been responsible for reducing predation-related juvenile salmonid mortality since 1990. The northern pikeminnow has been responsible for approximately 8 percent predation-related mortality of juvenile salmonid migrants in the Columbia River Basin in the absence of the NPMP (2000 FCRPS BiOp at 9-106). The improvement in life cycle survival attributed to the NPMP is estimated at 2 percent for migrating juvenile salmonids (Friesen and Ward 1999). The ongoing NPMP is already accounted for in the estimation of survival improvements modeled within the reservoir mortality life stage. This is because the modeling estimates are calibrated to empirical reach survival estimates that included the ongoing program.

5.3.1.5 Hatchery Management Survival Improvements

Hatchery-origin salmon and steelhead had lower reproductive success relative to natural-origin fish in almost all of the studies reviewed by Berejikian and Ford (2004). The difference in relative reproductive success was greatest for non-local, domesticated hatchery stocks, which would be unlikely to be well adapted to the environmental conditions at their release location. This was the case in the Grande Ronde River watershed for much of the base period used for this analysis. Hatchery reforms instituted in the mid- to late-1990s both reduced straying of non-native fish into certain watersheds (Wenaha and Minam rivers) and emphasized the use of locally adapted broodstock. These changes have likely contributed to increased R/S productivity for the population as a whole. Preliminary and draft guidance from NMFS was used to set assumptions regarding relative reproductive effectiveness of hatchery fish before and after these reforms to arrive at the survival improvement estimates in Table 5-7. A more thorough description of the methods used can be found in Appendix A. A discussion of the specific assumptions used to estimate the survival changes used in this analysis follows.

Upper Grande Ronde River, Catherine Creek, and Lostine River: Hatchery influence is a relatively recent occurrence here. There were no returns of hatchery-origin spawners to these areas until 1986 (except for occasional strays). Between 1986 and 2002, hatchery-origin Chinook salmon not included in the ESU returned to spawn in these areas. This was a Category 1 hatchery program, and hatchery-origin spawners were assumed to be 20 percent as effective as natural-origin spawners. Supplementation rescue programs were initiated (starting with a captive broodstock phase) to preserve and build the Chinook salmon populations in the Upper Grande Ronde River and Catherine Creek in 1996, and in the Lostine River in 1997. These are Category 3 Hatchery programs, and this analysis assumes that hatchery-origin spawners are 50 percent as effective as natural-origin spawners, beginning in 2003 and continuing into the future. The future percentage of hatchery-origin spawners is assumed to be equal to the average over the most recent 10 years for which data are available.

Summary for the Minam and Wenaha Rivers: These populations are managed for natural-origin fish only (i.e., hatchery supplementation is precluded). Between 1986 and about 1994, fish from Category 1 hatchery programs strayed into these areas in significant numbers, and spawned naturally. Straying was largely curtailed after 1994. Hatchery strays, both past and into the future, are assumed to have a relative reproductive effectiveness of 20 percent. The survival improvements shown in this analysis for the base-to-current period reflect the significant reduction in hatchery straying that is evidenced in the data used for this analysis.

Other specific actions under qualitative consideration include:

- BPA funded (required in a Reasonable and Prudent Alternative in the 2000 FCRPS BiOp) the development of Hatchery and Genetic Management Plans (HGMPs) for all Federally funded hatchery programs in the ESU. While the estimated survival benefit was low in the near term, it was potentially moderate to high in the long term. The objective was to develop the HGMPs for NMFS approval and identification of and prioritization of hatchery reform measures by NMFS;
- BPA funded the Safety-Net Artificial Propagation Program planning process to identify any additional Spring and Summer Chinook populations at high risk of extinction that would benefit from implementation of a safety-net hatchery program;
- Lower Snake, Tucannon River – BPA funded the Tucannon River Spring Chinook Captive Broodstock Program (a safety-net program) from 2000 through 2006 to increase abundance and reduce the extinction risk of the target population;
- Upper Salmon; East Fork, West Fork Yankee Fork, and Lemhi River – BPA funded the Salmon River Captive Rearing Program (a safety-net program) from 2000 through 2006 to increase abundance and reduce extinction risk of the target populations;
- Grande Ronde/Imnaha; Upper Grande Ronde, Catherine Creek, and Lostine River – BPA funded the Grande Ronde Captive Broodstock Program (a safety-net program) and the Grande Ronde

Recovery Program (a conventional supplementation program) from 2000 through 2006 to increase abundance and reduce extinction risk of the target populations;

- Grande Ronde/Imnaha, Lostine and Imnaha River – BPA funded development of a Master Plan and other planning and design for the Northeast Oregon Hatchery from 2000 through 2006; and
- South Fork Salmon, Johnson Creek – BPA funded the Johnson Creek Artificial Propagation and Enhancement Program (a safety-net program) from 2000 through 2006 to increase abundance and reduce extinction risk of the target population.

5.3.2 Current Status Gaps

Over the current period (2000 to 2006) the Action Agencies implemented multiple actions to improve fish survival relative to the base period prior to 2000. The percentage improvements in life cycle survival used in the base-to-current adjustments for Spring and Summer Chinook salmon are summarized in Table 5-8.

5.3.3 Prospective Status Analysis

As noted above, the Prospective Status is the projected status of the population based on adjustment of the survival metrics for expected improvements associated with the Proposed RPA (including Upper Snake River flow augmentation). As was the case for the base-to-current adjustment, the improvements for the current-to-prospective are divided into the categories of those expected from changes in hydropower operations and configuration, changes in tributary habitat conditions attributable to actions implemented in the periods 2007 to 2009 and 2010 to 2017, changes in estuarine habitat, reduced impacts of avian predation, and improved hatchery operations. Over this period the Action Agencies will implement multiple actions to improve fish survival relative to the current period. The percentage improvements in life cycle survival used in the current-to-prospective adjustments for the Snake River Spring and Summer Chinook Salmon populations are summarized in Table 5-9. Actions are summarized below.

5.3.3.1 Hydropower Survival Improvements

The Action Agencies have formulated a broad array of hydropower actions to further increase the survival of this ESU during migration through the hydrosystem. Specific survival benefits for each action were derived using best professional judgment, then input into COMPASS for calculating an estimated overall survival benefit that the specified actions may provide to this ESU. The resultant estimated overall survival benefit to the ESU from these specific actions is 8.2 percent (Table 5-9). The configuration and operational improvement actions that contribute to these survival increases are organized into strategies. Specific actions contained within these strategies are listed in the Hydrosystem Action Summary. These strategies include:

1. Operate the FCRPS to more closely approximate the shape of the natural hydrograph and to improve juvenile and adult fish survival;
2. Modify Columbia and Snake River dams to facilitate safe passage;
3. Implement operational improvements at Columbia and Snake river dams;
4. Operate and maintain juvenile and adult fish passage facilities; and

Table 5-8. Current Status: Adjusted Gaps after Base-to-Current Adjustment

MPG	Pop.	Adjusted 20-year R/S Gap	Adjusted 20-year λ Gap	Adjusted Long-term Trend Gap	Adjusted Ext. Risk Gap QET = 1	Adjusted Ext. Risk Gap QET = 10	Adjusted Ext. Risk Gap QET = 30	Adjusted Ext. Risk Gap QET = 50
Lower Snake	Tucannon	1.00	0.76	1.28	0.32	0.56	0.83	1.02
Grande Ronde/ Imnaha	Catherine Cr.	1.55	0.68	0.82	1.07	1.84	2.60	3.12
	Lostine R.	1.01	0.58	0.70	0.37	0.67	0.99	1.25
	Minam R.	0.81	0.52	0.59	0.21	0.40	0.63	0.83
	Imnaha R.	1.30	0.62	0.85	0.33	0.55	0.77	0.94
	Wenaha R.	0.86	0.37	0.47	0.45	0.75	1.09	1.35
	Upper GR R.	1.79	N/A	0.79	0.41	0.85	1.41	1.94
S. Fork Salmon R.	South Fork	0.90	0.49	0.63	0.13	0.21	0.28	0.35
	Secesh R.	0.76	0.58	0.72	0.31	0.49	0.61	0.69
	E. Fork S. Fork.	0.80	0.56	0.69	0.26	0.42	0.51	0.59
Middle Fork Salmon R.	Big Cr.	0.64	0.53	0.72	0.34	0.76	1.41	2.11
	Bear Valley Cr.	0.58	0.51	0.63	0.20	0.41	0.70	.97
	Marsh Cr.	0.80	0.56	0. 79	0.57	1.23	2.18	3.14
	Sulphur Cr.	0.88	0.63	0.75	0.31	1.24	2.99	4.79
	Camas Cr.	0.88	0.66	0.86	N/A	N/A	N/A	N/A
	Loon Cr.	0.65	N/A	0.60	N/A	N/A	N/A	N/A
	Chamberlain Cr.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Lower Mid. Fork	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Upper Salmon	Lemhi R.	0.72	0.72	0.86	N/A	N/A	N/A	N/A
	Valley Cr.	0.72	N/A	0.72	0.25	0.95	2.42	3.92
	Yankee Fork	1.16	N/A	0.69	N/A	N/A	N/A	N/A
	Upper Salmon	0.52	0.60	0.75	0.07	0.17	0.34	0.50
	N.F. Salmon	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Lower Salmon	0.64	0.72	0.78	0.10	0.33	0.77	1.24
	E. Fork Salmon	0.67	0.66	0.75	0.09	0.30	0.74	1.21
	Pahsimeroi	0.87	0.55	0.21	N/A	N/A	N/A	N/A

Note:
Gaps are expressed as multipliers. A gap of 1.11 indicates that an 11 percent survival improvement is needed to meet the criterion. A gap less than 1.0 indicates no further improvement is needed.

Table 5-9. Estimated Improvements in Survival Used in the Current-to-Prospective Adjustment

Pop.	Hydro	2007-2017 Habitat (tributary)	Habitat (estuary)	Avian predation	P. minnow predation
Tucannon	8.2%	17.0%	5.7%	2.1%	1.0%
Catherine Cr.	8.2%	23.0%	5.7%	2.1%	1.0%
Lostine R.	8.2%	2.0%	5.7%	2.1%	1.0%
Minam R.	8.2%		5.7%	2.1%	1.0%
Imnaha R.	8.2%	1.0%	5.7%	2.1%	1.0%
Wenaha R.	8.2%		5.7%	2.1%	1.0%
Upper GR R.	8.2%	23.0%	5.7%	2.1%	1.0%
South Fork	8.2%	1.0%	5.7%	2.1%	1.0%
Secesh R.	8.2%	1.0%	5.7%	2.1%	1.0%
E. Fork S. Fork.	8.2%		5.7%	2.1%	1.0%
Big Cr.	8.2%	1.0%	5.7%	2.1%	1.0%
Bear Valley Cr.	8.2%		5.7%	2.1%	1.0%
Marsh Cr.	8.2%		5.7%	2.1%	1.0%
Sulphur Cr.	8.2%		5.7%	2.1%	1.0%
Camas Cr.	8.2%		5.7%	2.1%	1.0%
Loon Cr.	8.2%		5.7%	2.1%	1.0%
Chamberlain Cr.	8.2%		5.7%	2.1%	1.0%
Lower Mid. Fork	8.2%		5.7%	2.1%	1.0%
Lemhi R.	8.2%	7.0%	5.7%	2.1%	1.0%
Valley Cr.	8.2%	1.0%	5.7%	2.1%	1.0%
Yankee Fork	8.2%	30.0%	5.7%	2.1%	1.0%
Upper Salmon	8.2%	14.0%	5.7%	2.1%	1.0%
N.Fk Salmon	8.2%		5.7%	2.1%	1.0%
Lower Salmon	8.2%	1.0%	5.7%	2.1%	1.0%
E. Fork Salmon	8.2%	1.0%	5.7%	2.1%	1.0%
Pahsimeroi	8.2%	41.0%	5.7%	2.1%	1.0%

Changes in the timing of Upper Snake River flow augmentation, as addressed in Reclamation's Upper Snake River BA, are expected to improve conditions for survival.

5.3.3.2 Tributary Habitat Survival Improvements

Table 5-9 displays estimated population level survival improvement percentages expected to result from Action Agencies' implementation of actions to address limiting factors in the tributary areas used by this DPS. The survival improvements identified represent an increase in Action Agencies' tributary habitat effort compared to efforts under the 2000 and 2004 FCRPS BiOps. Survival improvements were estimated as described in Appendix C, Attachment C-1.

2007 to 2017

BPA will fund and Reclamation will provide technical assistance for projects that implement new actions to address key limiting factors and improve survival of this ESU. BPA will fund projects primarily through its Fish and Wildlife Program; Reclamation will provide technical assistance through annual congressional appropriations. The Action Agencies will work with multiple parties for the successful implementation of these actions.

Initial Actions and Action Expansion

Consistent with its 2007 to 2009 Fish and Wildlife Program funding decision, BPA will fund implementation of 16 projects in the Tucannon, Asotin, Grande Ronde, Imnaha, and Salmon subbasins. BPA has also dedicated 70 percent of the Columbia Basin Water Transactions Program (CBWTP) $5 million annual budget to secure water acquisitions and riparian easements for anadromous fish, including populations of Snake River Spring and Summer Chinook Salmon. The BPA average annual planned budget (based on BPA Final Decision Letter) for the 16 projects is approximately $6.7 million (not including the CBWTP).

Based on biological needs identified in the recent lifecycle biological analyses and input from the Remand Collaboration Process, BPA will also fund a suite of further actions beyond those identified in the 2007 to 2009 Fish and Wildlife Program decision for implementation beginning in the 2008 and 2009 (see Table 4-a in Attachment B.2.2-2 to Appendix B of the FCRPS BA document).

BPA will fund projects to implement new actions that:

- Increase instream flows;
- Remove passage barriers;
- Improve fish passage structures;
- Install fish screens;
- Increase channel complexity;
- Protect and enhance riparian habitat;
- Enhance floodplains, and
- Improve water quality.

Reclamation will provide technical assistance for habitat projects in the Grande Ronde, Upper Salmon, and Lemhi subbasins.

Future Implementation

BPA will expand the level of effort and increase funding above the 2007 to 2009 time period. Project funding decisions will be based on prioritized biological criteria and consistent with recovery plans. Reclamation will continue to provide technical assistance where appropriate with funding consistent with its Congressional funding authorizations.

Further detail about Reclamation's actions is available in Table 5 in Attachment B.2.2-2 to Appendix B in the FCRPS BA document; project-level detail of the BPA-funded projects is available in Table 3-b in Attachment B.2.2-2.

5.3.3.3 Estuary Habitat Survival Improvements

2007 to 2009

The estimated survival benefits for Snake River Spring and Summer Chinook Salmon (stream-type life history) associated with the specific actions discussed below can be found in Table 5-10. The estimated benefit for 2007 is based on actions that are underway or will be underway in the very near-term. For

2008 and 2009 the Action Agencies' estimated benefit is based on the increased funding level described in the BA.[3] Specific estuary actions are:

- Restore partial tidal influence and access to several acres (exact amount unknown at this time) by a tide gate retrofit;
- Improve hydrologic flushing and salmonid access to a lake (Sturgeon Lake is approximately 3,200 acres);
- Acquire and protect 40 acres of critical floodplain habitat and 40 acres of riparian forest restoration; install six to eight engineered log-jams that will help to slow flood flows, reduce erosion, contribute to sediment storage, enhance fish habitat, and contribute wood into the project area;
- Acquire and restore floodplain connectivity to 380 acres of off-channel rearing habitat for juveniles; install fish-friendly tide gates to increase tidal flushing and fisheries access to approximately 110 acres;
- Complete riparian planting of up to 210 acres;
- Re-establish hydrologic connectivity to reclaim and improve floodplain wetland functions, increase off-channel rearing and refuge habitat on 5 acres, plant native vegetation along shoreline and reconstruct slough channels on 2.5 acres of annually inundated off-channel habitat;
- As part of a long-term 1,500-acre restoration effort: breach a dike and re-establish flow to portion of original channel, plant vegetation on 50 acres, remove invasive weeds on 180 acres, plant wetland scrub shrub on 45 acres, and control and remove invasive wetland plants on 45 acres;
- Retrofit tide gate (acreage unknown at this time);
- Protect and restore approximately 5 to 10 acres of emergent wetland and riparian forest habitats;
- Reconnect 45-acre floodplain by tide gate removal;
- Acquire 45-acre floodplain with future dike removal;
- Reconnect 50 acres of floodplain;
- Acquire 320 acres of tidelands and 119 acres of riparian/upland forest; and
- Restore 30 acres of riparian habitat.

There will be approximately 15 to 20 additional projects and associated actions similar to actions listed above that are undergoing scoping and sponsor development (with the number of projects and associated actions based on the increased level of funding described in the FCRPS BA).

As noted above, further detail about Reclamation's actions I and project-level detail of BPA funded projects is presented in Tables 5 and 3b in Attachment B.2.2-2 to Appendix B of the FCRPS BA document, respectively.

[3] A more thorough report detailing this evaluation process is: *Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary* (PC Trask & Associates 2007), which is included in Appendix D to this document.

2010 to 2017

The estimated survival benefit for Snake River Spring and Summer Chinook Salmon (stream-type life history) associated with these actions can be found in Table 5-10. The estimated benefits for 2010 to 2017 are based on continuing the same level of effort as 2007 to 2009. However, the level of effort in this time period may increase depending on the outcome of a General Investigation study of Ecosystem Restoration opportunities, depending on Congressional appropriations and future funding scenarios. Specific projects have yet to be identified. Actions for this period will be similar in nature to actions implemented in previous periods discussed above. Actions will include protection and restoration of riparian areas, protection of remaining high-quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, and reduction of noxious weeds, among others. The estimated number of actions is based on continuing the same level of effort as in 2007 to 2009.

5.3.3.4 Predation Management Survival Improvements

Avian Predation

The survival attributed to improved management of Caspian tern populations in the lower Columbia are estimated at 2.1 percent for yearling Chinook salmon. The benefits beyond 2017 are the same; there are no further actions, and therefore no further benefits.

Piscivorous Predation

The percentage improvement in life cycle survival attributable to the proposed continuation of the increase in incentives in the NPMP and resultant marginal increase in observed exploitation rate is estimated at 1 percent total from 2007 to 2017. This estimate was derived based on the difference between the estimated benefits from the base NPMP (defined as the period 1990 to 2003) and estimated survival benefits under the increased incentive program (defined as the period of 2004 to present). This rate would generally apply to all juvenile salmonids.

5.3.3.5 Hatchery Management Survival Improvements

2007 to 2017

Qualitatively assessed survival and recovery benefits are gained through these specific actions:

- Adopt programmatic criteria for funding decisions on FCRPS mitigation hatchery programs;
- Create artificial propagation safety-net programs to reduce extinction risk for Tucannon River, East Fork, West Fork, Yankee Fork, Upper Grande Ronde, Catherine Creek, Lostine River, and Johnson Creek populations in the Snake River Spring and Summer Chinook Salmon ESU. Programs will positively affect abundance, spatial scale, and genetic diversity and provide high benefits to the natural populations;
- Implement conservation hatchery programs to increase abundance of target populations in Snake River Spring and Summer Chinook Salmon ESU;
- In the future, implement additional ESA-relevant hatchery reforms identified through Columbia River Hatchery Scientific Review Group’s hatchery review process, combined with use of Best Management Practices at FCRPS hatchery facilities; and
- Fund construction of Northeast Oregon Hatchery (NEOH) and future operations and maintenance of NEOH, pending recovery benefits determination.

5.3.3.6 Harvest Survival Improvements

From 2007 to 2017 there are no survival benefits from harvest actions estimated for this ESU.

5.3.4 Prospective Status

Comprehensive analyses of the changes in life cycle survival resulting from the FCRPS Proposed RPA and upper Snake Proposed Actions and analysis of how they will change the survival metrics are summarized in Table 5-10.

5.3.5 Remand Conceptual Framework Analysis

The FCRPS BiOp remand's collaboration among the sovereigns developed a Conceptual Framework approach intended to help the Action Agencies develop their Proposed RPA. The Framework approach attempted to estimate the relative magnitude of mortality factors affecting Interior Columbia Basin salmonid populations. That assessment was intended to define the FCRPS' "relative expectation…for recovery" (FCRPS 2006). The collaboration's Framework working group developed high and low mortality estimates for all sources of mortality, including the FCRPS. The collaboration's Policy Working Group has not determined where in that range the Action Agencies' Proposed RPA should be assessed. The range of "gaps" that the Framework approach would expect the FCRPS to fill was reviewed and the Action Agencies assessed whether the total survival improvements estimated in this biological analysis would "fill" those gaps. For the purposes of this comparison, the Interior Columbia Basin TRT gaps were used for "recent" ocean and "base hydro" conditions (corresponding to the base period used for R/S productivity estimation), and the TRT's 5 percent risk level.

The Conceptual Framework was intended, among other things, to "provide a clear and complementary link to ongoing recovery planning efforts" (FCRPS 2006). As such, it can be understood to represent the collaboration parties' view of the appropriate contribution of the FCRPS toward long-term recovery of the listed ESUs in the Interior Columbia River Basin. Therefore, it provides another "metric" for use in considering the impacts of the Proposed RPA on a listed species' prospects for recovery. The results of this analysis are displayed in Table 5-11.

Briefly, the Proposed RPA (without considering either improvements in the environmental baseline or other actions reasonably certain to occur) fills Framework gaps at the low end of the range for 21 of the 23 populations in this ESU for which the TRT has calculated gaps in its Interim Gaps Report. Minimal gaps remain at the low end of the Framework range for two populations in the Middle Fork Salmon MPG. Interestingly, for the two populations in the Grande Ronde/Imnaha MPG for which the largest gaps remain in the Action Agencies' biological analysis (Catherine Creek and Upper Grande Ronde), the Framework analysis shows no gap at the high or low ends of the range for the Catherine Creek and Upper Grande Ronde populations.

Table 5-10. Estimated Future Status With Proposed RPA

MPG	Population	Estimated Future R/S	Estimated Future λ	Estimated Future Trend	Risk Gap (QET=1)	Risk Gap (QET=10)	Risk Gap (QET=30)	Risk Gap (QET=50)
Lower Snake	Tucannon	1.38	1.14	1.02	0.23	0.41	0.61	0.75
Grande Ronde/ Imnaha	Catherine Cr.	0.93	1.18	1.14	0.74	1.28	1.81	2.17
	Lostine R.	1.19	1.17	1.13	0.31	0.56	0.83	1.05
	Minam R.	1.47	1.20	1.17	0.18	0.34	0.54	0.71
	Imnaha R.	0.92	1.15	1.08	0.28	0.47	0.65	0.80
	Wenaha R.	1.38	1.30	1.22	0.38	0.65	0.93	1.16
	Upper GR R.	0.81	#N/A	1.14	0.28	0.59	0.98	1.35
S. Fork Salmon R.	South Fork	1.32	1.22	1.15	0.11	0.18	0.24	0.29
	Secesh R..	1.58	1.17	1.12	0.26	0.41	0.52	0.59
	E. Fork S. Fork.	1.47	1.18	1.13	0.22	0.36	0.44	0.50
Middle Fork Salmon R.	Big Cr.	1.87	1.20	1.12	0.29	0.65	1.19	1.79
	Bear Valley Cr.	2.04	1.20	1.15	0.17	0.35	0.60	0.83
	Marsh Cr.	1.47	1.18	1.09	0.49	1.06	1.86	2.69
	Sulphur Cr.	1.34	1.15	1.11	0.26	1.06	2.56	4.09
	Camas Cr.	1.34	1.14	1.07	N/A	N/A	N/A	N/A
	Loon Cr.	1.82	#N/A	1.16	N/A	N/A	N/A	N/A
	Chamberlain Cr.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Lower Mid. Fork	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Upper Salmon	Lemhi R.	1.76	1.13	1.09	#N/A	#N/A	#N/A	#N/A
	Valley Cr.	1.65	#N/A	1.12	0.21	0.80	2.05	3.32
	Yankee Fork	1.33	#N/A	1.20	#N/A	#N/A	#N/A	#N/A
	Upper Salmon	2.58	1.20	1.14	0.05	0.13	0.25	0.38
	N.F. Salmon	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	Lower Salmon	1.88	1.12	1.10	0.09	0.28	0.66	1.05
	E. Fork Salmon	1.78	1.14	1.11	0.07	0.26	0.63	1.03
	Pahsimeroi	1.92	1.28	1.59	#N/A	#N/A	#N/A	#N/A

Notes:
Future productivity values represent estimates of future R/S, lambda, and trend after consideration of the effects of the Proposed RPA. A value >1.0 indicates a growing population; a value <1.0 indicates a population in decline. A risk gap <1.0 indicates no further improvement is necessary to meet a <5 percent risk criterion.

Table 5-11. Gap Calculations from the Conceptual Framework

MPG	Population	TRT Gap	FCRPS Relative Impact (high)	FCRPS Relative Impact (low)	Framework Gap (high hydro)	Framework Gap (low hydro)	Total Survival Change	Remaining Framework Gap (high)	Remaining Framework Gap (low)
Lower Snake	Tucannon R.	1.55	0.86	0.54	1.46	1.27	1.81	0.81	0.70
Grande Ronde/ Imnaha	Catherine Cr.	3.16	0.58	0.31	1.95	1.43	2.44	0.80	0.59
	Lostine R.	1.88	0.79	0.47	1.65	1.35	1.64	1.00	0.82
	Minam R.	1.55	0.79	0.47	1.41	1.23	1.82	0.78	0.68
	Imnaha R.	1.88	0.79	0.47	1.65	1.35	1.52	1.08	0.89
	Wenaha R.	2.14	0.86	0.54	1.92	1.51	2.07	0.93	0.73
	Upper GR R.	3.97	0.58	0.31	2.22	1.53	2.52	.88	0.61
S. Fork Salmon R.	South Fork	1.59	0.86	0.54	1.49	1.28	1.50	0.99	0.85
	Secesh R.	1.52	0.86	0.54	1.43	1.25	1.50	0.95	0.83
	East Fork South Fork	1.50	0.79	0.47	1.38	1.21	1.49	0.92	0.81
Middle Fork Salmon R.	Big Cr.	1.65	0.86	0.54	1.54	1.31	1.50	1.02	0.87
	Bear Valley Cr.	1.26	0.86	0.54	1.22	1.13	1.49	0.82	0.76
	Marsh Cr.	2.18	0.87	0.55	1.97	1.54	1.49	1.32	1.03
	Sulphur Cr.	2.03	0.87	0.55	1.85	1.48	1.49	1.24	0.99
	Camas Cr.	2.03	0.86	0.54	1.84	1.47	1.49	1.23	0.98
	Loon Cr.	2.13	0.87	0.55	1.93	1.52	1.49	1.30	1.02
	Chamberlain Cr.								
	Lower Middle Fork								
Upper Salmon	Lemhi R.	1.60	0.58	0.31	1.31	1.16	1.60	0.82	0.72
	Valley Cr.	1.96	0.79	0.47	1.70	1.37	1.51	1.13	0.91
	Yankee Fork	2.34	0.86	0.54	2.08	1.58	1.94	1.07	0.82
	Upper Salmon	1.49	0.79	0.31	1.37	1.13	1.71	0.80	0.66
	N. Fk. Salmon								
	Lower Salmon	3.77	0.58	0.31	2.16	1.51	1.51	1.43	1.00
	East Fork Salmon	1.21	0.79	0.47	1.16	1.09	1.51	0.77	0.72
	Pahsimeroi	3.49	0.79	0.31	2.68	1.47	2.11	1.27	0.70

Notes:
1/ Interior Columbia Basin TRT gaps are expressed as multipliers. Gaps are for 5 percent risk, recent ocean/base hydro conditions. A "remaining" gap value <1.0 indicates no further improvement is necessary. Total survival changes combine all estimated survival improvements for the base-to-current and current-to-prospective adjustment EXCEPT the estimated hatchery improvements in the base-to-current table.
2/ FCRPS impacts are based on river flows that enter the FCRPS action area, including those that enter the Snake River at the toe of Hells Canyon Dam, which are affected by the operation of Reclamation's Upper Snake River projects.

5.4 ADDITIONAL ACTIONS TO BENEFIT THE ESU

5.4.1 Other Reasonably Certain to Occur Actions[4]

This analysis qualitatively considers non-Federal actions that are reasonable certain to occur, developed as part of the Remand Collaboration. Based on information developed in the Remand Collaboration, ESA listed populations of Snake River Spring and Summer Chinook Salmon and Steelhead in the Asotin and Tucannon subbasins will benefit from a combined 68 non-Federal habitat improvement actions. Though the benefits of these actions are not quantified, they would be expected to add to the benefits expected from the Action Agencies' Proposed RPA.

5.4.2 Other Federal Actions with Completed Section 7 Consultations

NMFS searched its Public Consultation Tracking Database (PCTS) for Federal actions that had completed Section 7 consultation since November 30, 2004 that could be used to adjust the status of the populations between the base and current periods. No such actions were found for populations within the Lower Snake MPG. Results for the other MPGs/populations are described below.[5]

5.4.2.1 MPG: Grande Ronde/Imnaha

NMFS had not completed any Section 7 consultations in the subject timeframe that would affect the Wenaha or Lostine river populations.

Catherine Creek

The U.S. Forest Service (USFS) consulted on a single fuels reduction project that would have discountable or insignificant adverse effects on the Catherine Creek population.

Upper Mainstem Grande Ronde

The USFS consulted on two grazing allotments and a rangeland analysis and the Federal Highways Administration (FHWA) consulted on a bridge repair project, all of which were determined to have discountable or insignificant adverse effects upon the Upper Mainstem Grande Ronde population.

Imnaha River

The USFS consulted on a harvest/vegetation management project in the Upper Imnaha and a bridge replacement project in the Middle Imnaha River watershed. The USFS also consulted on granting a Special Use Permit to private energy companies for operating and maintaining transmission lines in the Upper Imnaha River watershed, which included replacing two bridges (relieving channel constrictions), restoring local floodplain connectivity. The USFS also consulted on a culvert replacement project in the upper Imnaha watershed that was designed to restore access to 3.5 miles of rearing habitat.

[4] Many of the actions listed above have a cost-share component with a variety of other Federal funding sources and therefore may be properly described as contributing to the status of the environmental baseline rather than cumulative effects. The Action Agencies will sort the projects described in this section into the appropriate parts of the biological analysis, but for the purposes of discussion at the April 11, 2007, PWG workshop, believe that the effect on prospective status will be the same.

[5] This information does not include any habitat conservation or restoration projects funded by BPA under NMFS' Programmatic Biological Opinion for the Habitat Improvement Program (HIP). The effects of those projects are already taken into account in the base-to-current adjustment for species/population status.

5.4.2.2 MPG: South Fork Salmon River

NMFS did not complete any Section 7 consultations in the subject timeframe that would affect the South Fork Salmon River mainstem, Secesh River, or East Fork South Fork Salmon River populations. The USFS consulted on replacing a diversion dam and consolidating water rights, which were designed to restore fish passage to 3 miles of Squaw Creek and to achieve a net increase in stream flow of 4 cfs, enough to support a low temperature thermal refuge. The USFS also consulted on a trailhead construction project. Reclamation consulted on a culvert replacement project that would improve access to 4 miles of habitat in Squaw Creek and improve habitat complexity in Squaw and Papoose creeks.

5.4.2.3 MPG: Middle Fork Salmon River

NMFS did not complete any Section 7 consultations in the subject timeframe that would affect the Middle Fork Salmon River—above or below Indian Creek, or the Big, Camas, Loon, Sulphur, Bear Valley, or Marsh Creek populations. The USFS consulted on a timber sale/salvage project in the lower South Fork Salmon River.

5.4.2.4 MPG: Upper Salmon River

NMFS did not complete any Section 7 consultations in the subject timeframe that would affect the Yankee Fork or Valley Creek populations. The other populations in the MPG were affected by the following projects:

North Fork Salmon River

The USFS consulted on a culvert replacement project in the North Fork Salmon River, designed to restore both access and the hydraulic processes that transport sediment and large wood. The USFS also consulted on a riparian restoration project in Tower Creek (Middle Salmon River—Indian Creek watershed).

Lemhi River

The Federal Highway Administration (FHWA)/Idaho Department of Transportation (IDT) consulted on the construction of a pedestrian bridge over the Salmon River (Middle Salmon River—Williams Creek watershed). The USFS consulted on a bank stabilization project at Bog Creek Crossing (Upper Lemhi watershed) and two projects to rehabilitate stream channels and their associated riparian zones in the Middle Salmon River—Carmen Creek and Hayden Creek watersheds, respectively. NMFS consulted with itself on providing funds to screen a water diversion on Kenney Creek (Eighteenmile Creek watershed).

Lower Mainstem Salmon River—below Redfish Lake

The USFS consulted on a whitebark pine treatment project and FHWA/IDT consulted on two bridge construction/repair projects.

Pahsimeroi

The Corps consulted on a project to prevent a hatchery facility from contaminating the naturally spawning population in the upper Pahsimeroi River (disease). The U.S. Bureau of Land Management (BLM) proposed to rehabilitate Fall Creek and its associated riparian zone (Middle Pahsimeroi River watershed). NMFS and USFWS each consulted on projects intended to remove passage barriers by modifying water diversions Lower Pahsimeroi River watershed.

East Fork Salmon River

The USFS consulted on a road construction and maintenance project in the Lower East Fork Salmon River watershed.

Upper Mainstem Salmon River—above Redfish Lake

The USFS consulted on an emergency fire project and whitebark pine treatment in the Salmon River—Pole Creek and Salmon River—Redfish Lake watersheds.

Panther Creek

The Corps consulted on a culvert and wetlands fill project in Upper Panther Creek, which would result in the conversion of irrigated agricultural land to low-density residential housing. The project was expected to increase safe passage for fish in upper Panther Creek and in the mainstem Salmon River by eliminating rapid drawdowns when water was withdrawn from irrigation ditches. The National Resources Conservation Service completed instream flow work (conversion from flood irrigation to sprinklers) along Iron Creek (Upper Panther Creek). The BLM consulted on watershed rehabilitation activities associated with managing waste from the abandoned Twin Peaks Mine (Lower Panther Creek).

5.5 OBSERVATIONS

5.5.1 Lower Snake Major Population Group

There are two populations in this MPG: the Tucannon River and Asotin Creek populations. However, the TRT has determined that the Asotin Creek population is functionally extirpated. The Tucannon River population has a low risk of extinction at all modeled QET sensitivities.

The 20- and 12-year lambda estimates for the Tucannon River population are greater than 1.0; however, the presence of hatchery fish in the spawning population causes this indicator to overestimate annual population growth.

Extinction probability modeling suggests that the only extant population in this MPG is at a low risk of extinction. This conclusion is consistent with the estimated future values of other biological indicators, such as R/S productivity and abundance trends.

Base period trends of natural-origin spawners are less than 1.0. Base period R/S is also less than 1.0. However, after considering recently implemented actions and the likely effects of the Proposed RPA, we estimate that all three recovery indicators will be well above 1.0. Conceptual Framework gaps are filled at the high and low ends of the range.

5.5.2 Grande Ronde/Imnaha MPG

Of the eight populations in this MPG, Big Sheep Creek and Lookingglass Creek are considered by the TRT to be functionally extirpated. After considering recently implemented actions and the likely effects of the Proposed RPA, all other populations are at a low risk of extinction at QET=1. All populations except Catherine Creek are at low risk of extinction at QET=10 and QET=30. Most of the populations at moderate to high risk at QET=50 are supported by “safety net” hatchery programs that are expected to ameliorate short-term extinction risk while limiting factors that have led to the decline of these populations are addressed. The extinction probability results assuming continued supplementation support this view.

Even with significant commitments to improve tributary habitat for the Catherine Creek and Upper Grande Ronde River populations, three of the six populations in this MPG fail to meet our criterion for

R/S, when we assume only the survival improvements from our habitat actions that will accrue during the 10-year period of the FCRPS BiOp. However, two of the three (Imnaha River and Catherine Creek) have shown increasing trends in abundance since 1990, while Upper Grande Ronde R. has been flat (1.0). This trend is likely due in part to a boost to natural spawner numbers resulting from ongoing supplementation from a hatchery program. The boost is provided by the second-generation progeny of fish spawned in the hatchery program (so-called F_2 progeny of hatchery-spawned fish). In effect, the hatchery programs for these populations provide not only a hedge against short-term extinction risk, they also provide an annual “subsidy” to the population that results in a steady increase in abundance of naturally spawning fish. This increase buys time to address the limiting factors that led to the decline in productivity in the first place. Making the needed productivity improvements for Catherine Creek and the Upper Grande Ronde populations, in particular, is expected to take a decades-long effort on the part of the Federal government working with State, Tribal, and local interests, public and private.

In addition, the Action Agencies propose to fund numerous hatchery actions to continue and improve supplementation efforts for the Catherine Creek, Imnaha River, and Upper Grande Ronde River populations. These efforts are expected to boost abundance in the near term and, combined with broader efforts to improve survival, provide a boost to the recovery prospects for these populations. And though we have not attempted to quantitatively estimate the productivity improvements that might accrue to the naturally spawning populations as a result of these efforts, it is likely that there will be improvements to population productivity as we continue to address negative genetic, ecological, demographic, and facility effects of past hatchery practices.

On the other hand, Conceptual Framework gaps are filled at the low end of the range for all populations in this MPG, and at the high end of the range for all but one population.

5.5.3 South Fork Salmon MPG

There are four extant populations in this MPG: South Fork Salmon, Secesh River, the East Fork of the South Fork Salmon, and the Little Salmon River. Spawner-recruit data are not available for the Little Salmon River population. All populations are at a low risk of extinction for all modeled QETs.

Average 20-year R/S productivity (base period) is 0.78 for the South Fork Salmon population and 0.98 for Secesh River and the East Fork South Fork. Short- and long-term lambda and abundance trends of natural-origin spawners are greater than1.0 for all populations. Only the South Fork Salmon population has a significant number of hatchery-origin fish in the spawning population (24 percent over the 20-year period used to estimate R/S). Therefore these lambda estimates are useful measures of annual population growth for at least two of the populations.

After considering the effects of the Proposed RPA, it is estimated that R/S productivity will be well above replacement (1.0) for all populations and that positive population growth rates will continue into the future. Conceptual Framework gaps are filled at the high and low ends of the range for all populations in this MPG.

5.5.4 Middle Fork Salmon MPG

There are nine populations in this MPG. Spawner-recruit data are lacking for three of those populations: Chamberlain Creek, Lower Middle Fork Salmon, and Upper Middle Fork Salmon. Further, data limitations preclude estimation of several of the metrics for Loon and Camas creeks.

All four populations for which valid results were obtained are expected to have a low risk of extinction at QET=1. Big Creek and Bear Valley Creek have low risk at QET=10. However Marsh Creek has a gap at this sensitivity of 1.06 (an additional 6 percent survival improvement needed to meet the criterion) and

Sulphur Creek has a remaining gap of 1.06. Three of four populations fail to meet the criterion at QET=30 and QET=50.

All of the populations in this MPG – with the exception of Bear Valley Creek – are currently at relatively low levels of abundance. The 10-year geometric mean abundance is below 50 fish for three populations, just above 50 for one population, and below 100 for one population. Bear Valley Creek is the exception, with a 10-year geomean abundance of 188 fish.

A population will naturally have much higher modeled extinction risk when the population's current abundance is already below (or only slightly above) the model's quasi-extinction threshold. In fact, of the six populations in this MPG for which good data are available, three have fallen below the 50 spawner for 4 consecutive years modeling threshold within the last 20 years, yet are *not* extinct. Two others have fallen below the threshold in 3 consecutive years during the mid-1990s. The significant rebounds in abundance experienced by these populations between 2001 and 2003 indicate a resilience that is not captured by the most conservative modeling assumptions.

Higher QETs used for recovery planning purposes are probably not appropriate for short-term extinction risk modeling, particularly for relatively small populations. Therefore we consider the full range of modeled sensitivities in concert with other productivity and population growth rate indicators in considering extinction risk for individual populations.

For instance, recent (1990 to 2005) trends in abundance of natural-origin spawners indicate positive growth trends for all of the populations in this MPG, including the populations with moderate-to-high risk at higher QETs. After considering the effects of the Proposed RPA, these trends are expected to continue and improve, suggesting that short-term extinction is less likely than the model might suggest. The same can be said for recruit-per-spawner productivity and lambda.

It should also be noted that the Interior Columbia Basin TRT's gap analysis estimates significantly *smaller* gaps for most of the populations at risk in this MPG than our analysis indicates. The TRT estimates a needed survival improvement (at the 5 percent risk level) of 65 percent for the Big Creek population, 26 percent for Bear Valley Creek, 118 percent for Marsh Creek, and 103 percent for Sulphur Creek. These are the improvements the TRT suggests would be needed for full recovery of these populations. Our analysis indicates needed survival improvements to achieve the 5 percent risk level (at QET=50) of 169 percent for Big Creek, 24 percent for Bear Valley Creek, 300 percent for Marsh Creek, and 509 percent for Sulphur Creek. The significant disparity between these analytic results suggests that the results are driven by the models and represent, in part, the high degree of uncertainty in modeling extinction probabilities.

Lambda estimates for the most recent 12- and 20-year periods are greater than 1.0, indicating growing populations in the Middle Fork Salmon MPG. After considering recently implemented actions and the likely effects of the Proposed RPA, future lambda estimates indicate populations that would be expected to grow at rates of between 12 percent and 21 percent each year, until a state of equilibrium is approached. R/S productivity is expected to be greater than 1.0 for populations in this MPG, as well. Conceptual Framework gaps are filled at the low end of the range for four of the six populations for which Interior Columbia Basin TRT gaps have been estimated. Remaining gaps at the low end of the range are negligible for the two populations that fail to meet this criterion.

5.5.5 Upper Salmon MPG

There are nine populations in this MPG. However, Panther Creek is believed to be functionally extirpated. Spawner-recruit data are lacking for the North Fork Salmon population.

All modeled populations are expected to have acceptably low risk of extinction at QET=1 and QET=10. Three of four modeled populations have acceptably low risk at QET=30. Only the Valley Creek population fails to meet the criterion at this sensitivity. Three of the four populations fail to meet the criterion at QET=50. Of those, Valley Creek has a 10-year geomean abundance at or below the 50 spawner QET, which explains (in part) the modeling results at QET=50. Valid results were not obtained for the Lemhi River, Yankee Fork, Pahsimeroi, and North Fork Salmon populations.

Base period R/S productivity for all populations except Yankee Fork is greater than 1.0. The Pahsimeroi is treated as a special case and is explained below. After considering the effects of the Proposed RPA, R/S productivity is expected to be well above 1.0 (replacement rate) for all populations.

Recent trends in abundance of natural-origin spawners (1990-2003, 2004, or 2005, depending on the population) are expected to continue and improve after the effects of the Proposed RPA are considered. Lambda estimates for those populations with little known hatchery influence have been >1.0 for both 20- and 12-year periods. These population growth rates are expected to continue and improve into the future. Conceptual Framework gaps are filled at the low end of the range for all populations except the Lower Salmon, which has a remaining gap of 3 percent. Framework gaps are filled at the high end of the range for three of seven populations.

The Pahsimeroi River population was largely managed as a hatchery population until at least 1986. The TRT reports no natural spawners prior to 1986, though the Pahsimeroi hatchery is reported to have allowed fish to pass its weir and spawn naturally upstream prior to that time. Until about 1985, the Pahsimeroi hatchery was using a non-native Spring-run broodstock. In 1985 Idaho Department of Fish and Game discontinued the stock and began to use the native Pahsimeroi summer run Chinook as broodstock. Beginning that year through 1990 the hatchery program didn't use the early returning, non-native fish for broodstock (most were outplanted to the Yankee Fork, but the disposition of many is unknown). In 1991 the hatchery used all returns for broodstock and continues to do so, allowing the excess adults to escape past the weir (Fisher 2007). Beginning in about 1990 the population as a whole grew steadily (this was likely due in large part to the change to a native summer-run broodstock). The population’s growth was impressive during the 1990s, a period when many other populations in this ESU struggled. Average R/S productivity since the 1990 brood year has been 0.90. The trend in abundance for natural-origin spawners has been 1.33 during that period.

It was concluded that the first four years of data after the change to a native broodstock (and this population’s *de facto* reintroduction into the wild) are not representative of the population’s dynamics. This conclusion is supported by the fact that the Pahsimeroi population’s 15-year geomean R/S (brood years 1986-2000) is more than 2 standard deviations below the mean of the ESU as a whole, which is considered exceptional. However, when the first 4 years of observations are ignored, the geomean R/S of the Pahsimeroi population is not exceptional.

The Interior Columbia Basin TRT reports a 15-year R/S estimate of .39 for the Pahsimeroi population. This BA uses an 11- year R/S estimate of 0.90 as its base period estimate.

5.6 CONCLUSION

The ESU is likely to survive based on the analysis and considerations articulated in the Observations section. The Conceptual Framework analysis indicates that the proposed action fills most gaps at the high and low ends of the Framework range for four of the five MPGs. And for populations in the Middle Fork Salmon MPG that are not estimated to meet the Framework criteria, the gaps at the low end of the range (which we believe is the appropriate comparison) are negligible. By and large, we conclude that the

Proposed RPA is "in the ball park" with respect to the Conceptual Framework approach, providing a positive indication of the Proposed RPA's expected effects on this ESU's prospects for recovery. Nearly all of the populations in this ESU more than satisfy the recovery criteria. For example, of the 23 populations for which recruit-per-spawner estimates are available, 20 are expected to exceed the R/S>2.0 criterion. The mean expected future R/S estimate for all 23 of those populations is 1.53. A Chinook salmon population with average R/S productivity of 1.53 would be expected to triple in size in just under 12 years (assuming density independent, linear growth). The Action Agencies have worked with the States and Tribes through the Remand Collaboration Process and other forums to identify actions intended to address the needs of listed salmon and steelhead as determined by quantitative and qualitative biological analyses. Acknowledging that NMFS will review the actions and the effects analyses contained herein to make a final jeopardy determination in the forthcoming biological opinions, the Action Agencies are making the following conclusions. Based on our assessment of the FCRPS and Upper Snake River actions and analysis of effects, considering the present and future human and natural context, the Action Agencies conclude that the net effects of the proposed actions, including the existence and operations of the dams with the proposed mitigation, meet or exceed the objectives of doing no harm and contributing to recovery with respect to this ESU.

Chapter 6
Snake River Sockeye Salmon
Evolutionarily Significant Unit

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

6.1 INTRODUCTION

This chapter briefly summarizes the currently available biological status and assessments for the Snake River Sockeye Salmon Evolutionarily Significant Unit (ESU) related to extinction risk and the effects of the Federal Columbia River Power System (FCRPS) Proposed Reasonable and Prudent Alternative (RPA) in the context of recovery plan actions. First, it summarizes current status information including key limiting factors and extinction risks. Second, it includes a biological assessment of the survival effects of recent and planned actions on current and prospective conditions, respectively. Finally, it identifies additional actions to benefit the ESU. Summary data for the ESU are presented in Table 6-1 and its geographic extent is shown in Figure 6-1.

Table 6-1. ESU Description and Major Population Group (MPG)

ESU Description[1]	
Endangered	Listed under ESA in 1991; reaffirmed in 2005
Hatchery programs included in ESU	Captive Broodstock Program – Eagle, Oxbow, Burley Creek and Manchester Research Station
Major Population Group	**Population**
Stanley Lakes Basin	Redfish Lake

[1/] 70 FR 37160; Interior Columbia Basin Technical Recovery Team (TRT) 2003, 2005

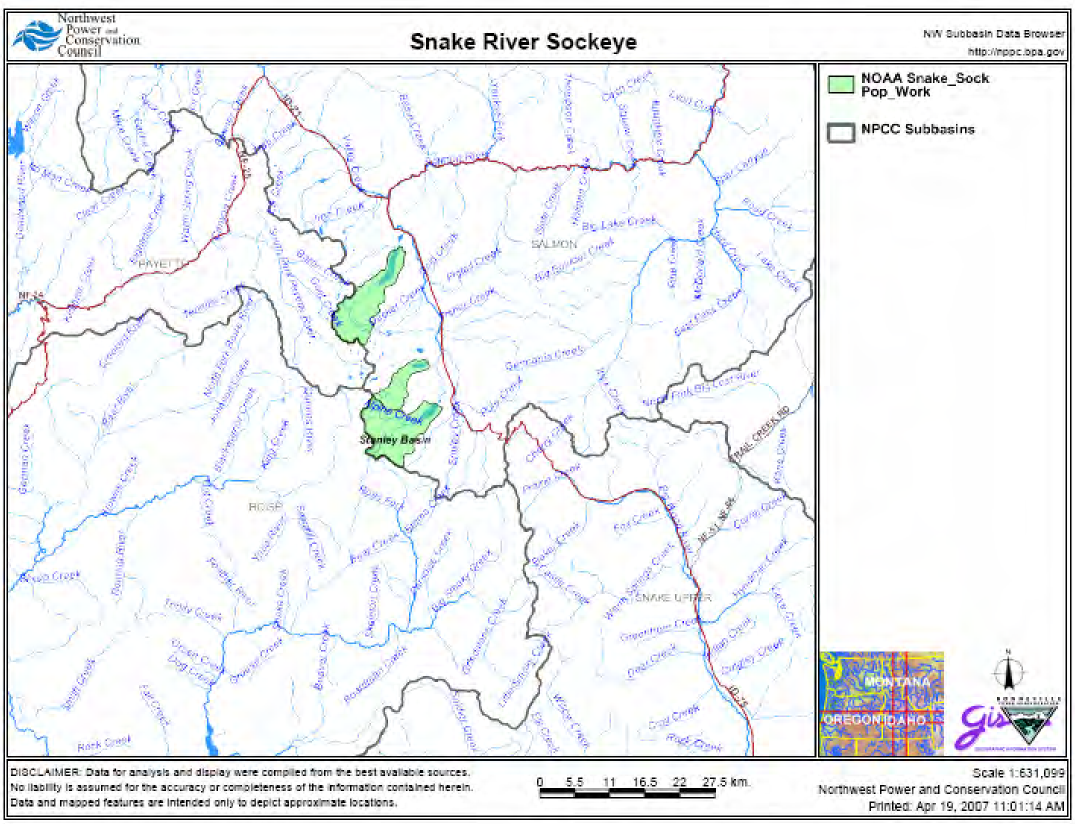

Figure 6-1. Snake River Sockeye Salmon ESU

This chapter is organized into five sections. Section 6.1 provides an overview of the ESU and the factors limiting its viability. Section 6.2 summarizes population-level status information during the 20 year base period used for this analysis. Section 6.3 provides the analysis of the current status and provides estimates of the "gaps," or needed lifecycle survival improvements for individual populations to meet certain biological criteria. It summarizes the improvements made to the hydropower (hydro) system and in other Hs (habitat, hatcheries and harvest) since about 2000 and estimates the salmonid survival benefits associated with those improvements. Section 6.4 describes the actions proposed to be implemented into the future, and Section 6.5 estimates their effects on salmonid survival when aggregated with the environmental baseline and cumulative effects.

This ESU was listed under the Endangered Species Act (ESA) as "endangered" in 1991, and is currently a hatchery-based ESU. Although sockeye salmon were historically numerous in many areas of the Snake Basin prior to the westward expansion, the only remaining population now resides in Redfish Lake in the Stanley Basin, and even here the population is a remnant run (56 FR 58619; November 20, 1991). At the time of listing, the preceding 3-year abundance was one fish, one fish, and zero fish, respectively, and some contended that the ESU was "functionally extinct." However, the National Marine Fisheries Service (NMFS, also known as National Oceanic and Atmospheric Administration [NOAA] Fisheries) determined to proceed with listing "to make a conservative decision in this circumstance" (Waples et al. 1991). Even now, after over 10 years of intense effort, the numbers of returning adult fish annually total only about 30 fish.

The low numbers of sockeye salmon are the legacy of over a hundred years of actions and inaction. Beginning in the late nineteenth century, anadromous sockeye salmon were reduced in abundance by heavy harvest pressures, unscreened irrigation diversions, and dam construction (Interior Columbia Basin TRT 2003). This includes construction of the 30-foot-high Sunbeam Dam on the mainstem Salmon River in 1910, which effectively blocked fish passage until its partial removal in the 1930s. Fishery management decisions also played a role in the near elimination of sockeye salmon from the Snake River. In the 1950s and 1960s, the Idaho Department of Fish and Game (IDF&G) actively eradicated sockeye salmon and other fish from some locations (Pettit, Yellowbelly, and Stanley lakes) and managed fisheries for resident fish populations.

6.1.1 Key Limiting Factors

Salmon and steelhead have been adversely affected over the last century by many activities including human population growth, introduction of exotic species, over fishing, developments of cities and other land uses in the floodplains, water diversions for all purposes, dams, mining, farming, ranching, logging, hatchery production, predation, ocean conditions, loss of habitat, and other causes (Lackey et al. 2006). For Snake River Sockeye Salmon, the legacy effects described above, which have left only a remnant run, largely control the condition of the ESU. Summarized below in Table 6-2 are key current limiting factors for this ESU identified by NMFS in the ESU Overviews for the Remand Collaboration (NMFS 2005e).

Table 6-2. Key Limiting Factors

Hydropower	Adult sockeye salmon loss through the hydro system is estimated at 22 percent, high compared to other species. Survival studies from the upper Columbia River have shown that juvenile sockeye salmon survival through dams can vary by project. Dam survival has been lower than for Chinook salmon or steelhead at some projects but higher at others. Hydro impacts include volume, timing, and quality of flows that enter the geographic area, including flows from the Snake River at the toe of Hells Canyon Dam, which are impacted by the operation of the U.S. Bureau of Reclamation's (Reclamation’s) upper Snake River projects as well as non-Federal irrigation projects in the upper Snake River. Other hydrosystem impacts within the geographic area include the mainstem effects of Reclamation’s other projects within the Columbia River Basin and many non-Federal irrigation projects within the Columbia River Basin.
Habitat	With regard to habitat, the Redfish Lake Watershed lies within designated wilderness and the non-wilderness lake area habitat conditions are considered excellent.
Harvest	The legacy effects of harvest and resource management decisions are still affecting this ESU’s prospects today. Nevertheless, more recent harvest management decisions have reduced effects on the ESU, but not all harvest has been eliminated, despite the poor condition of the sockeye population. The remaining harvest is a reduced Tribal allocation and incidental catch from these other fisheries. Incidental catch in zone 1-5 is 0-1 percent and Tribal incidental take ranges from 2.8 to 7 percent. NMFS assumes ocean by catch to be less than 1percent.

6.2 BASE STATUS

Artificially propagated Sockeye Salmon from the Redfish Lake Captive Broodstock Program are now the core of this ESU. Only 16 naturally produced adults have returned to Redfish Lake since the Snake River Sockeye Salmon ESU was listed. All have been taken into the Redfish Lake Captive Broodstock Program, which was initiated as an emergency measure in 1991. The return of over 250 adults in 2000 was encouraging; however, subsequent returns from the captive program from 2001 and 2006 have been fewer than 30 fish per year. A total of 39 adults, virtually all of hatchery origin, have returned to Redfish Lake from 1999 to 2006.

Harvest levels have been reduced and only incidental catch and Tribal fisheries are now allowed for listed sockeye salmon in the Columbia River Basin. The harvest rate is now in the range of 5 to 7 percent. The FCRPS has also implemented improved operations to benefit listed fish starting in the early 1990s. Since the 1970s, land use practices also have begun to change to reduce impacts on fish released into the habitat. In spite of the beneficial changes that have occurred to date, however, Snake River Sockeye Salmon have remained at very low levels.

6.2.1 Spatial Structure and Biological Diversity

Conserving and rebuilding sustainable salmonid populations involves more than meeting abundance and productivity criteria. Accordingly, NMFS has developed a conceptual framework defining a Viable Salmonid Population (VSP) (McElhany et al. 2000). In this framework there is an explicit consideration of four key population characteristic or parameters for evaluating population viability status: abundance, productivity (or population growth rate), biological diversity, and population spatial structure. The reason that certain other parameters, such as habitat characteristics and ecological interactions, were not included among the key parameters is that their effects on populations are implicitly expressed in the four key parameters. Based on the current understanding of population attributes that lead to sustainability, the VSP construct is central to the goal of ESA recovery, and warrants consideration in a jeopardy determination. However, it must also be stressed that the ability to significantly improve either a species’ biological diversity or its spatial structure and distribution is limited within the timeframe of the Action Agencies' Proposed RPA.

Spatial Structure. Spatial structure, as the term suggests, refers to the geographic distribution of individuals in a population unit and the processes that generate that distribution. Distributed populations that interact genetically are often referred to as metapopulation. Although the spatial distribution of a population, and thus its metapopulation structure, is influenced by many factors, none are perhaps as important as the quantity, quality, and distribution of habitat. One way to think about the importance or value of a broad geospatial distribution is that a population is less likely to go extinct from a localized catastrophic event or localized environmental perturbations.

Biological Diversity. Biological diversity within and among populations of salmonids is generally considered important for three reasons. First, diversity of life history patterns is associated with a use of a wider array of habitats. Second, diversity protects a species against short-term spatial and temporal changes in the environment. And third, genetic diversity is the so-called raw material for adapting to long-term environmental change. The latter two are often described as nature's way of hedging its bets – a mechanism for dealing with the inevitable fluctuations in environmental conditions – long and short term. With respect to diversity, more is better from an extinction-risk perspective.

The Snake River Sockeye Salmon ESU is comprised of a single MPG and single population spawning and rearing in Redfish Lake in the Stanley Basin. The Interior Columbia Basin TRT has designated this population at high risk for spatial diversity and diversity. Considering that this is the last remaining population of a group of what were likely independent populations occupying the Stanley Basin lakes, this designation is readily justified. Moreover, the extremely low abundance of the population and the fact that a captive Broodstock Program was implemented in 1992 as a last-ditch attempt to avoid extinction clearly speaks to the high degree of risk faced by this population. At the present time it is uncertain whether the BPA-funded captive Broodstock Program will be successful in reviving this population.

6.3 BIOLOGICAL ANALYSIS OF ACTIONS

Historical abundance of Snake River Sockeye Salmon was estimated to have been between 40,000 and nearly 60,000 adult returns (NMFS 2006b). Between 1954 and 1991, when this ESU was listed as endangered, adult returns peaked above 4,000 returns in the mid-1950s, but declined to near zero (see Figure 6-2). Recent returns have been comprised of virtually 100 percent hatchery-origin adults, with a few unmarked adults that could be naturally produced offspring of adults released in Redfish Lake, mismarked juvenile hatchery releases, or adults resulting from outplants of hatchery-produced eggs. The 250 adult returns in 2001 marked a recent peak in adult returns, but other than that year, adult returns have been less than 30 individuals per year. Abundance trends are slightly higher than replacement, but overall abundance remains very low. Between 1999 and 2006, only 339 adults in total have returned to the Redfish Lake region.

Snake River Sockeye Salmon cannot be evaluated in the same manner as many other ESUs for their recovery and survival status. As noted above, they are a unique case, consisting of only about 30 or fewer adult fish returning each year (since the recent peak in 2000) supported by a captive Broodstock Program. Although this program is currently avoiding extinction and providing a base for recovery efforts, the legacy effects of past actions are presenting many challenges. An examination of other sockeye salmon stocks in the upper Columbia River Basin and other safety-net programs may indicate that possible genetic limitations (possible reduced fitness due to a population bottleneck) or other factors, not the FCRPS, may be limiting Snake River Sockeye Salmon recovery.

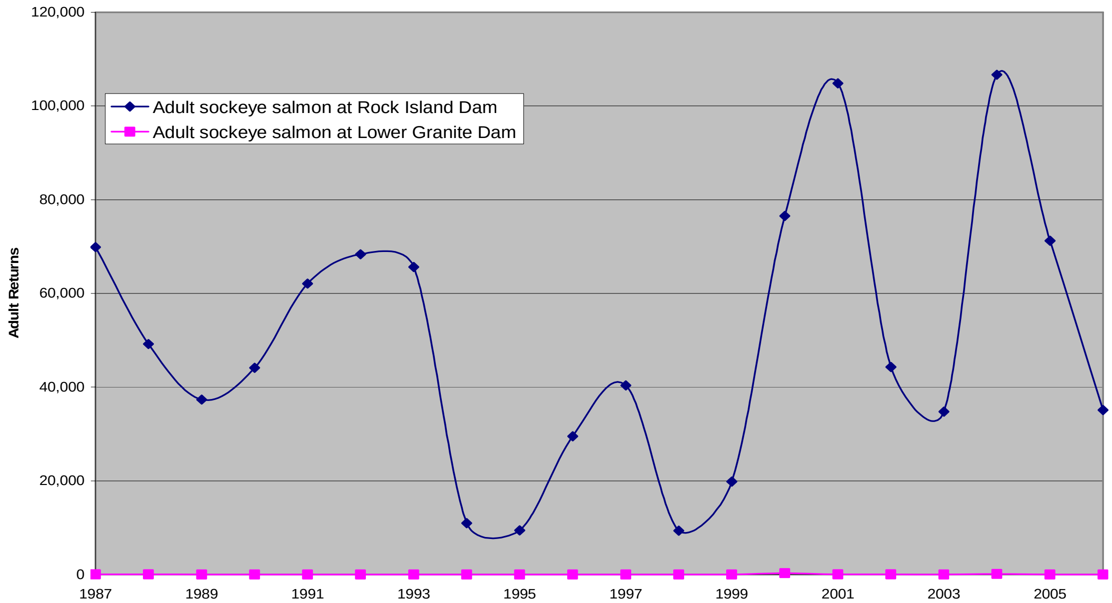

Figure 6-2. Adult Sockeye Salmon Returns to the Columbia and Snake Rivers

Sockeye salmon in the Okanogan and Wenatchee tributaries of the Upper Columbia, which experience life history impacts similar to those experienced by to Snake River Sockeye Salmon, are in fluctuating condition over the last two decades, but have maintained a run size of at least 10,000 fish, with two peaks of over 100,000 fish (Figure 6-2), and are not listed under the ESA. Although there is currently some hatchery augmentation of the run through the Wenatchee Sockeye Program (started 1989) and the Okanogan Sockeye Program (started 1992), these programs probably account for only a small portion of the run (estimated ~2,800 fish), based on annual releases of 200,000 juveniles per program and an average release-to-adult return rate of 0.7 percent (NMFS et al. 1998). The common impacts include passage through multiple dams and the estuary, as well as some harvest pressure (NMFS Status Review of Sockeye Salmon from Washington and Oregon 1997; 63 FR 11757, March 10, 1998).

Recent abundance of Upper Columbia Sockeye Salmon, shown below, is markedly higher than for Snake River Sockeye Salmon. Upper Columbia Sockeye Salmon migrate through the hydro system (four FCRPS and three to five public utility dams) between the end of June and about August 3, with peak migration in early July. Harvest has been in the general range of 5 percent to 7 percent of the run. The harvest rate of fisheries conducted by Columbia River Treaty Tribes is based on run size at Priest Rapids, with a 5 percent harvest rate when the run is <50,000, and 7 percent when the run size is between 50,000 and 75,000 (*US v. OR* Parties 2005).

This comparison may point to legacy effects and possible genetic limitations, FCRPS passage, as a limit to the current recovery efforts for Snake River Sockeye Salmon.

The safety-net program for Snake River Sockeye Salmon has been moderately successful. For example, smolt-to-adult return rates (SAR) for Redfish Lake Sockeye Salmon for adult return years 2000-2002 ranged from a high of 0.66 percent (eyed egg and pre-spawn adult release strategies combined) to a low of 0.04 percent (for Sawtooth Hatchery-reared presmolt and smolt release strategies combined) in two different years, 2000 and 2001 (Hebdon et al. 2004). In comparison, the Grande Ronde Chinook Salmon Captive Broodstock Program SARs for the 1998 cohort were 0.76 percent, 0.20 percent, and 1.99 percent for Catherine Creek, Grande Ronde River, and Lostine River fish, respectively (Hoffnagle et al. 2003).

However, higher SARs would be expected for Grande Ronde captive brood Chinook salmon due to its shorter migration pathway.

The Independent Scientific Review Panel (ISRP) recently recommended an end to funding of the captive broodstock program based on the program's disappointing results to date. It noted that "juvenile life stages of captive individuals that were re-introduced did not successfully emigrate to the marine environment and return and reproduce in sufficient numbers to meaningfully affect the viability and aid in the recovery of a self-sustaining Snake River sockeye ESU." It also pointed out that "the fish themselves are likely to be changing as a result of intensive propagation and rearing procedures so that their viability even under restored conditions is increasingly in doubt" (ISRP, Preliminary Review of Proposals, 2007).

6.3.1 Prospective Status

At the time of listing, as now, this ESU consisted only of handful of natural origin adult fish. Currently, this ESU is maintained through a "safety-net" captive Broodstock Program, consistent with the draft recovery plan. The Action Agencies' strategy for Snake River Sockeye Salmon involves changes in the current captive Broodstock Program, combined with improvements in the hydro corridor, predation control, and estuary habitat. The avoidance of extinction and the future prospects for recovery are both dependent on this two-pronged program.

The Action Agencies agree with the conclusions in a recent peer-reviewed paper regarding the Sockeye Program, which indicates that the current program has had a 20-fold benefit. The current efforts to prevent extinction of Redfish Lake Sockeye Salmon have provided a large measure of success, between 1999 and 2002, more than 312 adults returned from the ocean from captive broodstock releases – an amplification of almost 20 times the wild fish that returned in the 1990s. Important lineages of Redfish Lake Sockeye Salmon are being maintained in culture as preserves for genetic variability and for numerical and demographic amplification of the extant wild population. Most importantly, the Broodstock Program has prevented extinction and allowed some rebuilding of Redfish Lake Sockeye Salmon (Flagg et al. 2004).

Changes are being proposed by the Action Agencies in an effort to improve the captive Broodstock Program. For all the other Hs – hydro, harvest, and predation management – actions by the Action Agencies for this ESU will be similar to those for Snake River Spring/Summer Chinook Salmon. Experience with Upper Columbia River Sockeye Salmon has shown that they migrate through the upper water column and use surface passage routes when available, indicating that the removable spillway weir (RSW) and surface bypass action will be beneficial for Sockeye salmon. Sockeye salmon appear to pass via surface routes at a higher rate than Chinook salmon, but other passage metrics are very similar to Spring/Summer Chinook salmon, making them a suitable surrogate.

6.4 ADDITIONAL ACTIONS TO BENEFIT THE ESU

6.4.1 Other Federal Actions with Completed Section 7 Consultations

NMFS searched its Public Consultation Tracking Database (PCTS) for Federal actions that had completed Section 7 consultation since November 30, 2004 that could be used to adjust the status of the Redfish Lake population between the base and current periods. The U.S. Forest Service completed consultation on two projects—the Valley Road Fire (emergency consultation) and Whitebark Pine Treatment. The Federal Highway Administration (FHWA)/Idaho Department of Transportation (IDT) consulted on repairs at Buckhorn Bridge (Salmon River Milepost 184).[1] All of these projects were expected to have only discountable or insignificant adverse effects.

6.5 OBSERVATIONS

Based on the "diagnosis" provided by the preceding information, the Action Agencies' strategy for Snake River Sockeye Salmon is heavily weighted toward changes in the captive Broodstock Program. For all the other Hs – hydropower, harvest, and predation management – Action Agency actions for this ESU will be similar to those for Snake River Spring/Summer Chinook Salmon. The avoidance of extinction and the future prospects for recovery are both dependent on this two-pronged program.

Changes are being proposed by the Action Agencies in an effort to improve the captive Broodstock Program. The safety net program will be continued through the period of the new Biological Opinion and enhance current broodstock by:

1. Examining the early release mortality of sockeye salmon before they reach the Snake River and undertake a study of possible sources and locations of mortality; and
2. Expanding the current program capacity to produce between 500,000 and 1 million smolts to determine whether higher numbers of smolt production may be necessary for meaningful adult returns.

As a contingency if the experimental expanded smolt program fails to meet performance standards, the Action Agencies will consider funding implementation of other alternative actions, including, but not limited to, reintroduction of Snake River Sockeye Salmon into Wallowa Lake or establishment of a Snake River Sockeye Hatchery Program below Bonneville Dam that would serve as an "egg bank."

In addition, the Action Agencies will explore the feasibility of truck transport of a number of returning sockeye salmon adults from Lower Granite Dam to natural or artificial spawning locations in the Stanley Basin. If feasible, a transport plan will be developed and serve as guidance for implementation activities.

6.6 CONCLUSION

The Action Agencies have worked with the states and Tribes through the Remand Collaboration Process and other forums to identify actions intended to address the needs of listed salmon and steelhead as determined by quantitative and qualitative biological analyses. Acknowledging that NMFS will review the actions and the effects analyses contained herein to make a final jeopardy determination in the forthcoming biological opinions, the Action Agencies are making the following conclusions. Based on our assessment of the FCRPS and Upper Snake River actions and analysis of effects, considering the present and future human and natural context, the Action Agencies conclude that the net effects of the proposed actions, including the existence and operations of the dams with the proposed mitigation, meet or exceed the objectives of doing no harm and contributing to recovery with respect to this ESU.

[1] This information does not include any habitat conservation or restoration projects funded by BPA under NMFS' programmatic biological opinion for the Habitat Improvement Program (HIP). The effects of those projects are already taken into account in the base-to-current adjustment for species/population status.

Chapter 7
Snake River Steelhead
Distinct Population Segment

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

7.1 INTRODUCTION

This chapter briefly summarizes the current biological status of the Snake River Steelhead Distinct Population Segment (DPS) related to extinction risk and the effects of the Federal Columbia River Power System (FCRPS) Proposed Reasonable and Prudent Alternative (RPA) in the context of recovery plan actions. First, it summarizes current status information including key limiting factors and extinction risks. Second, it includes a biological assessment of the survival effects of recent and planned actions on current and prospective conditions, respectively. Finally, it identifies additional actions to benefit the DPS. Summary data for the DPS are presented in Table 7-1. The geographic extent of the DPS is shown in Figures 7-1 and 7-2, respectively, for winter and spring steelhead populations.

This chapter is organized into five sections. Section 7.1 provides an overview of the DPS and the factors limiting its viability. Section 7.2 summarizes population-level status information during the 20-year base period used for this analysis. Section 7.3 provides the analysis of the current status and provides estimates of the "gaps," or needed lifecycle survival improvements for individual populations to meet certain biological criteria. It summarizes the improvements made to the hydropower (hydro) system and in other Hs (habitat, hatcheries, and harvest) since about 2000 and estimates the salmonid survival benefits associated with those improvements. Section 7.4 describes the actions proposed to be implemented into the future, and Section 7.5 estimates their effects on salmonid survival when aggregated with the environmental baseline and cumulative effects.

Table 7-1. DPS Description and Major Population Groups (MPGs)

DPS Description[1/]	
Threatened	Listed under Endangered Species Act (ESA) in 1997; reaffirmed in 2006
5 to 6 current major population groups (key research needed to determine if fish occupying several small tributaries in Hells Canyon are hatchery strays)[2/]	24 to 25 current populations
Hatchery programs included in DPS	Tucannon, Dworshak, Lolo Creek, North Fork Clearwater, East Fork Salmon, Little Sheep/Imnaha
Major Population Groups	**Populations**
Clearwater River	Clearwater River lower mainstem Clearwater River south fork Lochsa River Lolo Creek Selway River
Grande Ronde River	Grande Ronde River lower mainstem tributaries Grande Ronde River upper mainstem Joseph Creek Wallowa River
Hells Canyon	Hells Canyon (key research needed to determine if fish occupying several small tributaries in Hells Canyon are remnants of this MPG or hatchery strays)[3/]
Imnaha River	Imnaha River
Lower Snake	Asotin Creek Tucannon River

Table 7-1. DPS Description and Major Population Groups (MPGs)

Major Population Groups	Populations
Salmon River	Lower Middle Fork (Big, Camas, and Loon Creek) Chamberlain Creek East Fork Salmon River Lemhi River Little Salmon and Rapid River Middle Fork Salmon River upper mainstem North Fork Salmon River Pahsimeroi River Panther Creek Salmon River upper mainstem Secesh River South Fork Salmon River

1/ 70 FR 37160; Interior Columbia Basin Technical Recovery Team (TRT) 2003, 2005
2/ Planned Interior Columbia Basin TRT task for 2008
3/ Interior Columbia Basin TRT 2007

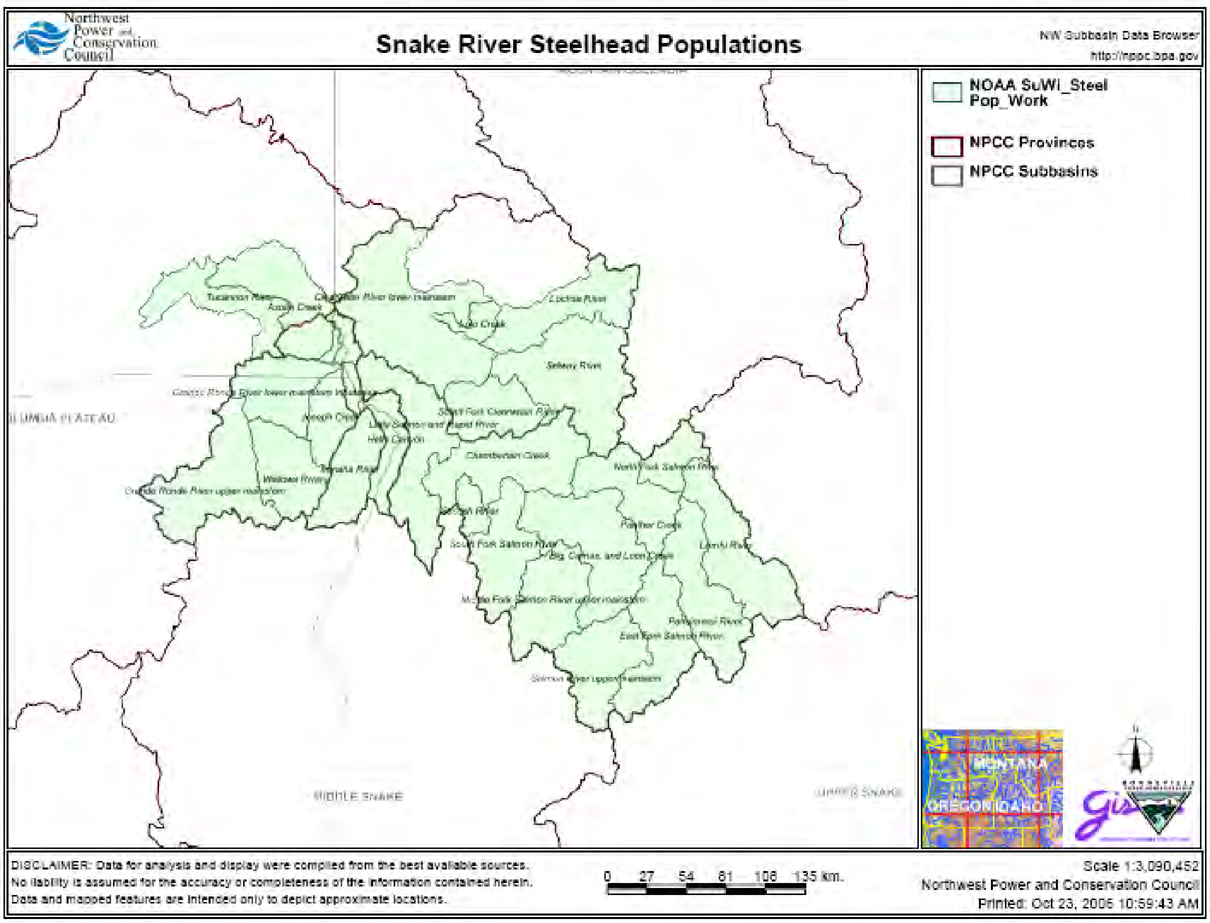

Figure 7-1. Snake River Steelhead DPS

Due to the lack of population-specific information for the majority of the populations comprising this DPS, the quantitative aspect of this analysis is limited to the three populations for which information is available, as well as the estimated effects on two "average" population profiles developed by the Interior

Columbia Basin Technical Recovery Team (TRT). Given the uncertainties regarding the current status of most of these populations, the assessments in this analysis will be primarily qualitative. Without a reasonable basis for estimating base period status for individual populations, it is not possible to perform the detailed gap analysis undertaken for other Interior Columbia Evolutionarily Significant Units (ESUs).

Almost all of the metrics used in this analysis are estimates for individual populations within the DPS or average population profiles, as noted above. The ESA is concerned with the status of a species, DPS, or ESU. Individual populations and major population groups (where they exist) obviously contribute to ESU status. However, the status of the ESU is not wholly dependent upon the status of any of the ESU's individual components.

Snake River Steelhead spawn and rear in the mainstem Snake River and its tributaries between Ice Harbor Dam and the Hells Canyon Hydropower Complex. The primary spawning and rearing habitats are in the middle to lower upper reaches of the numerous rivers and tributaries in the states of Washington, Oregon, and Idaho. The upriver limit of migration has been Hells Canyon Dam (Snake River Mile 250) since it was completed in 1961. Built without adequate fish passage facilities, the Idaho Power Company's Hells Canyon Dam complex blocked migration of all anadromous salmonids and eliminated access to historically occupied upriver habitat. Whether the populations previously utilizing the blocked habitat would be considered part of the current DPS is unknown.

The Interior Columbia Basin TRT has identified 20 extant populations occupying tributaries of the mainstem Snake River, the Grand Ronde River, the Clearwater River, and the Salmon River. The Interior Columbia Basin TRT has organized these populations into five major population groups (MPGs): the Lower Snake River, Imnaha River, Grande Ronde River, Clearwater River, and Salmon River MPGs (Table 7-1).

Inland steelhead of the Columbia River Basin, and especially the Snake River DPS, are commonly referred to as either A-run *or* B-run. These designations are based on the observation of a bimodal migration of adult steelhead at Bonneville Dam (Columbia River Mile 147) and differences in age-at-return (1- versus 2-ocean) and adult size observed among Snake River Steelhead. Adult A-run steelhead enter fresh water from June to August; as defined, the A-run passes Bonneville Dam before August 25 [Columbia Basin Fish and Wildlife Authority (CBFWA) 1990, Idaho Department of Fish and Game (IDFG) 1994). Adult B-run steelhead enter fresh water from late August to October, passing Bonneville Dam after August 25 (CBFWA 1990, IDFG 1994). Above Bonneville Dam (e.g., at Lower Granite Dam on the Snake River, 695 kilometers from the mouth of the Columbia River), run-timing separation is not observed, and the groups are separated based on ocean age and body size (IDFG 1994). A-run steelhead are defined as predominantly age-1-ocean, while B-run steelhead are defined as age-2-ocean (IDFG 1994). Adult B-run steelhead are also thought to be on average 75-100 millimeters larger than A-run steelhead of the same age; this is attributed to their longer average residence in salt water [Bjornn 1978, CBFWA 1990, Columbia River Fish Management Plan Technical Advisory Committee (CRFMP TAC) 1991]. It is unclear, however, if the life history and body size differences observed upstream have been correlated back to the groups forming the bimodal migration observed at Bonneville Dam. Furthermore, the relationship between patterns observed at the dams and the distribution of adults in spawning areas throughout the Snake River Basin is not well understood.

A-run steelhead are believed to occur throughout the steelhead-bearing streams of the Snake River Basin; additionally, inland Columbia River steelhead outside of the Snake River Basin are also considered A-run (IDFG 1994). B-run steelhead are thought to be produced only by populations in the Clearwater River MPG and by selected populations in the Salmon River MPG (i.e., Secesh, South Fork, Lower Middle Fork, and Upper Middle Fork). Significant uncertainties in the available information make a quantitative analysis problematic for this DPS.

Resident *O. mykiss* are believed to be present in many of the watersheds used by Snake River Steelhead. Very little is known about interaction between co-occurring resident and anadromous forms within this DPS.

Hatchery programs operating in the geographic area occupied by the Snake River Steelhead DPS and listed as part of the DPS include the Washington Department of Fish and Wildlife's Tucannon Hatchery, U. S. Fish and Wildlife Service Dworshak National Fish Hatchery, Lolo Creek, North Fork Clearwater, East Fork Salmon, and Little Sheep/Imnaha. These hatchery programs were derived using broodstock from local, natural populations and produce roughly half a million smolts annually. Other hatchery programs within the geographic area of the DPS but not listed include Lyons Ferry, Cottonwood Pond - Wallowa stock, Wallowa Hatchery and Big Canyon satellite pond, Lower Snake and Hells Canyon Mitigation, Pahsimeroi Hatchery, Dworshak B stock, and Sawtooth Hatchery A stock. These hatchery programs produce about 5 million smolts annually.

Harvest of Snake River Steelhead is managed independently for A- and B-run steelhead under the Columbia River Fisheries Compact. A-run fish are harvested on a sliding scale (depending on estimated run size) between 4.5 and 10 percent. B-run fish are harvested up to a 17 percent limit. The 2000 to 2003 combined harvest rates have averaged 12.4 percent. The majority of this harvest occurs in the Tribal gillnet fisheries in Zone 6 and in sport fisheries in Idaho.

The National Marine Fisheries Service (NMFS, also known as National Oceanic and Atmospheric Administration [NOAA] Fisheries') Biological Review Team (BRT) recently confirmed this DPS's Threatened status in its June 2005 status review, while noting that adult returns had generally improved in recent years relative to the 1990s. For the purposes of recovery planning, the Interior Columbia Basin TRT assigns the "average" A-run steelhead population a "Medium" risk rating for abundance and productivity. The "average" B-run population is assigned a "High" risk rating for abundance and productivity.

Human impacts and current limiting factors for this DPS come from multiple sources: hydro passage, habitat degradation, hatchery effects, fishery management and harvest decisions, predation, and other sources.

7.1.1 Key Limiting Factors

Salmon and steelhead have been adversely affected over the last century by many activities including human population growth, introduction of exotic species, over fishing, developments of cities and other land uses in the floodplains, water diversions for all purposes, dams, mining, farming, ranching, logging, hatchery production, predation, ocean conditions, loss of habitat and other causes (Lackey et al. 2006). Summarized below in Table 7-2 are key limiting factors for this DPS identified by NMFS in the ESU Overviews for the Remand Collaboration (NMFS 2005e).

Table 7-2. Key Limiting Factors

Hydro	Snake River Basin Steelhead migrate through four Columbia River dams and two to four Snake River dams as juveniles and as adults. Efforts to improve survival through flow management, project modifications, and transportation of smolts have improved survival through the dams to around 50 percent and declines have slowed. According to the Step 4 report, the estimated portion of the human impact attributable to the FCRPS dams (compared to natural river estimates) is 71 to 88 percent. If the latent mortality hypothesis is omitted, the human impact associated with the hydro system is 42 percent. Hydro impacts include volume, timing, and quality of flows that enter the geographic area, including flows from the Snake River at the toe of Hells Canyon Dam, which are impacted by the operation of Reclamation's upper Snake River projects as well as non-Federal irrigation projects in the upper Snake River. Other hydrosystem impacts within the geographic area include and the mainstem effects of Reclamation's other projects within the Columbia River Basin and many non-Federal irrigation projects within the Columbia River Basin.
Predation	Predation has been noted as a factor limiting fish survival for steelhead in the mainstem reservoirs and in the Columbia Estuary. In recent years, avian predators at Crescent Island have taken from 7 to 14 percent of the passive integrated transponder (PIT)-tagged steelhead released from Lower Monumental Dam. Avian predators also take significant numbers of steelhead in the estuary.
Habitat	Many of the historically productive populations such as the Wenaha and Minam, Selway, Lochsa, Chamberlain, and upper and lower Middle Fork Salmon lie within designated wilderness where habitat conditions are mostly pristine. This being the case, there is probably little opportunity to improve productivity for these populations through habitat improvements. Current and legacy land uses continue to cause declines in steelhead survival in some tributaries. Of particular concern are reduced complexity of the stream system, water quantity during the summer, and water quality (mostly temperature and sediment). Some populations would benefit from these types of habitat improvements, including the lower Snake MPG, lower Clearwater A-run, upper Grande Ronde, and upper Salmon River. According to the Step 4 report,, the estimated portion of the human impact attributable to combined habitat effects in the tributaries and the estuary is 20 to 26 percent. If the latent mortality hypothesis is omitted, the human impact associated with habitat degradation is 14 percent.
Harvest	As fisheries have become more stock-specific, direct commercial harvest of Snake River Basin Steelhead has been eliminated. The remaining harvest is a reduced Tribal allocation and the incidental catch from other fisheries. Any impact from the catch-and-release recreational fishery is low. Together these result in a 5 to 20 percent mortality rate. This harvest rate has been reduced from 40 to 60 percent historically, but may still be a factor in decline of some populations. According to the Step 4 report, the estimated portion of the human impact attributable to combined Tribal and non-Tribal harvest effects is 17 to 19 percent. If the latent mortality hypothesis is omitted, the range associated with the combined harvest impacts is 31 to 1 percent.
Hatcheries	Planned steelhead smolt production in the Snake River Basin totals just over 10 million fish annually. Most steelhead production is based on non-listed stocks that are released for harvest augmentation and mitigation. Most hatchery production is managed to be isolated from natural spawning areas; most of the releases are made at weirs and acclimation ponds or in stream sections where hatchery-origin adults are not likely to spawn successfully. Supplementation programs exist in the Tucannon and East Fork Salmon rivers; Little Sheep Creek on the Imnaha are exceptions to this rule. According to the Step 4 report,, the estimated portion of the human impact attributable to hatchery effects is 4 to 6 percent. If the latent mortality hypothesis is omitted, the human impact associated with the hatchery system is 1 percent.

7.2 BASE STATUS

7.2.1 Methods for Estimating Snake River Steelhead Average A-Run and B-Run Population Profiles

The method used to estimate the average A-run and B-run population profiles is briefly described in the Interior Columbia Basin TRT Interim Gaps Report (Interior Columbia Basin TRT 2006). To quote from the report: "We developed estimates for two average populations representing the remaining populations within this DPS, each representing a major run type (A and B). For B-run steelhead populations, productivity and abundance characteristics were estimated for an average population, assuming that natural origin returns over Lower Granite Dam were allocated proportionally among populations. The Grand Ronde populations with specific data series are classified as A-run steelhead. Estimated natural origin returns accounted for in the Grand Ronde populations [*Joseph Creek, Upper Grande Ronde and Wallowa Rivers*] were subtracted from the count of natural origin A-run steelhead at Lower Granite Dam." The Interior Columbia Basin TRT assumes that returns not accounted for in the available population sets were distributed among the remaining populations in proportion to available habitat. Average population profiles were developed accordingly.

7.2.2 DPS Abundance and Trends

As noted, population-specific adult abundance trend data sets are generally not available for Snake River Steelhead populations. The estimated 10-year geomean abundance for the average A-run population is 456 natural-origin spawners. The 10-year geomean abundance for the average B-run population is estimated to be 272 natural-origin spawners. Five-year estimates of geomean abundance are, respectively, 1,311 and 383 natural-origin spawners, indicating an improvement in recent years. 1980 to most recent and 1990 to most recent abundance trends are both greater than 1.0 for the average A-run population and less than 1.0 for the average B-run population. See Figure 7-2.

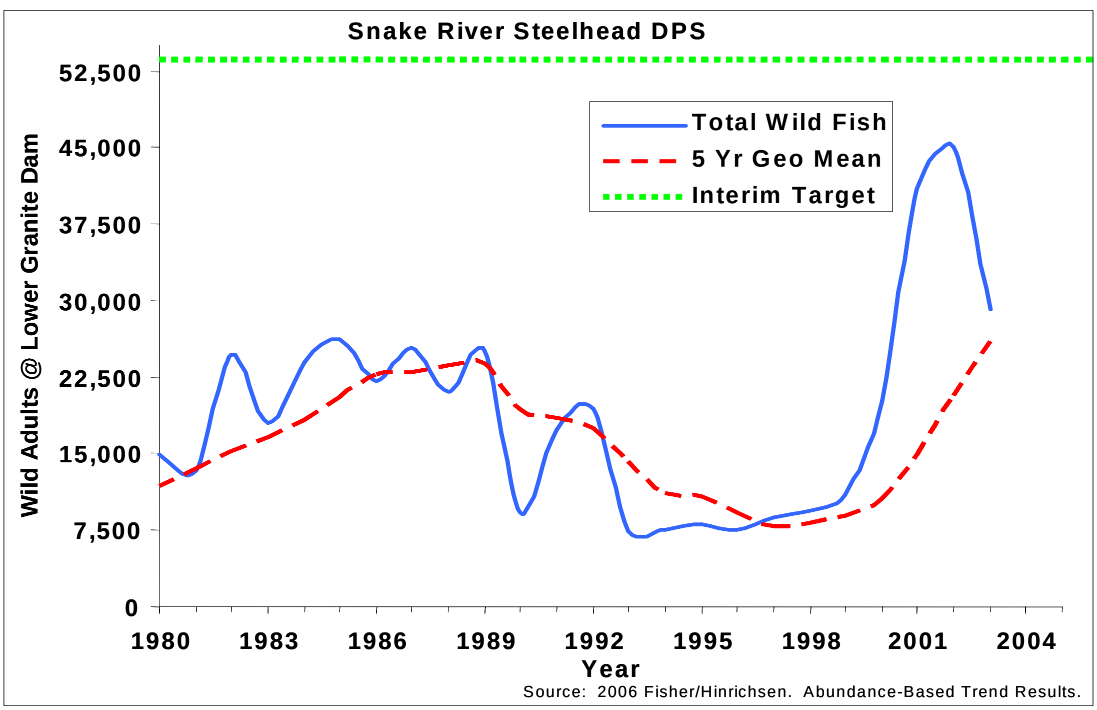

Figure 7-2. Snake River Steelhead DPS Abundance and 5-Year Geometric Mean

7.2.3 Extinction Probabilities

It was only possible to develop extinction probability results for the Interior Columbia Basin TRT's average A-run population, and two actual populations: the Grande Ronde Upper Mainstem and Joseph Creek A-run Steelhead populations. Extinction probability estimates were developed for populations in this DPS using the Ricker production function, which was fit to spawner-recruit data from brood years 1978 to the present. The estimated Ricker function was used to project populations over a 24-year time horizon to estimate extinction probability. Alternative quasi-extinction thresholds (QETs) of 1, 10, 30, and 50 spawners were used in the analysis. In the modeling, extinction was assumed to occur when spawners fell below the QET for 4 years running. Reproductive failure was assumed to occur in any year in which spawner numbers fell below 10, except in the case of QET=1, where reproductive failure was assumed when spawners fell below 2.[1] It was not possible to calculate gaps for this metric.

Twenty-four-year extinction probabilities were quite low at all modeled QETs for the Grande Ronde Upper Mainstem and Joseph Creek populations. Base period risks are low at QETs 1, 10, and 30 for the average A-run population and moderate at QET=50. It is assumed that base period extinction probabilities are generally higher for B-run populations.

7.2.4 Recruit-per-Spawner Productivity, Lambda, and Trends

The steelhead populations in this DPS are all summer run, spawning in late spring and early summer. As a result of environmental conditions during the spawning period, it can be difficult to conduct representative surveys of the number of spawners within specific populations using redd counts or fish counts.

As noted, detailed abundance trend and run reconstruction information is available only for the Grande Ronde Upper Mainstem and Joseph Creek populations. A dataset for two index reaches in the Wallowa River population has been developed by the Interior Columbia Basin TRT. This dataset was used to estimate recruits per spawner (R/S) productivity for the Wallowa River population. All of these populations have relatively high natural abundance and productivity levels.

The productivity and survival metrics for the average A-run and B-run populations and the three populations for which information is available are summarized in Tables 7-3 and 7-4. Productivity, as reflected by estimates of R/S using a 20-year time series of data, averages 1.26 for the A-run populations, indicating that these populations are on a trend toward recovery. In contrast, the R/S average of 0.82 for the B-run population indicates a needed survival improvement of at least 18 percent over the base period to meet the R/S criteria. No 20-year estimates of median population growth rate (λ) are available for the majority of the populations. Twelve-year λ estimates for both A-and B-run populations averaged 1.0 or greater.

[1] Reproductive failure is the assumption that zero progeny are produced in any year where spawner numbers fall below the identified threshold.

Table 7-3. Base Status Metrics

MPG	Population[a]	20 year R/S	10 year R/S	20 year λ	12 year λ	1980-current Trend	1990-current Trend
	Average A-run population	1.26	1.49	N/A	1.07	1.01	1.08
	Average B-run population	0.82	0.86	N/A	1.00	0.95	0.99
Grande Ronde	Upper Mainstem (A)	1.00	0.96	1.01	0.98	0.99	1.01
	Joseph Cr. (A)	1.27	1.42	1.05	1.00	1.02	1.05
	Wallowa R. (A)	1.26	1.49	N/A	1.07	1.01	1.08
All other MPGs	All other populations	N/A	N/A	N/A	N/A	N/A	N/A

Notes:
1/ A- or B-run classification in parentheses. For R/S, lambda, and trend, a value >1.0 indicates a growing population; a value <1.0 indicates a population in decline.

Table 7-4. Estimated Extinction Risk

MPG	Population	Ext. Risk QET = 1	Ext. Risk QET = 10	Ext. Risk QET = 30	Ext. Risk QET = 50
	Average A-run population	0.00	0.02	0.05	0.11
	Average B-run population	N/A	N/A	N/A	N/A
Grande Ronde	Upper Mainstem (A)	0.00	0.00	0.00	0.00
	Joseph Cr. (A)	0.00	0.00	0.00	0.00
All other MPGs	All other populations	N/A	N/A	N/A	N/A

Notes:
1/ A risk level of 0.11 indicates an 11 percent risk of extinction, assuming that spawner abundance below the QET for 4 years running results in extinction.

Abundance and a rolling 5-year geometric mean of abundance for the DPS compared to NMFS' interim recovery target are shown in Figure 7-2.

Based on these base estimates of survival metrics for the 25 Snake River Steelhead populations, Table 7-5 summarizes the needed improvements in lifecycle survival to bring the estimates in line with the proposed survival standard. Note that gap estimates for the average A-run and B-run populations are rough approximations and should not be understood to represent the actual condition of any specific population in this DPS. A metric of 1.0 reflects no gap. A number below 1.0 reflects a positive condition, while a number above 1.0 reflects a gap. For example, a gap of 1.2 indicates that 20 percent productivity is needed in the future.

Table 7-5. Base Status Gaps

MPG	Population	20-year R/S Gap	12-year λ Gap	Long-term Trend Gap
	Average A-run population	0.79	0.74	0.96
	Average B-run population	1.22	1.00	1.20
Grande Ronde	Upper Mainstem(A)	1.00	1.10	1.05
	Joseph Cr. (A)	0.79	1.00	0.91
	Wallowa R. (A)	0.78	N/A	N/A
All other MPGs	All other populations	N/A	N/A	N/A

Notes:
1/ Gaps are expressed as multipliers. For example, a 1.10 gap indicates a 10 percent improvement is necessary to close gap. If gap is ≤ 1.0, no further improvement is necessary to close gap.

7.2.5 Spatial Structure and Biological Diversity

Conserving and rebuilding sustainable salmonid populations involves more than meeting abundance and productivity criteria. Accordingly, NMFS has developed a conceptual framework defining a Viable Salmonid Population (VSP) (McElhany et al. 2000). In this framework there is an explicit consideration of four key population characteristic or parameters for evaluating population viability status: abundance, productivity (or population growth rate), biological diversity, and population spatial structure. The reason that certain other parameters, such as habitat characteristics and ecological interactions, were not included among the key parameters is that their effects on populations are implicitly expressed in the four key parameters. Based on the current understanding of population attributes that lead to sustainability, the VSP construct is central to the goal of ESA recovery, and warrants consideration in a jeopardy determination. However, it must also be stressed that the ability to significantly improve either a species' biological diversity or its spatial structure and distribution is limited within the timeframe of the Action Agencies' Proposed RPA.

Spatial Structure. Spatial structure, as the term suggests, refers to the geographic distribution of individuals in a population unit and the processes that generate that distribution. Distributed populations that interact genetically are often referred to as metapopulation. Although the spatial distribution of a population, and thus its metapopulation structure, is influenced by many factors, none are perhaps as important as the quantity, quality, and distribution of habitat. One way to think about the importance or value of a broad geospatial distribution is that a population is less likely to go extinct from a localized catastrophic event or localized environmental perturbations.

Biological Diversity. Biological diversity within and among populations of salmonids is generally considered important for three reasons. First, diversity of life history patterns is associated with a use of a wider array of habitats. Second, diversity protects a species against short-term spatial and temporal changes in the environment. And third, genetic diversity is the so-called raw material for adapting to long-term environmental change. The latter two are often described as nature's way of hedging its bets – a mechanism for dealing with the inevitable fluctuations in environmental conditions – long and short term. With respect to diversity, more is better from an extinction-risk perspective.

The Interior Columbia Basin TRT has divided the Snake River Steelhead DPS into 20 extant populations distributed across six MPGs. Because of the paucity of demographic and other data on the individual populations, the Interior Columbia Basin TRT did not classify these populations based on spatial structure and diversity (SSD) risk. What information is available does suggest that A-run populations in most MPGs occupy a diverse array of habitats and are performing well (i.e., are mostly replacing themselves). The situation is less clear for B-run populations which, based on sparse data, appear to be on a downward trend in all their habitats. The long-term status of this DPS from both an abundance/productivity and SSD perspective is at this time unclear. Developing the information to better understand the status of this DPS is a priority for more intensive monitoring and evaluation.

7.3 BIOLOGICAL ANALYSIS OF ACTIONS: RECRUITS-PER-SPAWNER, LAMBDA, AND TRENDS WITH CURRENT AND PROSPECTIVE ADJUSTMENTS

The Base Status is the historical status of the DPS, defined as the status of the population based on the *average* of quantitative survival metrics estimated from a time series of abundance data beginning in about 1980. For the most part, longer-term averages (generally 20 years) were used where they were available. In the biological analysis, this is the starting point, shown in the tables above.

The next step is Current Status, an adjustment of the initial base estimates to reflect our best estimate of current survivals, as opposed to an average of survivals that prevailed over a period in the past. This would obviously include recent improvements already implemented but not fully reflected in the Base conditions. Current Status is defined as estimated survival metrics adjusted for recently implemented changes in hydropower configuration and operations, hatchery operations, tributary and estuarine habitat improvements, and reduced avian predation. These are actions that have recently been implemented, but their effects are not reflected in the time series of survival data that for the most part started in 1980.

The final step is Prospective Status, which adjusts Current-to-Prospective Status based on the estimated effects of future actions. The current-to-prospective adjustment is simply an adjustment of the current survival estimates to reflect survival improvements expected from the hydro, habitat, and hatchery changes included in the Proposed RPA, and in particular those that are expected to be implemented in the period 2007 to 2017. Refer to Section 1.3 of this Comprehensive Analysis for a discussion of Reclamation's qualitative analysis for the years 2017 through 2034.

This analysis assumes that future ocean and climate conditions will approximate the average conditions that prevailed during the 20-year base period used for our status assessments. For most populations, that period is about equivalent to the "recent" ocean period used by the Interior Columbia Basin TRT in its analyses. This period was characterized by relatively poor ocean conditions that presumably contributed to poor early ocean survival of salmonids. To illustrate, the Interior Columbia Basin TRT's "pessimistic" ocean condition scenario results in survivals that are about 15 percent lower for Snake River Spring/Summer Chinook Salmon than the "recent' ocean conditions scenario, and about 36 percent lower for Upper Columbia Spring Chinook Salmon. Alternatively, Interior Columbia Basin TRT's "historical" ocean conditions scenario results in survivals that are about 39 percent higher for both Snake River Spring/Summer and Upper Columbia Spring Chinook Salmon (Interior Columbia Basin TRT and Zabel 2006). This subject is treated at greater length in the discussion of the effects of potential climate change in Appendix H.

The analysis of status assumes a certain amount of annual take of natural adult fish based on recent harvest levels. Snake River Steelhead are harvested at a relatively high rate, particularly the B-run fish whose adult migration coincides with that of Hanford Reach and Snake River Fall Chinook. No non-Tribal commercial harvest is allowed under the current harvest management plan; in-river harvest is limited to Tribal harvest and sport fishing. Tribal harvest levels of B-run steelhead during the base period (adult returns corresponding to brood years 1986 to 1998) was about 18.6 percent. Harvest levels since 2001 averaged about 11.6 percent.

It should be noted that some unaccounted steelhead harvest in state sport fisheries above McNary Dam is currently an issue being discussed between the salmon managers and NMFS. There is a potential that this harvest, once accounted for, may impact the trend and supporting analysis of this DPS.

7.3.1 Current Status Analysis

Over this period the Action Agencies implemented multiple actions to improve survival for all populations on this DPS. The percentage improvements in lifecycle survival used in the base-to-current adjustments for Snake River Steelhead populations are summarized in Table 7-6. Gaps are not shown for populations for which specific data is not available. However, population-specific survival improvements are noted, reflecting estimated benefits from projects already implemented. Actions are described in summary below:

Table 7-6. Estimated Survival Improvements Used in the Base-to-Current

MPG	Population	Hydro	Habitat (tributary)	Habitat (estuary)	Avian predation	Harvest[2]
Lower Snake	Tucannon	-2.1%	6.5%	0.3%	-0.3%	8.0%
	Asotin	-2.1%	8.5%	0.3%	-0.3%	8.0%
Imnaha River	Imnaha	-2.1%	0.1%	0.3%	-0.3%	8.0%
Grande Ronde	Upper Mainstem	-2.1%	2.0%	0.3%	-0.3%	8.0%
	Lower mainstem	-2.1%	0.1%	0.3%	-0.3%	8.0%
	Joseph Cr.	-2.1%	2.0%	0.3%	-0.3%	8.0%
	Wallowa R.	-2.1%	2.0%	0.3%	-0.3%	8.0%
Clearwater R.	Lower mainstem	-2.1%	2.5%	0.3%	-0.3%	8.0%
	Lolo Cr.	-2.1%	0.5%	0.3%	-0.3%	8.0%
	Lochsa R.	-2.1%	0.5%	0.3%	-0.3%	12.0%
	Selway R.	-2.1%	0.7%	0.3%	-0.3%	12.0%
	South Fork	-2.1%	1.5%	0.3%	-0.3%	12.0%
	North Fork (ext.)					
Salmon R.	Little Salmon/Rapid	-2.1%	0.5%	0.3%	-0.3%	8.0%
	Chamberlain Cr.	-2.1%		0.3%	-0.3%	8.0%
	Secesh R.	-2.1%		0.3%	-0.3%	12.0%
	S. Fork Salmon	-2.1%		0.3%	-0.3%	12.0%
	Panther Cr.	-2.1%		0.3%	-0.3%	8.0%
	Lower M.F. Tribs	-2.1%		0.3%	-0.3%	12.0%
	Upper M.F. Tribs	-2.1%		0.3%	-0.3%	12.0%
	N. Fork	-2.1%		0.3%	-0.3%	8.0%
	Lemhi R.	-2.1%	0.5%	0.3%	-0.3%	8.0%
	Pahsimeroi R.	-2.1%	6.5%	0.3%	-0.3%	8.0%
	E. Fork Salmon	-2.1%	0.5%	0.3%	-0.3%	8.0%
	Upper Mainstem	-2.1%	0.5%	0.3%	-0.3%	8.0%

7.3.1.1 Hydropower Survival Improvements

The percentage improvement in lifecycle survival attributable to changes in hydropower operations for the base-to-current period is the estimated differences in juvenile migrant juvenile during the base period 1980 to 2001 and the more recent period from 2001 to 2005. These changes are expected to have uniformly decreased lifecycle survival of the Snake River Steelhead populations by 2.1 percent. Additional detail on how these percentages were estimated is described in Appendix B. The current estimates of survival are primarily based on changes in transport operations in recent years. These estimates represent the "best estimates" of NMFS (see COMPASS tables in Appendix B). The configuration and operational and maintenance changes to fish passage facilities and other projects areas that contributed to these effects include:

- Bonneville Powerhouse I (PH1) minimum gap runner (MGR) installations;
- Bonneville Powerhouse II (PH2) Corner Collector installation;
- Bonneville PH2 fish guidance efficiency (FGE) improvements;
- Bonneville spill operation improvements;
- Bonneville PH1 juvenile bypass system (JBS) screen removal;
- Bonneville PH2 operation as first priority;

[2] Harvest adjustments in this table represent estimated harvest decreases between the base and current periods. Estimates supplied by A. Nigro (ODF&W) on behalf of an ad hoc *US v. OR* technical workgroup (Nigro 2007).

- The Dalles spill wall construction;
- The Dalles spill pattern improvements;
- The Dalles adult collection channel improvements;
- The Dalles sluiceway operation improvements;
- John Day spill operation improvements;
- John Day South Fish Ladder improvements;
- McNary spill operation improvements;
- McNary end spillbay deflectors and hoists;
- McNary full flow juvenile passive integrated transponder (PIT)-tag detection;
- McNary juvenile transport facility bypass piping improvements;
- McNary spare extended-length submerged bar screen (ESBS);
- McNary improved juvenile bypass dewatering screens;
- McNary overhauling auxiliary water supply (AWS) pumps;
- McNary upgrading of adult fish ladders tilting weir controls;
- Ice Harbor removable spillway weir (RSW) installation and spill operation improvements;
- Ice Harbor full flow juvenile PIT-tag detection;
- Ice Harbor AWS improvements north shore adult fishway;
- Ice Harbor replaced adult fishway entrance weirs;
- Ice Harbor new bulkhead system for maintenance of south shore AWS pumps;
- Ice Harbor upgraded AWS hydraulic systems;
- Lower Monumental end spillbay deflectors, parapet walls, and stilling basin repair;
- Lower Monumental spill operations improvements;
- Lower Monumental juvenile fish separator improvement;
- Lower Monumental fish barge loading improvements;
- Lower Monumental rehabbed adult fish pumps;
- Lower Monumental replaced north shore adult fish counting station;
- Little Goose spill operations improvements;
- Little Goose ESBS improvements;
- Lower Granite RSW installation;
- Lower Granite ESBS improvements;
- Lower Granite modifications to adult transition pool to improve adult passage;
- Improved total dissolved gas monitoring program and equipment; and
- Delayed/staggered start of juvenile fish transportation program.

7.3.1.2 Tributary Habitat Survival Improvements

Bonneville Power Administration (BPA) and U.S. Bureau of Reclamation (Reclamation) implemented actions to address limiting factors for a number of populations in this DPS. BPA's annual expenditures for habitat projects in subbasins used by Snake River ESUs/DPSs averaged about $5.4 million for the 2001 to 2006 time frame. Reclamation spent over $6 million to provide technical support for habitat projects in this period. Some of these actions provided benefits with immediate survival improvements and some will result in long-term benefits with survival improvements accruing into the future. During this time period the Action Agencies, in coordination with multiple partners:

- Increased streamflow through water acquisitions;
- Addressed entrainment by installing or improving fish screens;
- Increased fish passage and access by removing passage barriers;
- Improved mainstem and channel habitat conditions; and
- Improved water quality and habitat conditions by protecting and enhancing riparian areas.

Additional detail of habitat actions implemented by BPA and Reclamation in the 2000 to 2006 time frame is available in the Action Agencies' Annual Progress Reports located at *www.salmonrecovery.gov*.

Survival improvements estimated to result from tributary habitat actions implemented by the Action Agencies in this time period are shown in Table 7-6. The percentages indicate the incremental survival improvement estimated to accrue by 2006 from the suite of implemented actions. Survival improvements were estimated as described in Appendix C, Attachment C-1.

7.3.1.3 Estuary Habitat Survival Improvements

From 2000 to 2006 the estimated survival benefit for Snake River Steelhead (stream-type life history) associated with the specific actions discussed above is 0.3 percent. Action Agencies implemented multiple habitat actions through 21 estuary habitat projects. Unrestricted fish passage and approximately 3 miles of access to quality habitat was provided via these specific actions:[3]

- Replaced three culverts with full-spanning bridges;
- Provided approximately 10 miles of improved tidal channel connectivity by installing a tide gate retrofit;
- Acquired approximately 473 acres of off-channel and riparian habitats;
- Restored and created 90 acres of marsh and tidal sloughs and approximately 100 acres of riparian forests
- Protected approximately 55 acres of high-quality riparian and floodplain habitat;
- Restored and preserved approximately 154 acres of off-channel habitat;
- Protected 80 acres of high-value off-channel forested wetland habitat;
- Restored approximately 96 acres of tidal wetlands habitat by replacing undersized culvert that limited fish access;

[3] A more thorough report detailing this evaluation process is: *Estimated Benefits of Federal Habitat Projects in the Lower Columbia River and Estuary* (PC Trask & Associates 2007), which is included in Appendix D to this document.

- Conserved 155 acres of forested riparian and upland habitat;
- Provided partial tidal channel reconnection by tide gate retrofit (acreage unknown at this time);
- Provided integrated pest management (purple loosestrife);
- Reconnected and restored 183 acres of historical floodplain by dike removal;
- Restored 25 acres of historical floodplain by breaching a dike;
- Provided fish passage access to 6 miles of stream habitat by removal of two culverts and replacement with bridges;
- Restored 310 acres of native hardwood riparian forest, 200 acres of seasonally wet slough, and 155 acres of degraded riparian habitats; increased circulation in approximately 92 acres of backwater and side-channel habitat by tide gate retrofit;
- Improved embayment circulation for 335-plus acres of marsh/swamp and shallow-water and flats habitat; and
- Preserved 35 acres of historical wetland habitat.

7.3.1.4 Predation Management Survival Improvements

Avian Predation

The estimated survival change for Snake River Steelhead from the baseline to current condition is -0.3 percent. This reflects a reduction in survival from the base to current condition, because the tern population was increasing over the base period. Averaging tern consumption of juvenile salmonids across the 20-year base period downplays the actual change in survival that resulted from relocating terns from Rice Island to East Sand Island in 1999. In 1999 tern consumption of juvenile salmonids was at its peak with an estimated 13,790,000 smolts consumed, compared to 8,210,000 in 2000 after relocation.

Piscivorous Predation

The ongoing Northern Pikeminnow Management Program (NPMP) has been responsible for reducing predation related juvenile salmonid mortality since 1990. The improvement in lifecycle survival attributed to the NPMP is estimated at 2 percent for migrating juvenile salmonids (Friesen and Ward 1999). The northern pikeminnow has been responsible for approximately 8 percent predation-related mortality of juvenile salmonid migrants in the Columbia River Basin in the absence of the NPMP (2000 FCRPS BiOp at 9-106). The ongoing NPMP is already accounted for in the estimation of survival improvements modeled within the reservoir mortality life stage. This is because the modeling estimates are calibrated to empirical reach survival estimates that included the ongoing program.

Hatchery Management Survival Improvements

From 2000 to 2006 as required by the 2000 BiOp Reasonable and Prudent Alternative, BPA funded the development of Hatchery Genetic Management Plans (HGMPs) for all Federally funded hatchery programs in this DPS. BPA also funded the Safety-Net Artificial Propagation Program planning process to identify any additional steelhead populations at high risk of extinction that would benefit from implementation of a safety net hatchery program. No survival improvements from these planning processes are estimated for the 2000 to 2006 time period, though low benefits are expected as NMFS uses the HGMPs in its hatchery program ESA Section 7 consultations.

7.3.2 Current Status Survival Gaps

Over the current period (2000 to 2006) the Action Agencies implemented multiple actions to improve fish survival relative to the base period prior to 2000. The remaining needed lifecycle survival improvements are summarized in Table 7-7.

Table 7-7. Current Status: Adjusted Gaps after Base-to-Current Adjustment

MPG	Population	Adjusted 20-year R/S Gap	Adjusted 12-year λ Gap	Adjusted Long-term Trend Gap
Grande Ronde	Average A-run population	0.75	0.70	0.90
	Average B-run population	1.11	0.91	1.09
	Upper mainstem (A)	0.93	1.01	0.97
	Joseph Cr. (A)	0.73	0.93	0.85
	Wallowa R. (A)	0.72	N/A	N/A
All other MPGs	All other populations	N/A	N/A	N/A

Notes:
1/ Gaps are expressed as multipliers. For example, a 1.10 gap indicates a 10 percent improvement is necessary to close gap. If gap is ≤ 1.0, no further improvement is necessary to close gap.

7.3.3 Prospective Status Analysis

As noted above, the prospective status is the projected status of the population based on adjustment of the survival metrics for expected improvements associated with the Proposed RPA. As was the case for the base-to-current adjustment, the improvements for the current-to-prospective are divided into the categories of those expected from changes in hydropower operations and configuration, changes in tributary habitat conditions attributable to actions implemented in the periods 2007 to 2009 and 2010 to 2017, changes in estuarine habitat, reduced impacts of avian predation, and improved hatchery operations.

Over this period the Action Agencies implemented and will continue to implement multiple actions to improve fish survival. The percentage improvements in lifecycle survival used in the current-to-prospective adjustments for Snake River Steelhead populations are summarized in Table 7-8. Actions are described in summary below:

7.3.3.1 Hydropower Survival Improvements

The percentage change in lifecycle survival attributable to the proposed hydropower operation was estimated based on the difference between the estimated survival under the current operation (defined as the period 1999 to 2005) and estimated survival under the improved conditions. A detailed description of the methods used to generate these estimates can be found in Appendix B; these methods included the use of multiple data sources and the Comprehensive Fish Passage (COMPASS) model, and represent the "best estimates" of NMFS (see COMPASS tables in Appendix B). The configuration and operational improvement actions that contribute to these survival changes are organized into strategies.

Specific actions contained within these strategies are listed in the Hydrosystem Proposed Action Summary. Not all of these specific actions apply to this DPS, as some specific actions are aimed at benefiting Snake River stocks. These strategies include:

1. Operate the FCRPS to more closely approximate the shape of the natural hydrograph and to improve juvenile and adult fish survival;

Table 7-8. Estimated Improvements in Survival Used in the Current-to-Prospective Adjustment

MPG	Population.	Hydro	2007-17 Habitat	Habitat (est.)	Avian pred.	P.minnow Pred.	Hatchery	Harvest
Lower Snake River	Tucannon	-11.9%	5.0%	5.7%	3.4%	1.0%		
	Asotin	-11.9%	4.0%	5.7%	3.4%	1.0%		
Imnaha River	Imnaha	-11.9%		5.7%	3.4%	1.0%		
Grande Ronde	Upper Mainstem	-11.9%	4.0%	5.7%	3.4%	1.0%		
	Lower mainstem	-11.9%	1.0%	5.7%	3.4%	1.0%		
	Joseph Cr.	-11.9%	4.0%	5.7%	3.4%	1.0%		
	Wallowa R.	-11.9%	1.0%	5.7%	3.4%	1.0%		
Clearwater River	Lower mainstem	-11.9%		5.7%	3.4%	1.0%		
	Lolo Cr.	-11.9%	8.0%	5.7%	3.4%	1.0%		
	Lochsa R.	-11.9%	17.0%	5.7%	3.4%	1.0%		
	Selway R.	-11.9%	1.0%	5.7%	3.4%	1.0%		
	South Fork	-11.9%	14.0%	5.7%	3.4%	1.0%		
	North Fork (ext.)	-11.9%			3.4%	1.0%		
Salmon River	Little Salmon/Rapid	-11.9%		5.7%	3.4%	1.0%		
	Chamberlain Cr.	-11.9%		5.7%	3.4%	1.0%		
	Secesh R.	-11.9%	6.0%	5.7%	3.4%	1.0%		
	S. Fork Salmon	-11.9%	1.0%	5.7%	3.4%	1.0%		
	Panther Cr.	-11.9%		5.7%	3.4%	1.0%		
	Lower M.F. Tribs	-11.9%	7.0%	5.7%	3.4%	1.0%		
	Upper M.F. Tribs	-11.9%		5.7%	3.4%	1.0%		
	N. Fork	-11.9%		5.7%	3.4%	1.0%		
	Lemhi R.	-11.9%	3.0%	5.7%	3.4%	1.0%		
	Pahsimeroi R.	-11.9%	9.0%	5.7%	3.4%	1.0%		
	E. Fork Salmon	-11.9%	2.0%	5.7%	3.4%	1.0%		
	Upper Mainstem	-11.9%	6.0%	5.7%	3.4%	1.0%		

2. Modify Columbia and Snake river dams to facilitate safe passage;
3. Implement operational improvements at Columbia and Snake river dams; and
4. Operate and maintain juvenile and adult fish passage facilities.

Changes in the timing of upper Snake River flow augmentation, as addressed in Reclamation's Upper Snake River Biological Assessment (BA), are also expected to improve conditions for survival.

For the 25 Snake River Steelhead populations the change was a uniform 12 percent reduction in smolt to adult returns. This decrease in survival results from changes in transport operation. Currently the biological information suggests that reducing transport numbers will reduce lifecycle survival of this DPS. The strategy for changing transport operations is based on balancing the needs for other ESUs that have exhibited a different response to transport such as Snake River Spring/Summer Chinook Salmon. Adaptive management will be informed with research, monitoring, and evaluation to further refine our transportation or in-river operation during the course of the BiOp.

The Action Agencies are continuing to evaluate additional changes to the Proposed RPA to assist in improving this DPS. Using COMPASS modeling, different juvenile protocols are being evaluated that will improved the survival of this DPS while minimizing the effects on Snake River Spring/Summer Chinook salmon. The Action Agencies are continuing to evaluate actions such as nutrient supplementation, kelt reconditioning, and hatchery broodstock changes to determine if further improvements in survival can be made.

7.3.3.2 Tributary Habitat Survival Improvements

Table 7-6 displays estimated population level survival improvement percentages expected to result from Action Agency implementation of actions to address limiting factors in the tributary areas used by this DPS. The survival improvements identified represent an increase in Action Agency tributary habitat effort compared to efforts under the 2000 and 2004 FCRPS BiOps. Survival improvements were estimated as described in Appendix C, Attachment C-1.

2007 to 2017. BPA will fund and Reclamation will provide technical assistance for projects that implement actions to address key limiting factors for this DPS. BPA will fund projects primarily through its Fish and Wildlife Program; Reclamation will provide technical assistance through annual Congressional appropriations. The Action Agencies will work with multiple parties for the successful implementation of these actions.

Initial Actions and Action Expansion. Consistent with its 2007 – 2009 Fish and Wildlife Program funding decision, BPA will fund implementation of 26 projects in the Asotin, Clearwater, Grande Ronde, Imnaha, Salmon, and Tucannon subbasins. BPA has also dedicated 70 percent of the Columbia Basin Water Transactions Program (CBWTP) $5 million annual budget to secure water acquisitions and riparian easements for anadromous fish, including populations of Snake River Steelhead. For this time period, the average annual planned budget (based on the BPA Final Decision letter) for the 26 projects is approximately $9.3 million (not including the CBWTP).

Based on biological needs identified in the recent lifecycle biological analyses and input from the Remand Collaboration Process, BPA will also fund a suite of further actions beyond those identified in the 2007 - 2009 Fish and Wildlife Program decision for implementation beginning in 2008 and 2009 (see Table 4-b in Attachment B.2.2-2 to Appendix B of the FCRPS BA document).

BPA will fund projects to implement new actions that:

- Increase instream flows;
- Remove passage barriers;
- Improve fish passage structures;
- Install fish screens;
- Increase channel complexity;
- Protect and enhance riparian habitat, and
- Improve water quality.

Reclamation will provide technical assistance for habitat projects in the Grande Ronde and Upper Salmon subbasins.

Future implementation. BPA will expand the level of effort and increase funding above the 2007 to 2009 time period in priority population areas. Project funding decisions will be based on prioritized biological criteria and consistent with recovery plans. Reclamation will continue to provide technical assistance where appropriate with funding consistent with its Congressional funding authorizations.

Further detail about Reclamation's actions is available in Table 5 in Attachment B.2.2-2 to Appendix B in the FCRPS BA document; project-level detail of the BPA-funded projects is available in Table 3-a in Attachment B.2.2-2.

7.3.3.3 Estuary Habitat Survival Improvements

2007 to 2009. The estimated survival benefit for Snake River Steelhead (stream-type life history) associated with the specific actions discussed below is 1.4 percent. The Action Agencies' estimated benefit for 2007 is based on actions that are or will be underway in the very near-term. For 2008 and 2009 the estimated benefit is based on the increased funding level described in the BA.[4] Action agencies are or will be implementing multiple habitat actions through approximately 35 estuary habitat projects. Specific estuary habitat actions:

- Restore partial tidal influence and access to several acres (exact amount unknown at this time) by a tide gate retrofit;
- Improve hydrologic flushing and salmonid access to a lake (Sturgeon Lake is approximately 3,200 acres);
- Acquire and protect 40 acres of critical floodplain habitat and 40 acres of riparian forest restoration; install six to eight engineered log-jams that will help to slow flood flows, reduce erosion, contribute to sediment storage, enhance fish habitat, and contribute wood into the project area; acquire and restore floodplain connectivity to 380 acres of off-channel rearing habitat for juveniles;
- Install fish-friendly tide gates to increase tidal flushing and fisheries access to approximately 110 acres;
- Complete riparian planting of up to 210 acres;
- Re-establish hydrologic connectivity to reclaim and improve floodplain wetland functions, increase off-channel rearing and refuge habitat on 5 acres, plant native vegetation along shoreline and reconstruct slough channels on 2.5 acres of annually inundated off-channel habitat; as part of a long-term 1,500-acre restoration effort: breaching a dike and re-establishing flow to portion of original channel, planting vegetation on 50 acres, removing invasive weeds on 180 acres, planting wetland scrub shrub on 45 acres, and controlling and removing invasive wetland plants on 45 acres;
- Retrofit a tide gate (acreage unknown at this time);
- Protect and restore approximately 5 to 10 acres of emergent wetland and riparian forest habitats;
- Reconnect 45 acres of floodplain by tide gate removal;
- Acquire 45 acres of floodplain with future dike removal;
- Reconnect 50 acres of floodplain;
- Acquire 320 acres of tidelands and 119 acres of riparian/upland forest; and
- Restore 30 acres of riparian habitat.

There will be approximately 15 to 20 additional projects and associated actions similar to actions listed above that are undergoing scoping and sponsor development (the number of projects and associated actions is based on the increased funding level described in the FCRPS BA).

[4] A more thorough report detailing this evaluation process is: *Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary* (PC Trask & Associates 2007), which is included in Appendix D to this document.

2010 to 2017. The survival benefit for Snake River Steelhead (stream-type life history) associated with these actions is 4.3 percent. The Action Agencies' estimated benefits for 2010 to 2017 are based on continuing the same level of effort as 2007 to 2009. However, the level of effort in this time period may increase, depending on the outcome of a General Investigation study of Ecosystem Restoration opportunities, depending on Congressional appropriations, future funding scenarios, and results of actions.

Specific projects have yet to be identified. Actions for this period will be similar in nature to actions implemented in previous periods discussed above. Actions will include protection and restoration of riparian areas, protection of remaining high-quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, and reduction of noxious weeds, among others.

7.3.3.4 Predation Management Survival Improvements

Avian Predation

The estimated relative current to future survival benefit attributed to Snake River Steelhead is 3.4 percent, and this benefit is carried out to 2017 and beyond. This improvement is expected to result through the reduction in estuary tern nesting habitat, and subsequent relocation of terns outside the Columbia River Basin. Although the base to current shows a reduction in survival, the overall benefit (base to future) is positive.

Piscivorous Predation

The percentage improvement in lifecycle survival attributable to the proposed continuation of the increase in incentives in the NPMP and resultant marginal increase in observed exploitation rate is estimated at 1 percent total from 2007 to 2017. This estimate was derived based on the difference between the estimated benefits from the base NPMP (defined as the period 1990 to 2003) and estimated survival benefits under the increased incentive program (defined as the period of 2004 to present). This rate would generally apply to all juvenile salmonids.

7.3.3.5 Hatchery Management Survival Improvement

2007 to 2017. BPA will continue to fund the ongoing, small-scale program trapping locally returning steelhead in the East Fork Salmon River for a local Broodstock Supplementation Program. This program provides a medium level of benefits for abundance, productivity, and genetic diversity for this DPS.

7.3.4 Prospective Survival Status

Comprehensive analyses of the changes in lifecycle survival resulting from the proposed FCRPS and Upper Snake River actions and analysis of how they will change the survival metrics are summarized in Table 7-9. The analyses indicate that the only A-run population that requires additional improvement in survival is the Upper Mainstem population of the Grande Ronde MPG, where a 5 percent improvement remains to meet the survival criteria for λ and long-term trend. All other A-run populations are expected to meet all criteria.

Analysis for average B-run population suggests that additional improvements in survival may be needed to meet the survival criteria for both 20-year R/S and long-term trend. As noted, a lack of information prevents a gap analysis for most individual populations in this DPS. Generally, it appears that A-run populations will fare better than B-run populations after considering the effects of the Proposed RPA. Of the 24 extant populations in this DPS, 16 are believed to be A-run, seven are believed to be B-run and one is thought to be a mixed A- and B-run population.

Table 7-9. Estimated Future Status With Proposed RPA

MPG	Population	Estimated Future R/S	Estimated Future λ	Estimated Future Trend
Grande Ronde	Average A-run population	1.30	1.08	1.02
	Average B-run population	0.88	1.01	0.97
	Upper mainstem (A)	1.05	0.99	1.00
	Joseph Cr. (A)	1.39	1.02	1.04
	Wallowa R. (A)	1. 37	N/A	N/A
All other MPGs	All other populations	N/A	N/A	N/A

Notes:
Future productivity values represent estimates of future R/S, lambda, and trend after consideration of the effects of the Proposed RPA. A value >1.0 indicates a growing population; a value <1.0 indicates a population in decline. Future R/S, lambda, and trend estimates for average population profiles do not include benefits for tributary habitat improvements.

7.3.5 Remand Conceptual Framework Analysis

The FCRPS BiOp Remand's Collaboration Process among the sovereigns developed a Conceptual Framework approach intended to help the Action Agencies implement their Proposed RPA. The Framework approach attempted to estimate the relative magnitude of mortality factors affecting Interior Columbia River Basin salmonid populations. That assessment was intended to help define the FCRPS's "relative expectation…for recovery" (FCRPS 2006). The collaboration's Framework working group developed high and low mortality estimates for all sources of mortality, including the FCRPS.

The collaboration's Policy Working Group has not determined where in that range the Action Agencies' Proposed RPA should be assessed. The range of "gaps" that the Framework approach would expect the FCRPS to fill was reviewed and the Action Agencies assessed whether the total survival improvements estimated in this biological analysis would "fill" those gaps. For the purposes of this comparison, the Interior Columbia Basin TRT gaps were used for "recent" ocean and "base hydro" conditions (corresponding to the base period used for R/S productivity estimation), and the TRT's 5 percent risk level.

The Conceptual Framework was intended, among other things, to "provide a clear and complementary link to ongoing recovery planning efforts" (FCRPS 2006). It can be seen as the Policy Working Group's view of an appropriate level of effort for the FCRPS in the context of ongoing regional recovery planning. As such, it provides another "metric" for use in considering the impacts of the Proposed RPA on a listed species' prospects for recovery.

Since the Framework's estimate of relative impact varies from population to population, and since the benefits of tributary habitat projects are unevenly distributed, we have displayed the Framework results by population in Table 7-10.

Table 7-10. Recovery Gap Calculations from the Conceptual Framework

Population	TRT Gap	FCRPS Relative Impact (high)	FCRPS Relative Impact (low)	TRT Gap (high hydro)	TRT Gap (low hydro)	Total Survival Change	Remaining Framework Gap (high)	Remaining Framework Gap (low)
Average A-run	1.52	0.71	0.42	1.35	1.19	#N/A	#N/A	#N/A
Average B-run	1.65	0.80	0.48	1.43	1.23	#N/A	#N/A	#N/A
Upper Mainstem (A)	0.48	0.73	0.29	0.59	0.81	1.05	0.56	0.77
Joseph Cr. (A)	0.41	0.73	0.43	0.52	0.68	1.09	0.48	0.62

Notes:
1/ Interior Columbia Basin TRT gaps are expressed as multipliers. Gaps are for 5 percent risk, recent ocean/base hydro conditions. A "remaining" gap value <1.0 indicates that no further improvement is necessary. Total survival changes combine all estimated survival improvements for the base-to-current and current-to-prospective adjustment. Final Framework gaps not calculated due to inability to include habitat and other improvements for Interior Columbia Basin TRT average population profiles.

7.4 ADDITIONAL ACTIONS TO BENEFIT THE DPS

7.4.1 Other Reasonably Certain to Occur Actions[5]

In the State of Idaho, two subbasins have benefited from completed and on-going habitat improvements. In the Clearwater subbasin, populations of the Snake River Steelhead DPS have benefited from 28 projects that have provided over 74,000 acres of habitat improvements. These habitat improvements have occurred in both riparian and upland areas. Populations of both Snake River Steelhead and Chinook Salmon have benefited from 52 projects providing over 2,000 acres of similar habitat improvements.

7.4.2 Other Future Federal Actions with Completed Section 7 Consultations

NMFS searched its Public Consultation Tracking Database (PCTS) for Federal actions that had completed Section 7 consultation since November 30, 2004 that could be used to adjust the status of the populations between the base and current periods. Results for each MPG/population are described below.[6]

7.4.2.1 MPG: Lower Snake

Both of the populations within this MPG were affected by several projects, as described below.

Tucannon River

The U.S. Forest Service (USFS) consulted on one emergency fire action and two fire salvage/timber sale projects in the Upper Tucannon watershed. The Corps proposed maintenance dredging of a barge slip at the mouth of the Snake River.

[5] Many of the actions listed above have a cost-share component with a variety of other Federal funding sources and therefore may be properly described as contributing to the status of the environmental baseline rather than cumulative effects.
[6] This information does not include any habitat conservation or restoration projects funded by BPA under NMFS' programmatic biological opinion for the Habitat Improvement Program (HIP). The effects of those projects are already taken into account in the base-to-current adjustment for species/population status.

Asotin Creek

The BPA consulted on replacing a wood pole transmission line. The Federal Highway Administration (FHWA)/Washington State Department of Transportation (WSDOT) consulted on a project to replace a bridge, removing a channel constriction and thereby increase safe passage.

7.4.2.2 MPG: Grande Ronde River

No Section 7 consultations were completed in the subject timeframe that would affect the Wallowa River population. Projects that affected other populations in this MPG are described below.

Grande Ronde Lower Mainstem

The USFS consulted on two projects in the Grande Ronde River—Mud Creek watershed, construction of an off-highway vehicle (OHV) trail system and a fire salvage timber sale. The USFS also consulted on two habitat restoration projects that were designed to improve conditions in the Grande Ronde River—Mud Creek, Chesnimnus Creek and Upper and Lower Joseph Creek watersheds. In one project, the USFS proposed to plant vegetation in Riparian Habitat Conservation Areas, develop offsite livestock watering facilities, replace 10 culverts identified as passage barriers or unable to withstand the 100-year flood, maintain roads, harden four vehicle crossings; harden or otherwise protect livestock watering gaps, repair or modify 36 instream structures, and remove bridge abutments. These actions were expected to reduce sediment loads, improve temperatures, riparian conditions, improve passage conditions, and increase habitat complexity. In the second project, USFS would restore riparian habitat associated with a timber sale.

The Corps consulted on construction of a new floating dock at the Port of Clarkston on the lower Snake River.

Joseph Creek

The USFS consulted on a fuels reduction project in the Chesnimnus Creek watershed and a rangeland analysis for Joseph Creek. The USFS also consulted on two projects in the Chesnimnus Creek watershed that included habitat restoration elements: 2006 Peavine Noxious Weed Treatment and 2007 Peavine Trail Conservation.

Grande Ronde Upper Mainstem

The USFS proposed three fuels reduction projects in the Upper and Lower Catherine Creek watersheds. The USFS also proposed three grazing allotments and a rangeland analysis in the Upper Grande Ronde and Upper Grande Ronde-Five Points Creek watersheds. The USFS consulted on a habitat restoration project in the Meadow Creek and Grande Ronde—Beaver Creek watersheds that would improve 200 acres of riparian habitat and maintain cattle enclosures.

The Corps consulted on a culvert replacement project for Oregon Highway 82 at Pierce Slough (Grande Ronde—Five Points Creek watershed). The project was expected to improve fish passage, riparian vegetation, and water quality. BPA proposed the End Creek Habitat Restoration Project which was designed to increase channel length and habitat diversity and complexity; reduce peak summer temperatures and streambank erosion and sediment delivery to the streams; and improve wetland channel morphology and function in End, South Fork Willow, McDonald, and several small spring-fed creeks.

7.4.2.3 MPG: Clearwater River

NMFS did not complete any Section 7 consultations in the subject timeframe that would affect the North Fork Clearwater, Lolo Creek, or Lochsa River populations. Projects that affected other populations in this MPG are described below.

Lower Mainstem Clearwater

The USFS consulted on two projects, the Little Boulder Campground Hazard Tree Removal Project in the Lower Clearwater watershed and the Cottonwood Creek Bridge Repair project. The USFS also consulted on a stream crossing rehabilitation project on Webb Creek in the Lapwai Creek watershed that was designed to provide offsite water for cattle, reducing instream temperatures and improving the condition of spawning gravels.

The FHWA/Idaho Department of Transportation (IDT) consulted on a road construction project in Lewiston, Idaho.

Selway River

The USFS consulted on a project to replace a bridge over Lookout Creek (White Cap Creek watershed).

South Fork Clearwater River

The USFS consulted on one fire salvage and timber sale project in the Red River Watershed. The USFS also proposed two fuels reduction projects that affected the Upper South Fork Clearwater River, Crooked River, and Newsome Creek watersheds, which included construction of instream rock and log structures. These were designed to improve instream temperatures and forage for juvenile rearing habitat and increase the number of resting pools for adults. They also included rehabilitation of a portion of Newsome Creek and its floodplain area in the Johns Creek watershed, dredge-mined in 1937 to 1940. This project was designed to reduce sediment delivery from roads, removed fish passage impediments and culverts, and treat weeds. On the Red River in the Middle South Fork Clearwater River watershed, the USFS decommissioned 13 miles, improved 20 miles, and abandoned 3 miles of roads; restored soil on 8.5 acres of skid trails and landings; replaced one and removed eight other undersized culverts; and treated noxious weeds.

The Corps consulted on providing an in-water work permit for the Nez Perce County Fishing Pier in the Upper Clearwater River.

7.4.2.4 MPG: Salmon River

NMFS did not complete any Section 7 consultations in the subject timeframe that would affect the South Fork Salmon River; Secesh River; Big, Camas, and Loon Creeks; and Upper Mainstem Middle Fork Salmon River populations. Projects that affected other populations in this MPG are described below.

Little Salmon and Rapid Rivers

The USFS consulted on construction of the Rapid River Trailhead in the Upper Little Salmon River watershed. The USFS also proposed to install a fishway at an irrigation diversion dam, which would restore fish access to approximately 3 miles of Squaw Creek in the Upper Little Salmon River watershed. The project would also consolidate water rights, achieving a net increase in stream flow of 4 cfs, enough to support a low temperature thermal refuge for the Little Salmon River population.

Reclamation consulted on a culvert replacement on Squaw Creek in the Little Salmon River watershed that improved access to 4 miles of habitat in Squaw Creek and improved habitat complexity in Squaw and Papoose creeks.

Chamberlain Creek

The USFS consulted on a timber salvage project in the Lower South Fork Salmon River watershed and a bank protection (rip-rap) project in the Rock Creek watershed.

Panther Creek

The Corps consulted on a culvert and wetlands fill project in Upper Panther Creek, which would result in the conversion of irrigated agricultural land to low-density residential housing. The project was expected to increase safe passage for fish in upper Panther Creek and in the mainstem Salmon River by eliminating rapid drawdowns of irrigation ditches when water was withdrawn for irrigation. The National Resource Conservation Service proposed to rehabilitate stream habitat in Iron Creek (Upper Panther Creek watershed). The BLM consulted on watershed rehabilitation activities associate with managing waste from the abandoned Twin Peaks Mine (Lower Panther Creek).

North Fork Salmon River

The USFS consulted on a culvert replacement project in the North Fork Salmon River, designed to restore both access and the hydraulic processes that transport sediment and large wood.

Lemhi

The FHWA/IDT consulted on the construction of a pedestrian bridge. The USFS consulted on a bank stabilization project at Bog Creek Crossing (Upper Lemhi River watershed) and two projects designed to rehabilitate stream channels and their associated riparian zones in the Middle Salmon River—Carmen Creek, Middle Salmon River—Indian Creek, and Hayden Creek watersheds. NMFS consulted with itself on providing funds to screen a water diversion on Kenney Creek (Eighteenmile Creek watershed) and a culvert replacement in Twin Creek (North Fork Salmon River watershed). The latter project was designed to restore access and the hydraulic processes that transport sediment and large woody debris.

Pahsimeroi River

The Corps consulted on a project to prevent a hatchery facility from contaminating the naturally spawning population in the upper Pahsimeroi River (disease). The BLM proposed to rehabilitate Fall Creek and its associated riparian zone (Middle Pahsimeroi River watershed). NMFS and the U.S. Fish and Wildlife Service (USFWS) each consulted on projects intended to remove passage barriers by modifying water diversions Lower Pahsimeroi River watershed.

East Fork Salmon River

The USFS consulted on a road construction and maintenance project in the Lower East Fork Salmon River watershed, and the FHWA proposed a bridge repair/construction project over the Salmon River (Challis Creek watershed).

7.4.2.5 MPG: Imnaha River

Imnaha River

The USFS consulted on an emergency fire management project in the Salmon River—Pole Creek and Salmon River—Redfish Lake Creek watersheds, a whitebark pine treatment project in the Salmon River—Pole Creek and Redfish Lake Creek watersheds, a harvest/vegetation management project in the Upper Imnaha River watershed, and a bridge replacement project in the Middle Imnaha River. The USFS also consulted on granting a special use permit to private energy companies for operating and maintaining transmission lines in the Upper Imnaha River watershed, which included replacing two bridges (relieving channel constrictions) and restoring local floodplain connectivity. The USFS also consulted on a culvert replacement project, also in the Upper Imnaha watershed, designed to restore access to 3.5 miles of rearing habitat.

7.5 OBSERVATIONS

Generally, it appears that A-run steelhead populations in this DPS will be at a low risk of extinction, after considering recently implemented actions and the likely effects of the Proposed RPA. Data are too poor to allow extinction probabilities to be modeled for B-run populations. Likewise, metrics indicative of recovery are expected to be positive for most A-run populations and less so for B-run populations, though again the lack of population-specific information makes this assessment highly uncertain.

Given the high degree of uncertainty regarding the status of this DPS – particularly the B-run populations – a robust research and monitoring effort in order to better understand status and limiting factors for these populations, combined with targeted improvements in tributary habitat, seems the best course.

7.6 CONCLUSION

It is not possible to fully evaluate the effects of the proposed action for most individual populations in this DPS. While the DPS as a whole is likely to survive based on the preponderance of A-run populations, the likelihood appears to be that B-run populations will continue to decline unless mortality is further reduced through additional management actions in one or all of the four Hs (hydro, habitat, harvest, and hatcheries). It is not feasible to compare the Conceptual Framework analytic approach for this DPS due to lack of population-specific information. Given the high degree of uncertainty regarding the status of this DPS – particularly the B-run populations – a robust research and monitoring effort in order to better understand status and limiting factors for these populations, combined with targeted improvements in tributary habitat seems to best course in the face of significant uncertainty regarding this DPS. The Action Agencies have worked with the States and Tribes through the Remand Collaboration Process and other forums to identify actions intended to address the needs of listed salmon and steelhead as determined by quantitative and qualitative biological analyses. Acknowledging that NMFS will review the actions and the effects analyses contained herein to make a final jeopardy determination in the forthcoming biological opinions, the Action Agencies are making the following conclusions. Based on our assessment of the FCRPS and Upper Snake River actions and analysis of effects, considering the present and future human and natural context, the Action Agencies conclude that the net effects of the proposed actions, including the existence and operations of the dams with the proposed mitigation, meet or exceed the objectives of doing no harm and contributing to recovery with respect to this DPS.

Chapter 8
Upper Columbia River Spring Chinook Salmon Evolutionarily Significant Unit

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

8.1 INTRODUCTION

This chapter briefly summarizes the current biological status of the Upper Columbia River Spring Chinook Salmon Evolutionarily Significant Unit (ESU) related to extinction risk and the effects of the Federal Columbia River Power System (FCRPS) Proposed Reasonable and Prudent Alternative (RPA) in the context of recovery plan actions. First, it summarizes current status information including key limiting factors and extinction risks. Second, it includes a biological assessment of the survival effects of recent and planned actions on current and prospective conditions, respectively. Finally, it identifies additional actions to benefit the ESU. Summary data for the ESU are presented in Table 8-1. The geographic extent of the ESU is shown in Figure 8-1.

This chapter is organized into five sections. Section 8.1 provides an overview of the ESU and the factors limiting its viability. Section 8.2 summarizes population-level status information during the 20-year base period used for this analysis. Section 8.3 provides the analysis of the current status and provides estimates of the "gaps," or needed lifecycle survival improvements for individual populations to meet certain biological criteria. It summarizes the improvements made to the hydropower (hydro) and in other Hs (habitat, hatcheries, and harvest) since about 2000 and estimates the salmonid survival benefits associated with those improvements. Section 8.4 describes the actions proposed to be implemented into the future, and Section 8.5 estimates their effects on salmonid survival when aggregated with the environmental baseline and cumulative effects.

Table 8-1. ESU Description and Major Population Groups (MPGs)

ESU Description[1/]	
Endangered	Listed under Endangered Species Act (ESA) in 1999; reaffirmed in 2005
Hatchery programs included in ESU	Twisp, Chewuch, Methow composite, Winthrop, Chiwawa, White River
Major Population Groups (Extant)	**Extant Natural Populations**
Eastern Cascades	Entiat River Methow River Wenatchee River

Notes:
1/ 70 FR 37160; Interior Columbia Basin Technical Recovery Team (TRT) 2003, 2005

Almost all of the metrics used in this analysis are estimates for individual populations within the ESU. The ESA is concerned with the status of a species' ESU. Individual populations and major population groups (where they exist) obviously contribute to ESU status. However, the status of the ESU is not wholly dependent upon the status of any of the ESU's individual components.

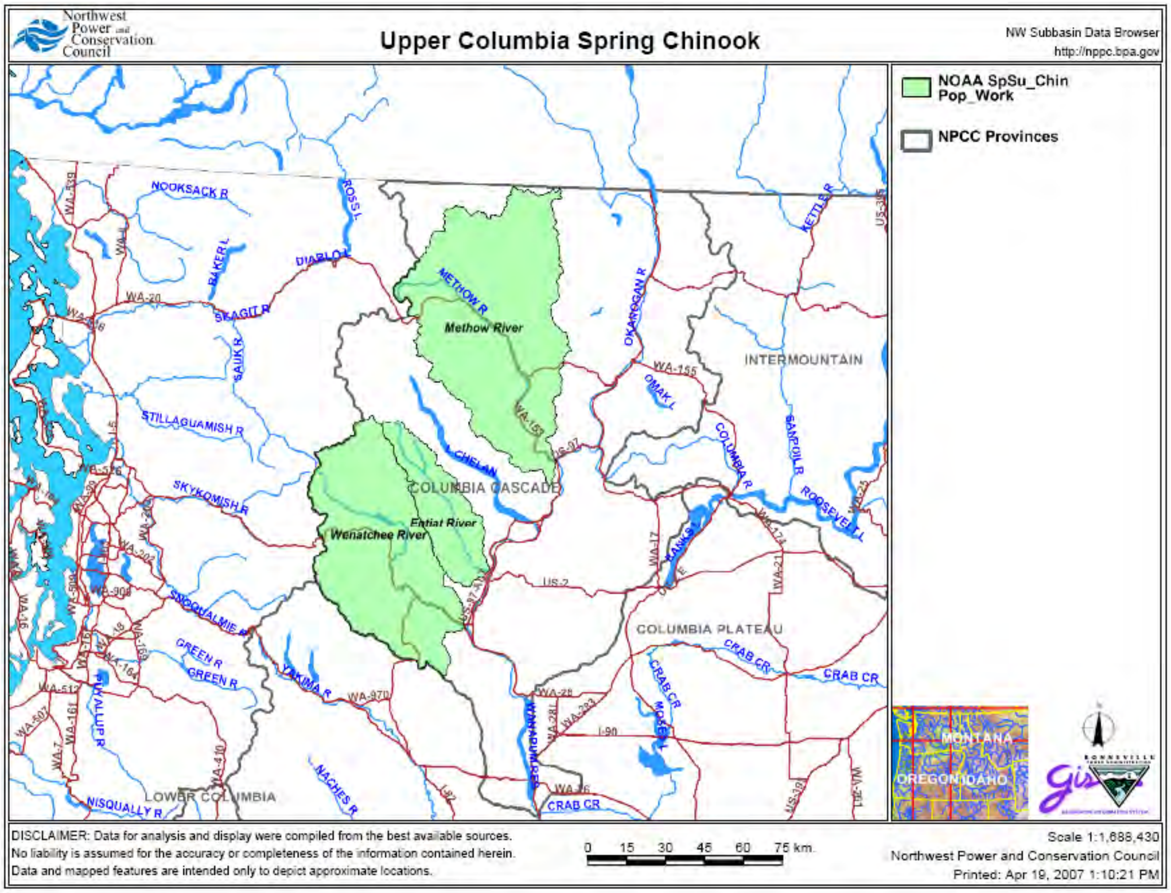

Figure 8-1. Upper Columbia River Spring Chinook Salmon ESU

Upper Columbia River Spring Chinook Salmon spawn and rear in the mainstem Columbia River and its tributaries between Rock Island Dam and Chief Joseph Dam. The primary spawning and rearing habitats are the upper reaches of the watersheds that drain the east slope of the Cascade Mountains. The upriver limit of migration has been Chief Joseph Dam (River Mile 545) since its completion in 1961; prior to that, the upriver limit was Grand Coulee Dam, which was completed in 1941. Both hydroelectric projects were constructed without fish passage facilities and block migration of anadromous fish. The Interior Columbia Basin TRT has identified one major population group (MPG) composed of three extant populations (Wenatchee, Entiat, and Methow rivers) and one extinct population (the Okanogan River). This ESU was first listed as an endangered species on March 24, 1999, and reaffirmed as endangered on June 28, 2005.

Unlike the Snake River Spring/Summer Chinook Salmon ESU, where both the spring- and summer-run fish are considered a single ESU based on a similar stream-type life history, the Upper Columbia River Spring Chinook Salmon ESU includes only the spring-run fish. In the upper Columbia River, the vast majority of the summer-run fish exhibit an ocean-type life history similar to the fall-run Chinook salmon in both the upper Columbia and Snake rivers.

Hatchery facilities located in the geographic area occupied by this ESU include the U. S. Fish and Wildlife Service (USFWS) Leavenworth National Fish Hatchery Complex (which includes the Leavenworth, Winthrop, and Entiat national fish hatcheries), and the Washington Department of Fish and Wildlife (WDFW)-operated Wells and Methow hatcheries (funded by Douglas Public Utility District [PUD]) and Eastbank, Chelan, and Rocky Reach hatcheries and their satellite facilities (funded by Chelan

PUD). Additional hatchery facilities are planned for this area as part of recent Habitat Conservation Plans developed for the operation of Wells, Rocky Reach and Rock Island dams, and under recent settlement agreements for the operation of Wanapum and Priest Rapids dams. The implementation of these programs is under the direction of multi-agency committees that include representatives of WDFW, USFWS, National Marine Fisheries Service (NMFS, also called National Oceanic and Atmospheric Administration [NOAA] Fisheries), Colville Tribes, Yakama Nation, and the Chelan, Douglas, and Grant PUDs.

The contributions of the hatchery program to the production of spring Chinook salmon in this ESU varies by watershed and individual population. Hatchery numbers have increased significantly in recent years. The Interior Columbia Basin TRT estimates the 10-year hatchery fraction of the Wenatchee at about 38 percent, the Entiat at about 31 percent, and the Methow at about 48 percent (Interior Columbia Basin TRT 1994, 2003). The 20-year average hatchery fraction for these populations is 11 percent for the Wenatchee, 14 percent for the Methow, and 15 percent for the Entiat, indicating increased supplementation in recent years. Both the use of non-native broodstock and significant straying has been a problem associated with some of the hatchery programs affecting this ESU. Most of the spring Chinook salmon hatchery programs in the Upper Columbia transitioned to the use of native broodstock in the late 1990s or early 2000s. The Entiat and Leavenworth national fish hatcheries are the exceptions.

Upper Columbia River Spring Chinook Salmon in this ESU are harvested on a sliding scale of 5.5 to 17 percent; the 2000 to 2004 average was 10.7 percent. These harvests levels are negotiated under the Columbia River Fisheries Compact, and include in-river tribal harvest in Zone 6 and the lower Columbia River commercial and sport harvest. Although considered uncertain by some, the rare recovery of tagged spring Chinook salmon in ocean fisheries suggests minimal ocean harvest impact on this ESU.

The Interior Columbia Basin TRT has concluded that the populations in this ESU are at high risk for both abundance and productivity and spatial structure/genetic diversity.

Human impacts and current limiting factors for this ESU come from multiple sources: hydro passage, habitat degradation, hatchery effects, fishery management and harvest decisions, predation, and other sources.

8.1.1 Key Limiting Factors

Salmon and steelhead have been adversely affected over the last century by many activities including human population growth, introduction of exotic species, over fishing, developments of cities and other land uses in the floodplains, water diversions for all purposes, dams, mining, farming, ranching, logging, hatchery production, predation, ocean conditions, loss of habitat, and other causes (Lackey et al. 2006).

Natural mortality of these fish throughout their lifecycle is 90 to 95 percent. NMFS identified juvenile fish passage as the most important area where improvements might be made to benefit this ESU. Juvenile outmigrants from this ESU must pass seven to nine mainstem Columbia River dams (Federal and PUD owned) during their outmigration to the ocean. It is estimated that survival through this life-stage and migration ranges from about 54 to 61 percent. In addition to juvenile passage, NMFS also identified hatchery practices as the second most important limiting factor affecting this ESU. The use of out-of-ESU stocks early in the hatchery programs likely has contributed to declines in this ESU. Summarized below in Table 8-2 are current key limiting factors for this ESU identified by NMFS in the ESU Overviews for the Remand Collaboration (NMFS 2005e).

Table 8-2. Key Limiting Factors

Hydropower	Upper Columbia River Spring Chinook Salmon migrate through 7 to 9 mainstem Columbia River dams as yearlings to reach the ocean. Some of these are federal dams and others are owned and operated by PUDs. Survival rates through these dams range from 92.6 percent at John Day Dam to 95.9-97.4 percent at Wells Dam. According to the Step 4 report, the estimated portion of the human impact attributable to the direct effects of the FCRPS dams (compared to natural river estimates) for each population ranges from 17 to 23 percent. Latent mortality hypotheses, an area of technical differences, would revise this figure to 30 to 35 percent. Hydro impacts include volume, timing, and quality of flows that enter the geographic area, including flows from the Snake River at the toe of Hells Canyon Dam, which are impacted by the operation of U. S. Bureau of Reclamation's (Reclamation's) upper Snake River projects as well as non-Federal irrigation projects in the upper Snake River. Other hydrosystem impacts within the geographic area include the mainstem effects of Reclamation's other projects within the Columbia River Basin and many non-Federal irrigation projects within the Columbia River Basin.
Hatcheries	Continued use of out-of-ESU stocks in the Entiat is a primary limiting factor, and legacy impacts of previous hatchery programs are a factor in the Wenatchee and Methow populations. Habitat has limited natural production potential, and high proportions of hatchery fish increase the risk to the populations because natural selective processes are driven by the hatchery environment rather than the natural environment. The recovery goal contemplates a transition from hatchery to natural fish production as natural fish recover. According to the Step 4 report, the estimated portion of the human impact attributable to hatchery effects for each population ranges from 5 to 9 percent. If latent mortality is included, the range associated with hatchery impacts is 9 to 19 percent.
Habitat	The primary tributary habitat problems vary among the three extant populations in this ESU. Degraded stream channel and riparian habitats, primarily in the mainstem, are a key concern for the Wenatchee. The Entiat River is also characterized by losses in mainstem habitat; sedimentation is a second major concern in upper tributary reaches. The primary concern in the Methow Basin is late summer/winter flow conditions in key rearing areas. Passage barriers, inadequate irrigation screening and channel habitat loss are also concerns. The Okanogan Basin is highly affected by temperature, flow, and sedimentation. High-priority locations include the Methow, lower Entiat, and lower Wenatchee. According to the Step 4 report, the estimated portion of the human impact attributable to combined habitat effects in the tributaries and the estuary for each population ranges from 13 to 23 percent. If latent mortality is included, the range associated with habitat impacts is 26 to 49 percent.
Harvest	The only harvest above Priest Rapids Dam is mark-select for Leavenworth spring Chinook salmon. In the mainstem, current harvest rates average about 8 percent, though harvest rates since the adoption of a new management regime in 2001 have been higher, averaging about 11 percent. The current 3-year in-river harvest agreement allows for harvest between 5.5 percent and 17 percent, depending upon run strength. According to the Step 4 report, the estimated portion of the human impact attributable to combined Tribal and non-Tribal harvest effects for each population ranges from 42 to 1 percent. If latent mortality is included, the range associated with harvest impacts increases to 10 to 16 percent.
Predation	Predation has been noted as a factor limiting fish survival at mainstem reservoirs and in the Columbia estuary.
Estuary	Predation, levels of toxic substances, and habitat conditions in the plume are potential limiting factors.

8.2 BASE STATUS

This section summarizes the average status of this ESU during the base period, which for these populations is a 20-year period beginning in brood year 1979 and ending in brood year 1998. All of the analysis in this paper relies on datasets supplied by the Interior Columbia Basin TRT, which do not include adult return information after 2003. These datasets were relied on, in part, for the sake of consistency with the Interior Columbia Basin TRT analyses.

8.2.1 ESU Abundance and Trend

The geometric mean abundance of natural-origin spring Chinook salmon returning to the Wenatchee, Methow, and Entiat rivers has averaged 226, 205, and 63, respectively, for the most recent 10-year period for which data are available. The 1994 to 1998 geomean abundance for these populations was 190, 129, and 38, respectively. The 1999 to 2003 geomean abundance for these populations was 467, 324, and 103, respectively, indicating a 38 percent improvement in natural-origin spawner abundance for the ESU as a whole between the two periods.

However, longer-term abundance trends of natural-origin fish have shown declines for both the 1980 to 2003 and the 1990 to 2003 periods, with the exception of the Entiat, which showed a slight increase for the most recent period.

Abundance and a rolling 5-year geometric mean of abundance for the ESU compared to the NMFS interim recovery target are shown in Figure 8-2.

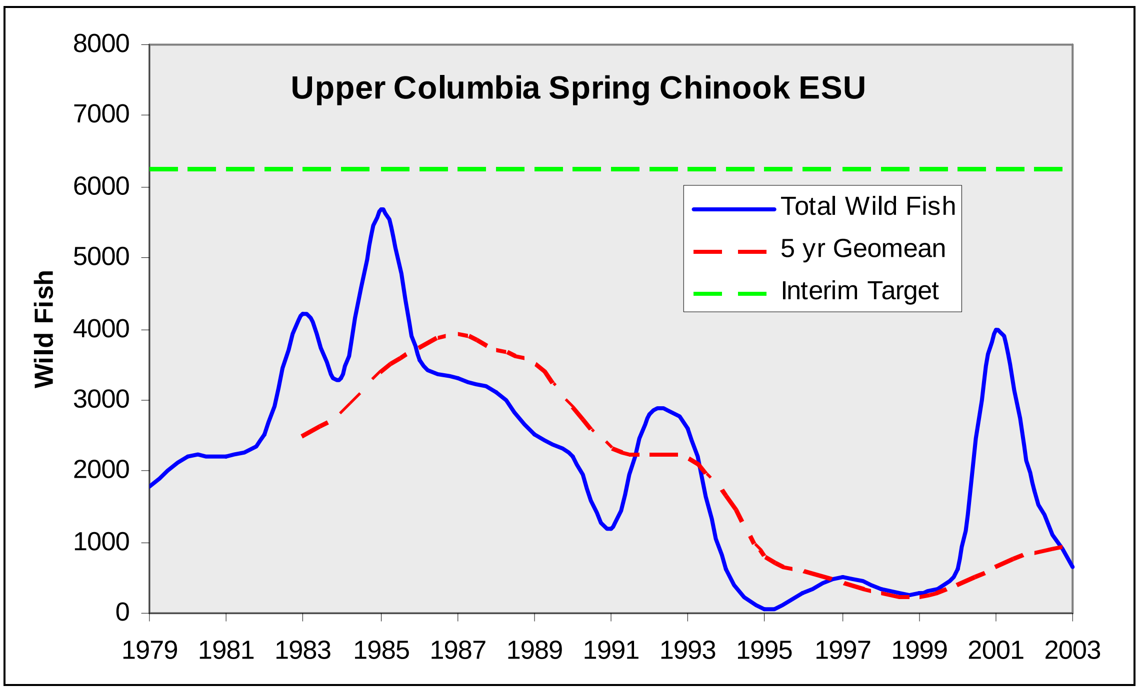

Figure 8-2. Upper Columbia River Spring Chinook Salmon Abundance

8.2.2 Extinction Probabilities, Recruit-per-Spawner Productivity, and Lambda

The productivity and survival metrics for three populations comprising this ESU are summarized in Table 8-3. Extinction probability estimates were developed for populations in this ESU using the Beverton-Holt production function, which was fit to spawner-recruit data from brood years 1978 to the present. The

Table 8-3. Base Status Metrics

Population	20-year R/S	10-year R/S	20-year λ	12-year Λ	1980-current Trend	1990-current Trend	Ext. Risk QET=1	Ext. Risk QET=10	Ext. Risk QET=30	Ext. Risk QET=50
Wenatchee	0.73	0.71	1.01	1.02	0.89	0.98	0.00	0.00	0.01	0.03
Methow	0.74	0.40	1.10	1.08	0.95	0.91	N/A	N/A	N/A	N/A
Entiat	0.72	0.82	0.99	1.03	0.97	1.08	0.00	0.00	0.06	0.17

Notes:
For R/S, lambda, and trend, a value >1.0 indicates a growing population; a value <1.0 indicates a population in decline.
Extinction probabilities are expressed as percentages, e.g., a value of 0.11 indicates an 11 percent risk of extinction within 24 years.

estimated Beverton-Holt function was used to project populations over a 24-year time horizon to estimate extinction probability. Alternative quasi-extinction thresholds (QETs) of 1, 10, 30, and 50 spawners were used in the analysis. In the modeling, extinction was assumed to occur when spawners fell below the QET for 4 years running. Reproductive failure was assumed to occur in any year in which spawner numbers fell below 10, except in the case of QET=1, where reproductive failure was assumed when spawners fell below two.[1]

Productivity, as reflected by estimates of recruits per spawner (R/S) using a 20-year time series of data, is less than 1.0 for all three populations. Lambdas are generally greater than 1.0. A metric of 1.0 reflects no gap. In this analysis, a metric of 1.0 reflects no gap. A number below 1.0 reflects a positive condition, while a number above 1.0 reflects a gap. For example, a gap of 1.2 indicates that 20 percent productivity is needed in the future.

The 24-year extinction probabilities are displayed for the Wenatchee and Entiat populations at QETs of 1, 10, 30, and 50; valid results were not obtained for the Methow population, though an examination of the data suggests that extinction probabilities for the Methow are likely to be similar to those of the other populations in this ESU. At QETs of 1 and 10 the 24-year risk was low; at a QET of 30 it was 1 percent and 6 percent for the Wenatchee and Entiat, respectively; and at a QET of 50 it was 3 percent and 17 percent for these same populations.

Based on these base estimates of survival metrics for the Wenatchee, Methow, and Entiat populations, Table 8-4 summarizes the needed improvements in survival to bring the estimates in line with the proposed survival standard.

Table 8-4. Base Status Gaps

Population	20-year R/S Gap	20-year Λ Gap	Long-term Trend Gap	Ext. Risk Gap QET = 1	Ext. Risk Gap QET = 50
Wenatchee	1.37	0.96	1.69	0.13	0.66
Methow	1.35	0.65	1.26	N/A	N/A
Entiat	1.39	1.05	1.15	0.31	1.43

Notes:
Gaps are expressed as multipliers. For example, a 1.10 gap indicates a 10 percent survival improvement is necessary to close gap. If gap is ≤ 1.0, no further improvement is necessary to close gap.

[1] Reproductive failure is the assumption that zero progeny are produced in any year where spawner numbers fall below the identified threshold.

8.2.3 Spatial Structure and Biological Diversity

Conserving and rebuilding sustainable salmonid populations involves more than meeting abundance and productivity criteria. Accordingly, NMFS has developed a conceptual framework defining a Viable Salmonid Population, or VSP (McElhany et al. 2000). In this framework there is an explicit consideration of four key population characteristic or parameters for evaluating population viability status: abundance, productivity (or population growth rate), biological diversity, and population spatial structure. The reason that certain other parameters, such as habitat characteristics and ecological interactions, were not included among the key parameters is that their effects on populations are implicitly expressed in the four key parameters. Based on the current understanding of population attributes that lead to sustainability, the VSP construct is central to the goal of ESA recovery, and warrants consideration in a jeopardy determination. However, it must also be stressed that the ability to significantly improve either a species' biological diversity or its spatial structure and distribution is limited within the timeframe of the Action Agencies' Proposed RPA.

Spatial Structure – Spatial structure, as the term suggests, refers to the geographic distribution of individuals in a population unit and the processes that generate that distribution. Distributed populations that interact genetically are often referred to as metapopulation. Although the spatial distribution of a population, and thus its metapopulation structure, is influenced by many factors, none are perhaps as important as the quantity, quality, and distribution of habitat. One way to think about the importance or value of a broad geospatial distribution is that a population is less likely to go extinct from a localized catastrophic event or localized environmental perturbations.

Biological Diversity – Biological diversity within and among populations of salmonids is generally considered important for three reasons. First, diversity of life history patterns is associated with a use of a wider array of habitats. Second, diversity protects a species against short-term spatial and temporal changes in the environment. And third, genetic diversity is the so-called raw material for adapting to long-term environmental change. The latter two are often described as nature's way of hedging its bets – a mechanism for dealing with the inevitable fluctuations in environmental conditions – long and short term. With respect to diversity, more is better from an extinction-risk perspective.

The Upper Columbia River Spring Chinook Salmon ESU consists of three extant populations in a single MPG (Wenatchee River, Methow River, and Entiat River). Additional populations, MPGs, and perhaps ESUs were also historically present in the upper mainstem Columbia, but were extirpated from habitats blocked by the construction of Chief Joseph and Grand Coulee dams. Downstream of Chief Joseph Dam, the population or MPG that historically spawned and reared in the Okanogan basin has also been extirpated. Based on their Spatial Structure and Diversity (SSD) analyses and rating, the Interior Columbia Basin TRT assigned all three of the extant Upper Columbia River populations to the high-risk category. This rating is based on the presence of a single remaining MPG containing three populations, all of which have been heavily impacted by hatchery production utilizing out-of-basin broodstock. Although the SSD risk for this ESU will be reduced by current and prospective changes, the degree to which the risk will change is difficult to estimate.

8.3 BIOLOGICAL ANALYSIS OF ACTIONS: RECRUITS-PER-SPAWNER, LAMBDA, AND TRENDS WITH CURRENT AND PROSPECTIVE ADJUSTMENTS

The Base Status is the historical status of the ESU, defined as the status of the population based on the *average* of quantitative survival metrics estimated from a time series of abundance data beginning in about 1980. For the most part, longer-term averages (generally 20 years) were used where they were available. In the biological analysis, this is the starting point, shown in the tables above.

The next step is Current Status, an adjustment of the initial base estimates to reflect our best estimate of current survivals, as opposed to an average of survivals that prevailed over a period in the past. This would obviously include recent improvements already implemented but not fully reflected in the Base conditions. Current Status is defined as estimated survival metrics adjusted for recently implemented changes in hydropower configuration and operations, hatchery operations, tributary and estuarine habitat improvements, and reduced avian predation. These are actions that have recently been implemented, but their effects are not reflected in the time series of survival data that for the most part started in 1980.

The final step is Prospective Status, which adjusts Current to Prospective Status based on the estimated effects of future actions. The current-to-prospective adjustment is simply an adjustment of the current survival estimates to reflect survival improvements expected from the hydro, habitat, and hatchery changes included in the Proposed RPA, and in particular those that are expected to be implemented in the period 2007 to 2017. Refer to Section 1.3 of this Comprehensive Analysis for a discussion of Reclamation's qualitative analysis for the years 2017 through 2034.

This analysis assumes that future ocean and climate conditions will approximate the average conditions that prevailed during the 20-year base period used for our status assessments. For most populations, that period is about equivalent to the "recent" ocean period used by the Interior Columbia Basin TRT in its analyses. This period was characterized by relatively poor ocean conditions that presumably contributed to poor early ocean survival of salmonids. To illustrate, the Interior Columbia Basin TRT's "pessimistic" ocean condition scenario results in survivals that are about 15 percent lower for Snake River Spring/Summer Chinook Salmon than the "recent' ocean conditions scenario, and about 36 percent lower for Upper Columbia River Spring Chinook Salmon. Alternatively, Interior Columbia Basin TRT's "historical" ocean conditions scenario results in survivals that are about 39 percent higher for both Snake River Spring/Summer Chinook Salmon and Upper Columbia River Spring Chinook Salmon (Interior Columbia Basin TRT and Zabel 2006). This subject is treated at greater length in the discussion of the effects of potential climate change in Appendix H.

8.3.1 Current Status Analysis

Over the current period the Action Agencies implemented multiple actions to improve fish survival relative to the base period prior to 2000. The percentage improvements in lifecycle survival used in the base-to-current adjustments for the Wenatchee, Methow, and Entiat populations are summarized in Table 8-5. Actions are described in summary below.

Table 8-5. Estimated Survival Improvements Used in the Base-to-Current Adjustment

Population	Hydro (FCRPS)	Hydro (PUDs)	Habitat (tributary)	Habitat (estuary)	Avian predation	Hatchery	Harvest[2]
Wenatchee	-3%	24%	2.0%	0.3%	-0.4%		4.0%
Methow	-3%	42%	2.0%	0.3%	-0.4%	1.0%	4.0%
Entiat	-3%	32%	2.0%	0.3%	-0.4%		4.0%

[2] Harvest adjustments represent estimated harvest decreases between the base and current periods. Estimates supplied by A. Nigro (ODFW) on behalf of an ad hoc *US v. OR* technical workgroup (Nigro 2007).

8.3.1.1 Hydropower Survival Improvements

The estimated percentage improvement in lifecycle survival attributable to changes in hydropower operations for the base-to-current period is based on estimated differences in juvenile migrant survival during the base period 1980 to 2001 and the more recent period of 2001 to 2006. The configuration and operational changes that contributed to these improvements include:

- Bonneville Powerhouse I (PH1) minimum-gap turbine runner (MGR) installations;
- Bonneville Powerhouse II (PH2) Corner Collector installation;
- Bonneville PH2 fish guidance efficiency (FGE) improvements;
- Bonneville spill operation improvements and five additional spillway deflectors;
- Bonneville PH1 juvenile bypass system (JBS) screen removal;
- Bonneville PH2 operation as first priority;
- The Dalles spill wall construction;
- The Dalles spill pattern improvements;
- The Dalles adult collection channel improvements;
- The Dalles sluiceway operation improvements;
- John Day spill operation improvements;
- John Day South Fish Ladder improvements;
- McNary spill operation improvements;
- McNary end spillbay deflectors and hoists;
- McNary full flow juvenile passive integrated transponder (PIT)-tag detection;
- McNary juvenile transport facility bypass piping improvements;
- McNary spare extended-length submerged bar screen (ESBS);
- McNary improved juvenile bypass dewatering screens;
- McNary overhauling auxiliary water supply (AWS) pumps; and
- McNary upgrading of adult fish ladders tilting weir controls.

For the Wenatchee, Methow, and Entiat populations these improvements totaled 21 percent, 39 percent, and 29 percent, respectively, when FCRPS and PUD actions were combined (Table 8-5). Additional detail on how these percentages were estimated is in Appendix B. These estimates represent the "best estimates" of NMFS (see COMPASS tables in Appendix B).

8.3.1.2 Tributary Habitat Survival Improvements

From 2000 to 2006, BPA and Reclamation implemented actions to address limiting factors for all current populations of this ESU. BPA's annual expenditures for habitat projects in the upper Columbia subbasins averaged about $500,000 for the 2001 to 2006 time frame. Reclamation's technical assistance during this period totaled about $9 million annually. Some of these actions have provided benefits with immediate survival improvements and some will result in long-term benefits with survival improvements accruing into the future. During this time period the Action Agencies, in coordination with multiple partners:

- Increased streamflow through water acquisitions;
- Addressed entrainment by installing or improving fish screens;
- Increased fish passage and access by removing passage barriers;
- Improved mainstem and side channel habitat conditions, and
- Improved water quality and habitat conditions by protecting and enhancing riparian areas.

Survival improvements estimated to result from tributary habitat actions implemented by the Action Agencies in this time period are shown in Table 8-4. The percentages indicate the incremental survival improvement estimated to accrue by 2006 from the suite of implemented actions. Survival improvements were estimated as described in Appendix C, Attachment C-1.

Additional detail on habitat actions implemented by BPA and Reclamation in the 2000 to 2006 time frame is available in the Action Agencies' Annual Progress Reports located at www.salmonrecovery.gov.

8.3.1.3 Estuary Habitat Survival Improvements

The estimated survival benefit for Upper Columbia River Spring Chinook Salmon (stream-type life history) associated with the specific actions discussed above is 0.3 percent. Action Agencies implemented habitat actions through 21 estuary habitat projects. Unrestricted fish passage and approximately 3 miles of access to quality habitat was provided by these specific actions:[3]

- Replaced three culverts with full-spanning bridges; provided approximately 10 miles of improved tidal channel connectivity by installing a tide gate retrofit;
- Acquired approximately 473 acres of off-channel and riparian habitats;
- Restored and created 90 acres of marsh and tidal sloughs and approximately 100 acres of riparian forests; protected approximately 55 acres of high-quality riparian and floodplain habitat;
- Restored and preserved approximately 154 acres of off-channel habitat;
- Protected 80 acres of high-value off-channel forested wetland habitat;
- Restored approximately 96 acres of tidal wetlands habitat by replacing undersized culvert that limited fish access; conserved 155 acres of forested riparian and upland habitat;
- Provided partial tidal channel reconnection by tide gate retrofit (acreage unknown at this time); provided integrated pest management (purple loosestrife);
- Reconnected and restored 183 acres of historical floodplain by dike removal;
- Restored 25 acres of historical floodplain by breaching a dike; provided fish passage access to 6 miles of stream habitat by removal of two culverts and replacement with bridges;

[3] A more thorough report detailing this evaluation process is: *Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary*(PC Trask & Associates 2007), which is included in Appendix D to this document.

- Restored 310 acres of native hardwood riparian forest, 200 acres of seasonally wet slough, and 155 acres of degraded riparian habitats; increased circulation in approximately 92 acres of backwater and side-channel habitat by tide gate retrofit;
- Improved embayment circulation for 335-plus acres of marsh/swamp and shallow-water and flats habitat; and
- Preserved 35 acres of historical wetland habitat.

8.3.1.4 Predation Management Survival Improvements

Avian Predation

The estimated relative baseline to current survival of Upper Columbia River Spring Chinook Salmon is -0.4 percent. This reflects a reduction in survival from the base to current condition, because the tern population was increasing over the base period. Averaging tern consumption of juvenile salmonids across the 20-year base period downplays the actual change in survival that resulted from relocating terns from Rice Island to East Sand Island in 1999. In 1999 tern consumption of juvenile salmonids was at its peak with an estimated 13,790,000 smolts consumed, compared to 8,210,000 in 2000 after relocation.

Piscivorous Predation

The ongoing Northern Pikeminnow Management Program (NPMP) has been responsible for reducing predation-related juvenile salmonid mortality since 1990. The improvement in lifecycle survival attributed to the NPMP is estimated at 2 percent for migrating juvenile salmonids (Friesen and Ward 1999). The northern pikeminnow has been responsible for approximately 8 percent predation-related mortality of juvenile salmonid migrants in the Columbia River Basin in the absence of the NPMP (2000 FCRPS BiOp at 9-106). The ongoing NPMP is already accounted for in the estimation of survival improvements modeled within the reservoir mortality life stage. This is because the modeling estimates are calibrated to empirical reach survival estimates that included the ongoing program.

8.3.1.5 Hatchery Management Survival Improvements

In the early 2000s the lower river out-of-basin Carson stock had been raised at the Winthrop National Fish Hatchery (NFH) and was phased out and replaced with a locally derived Methow Composite stock, which was primarily, but not exclusively, of Methow River origin. The Leavenworth NFH program continues to raise out-of-basin Carson stock spring Chinook salmon as mitigation for Grand Coulee, as does the Entiat NFH. The Winthrop NFH also raises upper Columbia River steelhead. Developing and using locally derived broodstock for the hatchery programs reduces impacts on listed fish in the basin.

From 2000 to 2006, BPA funded the development of Hatchery and Genetic Management Plans (HGMPs) for all Federally funded hatchery programs in the ESU. The objective was to develop the HGMPs for NMFS approval and identification of and prioritization of hatchery reform measures by NMFS. We expect NMFS to use the HGMPs in its hatchery program ESA Section 7 consultation to identify operational changes that will benefit listed populations.

8.3.2 Current Survival Gaps

Improvements of 7 percent and 2 percent are necessary to achieve the R/S criteria for the Wenatchee and Entiat populations, respectively; no improvement is needed for the Methow. No improvements are needed to achieve the 20-year λ criterion; a 32 percent improvement is needed for the Wenatchee to meet the 20-year trend criterion. All populations meet the 24-year extinction risk criteria at a QET = 1.0; whereas at a QET =50 the Entiat population still requires a 5 percent improvement in lifecycle survival (Table 8-6).

Table 8-6. Current Status: Adjusted Gaps After Base-to-Current Adjustment

Population	Adjusted 20-year R/S Gap	Adjusted 20-year λ Gap	Adjusted Long-term Trend Gap	Adjusted Ext. Risk Gap QET = 1	Adjusted Ext. Risk Gap QET = 50
Wenatchee	1.07	0.75	1.32	0.10	0.52
Methow	0.91	0.44	0.85	N/A	N/A
Entiat	1.02	0.77	0.84	0.23	1.05

Notes:
Gaps are expressed as multipliers. For example, a 1.10 gap indicates a 10 percent improvement is necessary to close gap. If gap is ≤ 1.0, no further improvement is necessary to close gap.

8.3.3 Prospective Status Analysis

As noted above, the prospective status is the projected status of the population based on adjustment of the survival metrics for expected improvements associated with the Proposed RPA. As was the case for the base-to-current adjustment, the improvements for the current-to-prospective are divided into the categories of those expected from changes in hydropower operations and configuration (including Upper Snake River flow augmentation), changes in tributary habitat conditions attributable to actions implemented in the periods 2007 to 2009 and 2010 to 2017, changes in estuarine habitat, reduced impacts of avian predation, and improved hatchery operations.

The percentage improvements in lifecycle survival used in the current-to-prospective adjustments for the Wenatchee, Methow, and Entiat populations are summarized in Table 8-7.

Table 8-7. Estimated Improvements in Survival Used in the Current-to-Prospective Adjustment

Population	Hydro (FCRPS)	Hydro (PUDs)	2007-2017 Habitat (tributary)	Habitat (estuary)	Avian predation	Pikeminnow predation	Hatchery	Harvest
Wenatchee	9.0%	0%	3.0%	5.7%	2.1%	1.0%	N/A	N/A
Methow	9.0%	1%	6.0%	5.7%	2.1%	1.0%	N/A	N/A
Entiat	9.0%	1%	22.0%	5.7%	2.1%	1.0%	N/A	N/A

Notes:
N/A = not applicable
The hydro benefit incorporates improvements from the Public Utility Districts (PUDs) Habitat Conservation Plan (HCP) BiOp.

8.3.3.1 Hydropower Survival Improvements

The estimated lifecycle survival benefit percentage increase attributable to the proposed hydropower operational and configuration improvement actions was estimated based on the difference between the estimated survival under the current operation (defined as the period 2001 to 2006) and estimated survival following implementation of the Proposed RPA. These increases in lifecycle survival range from 9 percent to 10 percent for populations within this ESU when FCRPS and PUD actions are combined (Table 8-7). These values include both the PUD improvements and the FCRPS improvements. However, for Upper Columbia River Spring Chinook Salmon prospective analysis, nearly all the benefits are primarily from the FCRPS improvements (100 percent benefits from Wenatchee River and over 90 percent for Entiat and Methow for FCRPS actions). A detailed description of the methods used to generate these estimates can be found in Appendix B; these methods included the use of multiple data sources and the COMPASS model, and represent the “best estimates” of NMFS (see COMPASS tables in Appendix B). The configuration and operational improvement actions that contribute to these survival increases are organized into strategies. Specific actions contained within these strategies are listed in the Hydrosystem Action Summary. These strategies include:

1. Operate the FCRPS to more closely approximate the shape of the natural hydrograph and to improve juvenile and adult fish survival;
2. Modify Columbia and Snake river dams to facilitate safe passage;
3. Implement operational improvements at Columbia and Snake river dams; and
4. Operate and maintain juvenile and adult fish passage facilities.

Changes in the timing of Reclamations Upper Snake River flow augmentation as addressed in Reclamation's Upper Snake River Biological Assessment (BA), are also expected to improve conditions for survival.

8.3.3.2 Tributary Habitat Survival Improvements

Table 8-8 displays estimated population-level survival improvement percentages expected to result from Action Agency implementation of actions to address limiting factors in the tributary areas used by this ESU. The survival improvements identified represent an increase in Action Agency tributary habitat effort compared to efforts under the 2000 and 2004 FCRPS BiOps. Survival improvements were estimated as described in Appendix C, Attachment C-1.

2007 to 2017

BPA will fund and Reclamation will provide technical assistance for projects that implement new actions to address key limiting factors for this ESU in the Wenatchee, Entiat, and Methow subbasins where this ESU is present. BPA will fund projects primarily through its Fish and Wildlife Program; Reclamation will provide technical assistance through annual Congressional appropriations. The Action Agencies will work with multiple parties for the successful implementation of these actions.

Initial Actions

Consistent with its 2007 to 2009 Fish and Wildlife Program funding decision, BPA will fund implementation of 15 projects in the Wenatchee, Entiat, and Methow subbasins. BPA has also dedicated 70 percent of the Columbia Basin Water Transactions Program (CBWTP) $5 million annual budget to secure water acquisitions and riparian easements for anadromous fish, including populations of Upper Columbia River Spring Chinook Salmon. For this time period, the average annual planned budgets (based on BPA Final Decision Letter) for these projects is approximately $3.4 million (not including the CBWTP). The Action Agencies will work with multiple parties for the successful implementation of these actions.

The BPA will fund projects in the three subbasins to implement new actions that:

- Increase instream flows;
- Remove fish passage barriers;
- Improve fish passage structures;
- Install fish screens;
- Increase channel complexity;
- Protect and enhance riparian habitat, and

- Improve water quality.

Reclamation will provide technical assistance for habitat projects in the Wenatchee, Entiat, and Methow subbasins.

Future Implementation

BPA will expand the level of effort and increase funding above the 2007 to 2009 period. Project funding decisions will be based on prioritized biological criteria and consistent with recovery plans. Reclamation will continue to provide technical assistance where appropriate with funding consistent with its Congressional funding authorizations.

Further detail about Reclamation actions is available in Table 5 in Attachment B.2.2-2 to Appendix B of the FCRPS BA document; project-level detail of the BPA-funded projects is available in Table 1-b in Attachment B.2.2-2.

8.3.3.3 Estuary Habitat Survival Improvements

2007 to 2009

The estimated survival benefit for Upper Columbia River Chinook Salmon (stream-type life history) associated with the specific actions discussed above is 1.4 percent. The Action Agencies' estimated benefit for 2007 is based on actions that are or will be underway in the very near-term. For 2008 and 2009 the estimated benefit is based on the increased funding level described in the FCRPS BA.[4] Action Agencies are or will be implementing multiple habitat actions through approximately 35 estuary habitat projects. Specific estuary habitat actions:

- Restore partial tidal influence and access to several acres (exact amount unknown at this time) by a tide gate retrofit;
- Improve hydrologic flushing and salmonid access to a lake (Sturgeon Lake is approximately 3,200 acres);
- Acquire and protect 40 acres of critical floodplain habitat and 40 acres of riparian forest restoration; install six to eight engineered log-jams that will help to slow flood flows, reduce erosion, contribute to sediment storage, enhance fish habitat, and contribute wood into the project area; acquire and restore floodplain connectivity to 380 acres of off-channel rearing habitat for juveniles;
- Install fish-friendly tide gates to increase tidal flushing and fisheries access to approximately 110 acres;
- Complete riparian planting of up to 210 acres;
- Re-establish hydrologic connectivity to reclaim and improve floodplain wetland functions, increase off-channel rearing and refuge habitat on 5 acres, plant native vegetation along shoreline and reconstruct slough channels on 2.5 acres of annually inundated off-channel habitat; as part of a long-term 1,500-acre restoration effort: breaching a dike and re-establishing flow to portion of original channel, planting vegetation on 50 acres, removing invasive weeds on 180 acres, planting wetland scrub shrub on 45 acres, and controlling and removing invasive wetland plants on 45 acres;

[4] A more thorough report detailing this evaluation process is: *Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary* (PC Trask & Associates 2007), which is included in Appendix D to this document.

- Retrofit a tide gate (acreage unknown at this time);
- Protect and restore approximately 5 to 10 acres of emergent wetland and riparian forest habitats;
- Reconnect 45 acres of floodplain by tide gate removal;
- Acquire 45 acres of floodplain with future dike removal;
- Reconnect 50 acres of floodplain;
- Acquire 320 acres of tidelands and 119 acres of riparian/upland forest; and
- Restore 30 acres of riparian habitat.

There will be approximately 15 to 20 additional projects and associated actions similar to actions listed above that are undergoing scoping and sponsor development (the number of projects and associated actions is based on the increased funding level described in the FCRPS BA).

2010 to 2017

The survival benefit for Upper Columbia River Chinook Salmon (stream-type life history) associated with these actions is 4.3 percent. The Action Agencies' estimated benefits for 2010 to 2017 are based on continuing the same level of effort as 2007 to 2009. However, the level of effort in this time period may increase depending on the outcome of a General Investigation study of Ecosystem Restoration opportunities, depending on Congressional appropriations, future funding scenarios, and results of actions. Specific projects have yet to be identified. Actions for this period will be similar in nature to actions implemented in previous periods discussed above. Actions will include protection and restoration of riparian areas, protection of remaining high-quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, and reduction of noxious weeds, among others. The estimated numbers of actions are based on continuing the same level of effort as 2007 to 2009.

8.3.3.4 Predation Management Survival Improvements

Avian Predation

The estimated relative current to future survival of Upper Columbia River Spring Chinook Salmon is 2.1 percent, and this benefit is carried out to 2017 and beyond. This improvement is expected to result through the reduction in estuary tern nesting habitat, and subsequent relocation of terns outside the Columbia River Basin. Although the base to current shows a reduction in survival, the overall benefit (base to future) is positive.

Piscivorous Predation

The percentage improvement in lifecycle survival attributable to the proposed continuation of the increase in incentives in the NPMP and resultant marginal increase in observed exploitation rate is estimated at 1 percent total from 2007 to 2017. This estimate was derived based on the difference between the estimated benefits from the base NPMP (defined as the period 1990 to 2003) and estimated survival benefits under the increased incentive program (defined as the period 2004 to present). This rate would generally apply to all juvenile salmonids.

8.3.3.5 Hatchery Management Survival Improvements

2007 to 2017

The Action Agencies will implement the following hatchery actions to improve survival of Upper Columbia River Spring Chinook Salmon:

- Adopt programmatic criteria for funding decisions on FCRPS mitigation hatchery programs;

- Fund genetic analyses of spring Chinook salmon in the mainstem Columbia River as part of an alternative broodstock collection protocol to improve the genetic profile of hatchery; production and management of the proportion of wild fish on the spawning grounds. The action will enable tributary-specific population management without degrading overall production objectives;
- Implement high-priority reform actions for Upper Columbia River Spring Chinook Salmon in the FCRPS Grande Coulee mitigation program (Leavenworth Complex) to reduce potential adverse effects of hatchery operations and hatchery-origin fish on ESA-listed upper Columbia River spring Chinook salmon and steelhead; and
- Implement future additional hatchery reforms identified through Columbia River Hatchery Scientific Review Group's hatchery review process, combined with use of Best Management Practices at FCRPS hatchery facilities to improve productivity, diversity, and/or spatial structure of target populations, depending on the nature of the reform.

8.3.3.6 Harvest Survival Improvements

The Action Agencies will assist in the development of a plan to add PIT-tag detections in mainstem Columbia fisheries. The potential benefit of this monitoring is providing an independent assessment of harvest impacts and stock composition in mainstem fisheries.

8.3.4 Prospective Survival Status

Comprehensive analyses of the changes in lifecycle survival resulting from the Proposed RPA and analysis of how they will change the survival metrics indicate that the Upper Columbia River Spring Chinook Salmon ESU is likely to survive in the near term (Table 8-8). Based on the estimate of remaining survival gaps summarized in Table 6, the Entiat population meets all four criteria: 20-year R/S >1, 20-year $\lambda > 1.0$, long-term abundance trend > 1.0, and 24-year extinction risk < 5 percent at both QET = 1 and QET = 50; the Methow meets three of the four, with no results obtained for extinction risk. However, productivity and trend estimates, combined with the expected effects of the Proposed RPA, lead us to conclude that extinction risk for this population is also low. Only the Wenatchee population failed to meet all four criteria, needing a modest improvement in survival to meet the long-term trend criterion. However, after considering the effects of the Proposed RPA, it is expected that recent positive growth trends will continue.

Table 8-8. Estimated Future Status With Proposed RPA

Population	Estimated Future R/S	Estimated Future λ	Estimated Future Trend	Risk Gap (QET = 1)	Risk Gap (QET = 50)
Wenatchee	1.14	1.12	0.98	0.08	0.42
Methow	1.39	1.27	1.09	N/A	N/A
Entiat	1.44	1.15	1.13	0.16	0.72

Notes:
N/A = not applicable
Future productivity values represent estimates of future R/S, lambda, and trend after consideration of the effects of the Proposed RPA. A value >1.0 indicates a growing population; a value <1.0 indicates a population in decline. A risk gap <1.0 indicates the population meets a <5% risk criterion.

8.3.5 Remand Conceptual Framework Analysis

The FCRPS BiOp Remand's Collaboration among the sovereigns developed a Conceptual Framework approach intended to help the Action Agencies develop the Proposed RPA. The Framework approach attempted to estimate the relative magnitude of mortality factors affecting Interior Columbia River Basin salmonid populations. That assessment was intended to define the FCRPS's "relative expectation…for recovery" (FCRPS 2006). The Collaboration's Framework working group developed high and low mortality estimates for all sources of mortality, including the FCRPS. The Collaboration's Policy Working Group has not determined where in that range the Action Agencies' Proposed RPA should be assessed. The range of "gaps" that the Framework approach would expect the FCRPS to fill was reviewed and the Action Agencies assessed whether the total survival improvements estimated in this biological analysis would "fill" those gaps. For the purposes of this comparison, the Interior Columbia Basin TRT gaps were used for "recent" ocean and "base hydro" conditions (corresponding to the base period used for R/S productivity estimation), and the Interior Columbia Basin TRT's 5 percent risk level.

The Conceptual Framework was intended, among other things, to "provide a clear and complementary link to ongoing recovery planning efforts." As such, it can be understood to represent the collaboration parties' view of the appropriate contribution of the FCRPS toward long-term recovery of the listed ESUs in the Interior Columbia River Basin. Therefore it provides another "metric" for use in considering the impacts of the Proposed RPA on a listed species' prospects for recovery. The results of this analysis are displayed in Table 8-9.

Table 8-9. Gap Calculations from the Conceptual Framework

Population	TRT Gap	FCRPS Relative Impact (high)	FCRPS Relative Impact (low)	TRT Gap (high hydro)	TRT Gap (low hydro)	Total Survival Change	Remaining Framework Gap (high)	Remaining Framework Gap (low)
Wenatchee	2.35	0.36	0.23	1.36	1.24	1.57	0.87	0.78
Methow	1.98	0.30	0.17	1.23	1.12	1.88	0.65	0.60
Entiat	2.56	0.31	0.19	1.34	1.20	2.00	0.67	0.60

Notes:
Interior Columbia Basin TRT gaps are expressed as multipliers. Gaps are for 5 percent risk, recent ocean/base hydro conditions. A "remaining" gap value <1.0 indicates that no further improvement is necessary. Total survival changes combine all estimated survival improvements for the base-to-current and current-to-prospective adjustment.

Briefly, the Proposed RPA (without considering either improvement in the environmental baseline or other actions reasonably certain to occur) more than fills the Framework gaps at both the high and low ends of the range for all three populations in this ESU.

8.4 ADDITIONAL ACTIONS TO BENEFIT THE ESU

8.4.1 Other Reasonably Certain to Occur Actions[5]

Based on information developed by the Remand Collaboration, in the upper Columbia River, three subbasins – the Entiat, the Methow, and the Wenatchee – contain non-Federal projects that will benefit ESA-listed spring Chinook salmon. The Entiat, Methow, and Wenatchee subbasins will benefit from a combined 121 habitat actions, five non-Federal hydro actions, and hatchery reform actions. Though the benefits of most of these actions are not quantified, they would be expected to add to the benefits expected from the Action Agencies' Proposed RPA.

[5] Many of the actions listed above have a cost-share component with a variety of other Federal funding sources and therefore may be properly described as contributing to the status of the environmental baseline rather than cumulative effects. The Action Agencies will sort the projects described in this chapter into the appropriate parts of the biological analysis, but for the purposes of discussion at the April 11, 2007, Policy Workgroup workshop, believe that the effect on prospective status will be the same.

8.4.2 Other Future Federal Actions with Completed Section 7 Consultations

NMFS searched its Public Consultation Tracking Database (PCTS) for Federal actions that had completed section 7 consultation since November 30, 2004 that could be used to adjust the status of the populations between the base and current periods. Results for each population are described below.[6]

8.4.2.1 Mainstem Mid-Columbia Hydroelectric Projects

NMFS completed ESA Section 7(a)(2) consultations on its issuance of incidental take permits to Douglas and Chelan County PUDs in support of the proposed Anadromous Fish Agreements and HCPs for the Wells, Rocky Reach, and Rock Island hydroelectric projects in the mid-Columbia reach on August 12, 2003. Under the HCPs, Douglas and Chelan County PUDs agreed to use a long-term adaptive management process to achieve a 91 percent combined adult and juvenile survival standard for each salmon and steelhead ESU migrating through each project. In addition, compensation for up to 9 percent unavoidable project mortality is provided through hatchery and tributary programs, with compensation for up to 7 percent mortality provided through hatchery programs and compensation for up to 2 percent provided through tributary habitat improvement programs.

In May 2004, NMFS also completed an ESA Section 7 consultation on Federal Energy Regulatory Commission's (FERC's) proposed amendment to the existing license for the Grant County PUD's Priest Rapids Hydroelectric Project, which permitted implementation of an interim protection plan, including interim operations for Wanapum and Priest Rapids dams. Under this biological opinion and incidental take statement, NMFS expects that project-related mortalities (i.e., direct, indirect and delayed mortality resulting from project effects) for both hydro projects combined will not exceed 24.5 percent for juvenile Upper Columbia River Spring Chinook Salmon. NMFS also expects that implementation of the interim protection plan will result in mortality rates of no more than 2 percent per project or 4 percent combined for adult Upper Columbia River Spring Chinook Salmon.

Thus, NMFS expects the cumulative mortality through the mid-Columbia reach of juvenile Upper Columbia River Spring Chinook Salmon to be 18 percent for the Wenatchee population; 24 percent for the Entiat population; and 27 percent for the Methow population. The total mortality rates (natural and project-related) of adult Upper Columbia River Spring Chinook Salmon are expected to be 2 percent for adult spring Chinook salmon returning to the Wenatchee and Entiat rivers and 3 percent for fish returning to the Methow.

Wenatchee River

The U.S. Forest Service (USFS) proposed fuels reduction projects in the White River – Little Wenatchee and Wenatchee River – Nason Creek watersheds, respectively, and a fire salvage timber sale in the Lower Wenatchee River watershed. The USFS also proposed a habitat restoration project in the Natapoc Ridge Forest (Wenatchee River – Nason Creek and Chiwawa River watersheds). The USFS' project to relocate White River Road and stabilize the streambank used large woody debris to increase habitat complexity (White River – Little Wenatchee River watershed). Another USFS project, replacing three culverts along Sand and Little Camas creeks (Lower Wenatchee River watershed), improved passage and partially restored natural channel-forming processes. The USFS completed one project 2007 under its programmatic consultation (19 Aquatic Habitat Restoration Activities in Oregon, Washington, Idaho, and

[6] This information does not include any habitat conservation or restoration projects funded by BPA under NMFS' programmatic biological opinion for the Habitat Improvement Program (HIP). The effects of those projects are already taken into account in the base-to-current adjustment for species/population status.

California): a road decommissioning to improve riparian habitat and the connection to the floodplain along one mile of Clear Creek in the Chiwawa River watershed.

The Federal Highway Administration (FHWA)/Washington State Department of Transportation (WSDOT) consulted on a road construction project in the Wenatchee River – Icicle Creek watershed and a culvert replacement along Mill Creek (Wenatchee River – Nason Creek) to improve fish passage.

In the Lower Wenatchee watershed, NMFS consulted on the restoration of off-channel habitat; the USFWS funded the installation of a fishway on Peshastin Creek, designed to provide access to spawning and rearing habitat; and the Corps consulted on a fish passage enhancement project. The Corps also proposed 20 projects to build or maintain docks, piers, launches, boat lifts, moorage basins, and swimming beaches along the shores of Lake Entiat, Columbia River – Lynch Coulee, and Columbia River – Sand Hollow mainstem reaches (juvenile and adult migration corridors). The Department of the Army consulted on construction at the Yakima Training Center (Columbia River – Lynch Coulee and Columbia River – Sand Hollow mainstem reaches).

Entiat River

The USFS proposed a campground and summer home vegetation management project in the lower Entiat River watershed and habitat restoration activities in the Columbia River – Lynch Coulee portion of the mainstem Columbia River. NMFS consulted with itself on funding for a project in the lower Entiat River watershed that included building an overflow structure in an existing irrigation canal to improve fish passage; adding boulders and large wood to increase habitat complexity in a side channel; reconnecting the river and its floodplain; and enhancing the recruitment of spawning gravels.

The FHWA/WSDOT proposed road maintenance along State Route 28 (Sunset Highway), Eastside Corridor, East Wenatchee (Lake Entiat mainstem reach).

The Corps proposed 20 projects to build or maintain docks, piers, launches, boat lifts, moorage basins, and swimming beaches along the shores of Lake Entiat, Columbia River — Lynch Coulee, and Columbia River — Sand Hollow mainstem reaches (juvenile and adult migration corridors). The Department of the Army consulted on construction at the Yakima Training Center (Columbia River — Lynch Coulee and Columbia River — Sand Hollow mainstem reaches).

Methow River

The USFS consulted on a total of three timber sales in the Upper and Lower Chewuch and Twisp River watersheds; a grazing allotment plan for the Lower Chewuch and Middle Methow River watersheds; and a vegetation management plan for the Lower Methow River watershed. The USFS also consulted on projects to restore habitat damaged by grazing in the Lower Chewuch River watershed, improve passage (by replacing a diversion dam) into seven miles of Little Bridge Creek (Twisp River watershed), and modify an irrigation ditch for access to nine miles of habitat in a wilderness area (Middle Methow River watershed). The USFS completed two projects during 2007 under its programmatic consultation with NMFS (19 Aquatic Habitat Restoration Activities in Oregon, Washington, Idaho, and California): decommissioning and relocating the Twisp River/North Creek Trail to improve five acres of riparian habitat and installing a culvert in Reynolds Creek to allow access to four miles of stream.

The USBR consulted on leasing water from the Chewuch Canal Company (Lower Chewuch River watershed) to improve instream flows. The FHWA/WSDOT proposed a bridge rehabilitation project on Buttermilk Creek Road in the Twisp River watershed.

The Corps proposed 20 projects to build or maintain docks, piers, launches, boat lifts, moorage basins, and swimming beaches along the shores of Lake Entiat, Columbia River - Lynch Coulee, and Columbia River — Sand Hollow mainstem reaches (juvenile and adult migration corridors). The Department of the Army consulted on construction at the Yakima Training Center (Columbia River — Lynch Coulee and Columbia River — Sand Hollow mainstem reaches).

The FERC consulted on a license amendment for the Wells Hydroelectric Project—land easements for 11 irrigation diversions from Lake Entiat with new or improved fish screens. No adjustments were made based on this information.

8.5 CONCLUSION

The results of the analysis suggest that 24-year extinction is a low likelihood for all three populations in this ESU. The prospective effects analysis indicates that R/S productivity is likely to be >1.39 for the Entiat and Methow populations, and about 1.14 for the Wenatchee population after the effects of the action are realized. The Conceptual Framework analysis indicates that the Proposed RPA more than fills both the high and low Framework gaps, providing a positive indication of the proposed action's effects on this ESU's prospects for recovery. The Action Agencies have worked with the States and Tribes through the Remand Collaboration Process and other forums to identify actions intended to address the needs of listed salmon and steelhead as determined by quantitative and qualitative biological analyses. Acknowledging that NMFS will review the actions and the effects analyses contained herein to make a final jeopardy determination in the forthcoming biological opinions, the Action Agencies are making the following conclusions. Based on our assessment of the FCRPS and Upper Snake River actions and analysis of effects, considering the present and future human and natural context, the Action Agencies conclude that the net effects of the proposed actions, including the existence and operations of the dams with the proposed mitigation, meet or exceed the objectives of doing no harm and contributing to recovery with respect to this ESU.

Chapter 9
Upper Columbia River Steelhead
Distinct Population Segment

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

9.1 INTRODUCTION

This chapter briefly summarizes the current biological status of the Upper Columbia River Steelhead Distinct Population Segment (DPS) related to extinction risk and the effects of the Federal Columbia River Power System (FCRPS) Proposed Reasonable and Prudent Alternative (RPA) in the context of recovery plan actions. First, it summarizes current status information including key limiting factors and extinction risks. Second, it includes a biological assessment of the survival effects of recent and planned actions on current and prospective conditions, respectively. Finally, it identifies additional actions to benefit the DPS. Summary data for the DPS are presented in Table 9-1. The geographic extent of the DPS is shown in Figures 9-1.

Table 9-1. Upper Columbia Steelhead DPS Description and Major Population Groups (MPGs)

DPS Description[1/]	
Endangered	Listed under Endangered Species Act (ESA) in 1997; reaffirmed in 2006, reinstated to endangered status per U.S. District Court decision in June 2007.
Hatchery programs included in DPS	Wenatchee River, Wells hatchery (in Methow and Okanogan rivers), Winthrop, Omak Creek, Ringold
Major Population Group	**Extant Populations**
Eastern Cascades	Entiat River Methow River Wenatchee River Okanogan

Notes:
1/ 70 FR 37160; Interior Columbia Basin Technical Recovery Team (TRT) 2003, 2005

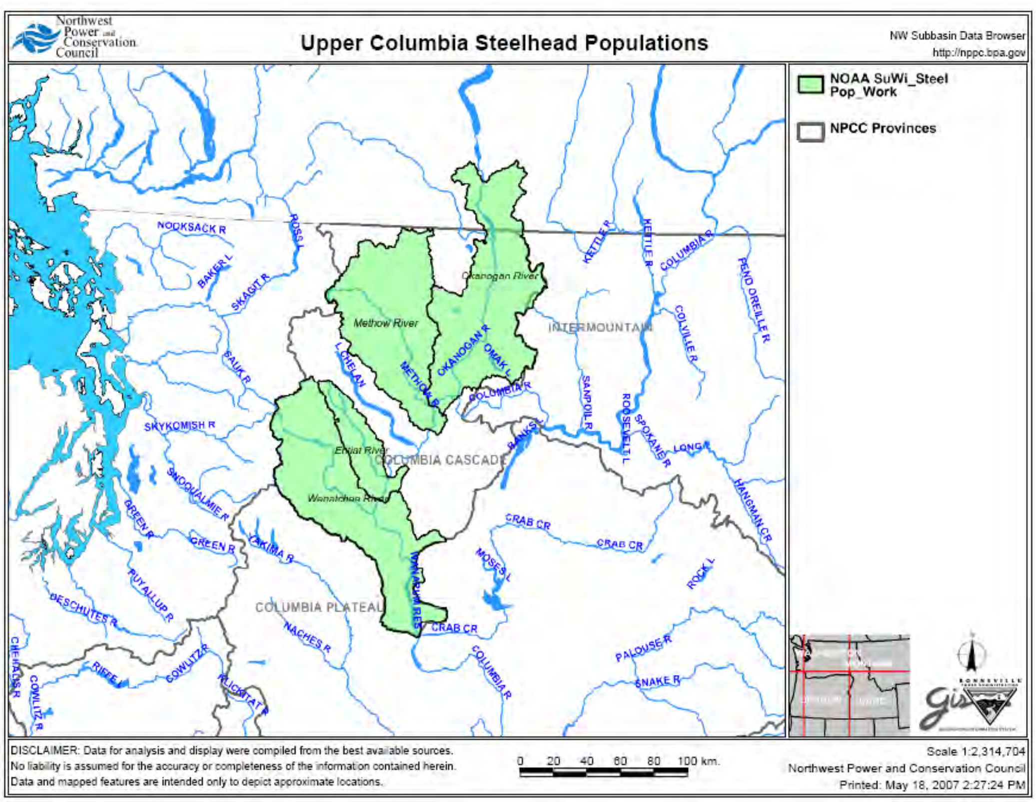

Figure 9-1. Upper Columbia River Steelhead DPS

This chapter is organized into five sections. Section 9.1 provides an overview of the DPS and the factors limiting its viability. Section 9.2 summarizes population-level status information during the 20-year base period used for this analysis. Section 9.3 provides the analysis of the current status and provides estimates of the "gaps," or needed lifecycle survival improvements for individual populations to meet certain biological criteria. It summarizes the improvements made to the hydropower (hydro) system and in other Hs (habitat, hatcheries, and harvest) since about 2000 and estimates the salmonid survival benefits associated with those improvements. Section 9.4 describes the actions proposed to be implemented into the future, and Section 9.5 estimates their effects on salmonid survival when aggregated with the environmental baseline and cumulative effects.

Almost all of the metrics used in this analysis are estimates for individual populations within the DPS. The ESA is concerned with the status of a species, either its DPS or Evolutionarily Significant Unit (ESU, an equivalent term used for salmon). Individual populations and major population groups (where they exist) obviously contribute to DPS or ESU status. However, the status of the DPS or ESU is not wholly dependent upon the status of any of the individual components.

The Upper Columbia River Steelhead DPS includes anadromous and resident *O. mykiss* in anadromous-accessible regions of the mainstem Columbia River upstream of Rock Island Dam. Upper Columbia River Steelhead spawn and rear in the middle reaches of the rivers and tributaries draining the eastern slope of the Cascade Mountain Range in this area. The Interior Columbia Basin Technical Recovery Team (TRT) has concluded that the DPS consists of a single Eastern Cascades Major Population Group (MPG) composed of four populations: Wenatchee River, Methow River, Okanogan River, and Entiat River. This DPS was listed as an endangered species on August 18, 1997. This decision was based in part on the hedge against extinction provided by listed hatchery fish in these populations. The Interior Columbia Basin TRT has concluded that the DPS is at high risk for abundance/productivity and high risk for spatial structure and genetic diversity.

Estimates of the annual returns of Upper Columbia River Steelhead populations are largely based on dam counts, although redd counts are also available for some tributaries. Traditionally, the difference between counts at Rock Island and Rocky Reach dams has been assumed to be returns to the Wenatchee River Basin. Counts over Wells Dam have been assumed to be returns originating from natural production and hatchery plants in the Methow and Okanogan river watersheds. The annual estimated adult returns above Wells Dam are allocated into hatchery and wild components by applying the ratios of hatchery versus wild fish observed at Wells Dam.

Hatchery returns have dominated natural spawning in all populations in this DPS. Historical broodstock management protocols have included the use of out-of-basin broodstock and the extensive mixing of stocks from different populations within the DPS. The low estimated recruits per spawner (R/S) productivity for these populations is almost certainly attributable in part to decades of poor hatchery practices.

Hatchery programs that are currently operated by the Washington Department of Fish and Wildlife (WDFW), U. S. Fish and Wildlife Service (USFWS), and Colville Tribes release steelhead in the Wenatchee, Methow, and Okanogan basins. The Federal hatcheries in the Upper Columbia were constructed as mitigation to compensate for the lack of access and loss of spawning and rearing habitat caused by the construction of Grand Coulee Dam. At the time, it was estimated that 85 to 90 percent of the fish counted at Rock Island Dam originated upstream from Grand Coulee Dam. About half of the Upper Columbia River Steelhead DPS were taken out of production by these dams. Although there are currently no steelhead releases in the Entiat River, there is believed to be an unknown level of straying of hatchery fish into this basin. Empirically documenting the stray rate into the Entiat River is currently a high priority for the Mid Columbia Public Utility Districts (PUDs), who are considering using the Entiat as a natural production reference stream for the purpose of comparisons to supplemented streams in their Hatchery Monitoring and Evaluation Program.

Prior to 1998, most of the hatchery steelhead in these programs were of a co-mingled stock collected either at Priest Rapids or Wells dams. In 1997 WDFW initiated a Wenatchee steelhead program with broodstock collected from the Wenatchee River Basin. This program is continuing to evolve, with the development of acclimation sites in the Wenatchee Basin that are expected to come on line in 2008 to 2009. The use of in-basin acclimation is expected to greatly increase the fidelity of return to the Wenatchee Basin. The Methow and Okanogan basins continue to use broodstock collected at Wells Dam. However, the potential to develop localized broodstock in the Methow River Basin (i.e., Chewuch, Twisp, and Methow rivers) has not been ruled out for the future and is, in fact, indicated as a WDFW-endorsed management alternative in the Methow River summer steelhead hatchery program's Hatchery and Genetic Management Plan (WDFW 2005).

Resident *O. mykiss* are abundant in Upper Columbia River tributaries currently accessible to steelhead, as well as in upriver tributaries blocked to anadromous fish access.

Human impacts and current limiting factors for this DPS come from multiple sources: hydro passage, habitat degradation, hatchery effects, fishery management and harvest decisions, predation, and other sources.

9.1.1 Key Limiting Factors

Salmon and steelhead have been adversely affected over the last century by many activities including human population growth, introduction of exotic species, over fishing, developments of cities and other land uses in the floodplains, water diversions for all purposes, dams, mining, farming, ranching, logging, hatchery production, predation, ocean conditions, loss of habitat and other causes (Lackey et al. 2006). Summarized below in Table 9-2 are current key limiting factors for this DPS identified by the National Marine Fisheries Service (NMFS, also called National Oceanic and Atmospheric Administration [NOAA]) in the ESU Overviews for the Remand Collaboration (NMFS 2005e).

Table 9-2. Key Limiting Factors

Hatcheries	Historically (pre-1996) the hatchery programs in this DPS held non-local hatchery broodstock on well water. This and other practices selected for hatchery fish that matured earlier than the local stocks. The hatchery stocks and the native stocks interbred. This, combined with previous high harvest rates on the native wild stocks, habitat limitations, and hydro impacts, resulted in few natural-origin fish being produced. This, combined with relatively high survival of hatchery fish, resulted in high proportions of hatchery fish on the spawning ground over many generations. Over time, production from hatcheries should transition to natural production consistent with recovery goals. According to the Step 4 report, the estimated portion of the human impact attributable to hatchery effects is 6 to 7 percent. If the latent mortality hypothesis is included, the range associated with hatchery impacts is 9 to 13 percent. However, as the Framework Group's Interim Human Mortality Report states, "Relative impacts related to hatchery programs and practices are highly uncertain, it is hoped that a more thorough treatment of this issue will be forthcoming from the Hatchery Workgroup, and that updated estimates can be incorporated into a subsequent version of this report" (*NWS v NMFS* 2006). The hoped-for work was never completed by the collaboration's Hatchery and Harvest Workgroup and the Interim Human Mortality Report was left incomplete n this regard.
Predation	Predation has been noted as a factor limiting fish survival for steelhead at mainstem hydro facilities and in the Columbia estuary.

Table 9-2. Key Limiting Factors

Hydro	Mainstem passage conditions result in an average mortality of about two-thirds of the juvenile steelhead. According to the Step 4 report, the estimated portion of the human impact attributable to the FCRPS dams (compared to natural river estimates) is 26 to 31 percent. If the latent mortality hypothesis is included, the range associated with the hydro system is 26 to 48 percent. Hydro impacts include volume, timing, and quality of flows that enter the geographic area, including flows from the Snake River at the toe of Hells Canyon Dam, which are impacted by the operation of U.S. Bureau of Reclamation's (Reclamation's) upper Snake River projects as well as non-Federal irrigation projects in the upper Snake River. Other hydrosystem impacts within the geographic area include the mainstem effects of Reclamation's other projects within the Columbia River Basin and many non-Federal irrigation projects within the Columbia River Basin.
Habitat	In the tributaries, reduced stream flow, unscreened water diversions, altered channel morphology, excessive sediment, and degraded water quality all contribute to poor survival of both juveniles and migrating adults. Rivers in the lower watersheds run through private agricultural lands, where summer water withdrawals result in low flows and, sometimes, dry stream beds in important rearing and holding areas. Upper watersheds in Federal ownership with logging roads and unstable slopes have caused heavy sedimentation in the streams. High-priority locations include the lower assessment units of the Methow, Entiat, Okanogan, and Wenatchee. According to the Step 4 report, the estimated portion of the human impact attributable to combined habitat effects in the tributaries and the estuary is 13 to 22 percent. If the latent mortality hypothesis is included, the human impact associated with habitat degradation is 33 to 40 percent.
Harvest	Harvest of natural-origin fish from Tribal treaty harvest and incidental catch in other fisheries is 4.5 to 10 percent. Increasingly selective harvest of surplus hatchery origin fish results in incidental take of natural-origin steelhead ranging from 0 to 5 percent in the Columbia River and some tributaries. According to the Step 4 report, the estimated portion of the human impact attributable to combined Tribal and non-Tribal harvest effects is 25 to 1 percent. If the latent mortality hypothesis is included, the range associated with the combined harvest impacts is 11 to 14 percent.
Estuary	Predation, levels of toxic substances, and habitat conditions in the plume are potential limiting factors.

9.2 BASE STATUS

This section summarizes the average status of this DPS during the base period, which for most populations is a 20-year period beginning in brood year 1980 or 1981, depending on the population. All of the analysis in this chapter relies on datasets supplied by the Interior Columbia Basin TRT. Those datasets do not include adult return information for the last 1 to 3 years, depending on the population.

9.2.1 DPS Abundance and Trends

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 (all abundance trend information from Fisher and Hinrichsen [2006]). The recent geomean abundance was influenced by exceptional returns in 2002, yet returns of natural-origin adults have been well above the 1996 to 2000 geomean in other years since 2000. The interim recovery abundance level identified by NMFS for the DPS as a whole is 5,500 (Lohn 2002). The sum of the Interior Columbia Basin TRT's minimum abundance thresholds for all populations in this DPS is 4,500 (Interior Columbia Basin TRT 1996).

Abundance and a rolling 5-year geometric mean of abundance for the DPS compared to the NMFS DPS interim recovery target are shown in Figure 9-2.

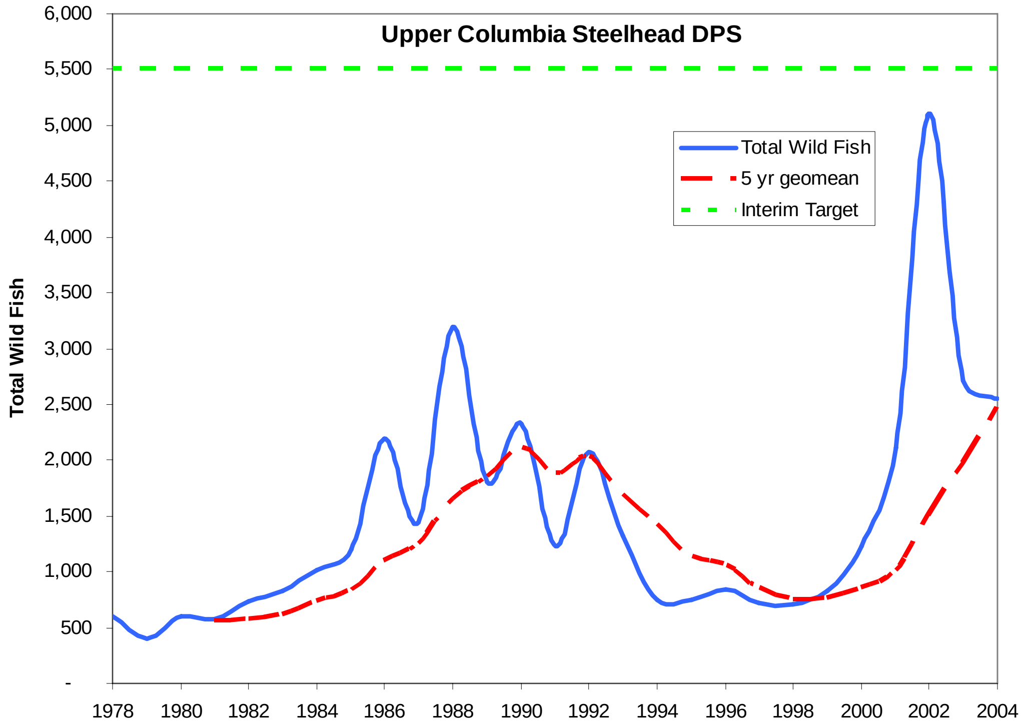

Figure 9-2. Upper Columbia River Steelhead Population Trends, 1978 to 2004

The DPS-level abundance trend of natural-origin spawners for 1990 to 2003 indicates an increasing population over that time. (The slope of the trend line for the DPS as a whole is 1.06 for this period.) The 1980 to 2003 DPS-level trend indicates slight negative growth (trend line slope of .99 for the DPS). All populations in the DPS show increasing population growth trends in the 1990 to recent period.

The geometric mean abundance of Upper Columbia River Steelhead returning to the Wenatchee, Methow, Entiat, and Okanogan rivers has averaged 951, 309, 100, and 114, respectively, for the most recent 10-year period for which data are available.

9.2.2 Extinction Probability and Risk

Results of extinction risk modeling are summarized in Table 9-3. Extinction probability estimates were developed for populations in this DPS using the Ricker production function, which was fit to spawner-recruit data from brood years 1978 to the present. The estimated Ricker function was used to project populations over a 24-year time horizon to estimate extinction probability. Alternative quasi-extinction thresholds (QETs) of 1, 10, 30, and 50 spawners were used in the analysis. In the modeling, extinction was assumed to occur when spawners fell below the QET for 4 years running. Reproductive failure was assumed to occur in any year in which spawner numbers fell below 10, except in the case of QET=1, where reproductive failure was assumed when spawners fell below two.

This modeling approach examined extinction risk first without future hatchery supplementation of the populations (Table 9-3), and then with future supplementation, the more likely prospect for three of the four extant populations (Table 9-4). It is expected that supplementation will continue for a number of the populations in this DPS for the foreseeable future. For that reason, we have also modeled extinction probabilities assuming continued supplementation at the average levels seen over the most recent 10 years. While modeling shows that supplementation provides a hedge against short-term extinction, we

Table 9-3. Base Status Metrics

Population	20-year R/S	20-year λ	12-year λ	1980-current Trend	1990-current Trend	Ext. Risk QET=1	Ext. Risk QET=10	Ext. Risk QET=30	Ext. Risk QET=50
Wenatchee	0.27	1.05	1.03	1.02	1.05	0.00	0.08	0.19	0.29
Methow	0.17	1.06	1.12	1.07	1.06	0.04	0.47	0.76	0.87
Entiat	0.27	1.04	1.03	1.02	1.05	0.08	0.44	0.72	0.83
Okanogan	0.12	N/A	N/A	1.06	1.06	0.40	0.91	0.99	1.00

Notes:
For R/S, lambda, and trend, a value >1.0 indicates a growing population. Extinction probabilities are expressed as percentages, e.g., a value of 0.11 indicates an 11 percent risk of extinction within 24 years.

Table 9-4. Extinction Probability Results Assuming Future Supplementation with Reduced Hatchery Fraction

Population	Ext. Risk QET = 1	Ext. Risk QET = 10	Ext. Risk QET = 30	Ext. Risk QET = 50
Upper Columbia River Steelhead -- Wenatchee River	0.00	0.00	0.00	0.00
Upper Columbia River Steelhead -- Methow River	0.00	0.00	0.01	0.01
Upper Columbia River Steelhead -- Entiat River	0.00	0.01	0.05	0.10
Upper Columbia River Steelhead -- Okanogan River	0.00	0.01	0.05	0.12

Notes:
Future supplementation levels were assumed to be significantly reduced from recent averages. Specifically, a future wild fraction of 0.67 was assumed for all populations. Hatchery effectiveness of 0.2 pre-1998 and0 .5 post-1998. A time horizon of 24 years. A risk level of 0.01 indicates a 1 percent risk of extinction, assuming that spawner abundance below the QET for 4 years running results in extinction.

acknowledge that longer-term supplementation must be carefully managed to control risks to viability. Supplementation is a strategy to support, not substitute for, self-sustaining natural populations.

Without future supplementation, base case extinction probability results indicate moderate to high probabilities of extinction for 75 percent of the modeled populations in this DPS, assuming QET=50. At QET=1 ("absolute" extinction as used in the 2000 FCRPS BiOp), only one population has a greater than 8 percent probability of extinction. Results at other QETs are displayed below. However, with the more likely scenario of future supplementation, the extinction risk is low for most of the modeled populations. Risk levels are highly dependent upon assumptions about past and future hatchery effectiveness and future numbers of hatchery-origin fish in the spawning populations. Table 9-4 assumes that management reforms significantly reduce the number of hatchery-origin fish in the spawning populations. Table 9-5 assumes that recent supplementation levels continue into the future. In both cases, stray rates into the Entiat are assumed to decline to one extent or another from base period levels.

Table 9-5. Extinction Probability Results Assuming Future Supplementation with No Change in Hatchery Fraction

Population	Ext. Risk QET = 1	Ext. Risk QET = 10	Ext. Risk QET = 30	Ext. Risk QET = 50
Upper Columbia River Steelhead -- Wenatchee River	0.00	0.00	0.00	0.00
Upper Columbia River Steelhead -- Methow River	0.00	0.00	0.00	0.00
Upper Columbia River Steelhead -- Entiat River	0.00	0.00	0.00	0.01
Upper Columbia River Steelhead -- Okanogan River	0.00	0.00	0.00	0.00

Notes:
Future supplementation levels were assumed to be equal to the average of the most recent 10 years. Hatchery effectiveness of 0.2 pre-1998 and 0.5 post-1998, except for the Entiat where future e=.2. A time horizon of 24 years. A risk level of 0.11 indicates an 11 percent risk of extinction, assuming that spawner abundance below the QET for 4 years running results in extinction.

9.2.3 Recruit-per-Spawner Productivity and Lambda

The productivity and survival metrics for the four populations comprising this DPS are summarized in Tables 9-3 through 9-5. Productivity, as reflected by estimates of R/S using a 20-year time series of data, is extremely low for all populations, averaging between 0.12 and 0.27. In contrast, 12- and 20-year λ estimates are > 1.0 for the Wenatchee, Methow, and Entiat populations, indicating an increase of total spawners (hatchery and natural origin); λ estimates have not been derived for the Okanogan population. In considering these results, it should be noted that λ, as calculated by the Interior Columbia Basin TRT (which is used here) overestimates annual population growth rates for populations with significant numbers of hatchery-origin fish in the spawning population.

Table 9-6 summarizes the needed improvements in survival to bring the base survival estimates in line with the proposed survival criteria. In this analysis, a metric of 1.0 reflects no gap. A number below 1.0 reflects a positive condition, while a number above 1.0 reflects a gap. For example, a gap of 1.2 indicates that 20 percent productivity is needed in the future.

Table 9-6. Base Status Gaps

Population	20-year R/S Gap	20-year λ Gap	Long-term Trend Gap
Wenatchee	3.70	0.80	0.91
Methow	5.88	0.77	0.75
Entiat	3.70	0.84	0.91
Okanogan	8.33	N/A	0.76

Notes:
Gaps are expressed as multipliers. For example, a 1.10 gap indicates a 10 percent improvement is necessary to close gap. If gap is ≤ 1.0, no further improvement is necessary to close gap.

9.2.4 Spatial Structure and Biological Diversity

Conserving and rebuilding sustainable salmonid populations involves more than meeting abundance and productivity criteria. Accordingly, NMFS has developed a conceptual framework defining a Viable Salmonid Population, or VSP (McElhany et al. 2000). In this framework there is an explicit consideration of four key population characteristic or parameters for evaluating population viability status: abundance, productivity (or population growth rate), biological diversity, and population spatial structure. The reason that certain other parameters, such as habitat characteristics and ecological interactions, were not included among the key parameters is that their effects on populations are implicitly expressed in the four key parameters. Based on the current understanding of population attributes that lead to sustainability, the VSP construct is central to the goal of ESA recovery, and warrants consideration in a jeopardy determination. However, it must also be stressed that the ability to significantly improve either a species' biological diversity or its spatial structure and distribution is limited within the timeframe of the Action Agencies' Proposed RPA.

Spatial Structure – Spatial structure, as the term suggests, refers to the geographic distribution of individuals in a population unit and the processes that generate that distribution. Distributed populations that interact genetically are often referred to as metapopulation. Although the spatial distribution of a population, and thus its metapopulation structure, is influenced by many factors, none are perhaps as important as the quantity, quality, and distribution of habitat. One way to think about the importance or value of a broad geospatial distribution is that a population is less likely to go extinct from a localized catastrophic event or localized environmental perturbations.

Biological Diversity – Biological diversity within and among populations of salmonids is generally considered important for three reasons. First, diversity of life history patterns is associated with a use of a wider array of habitats. Second, diversity protects a species against short-term spatial and temporal changes in the environment. And third, genetic diversity is the so-called raw material for adapting to long-term environmental change. The latter two are often described as nature's way of hedging its bets – a mechanism for dealing with the inevitable fluctuations in environmental conditions – long and short term. With respect to diversity, more is better from an extinction-risk perspective.

The Upper Columbia River Steelhead DPS is composed of four populations in a single MPG. Although these populations occupy diverse habitats within the accessible habitat downstream of Chief Joseph and Grand Coulee dams, the distribution of steelhead in this region was historically greater, with multiple populations spawning and rearing above these barriers. Whether the extant populations were part of a larger DPS that included these upper river populations is unknown. What is known is that these populations have been markedly impacted by hatchery programs that included the extensive use of homogenized broodstocks. As the result of this and other factors the Interior Columbia Basin TRT has designated all extant populations in this DPS at high risk for spatial structure and diversity (SSD). Although the status of this DPS will likely improve as a result of the recently implemented and proposed changes in the FCRPS and the Upper Snake River, it is unclear how much this will reduce SSD risk. However, particularly significant will be the continuing improvements in hatchery management and the reduced straying expected with locally adapted broodstocks in the Wenatchee Basin. Developing a locally adapted broodstock for the Okanogan River would also make an important contribution to reduced SSD risk.

Based on the magnitude of the gaps, improvements in survival will be needed to bring the 20-year R/S estimates in line with the survival and trending toward recovery criteria. The low productivity of the four Upper Columbia River Steelhead populations is likely due at least in part to the high proportion of poorly adapted hatchery fish in the historical spawning populations. The same is true of estimated extinction probabilities at all QET sensitivities and for much the same reason. Due to the nature of the model used for estimating extinction probabilities, we were not able to calculate gaps for steelhead populations. In addition to the major survival improvements already implemented and planned for the hydrosystem, we believe that a significant part of the needed productivity improvement for this DPS must come from a combination of ongoing and prospective hatchery management reforms and habitat improvements in the upper Columbia River Basin.

9.3 BIOLOGICAL ANALYSIS OF ACTIONS: RECRUITS-PER-SPAWNER, LAMBDA, AND TRENDS WITH CURRENT AND PROSPECTIVE ADJUSTMENTS

The Base Status is the historical status of the DPS, defined as the status of the population based on the *average* of quantitative survival metrics estimated from a time series of abundance data beginning in about 1980. For the most part, longer-term averages (generally 20 years) were used where they were available. In the biological analysis, this is the starting point, shown in the tables above.

The next step is Current Status, an adjustment of the initial base estimates to reflect our best estimate of current survivals, as opposed to an average of survivals that prevailed over a period in the past. This would obviously include recent improvements already implemented but not fully reflected in the Base conditions. Current Status is defined as estimated survival metrics adjusted for recently implemented changes in hydropower configuration and operations, hatchery operations, tributary and estuarine habitat improvements, and reduced avian predation. These are actions that have recently been implemented, but their effects are not reflected in the time series of survival data that for the most part started in 1980.

The final step is Prospective Status, which adjusts Current to Prospective Status based on the estimated effects of future actions. The current-to-prospective adjustment is simply an adjustment of the current survival estimates to reflect survival improvements expected from the hydro, habitat, and hatchery changes included in the FCRPS Proposed RPA and Upper Snake River Proposed Actions, and in particular those that are expected to be implemented in the period 2007 to 2017. Refer to Section 1.3 of this Comprehensive Analysis for a discussion of Reclamation's qualitative analysis for the years 2017 through 2034.

This analysis assumes that future ocean and climate conditions will approximate the average conditions that prevailed during the 20-year base period used for our status assessments. For most populations, that period is about equivalent to the "recent" ocean period used by the Interior Columbia Basin TRT in its analyses. This period was characterized by relatively poor ocean conditions that presumably contributed to poor early ocean survival of salmonids. To illustrate, the Interior Columbia Basin TRT's "pessimistic" ocean condition scenario results in survivals that are about 15 percent lower for Snake River Spring/Summer Chinook Salmon than the "recent' ocean conditions scenario, and about 36 percent lower for Upper Columbia River Spring Chinook Salmon. Alternatively, Interior Columbia Basin TRT's "historical" ocean conditions scenario results in survivals that are about 39 percent higher for both Snake River Spring/Summer Salmon and Upper Columbia River Spring Chinook Salmon (Interior Columbia Basin TRT and Zabel 2006). This subject is treated at greater length in the discussion of the effects of potential climate change in Appendix H.

9.3.1 Current Status Analysis

The Action Agencies implemented multiple actions to improve fish survival relative to the base period prior to 2000. The estimated survival improvements used in the base-to-current adjustments for the Wenatchee, Methow, Entiat, and Okanogan populations are summarized in Table 9-7. Actions are described in summary below.

Hatchery survival benefit estimates are primarily illustrative. WDFW-managed PUD summer steelhead hatchery programs in the Upper Columbia are undergoing significant reforms. The estimates in Table 9-7 are intended to illustrate the benefits that may already have been realized from reform actions, as well as potential benefits that could result from ongoing and expected future reforms. For simplicity's sake, this analysis combines base-to-current and current-to-prospective survival improvement estimates for hatchery reforms into one value displayed in either the base-to-current adjustment table below (Table 9-7 in Section 9.3.2) or the current-to-prospective table (Table 9-9 in Section 9.3.3). Some of the improvements underlying these estimates may take years or decades yet to realize. The estimates are based on differing assumptions about the past and future relative reproductive effectiveness of hatchery-origin spawners and the degree to which reform efforts succeed in meeting biological objectives described in these programs' hatchery genetic management plans (WDFW 2005). These estimates will be used to help inform a qualitative assessment of the expected future status of this DPS.

Table 9-7. Estimated Survival Improvements Used in the Base-to-Current Adjustment

Population	Hydro (FCRPS)	Hydro (PUD)	Habitat (tributary)	Habitat (estuary)	Avian predation	Hatchery (low)	Hatchery (high)	Harvest (ref)[1]
Wenatchee	14%	5%	2.0%	0.3%	-0.3%	52.0%	113.0%	8.0%
Methow	14%	22%	2.0%	0.3%	-0.3%	-	-	8.0%
Entiat	14%	10%	1.5%	0.3%	-0.3%	56.0%	150.0%	8.0%
Okanogan	14%	22%	6.0%	0.3%	-0.3%	-	-	8.0%

[1] Harvest adjustments represent estimated harvest decreases between the base and current periods. Estimates supplied by A. Nigro (ODFW) on behalf of an ad hoc *US v. OR* technical workgroup (Nigro 2007).

9.3.1.1 Hydropower Survival Improvements

The estimated percentage improvement in lifecycle survival attributable to changes in hydropower operations for the base-to-current period is based on estimated differences in juvenile migrant juvenile during the base period 1980 to 2001 and the more recent period 2001 to 2006. The configuration and operational changes that contributed to these improvements include:

- Bonneville Powerhouse I (PH1) minimum-gap turbine runner (MGR) installations;
- Bonneville Powerhouse II (PH2) Corner Collector installation;
- Bonneville PH2 fish guidance efficiency (FGE) improvements;
- Bonneville spill operation improvements including five additional flow deflectors;
- Bonneville PH1 juvenile bypass system (JBS) screen removal;
- Bonneville PH2 operation as first priority;
- The Dalles spill wall construction;
- The Dalles spill pattern improvements;
- The Dalles adult collection channel improvements;
- The Dalles sluiceway operation improvements;
- John Day spill operation improvements;
- John Day South Fish Ladder improvements;
- McNary spill operation improvements;
- McNary end spillbay deflectors and hoists;
- McNary full flow juvenile passive integrated transponder (PIT)-tag detection;
- McNary juvenile transport facility bypass piping improvements;
- McNary spare extended-length submerged bar screen (ESBS);
- McNary improved juvenile bypass dewatering screens;
- McNary adult PIT-tag detection in fish ladders;
- McNary overhauling auxiliary water supply (AWS) pumps; and
- McNary upgrading of adult fish ladders tilting weir controls.

For the Wenatchee, Methow, Entiat, and Okanogan populations these improvements when FCPRS and PUD actions were combined can be found in Table 9-5. Additional detail on how these percentages were estimated is in Appendix B. These estimates represent the "best estimates" of NMFS (see COMPASS tables in Appendix B).

9.3.1.2 Tributary Habitat Survival Improvements

From 2000 to 2006 BPA and Reclamation implemented actions to address limiting factors for all current populations in this DPS. BPA's annual expenditures for habitat projects in the Upper Columbia subbasins averaged about $500,000 for the 2001 to 2006 time frame. Reclamation's technical assistance cost totaled about $9 million during this period. Some of these actions provided benefits with immediate survival improvements and some will result in long-term benefits with survival improvements accruing into the future. During this time period the Action Agencies, in coordination with multiple partners:

- Increased streamflow through water acquisitions;
- addressed entrainment by installing or improving fish screens;
- Increased fish passage and access by removing passage barriers;
- Improved mainstem and side channel habitat conditions, and
- Improved water quality and habitat conditions by protecting and enhancing riparian areas.

Survival improvements estimated to result from tributary habitat actions implemented by the Action Agencies in this time period are shown in Table 9-7. The percentages indicate the incremental survival improvement estimated to accrue by 2006 from the suite of implemented actions. Survival improvements were estimated using as described in Appendix C, Attachment C-1.

9.3.1.3 Estuary Habitat Survival Improvements

The estimated survival benefit for Upper Columbia River Steelhead (stream-type life history) associated with the specific actions discussed above is 0.3 percent. Action Agencies implemented multiple habitat actions through 21 estuary habitat projects. Unrestricted fish passage and approximately 3 miles of access to quality habitat was provided via these specific actions:[2]

- Replaced three culverts with full-spanning bridges;
- Provided approximately 10 miles of improved tidal channel connectivity by installing a tide gate retrofit;
- Acquired approximately 473 acres of off-channel and riparian habitats;
- Restored and created 90 acres of marsh and tidal sloughs and approximately 100 acres of riparian forests
- Protected approximately 55 acres of high-quality riparian and floodplain habitat;
- Restored and preserved approximately 154 acres of off-channel habitat;
- Protected 80 acres of high-value off-channel forested wetland habitat;
- Restored approximately 96 acres of tidal wetlands habitat by replacing undersized culvert that limited fish access;
- Conserved 155 acres of forested riparian and upland habitat;
- Provided partial tidal channel reconnection by tide gate retrofit (acreage unknown at this time);
- Provided integrated pest management (purple loosestrife);
- Reconnected and restored 183 acres of historical floodplain by dike removal;
- Restored 25 acres of historical floodplain by breaching a dike;
- Provided fish passage access to 6 miles of stream habitat by removal of two culverts and replacement with bridges;

[2] A more thorough report detailing this evaluation process is: *Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary* (PC Trask & Associates 2007), which is included in Appendix D to this document.

- Restored 310 acres of native hardwood riparian forest, 200 acres of seasonally wet slough, and 155 acres of degraded riparian habitats; increased circulation in approximately 92 acres of backwater and side-channel habitat by tide gate retrofit;
- Improved embayment circulation for 335-plus acres of marsh/swamp and shallow-water and flats habitat; and
- Preserved 35 acres of historical wetland habitat.

9.3.1.4 Predation Management Survival Improvements

Avian Predation

The estimated survival change for Upper Columbia River Steelhead from the baseline-to-current condition is -0.3 percent. This reflects a reduction in survival from the base-to-current condition, because the tern population was increasing over the base period. Averaging tern consumption of juvenile salmonids across the 20-year base period downplays the actual change in survival that resulted from relocating terns from Rice Island to East Sand Island in 1999. In 1999 tern consumption of juvenile salmonids was at its peak with an estimated 13,790,000 smolts consumed, compared to 8,210,000 in 2000 after relocation.

Piscivorous Predation

The ongoing Northern Pikeminnow Management Program (NPMP) has been responsible for reducing predation-related juvenile salmonid mortality since 1990. The improvement in lifecycle survival attributed to the NPMP is estimated at 2 percent for migrating juvenile salmonids (Friesen and Ward 1999). The northern pikeminnow has been responsible for approximately 8 percent predation-related mortality of juvenile salmonid migrants in the Columbia River Basin in the absence of the NPMP (2000 FCRPS BiOp at 9-106). The ongoing NPMP is already accounted for in the estimation of survival improvements modeled within the reservoir mortality life stage. This is because the modeling estimates are calibrated to empirical reach survival estimates that included the ongoing program.

9.3.1.5 Hatchery Management Survival Improvements

Considering the significant impacts that hatchery practices have had on this DPS, and the likelihood that poorly adapted hatchery stock have depressed productivity – both demographically and through genetic effects and life history changes – the Action Agencies have attempted to quantitatively estimate a range of potential benefits that should result from past and proposed hatchery reforms. For simplicity, this estimate is combined into single values at the high and low ends of a range and included in the base-to-current or current-to-prospective adjustment tables. This range will be used to inform a qualitative assessment of the likelihood that this DPS will survive and be placed on a trend toward recovery.

The specific assumptions used in the hatchery survival change analysis are based on preliminary guidance from NMFS (NMFS 2007) and are described below. NMFS is currently reviewing and revising its guidance, but has not yet provided the Action Agencies with revised information for this analysis. The method used to develop these quantitative estimates is described in Appendix E.

Wenatchee

In 1998, the goal of the program changed from providing fish for harvest to intending fish to spawn naturally. Before 1998, the program fell into category 1 (hatchery-origin fish [HOF]<30 percent as effective as natural-origin fish [NOF]). After 1998, the program used local-origin NOF and HOF for broodstock (Category 3) and planted fish in primary steelhead production areas (to promote effectiveness); therefore, post-1998 hatchery effectiveness is likely to be in the 0.45 to 0.5 range. The “future f” (i.e., fraction of natural spawners) is likely to increase significantly. For this analysis, we have assumed a "future f" of 0.67 at the high end of the range. The low end of the survival change range for this population assumes hatchery effectiveness of 0.2 before 1998 and 0.45 after. It assumes that the future fraction of natural-origin spawners is equal to the most recent 10-year average (27 percent). The high end of the range assumes hatchery effectiveness of 0.2 before 1998 and 0.5 after. It assumes the future fraction of natural-origin spawners will be 0.67.

Entiat

The Entiat is being managed as a wild-only reference population. The Entiat hatchery program prior to its termination was most similar to Category 1 with hatchery effectiveness <.30. Broodstock originated from within the DPS (from Priest Rapids, Tumwater, and Wells collections). It is not reasonable to assume that any future hatchery strays into this basin would have hatchery effectiveness greater than .30. The goal for other WDFW-managed summer steelhead hatchery programs in the Upper Columbia is to limit straying to below 5 percent (Lohn 2002). The lower range of the hatchery survival change estimate for the Entiat assumes hatchery effectiveness of 0.2 for all periods and a stray rate of 50 percent. The upper end of the range assumes that hatchery managers will successfully curtail straying, limiting it to no more than 5 percent.

Methow

In 1998, the goal of the program changed from providing fish for harvest to intending fish to spawn naturally. Before 1998, the program fell into Category 1 (HOF<30 percent as effective as NOF) and HOF were planted in areas to accommodate fisheries, not promote HOF effectiveness (i.e., the majority of releases were not in prime steelhead production areas). After 1998, the program began to use some NOF in the broodstock (Category 3) and altered release locations to include steelhead production areas (to promote effectiveness). The program goal was changed to provide steelhead for both conservation and harvest. In recent years NOF in broodstock has increased to about 30 percent. Additionally, the eggs from earliest maturing broodstock are transferred to the Ringold Program as a hatchery reform measure to promote a synchronized maturation timing between HOF and NOF. Mechanisms are in place to decrease the number of HOF on the spawning grounds when returns of NOF meet identified criteria.

Available information would not support effectiveness estimates greater than 0.3 for HOF before 1998. HOF effectiveness was likely lower than 0.3 based on release practices and the propagation multiple generations of HOF. After 1998, HOF effectiveness may be incrementally increasing over time, but is still likely to be quite low in the 0.30 to 0.45 range. The "future f" (i.e., fraction of natural spawners) is likely to increase significantly. For this analysis, we have assumed a "future f" of 0.67 at the high end of the range. The low end of the survival change range for this population assumes hatchery effectiveness of 0.2 before 1998 and 0.3 after. It assumes that the future fraction of natural-origin spawners is equal to the most recent 10-year average (8 percent). The high end of the range assumes hatchery effectiveness of 0.2 before 1998 and 0.45 after. It assumes the future fraction of natural-origin spawners will be 0.67.

Okanogan

Similar to the other tributaries in the Upper Columbia River, the goal of the program was modified in 1998 to promote recovery. Prior to 1998 the program fell into Category 1 (hatchery effectiveness<.30). After 1998, the steelhead program at Wells Hatchery increased the use of natural-origin fish for broodstock. Additionally, the Colville Tribes have initiated a hatchery program in Omak Creek to promote local adaptation in the Okanogan River Basin. The Action Agencies propose to fund an expansion of this program. Before 1998, hatchery effectiveness was likely lower than 0.3 based on release practices and the propagation multiple generations of HOF. After 1998, hatchery effectiveness may be incrementally increasing over time, but is still likely to be in the 0.30 to 0.45 range based on current PUD program practices. We include a very conservative estimate of small additional survival improvements from the Colville Tribes' proposal in our high hatchery benefits estimate (below). Actual benefits could be much higher in the long term.

The low end of the hatchery benefits estimate range assumes that hatchery effectiveness was 0.2 before 1998 and 0.3 after 1998. For this estimate, the future wild fraction was assumed to be equal to the average of the most recent 10 years (8 percent). The high end of the range assumes hatchery effectiveness of 0.2 before 1998, hatchery effectiveness of 0.5 after (partly due to the Colville Tribes' proposal for the Okanogan population), and a future wild fraction of 0.67.

9.3.2 Current Survival Analysis

The Action Agencies implemented multiple actions to improve fish survival relative to the base period prior to 2000. The improvements in lifecycle survival used in the base-to-current adjustments for the Wenatchee, Methow, Entiat, and Okanogan populations are summarized in Table 9-8. Actions are described in summary below.

Table 9-8. Current Status: Adjusted Gaps after Base-to-Current Adjustment

Population	Adjusted 20-year R/S Gap (w/o hatchery)	Adjusted 20-year λ Gap (w/o hatchery)	Adjusted Long-term Trend Gap (w/o hatchery)
Wenatchee	2.81	0.61	0.69
Methow	3.84	0.50	0.49
Entiat	2.69	0.61	0.66
Okanogan	5.23	N/A	0.48

Notes:
Gaps are expressed as multipliers. For example, a 1.10 gap indicates a 10 percent improvement is necessary to close gap. If gap is ≤ 1.0, no further improvement is necessary to close gap.

9.3.3 Prospective Status Analysis

As noted above, the prospective status is the projected status of the population based on adjustment of the survival metrics for expected improvements associated with the Proposed RPA. As was the case for the base-to-current adjustment, the improvements for the current-to-prospective are divided into the categories of those expected from changes in hydropower operations and configuration (including Upper Snake River flow augmentation), changes in tributary habitat conditions attributable to actions implemented in the periods 2007 to 2009 and 2010 to 2017, changes in estuarine habitat, reduced impacts of avian predation, and improved hatchery operations.

Over this period the Action Agencies implemented and will continue to implement multiple actions to improve fish survival. The percentage improvements in lifecycle survival used in the current-to-prospective adjustments for the Wenatchee, Methow, Entiat, and Okanogan populations are summarized in Table 9-9.

Table 9-9. Estimated Improvements in Lifecycle Survival Used in the Current-to-Prospective Adjustment

Population	Hydro (FCRPS)[1/]	Hydro (PUD)	2007-2017 Habitat (trib.)	Habitat (estuary)	Avian predation	Pikeminnow predation	Hatchery (low)	Hatchery (high)
Wenatchee	12%	12%	4.0%	5.7%	3.4%	1.0%	-	-
Methow	12%	12%	4.0%	5.7%	3.4%	1.0%	27%	184%
Entiat	12%	12%	8.0%	5.7%	3.4%	1.0%	-	-
Okanogan	12%	12%	14.0%	5.7%	3.4%	1.0%	32%	208%

Notes:
1/ The hydro benefit incorporates improvements from the Public Utility District's (PUD's) Habitat Conservation Plan (HCP) BiOp.

9.3.3.1 Hydropower Survival Improvements

The estimated lifecycle survival benefit percentage increase attributable to the proposed hydropower operational and configuration improvement actions was estimated based on the difference between the estimated survival under the current operation (defined as the period 2001 to 2006) and estimated survival following implementation of the Proposed RPA. These increases in lifecycle survival from combined FCPRS and PUD actions can be found in Table 9-7. These estimates include prospective improvements from both the PUD Habitat Conservation Plan (HCP) improvements as well as FCRPS improvements, with over 50 percent of the benefits as a result of FCRPS actions. A detailed description of the methods used to generate these estimates can be found in Appendix B; these methods included the use of multiple data sources and the Comprehensive Fish Passage (COMPASS) model, and represent the "best estimates" of NMFS (see COMPASS tables in Appendix B). Specific actions contained within these strategies are listed in the Hydrosystem Action Summary. Not all of these specific actions apply to this DPS, as some specific actions are aimed at benefiting Snake River stocks. These strategies include:

1. Operate the FCRPS to more closely approximate the shape of the natural hydrograph and to improve juvenile and adult fish survival;
2. Modify Columbia and Snake river dams to facilitate safe passage;
3. Implement operational improvements at Columbia and Snake river dams;
4. Operate and maintain juvenile and adult fish passage facilities; and

Changes in the timing of Upper Snake River flow augmentation, as addressed in Reclamation's Upper Snake River Biological Assessment (BA), are also expected to improve conditions for survival.

9.3.3.2 Tributary Habitat Survival Improvements

Table 9-9 displays estimated population-level survival improvement percentages expected to result from Action Agency implementation of actions to address limiting factors in the tributary areas used by this DPS. The survival improvements identified represent an increase in Action Agency tributary habitat effort compared to efforts under the 2000 and 2004 FCRPS BiOps. Survival improvements were estimated as described in Appendix C, Attachment C-1.

2007 to 2017

BPA will fund and Reclamation will provide technical assistance for projects that implement new actions to address key limiting factors for this DPS. BPA will fund projects primarily through its Fish and Wildlife Program; Reclamation will provide technical assistance through annual Congressional appropriations. The Action Agencies will work with multiple parties for the successful implementation of these actions.

Initial Actions and Action Expansion

Consistent with its 2007 to 2009 Fish and Wildlife Program funding decision, BPA will fund implementation of 19 projects in the Wenatchee, Okanogan, Entiat, and Methow subbasins where this DPS is present. BPA has also dedicated 70 percent of the Columbia Basin Water Transactions Program (CBWTP) $5 million annual budget to secure water acquisitions and riparian easements for anadromous fish, including populations of Upper Columbia River Steelhead. For this time period, the average annual planned budgets (based on BPA Final Decision Letter) for these projects is approximately $4.7 million (not including the CBWTP).

Based on biological needs identified in the recent lifecycle biological analyses and input from the Remand Collaboration Process, BPA will also fund a suite of further actions beyond those identified in the 2007 to 2009 Fish and Wildlife Program decision for implementation beginning in the 2008 and 2009 (see Table 4-c in Attachment B.2.2-2 to Appendix B in the FCRPS BA).

BPA will fund projects in the four subbasins that:

- Increase instream flows;
- Remove fish passage barriers;
- Improve fish passage structures;
- Install fish screens;
- Increase channel complexity;
- Protect and enhance riparian habitat, and
- Improve water quality.

Reclamation will provide technical assistance for habitat projects in the Wenatchee, Entiat, and Methow subbasins. Further detail about Reclamation's actions is available in Table 5 in Attachment B.2.2-2 to Appendix B of the FCRPS BA document; project-level detail of the BPA-funded projects is available in Table 1-b in Attachment B.2.2-2.

Future Implementation

BPA will expand the level of effort and increase funding above the 2007 to 2009 period. Project funding decisions will be based on prioritized biological criteria and consistent with recovery plans. Reclamation technical assistance will be consistent with its Congressional funding authorizations.

9.3.3.3 Estuary Habitat Survival Improvements

2007 to 2009

The estimated survival benefit for Upper Columbia River Steelhead (stream-type life history) associated with the specific actions discussed below is 1.4 percent. The Action Agencies' estimated benefit for 2007 is based on actions that are or will be underway in the very near-term. For 2008 and 2009 the estimated benefit is based on the increased funding level described in the FCRPS BA.[3] The Action Agencies are or will be implementing multiple habitat actions through approximately 35 estuary habitat projects. Specific estuary habitat actions:

- Restore partial tidal influence and access to several acres (exact amount unknown at this time) by a tide gate retrofit;
- Improve hydrologic flushing and salmonid access to a lake (Sturgeon Lake is approximately 3,200 acres);
- Acquire and protect 40 acres of critical floodplain habitat and 40 acres of riparian forest restoration; install six to eight engineered log-jams that will help to slow flood flows, reduce erosion, contribute to sediment storage, enhance fish habitat, and contribute wood into the project area; acquire and restore floodplain connectivity to 380 acres of off-channel rearing habitat for juveniles;

[3] A more thorough report detailing this evaluation process is: *Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary* (PC Trask & Associates 2007), which is included in Appendix D to this document.

- Install fish-friendly tide gates to increase tidal flushing and fisheries access to approximately 110 acres;
- Riparian planting of up to 210 acres;
- Re-establish hydrologic connectivity to reclaim and improve floodplain wetland functions, increase off-channel rearing and refuge habitat on 5 acres, plant native vegetation along shoreline, and reconstruct slough channels on 2.5 acres of annually inundated off-channel habitat; as part of a long-term 1,500-acre restoration effort: breaching a dike and re-establishing flow to portion of original channel, planting vegetation on 50 acres, removing invasive weeds on 180 acres, planting wetland scrub shrub on 45 acres, and controlling and removing invasive wetland plants on 45 acres;
- Retrofit a tide gate (acreage unknown at this time);
- Protect and restore approximately 5 to 10 acres of emergent wetland and riparian forest habitats;
- Reconnect 45 acres of floodplain by tide gate removal;
- Acquire 45 acres of floodplain with future dike removal;
- Reconnect 50 acres of floodplain;
- Acquire 320 acres of tidelands and 119 acres of riparian/upland forest; and
- Restore 30 acres of riparian habitat.

There will be approximately 15 to 20 additional projects and associated actions similar to actions listed above that are undergoing scoping and sponsor development (the number of projects and associated actions is based on the increased funding level identified in the FCRPS BA).

2010 to 2017

The survival benefit for Upper Columbia River Steelhead (stream-type life history) associated with these actions is 4.3 percent. The Action Agencies' estimated benefits for 2010 to 2017 are based on continuing the same level of effort as 2007 to 2009. However, the level of effort in this time period may increase depending on the outcome of a General Investigation study of Ecosystem Restoration opportunities, depending on Congressional appropriations, future funding scenarios, and results of actions. Specific projects have yet to be identified. Actions for this period will be similar in nature to actions implemented in previous periods discussed above. Actions will include protection and restoration of riparian areas, protection of remaining high-quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, and reduction of noxious weeds, among others.

9.3.3.4 Predation Management Survival Improvements

Avian Predation

The estimated survival increase from the current-to-future condition for Upper Columbia River Steelhead is 3.4 percent, and this benefit is carried out to 2017 and beyond. This improvement is expected to result through the reduction in estuary tern nesting habitat, and subsequent relocation of terns outside the Columbia River Basin. Although the base-to-current shows a reduction in survival, the overall benefit (base-to- future) is positive.

Piscivorous Predation

The percentage improvement in lifecycle survival attributable to the proposed continuation of the increase in incentives in the NPMP and resultant marginal increase in observed exploitation rate is estimated at 1 percent total from 2007 to 2017. This estimate was derived based on the difference between the estimated benefits from the base NPMP (defined as the period 1990 to 2003) and estimated survival benefits under the increased incentive program (defined as the period of 2004 to present). This rate would generally apply to all juvenile salmonids.

9.3.3.5 Hatchery Management Survival Improvements

2007 to 2017

The Action Agencies will implement the following hatchery actions to improve survival of Upper Columbia River Steelhead:

- Fund the development of a locally adapted summer steelhead program to supplement natural production in the Okanogan River, as proposed by Colville Tribes. This program will improve abundance, productivity, and genetic diversity and a high level of benefits is expected to accrue during and after the BiOp period;
- Fund a steelhead kelt reconditioning program to increase abundance of steelhead in the Wenatchee, Entiat, and Methow basins, as proposed by WDFW and Yakama Nation. A high level of benefit is expected to accrue during and after the BiOp period;
- Implement high-priority hatchery reform actions, i.e., those needed to address hatchery programs that are considered by NMFS to be major limiting factors, resulting in improved abundance, productivity, diversity, and/or spatial structure of the target populations;
- Future implementation of ESA-relevant hatchery reforms identified through Columbia River Hatchery Scientific Review Group's hatchery review process, combined with use of Best Management Practices at FCRPS hatchery facilities, is expected to improve abundance, productivity, diversity, and/or spatial structure of target populations, depending on the nature of the reform; and
- In collaboration with the USFWS (the operator of the Leavenworth National Fish Hatchery [NFH] complex), the Action Agencies will accelerate various reforms or modify operations at the Leavenworth NFH Complex consistent with the "coarse screen" list of hatchery actions developed in the Hatchery/Harvest Workgroup and reviewed by the U.S. v. Oregon policy group. Reforms will reduce potential adverse effects of hatchery operations and hatchery-origin fish on ESA-listed Upper Columbia River spring Chinook salmon and steelhead.

In addition to specific changes to certain Upper Columbia River steelhead hatchery programs being proposed by the Action Agencies, it is expected that additional changes planned and implemented by the WDFW, NMFS, USFWS, and the Colville Tribes will continue to contribute to increasing survival and productivity. Although the aforementioned changes summarized for the base-to-current adjustment have already been factored into this analysis, it is important to recognize that these are estimates, and that the benefits of these actions may well be greater, but will likely take many years to accrue. This is expected to be the case with the development of locally adaptive broodstocks that were last present more than 60 years ago when Chief Joseph and Grand Coulee dams were constructed.

In the Wenatchee River, the expectation is that in-basin acclimation will markedly increase the fidelity of Wenatchee-origin fish returning to the Wenatchee Basin, and hence reduce their straying into other Upper Columbia River steelhead populations. This is expected to make a significant contribution to reducing straying into the Entiat. In the Methow and Okanogan programs, there are plans by WDFW and the Colville Tribes to develop locally adapted broodstocks. Not only will the continued development of locally adapted broodstock contribute to significantly enhanced productivity, but it will also make an important contribution to enhanced biodiversity.

9.3.3.6 Harvest Survival Improvements

2007 to 2017

The Action Agencies will fund the following harvest actions to improve survival of Upper Columbia River Steelhead:

- BPA will fund the Colville Tribes project proposal *Evaluation of Live Capture Selective Fishing Gear* through the Fish and Wildlife Program. This project will place selective gear in the Okanogan River where the percentage of known origin fish is high and will aim to remove non-localized stocks to improve Interior Columbia Basin TRT life-stage viability criteria. The Colville Tribes proposal describes the potential of up to over a 95 percent reduction in harvest impacts to listed species resulting from the implementation of selective gear and methods. The potential reduction in ESA impacts would be for application to fisheries that impact ESA fish; and
- The Action Agencies will also assist in the development of a plan to add PIT-tag detections in mainstem Columbia River fisheries. The potential benefit of this monitoring is providing an independent assessment of harvest impacts and stock composition in mainstem fisheries.

9.3.4 Prospective Survival Status

Comprehensive analyses of the changes in lifecycle survival resulting from the proposed FCRPS and upper Snake River actions and analysis of how they will change the survival metrics indicate that the Upper Columbia River Steelhead DPS still requires improvement in lifecycle survival to meet the R/S and extinction risk criteria for survival (Table 9-10).

Table 9-10 Estimated Future Status With Proposed RPA

Population	Estimated Future R/S (low hatchery)	Estimated Future R/S (high hatchery)	Estimated Future R/S (without hatchery)	Estimated Future λ (low hatchery)	Estimated Future λ (high hatchery)	Estimated Future Long-term Trend (low hatchery)	Estimated Future Long-term Trend (high hatchery)
Wenatchee	0.78	1.09	0.51	1.33	1.43	1.29	1.39
Methow	0.48	1.07	0.38	1.33	1.59	1.34	1.60
Entiat	0.87	1.39	0.56	1.35	1.50	1.32	1.47
Okanogan	0.40	0.93	0.30	N/A	N/A	1.39	1.68

Notes:
Future productivity values represent estimates of future R/S, lambda and trend after consideration of the effects of the Proposed RPA. A value >1.0 indicates a growing population; a value <1.0 indicates a population in decline. Low and high hatchery refer to the low and high ends of the range of estimated benefits that could accrue from successful hatchery reforms.

9.3.5 Remand Conceptual Framework Analysis

The FCRPS BiOp Remand's Collaboration among the sovereigns developed a Conceptual Framework approach intended to help the Action Agencies develop the Proposed RPA. The Framework approach attempted to estimate the relative magnitude of mortality factors affecting Interior Columbia River Basin salmonid populations. That assessment was intended to define the FCRPS's "relative expectation…for recovery" (FCRPS 2006). The collaboration's Framework working group developed high and low mortality estimates for all sources of mortality, including the FCRPS. The Collaboration's Policy Working Group has not determined where in that range the Action Agencies' Proposed RPA should be assessed with respect to recovery. The range of "gaps" that the Framework approach would expect the FCRPS to fill was reviewed and the Action Agencies assessed whether the total survival improvements estimated in this biological analysis would "fill" those gaps. For the purposes of this comparison, the

Interior Columbia Basin TRT gaps were used for "recent" ocean and "base hydro" conditions (corresponding to the base period used for R/S productivity estimation), and the Interior Columbia Basin TRT's 5 percent risk level.

The Conceptual Framework was intended, among other things, to "provide a clear and complementary link to ongoing recovery planning efforts" (FCRPS 2006). As such, it can be understood to represent the collaboration parties' view of the appropriate contribution of the FCRPS toward long-term recovery of the listed DPSs in the Interior Columbia River Basin. Therefore it provides another "metric" for use in considering the impacts of the Proposed RPA on a listed species' prospects for recovery. The results of this analysis are displayed in Table 9-11.

Briefly, even assuming no improvements from hatchery reforms, the Proposed RPA fills the Framework gaps at the high and low ends of the range for all populations in this DPS.

Table 9-11. Recovery Gap Calculations from the Conceptual Framework

Population	TRT Gap (as multiplier)	FCRPS Relative Impact (high)	FCRPS Relative Impact (low)	TRT Gap (high hydro)	TRT Gap (low hydro)	Total Survival Change (w/o hatchery)	Remaining Framework Gap (high)	Remaining Framework Gap (low)
Wenatchee	4.33	0.41	0.31	1.82	1.58	1.90	0.96	0.83
Methow	6.64	0.36	0.26	1.98	1.64	2.21	0.90	0.74
Entiat	6.31	0.38	0.28	2.01	1.67	2.06	0.98	0.81
Okanogan	8.69	0.35	0.26	2.13	1.75	2.52	0.85	0.70

Notes:
Interior Columbia Basin TRT gaps are expressed as multipliers. Gaps are for 5 percent risk, recent ocean/base hydro conditions. A "remaining" gap value <1.0 indicates no further improvement is necessary. Total survival changes combine all estimated survival improvements for the base-to-current and current-to-prospective adjustment.
FCRPS impacts are based on river flows that enter the FCRPS action area, including those that enter the Snake River at the toe of Hells Canyon Dam, which are affected by the operation of Reclamation's upper Snake Projects.

9.4 ADDITIONAL ACTIONS TO BENEFIT THE DPS

9.4.1 Other Reasonably Certain to Occur Actions

In the upper Columbia River, four subbasins – the Entiat, the Methow, the Okanogan, and the Wenatchee – contain non-Federal projects that will benefit ESA-listed steelhead. The Entiat, Methow, and Wenatchee subbasins will benefit from a combined 121 habitat actions, five non-Federal hydro actions, and hatchery reform actions. Specifically, reform efforts are underway in the PUD summer steelhead hatchery programs managed by WDFW. Management objectives are described in Hatchery Genetic Management Plans at *http://wdfw.wa.gov/hat/hgmp/*. Steelhead in the Okanogan subbasin will benefit from an additional 46 habitat actions. Though the benefits of most of these actions are not quantified, they would be expected to add to the benefits expected from the Action Agencies' Proposed RPA.

9.4.2 Other Future Federal Actions with Completed Section 7 Consultations

NMFS searched its Public Consultation Tracking Database (PCTS) for Federal actions that had completed Section 7 consultation since November 30, 2004 that could be used to adjust the status of the populations between the base and current periods. Results for each population are described below.[4]

[4] This information does not include any habitat conservation or restoration projects funded by BPA under NMFS' programmatic biological opinion for the Habitat Improvement Program (HIP). The effects of those projects are already taken into account in the base-to-current adjustment for species/population status.

9.4.2.1 Mainstem Mid-Columbia Hydroelectric Projects

NMFS completed ESA Section 7(a)(2) consultations on its issuance of incidental take permits to Douglas and Chelan County Public Utility Districts (PUDs) in support of the proposed Anadromous Fish Agreements and Habitat Conservation Plans (HCPs) for the Wells, Rocky Reach, and Rock Island hydroelectric projects in the mid-Columbia reach on August 12, 2003. Under the HCPs, Douglas and Chelan County PUDs agreed to use a long-term adaptive management process to achieve a 91 percent combined adult and juvenile survival standard for each salmon and steelhead ESU/DPS migrating through each project. In addition, compensation for up to 9 percent unavoidable project mortality is provided through hatchery and tributary programs, with compensation for up to 7 percent mortality provided through hatchery programs and compensation for up to 2 percent provided through tributary habitat improvement programs.

In May 2004, NMFS also completed an ESA Section 7 consultation on Federal Energy Regulatory Commission’s (FERC's) proposed amendment to the existing license for the Grant County PUD's Priest Rapids Hydroelectric Project, which permitted implementation of an interim protection plan, including interim operations for Wanapum and Priest Rapids dams. Under this biological opinion and incidental take statement, NMFS expects that project-related mortalities (i.e., direct, indirect and delayed mortality resulting from project effects) for both hydro projects combined will not exceed 23.2 percent for juvenile upper Columbia River Steelhead. NMFS also expects that implementation of the interim protection plan will result in mortality rates of no more than 3 percent per project or 6 percent combined for adult upper Columbia River Steelhead.

Thus, NMFS expects the cumulative mortality through the mid-Columbia reach of juvenile upper Columbia River Steelhead will be 19 percent for the Wenatchee population; 22 percent for the Entiat population; and 25 percent for the Methow population. The total mortality rates (natural and project-related) of adult upper Columbia River Steelhead are expected to be 4 percent for adult steelhead returning to the Wenatchee River, 5 percent for those returning to the Entiat, and 6 percent for those returning to the Methow.

Wenatchee River

The U.S. Forest Service (USFS) proposed fuels reduction projects in the White River – Little Wenatchee and Wenatchee River – Nason Creek watersheds, respectively, and a fire salvage timber sale in the Lower Wenatchee River watershed. The USFS also proposed a habitat restoration project in the Natapoc Ridge Forest (Wenatchee River – Nason Creek and Chiwawa River watersheds). The USFS' project to relocate White River Road and stabilize the streambank used large woody debris to increase habitat complexity (White River – Little Wenatchee River watershed). Another USFS project, replacing three culverts along Sand and Little Camas creeks (Lower Wenatchee River watershed), improved passage and partially restored natural channel-forming processes. The USFS completed one project 2007 under its programmatic consultation (19 Aquatic Habitat Restoration Activities in Oregon, Washington, Idaho, and California): a road decommissioning to improve riparian habitat and the connection to the floodplain along one mile of Clear Creek in the Chiwawa River watershed.

The Federal Highway Administration (FHWA)/Washington State Department of Transportation (WSDOT) consulted on a road construction project in the Wenatchee River – Icicle Creek watershed and a culvert replacement along Mill Creek (Wenatchee River – Nason Creek) to improve fish passage.

In the Lower Wenatchee watershed, NMFS consulted on the restoration of off-channel habitat; the USFWS funded the installation of a fishway on Peshastin Creek, designed to provide access to spawning and rearing habitat; and the U.S. Army Corps of Engineers (Corps) consulted on a fish passage enhancement project. The Corps also proposed 20 projects to build or maintain docks, piers, launches, boat lifts, moorage basins, and swimming beaches along the shores of Lake Entiat, Columbia River – Lynch Coulee, and Columbia River – Sand Hollow mainstem reaches (juvenile and adult migration corridors). The U.S. Department of the Army consulted on construction at the Yakima Training Center (Columbia River – Lynch Coulee and Columbia River – Sand Hollow mainstem reaches).

Entiat River

The USFS proposed a campground and summer home vegetation management project in the lower Entiat River watershed and habitat restoration activities in the Columbia River – Lynch Coulee portion of the mainstem Columbia River. NMFS consulted with itself on funding for a project in the lower Entiat River watershed that included building an overflow structure in an existing irrigation canal to improve fish passage; adding boulders and large wood to increase habitat complexity in a side channel; reconnecting the river and its floodplain; and enhancing the recruitment of spawning gravels.

The FHWA/WSDOT proposed road maintenance along State Route 28 (Sunset Highway), Eastside Corridor, East Wenatchee (Lake Entiat mainstem reach).

The Corps proposed 20 projects to build or maintain docks, piers, launches, boat lifts, moorage basins, and swimming beaches along the shores of Lake Entiat, Columbia River – Lynch Coulee, and Columbia River – Sand Hollow mainstem reaches (juvenile and adult migration corridors). The U.S. Department of the Army consulted on construction at the Yakima Training Center (Columbia River — Lynch Coulee and Columbia River — Sand Hollow mainstem reaches).

Methow River

The USFS consulted on a total of three timber sales in the Upper and Lower Chewuch and Twisp River watersheds; a grazing allotment plan for the Lower Chewuch and Middle Methow River watersheds; and a vegetation management plan for the Lower Methow River watershed. The USFS also consulted on projects to restore habitat damaged by grazing in the Lower Chewuch River watershed, improve passage (by replacing a diversion dam) into 7 miles of Little Bridge Creek (Twisp River watershed), and modify an irrigation ditch for access to 9 miles of habitat in a wilderness area (Middle Methow River watershed).

The USFS completed two projects during 2007 under its programmatic consultation with NMFS (19 Aquatic Habitat Restoration Activities in Oregon, Washington, Idaho, and California): decommissioning and relocating the Twisp River/North Creek Trail to improve 5 acres of riparian habitat and installing a culvert in Reynolds Creek to allow access to 4 miles of stream.

Reclamation consulted on leasing water from the Chewuch Canal Company (Lower Chewuch River watershed) to improve instream flows. The FHWA/WSDOT proposed a bridge rehabilitation project on Buttermilk Creek Road in the Twisp River watershed.

The Corps proposed 20 projects to build or maintain docks, piers, launches, boat lifts, moorage basins, and swimming beaches along the shores of Lake Entiat, Columbia River — Lynch Coulee, and Columbia River — Sand Hollow mainstem reaches (juvenile and adult migration corridors). The U.S. Department of the Army consulted on construction at the Yakima Training Center (Columbia River — Lynch Coulee and Columbia River — Sand Hollow mainstem reaches).

The FERC consulted on a license amendment for the Wells hydroelectric project—land easements for 11 irrigation diversions from Lake Entiat with new or improved fish screens.

9.5 OBSERVATIONS

The impact from historical hatchery practices on this DPS has likely been significant, as has mortality associated with Federal and non-Federal hydropower projects in the mainstem Columbia River. However, the difference in current status between Upper Columbia River Spring Chinook Salmon ESU and Upper Columbia River Steelhead DPS populations is telling. Listed fish from the DPS and the ESU pass through the same hydrosystem. Both occupy habitat that has been similarly impacted by human activity. The status of Upper Columbia River Steelhead, as evidenced by recruit-per-spawner productivity and other base period biological indicators, is generally much worse than the status of Upper Columbia River Spring Chinook Salmon. Two factors that distinguish steelhead from spring Chinook salmon populations in the Upper Columbia River are the extremely high proportion of hatchery fish in historical steelhead spawning populations and the wholesale homogenization of steelhead broodstock due to past broodstock collection practices. To the extent past hatchery practices have contributed to current low productivities in these populations, present and future hatchery reforms must be expected to help improve the situation.

Extinction probabilities, assuming no future hatchery supplementation, are high for all populations at QET=30 and QET=50. Risks are high for all populations except the Wenatchee at QET=10. However, when future supplementation is assumed, risks become low for all populations.

Base period R/S productivities are low for all populations. Assuming the high end of our range for future hatchery reform benefits, three of the four populations would be expected to have recruit-per-spawner productivity greater than 1.0. Assuming the low end of the range, significant gaps would remain. All of the populations in this DPS have shown increasing trends in abundance of natural-origin spawners between 1980 and 2004 or 2005. These trends are likely due in part to a boost in natural spawner numbers resulting from ongoing supplementation. The boost is provided by the second-generation progeny of fish spawned in the hatchery program (so-called F_2 progeny of hatchery-spawned fish). In effect, the hatchery programs for these populations provide not only a hedge against short-term extinction risk, they provide an annual "subsidy" for the population – a steady increase in abundance of naturally spawning fish that buys time to address the limiting factors that led to the decline in productivity in the first place, including poor hatchery practices. The Proposed RPA adds to the improvements that have taken place in hydrosystem survival in the last decade. It also increases efforts to address degraded habitat conditions. Significant survival improvements – and gap closure – are anticipated as a result. The collaboration's Conceptual Framework analysis also indicates that gaps are closed at the high and low ends of the Framework range.

9.6 CONCLUSION

Our analysis indicates that this DPS is likely to survive in the near term. We expect that ongoing and improved hatchery supplementation practices will lead to an increase in population productivity that, when combined with improvements in survival in the other Hs, should significantly improve the longer term status of this DPS. However, it could take decades to reverse the significant declines in natural productivity resulting from past hatchery practices and other human impacts. The Conceptual Framework analysis indicates that the proposed action more than fills both the high and low Framework gaps, providing a positive indication of the proposed action's effects on this DPS's prospects for recovery. The Action Agencies have worked with the States and Tribes through the Remand Collaboration Process and other forums to identify actions intended to address the needs of listed salmon and steelhead as determined by quantitative and qualitative biological analyses. Acknowledging that NMFS will review the actions and the effects analyses contained herein to make a final jeopardy determination in the forthcoming biological opinions, the Action Agencies are making the following conclusions. Based on our assessment of the FCRPS and Upper Snake River actions and analysis of effects, considering the present and future human and natural context, the Action Agencies conclude that the net effects of the proposed actions, including the existence and operations of the dams with the proposed mitigation, meet or exceed the objectives of doing no harm and contributing to recovery with respect to this DPS.

Chapter 10
Middle Columbia River Steelhead
Distinct Population Segment

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

10.1 INTRODUCTION

This chapter briefly summarizes the current biological status of the Middle Columbia River Steelhead Distinct Population Segment (DPS) related to extinction risk and the effects of the Federal Columbia River Power System (FCRPS) Proposed Reasonable and Prudent Alternative (RPA) in the context of recovery plan actions. First, it summarizes current status information including key limiting factors and extinction risks. Second, it includes a biological assessment of the survival effects of recent and planned actions on current and prospective conditions, respectively. Finally, it identifies additional actions to benefit the DPS. Summary data for the DPS are presented in Table 10-1. The geographic extent of the DPS is shown in Figure 10-1.

This chapter is organized into five sections. Section 10.1 provides an overview of the DPS and the factors limiting its viability. Section 10.2 summarizes population-level status information during the 20-year base period used for this analysis. Section 10.3 provides the analysis of the current status and provides estimates of the “gaps,” or needed lifecycle survival improvements for individual populations to meet certain biological criteria. It summarizes the improvements made to the hydropower (hydro) system and in other Hs (habitat, hatcheries, and harvest) since about 2000 and estimates the salmonid survival benefits associated with those improvements. Section 10.4 describes the actions proposed to be implemented into the future, and Section 10.5 estimates their effects on salmonid survival when aggregated with the environmental baseline and cumulative effects.

Table 10-1. DPS Description and Major Population Groups (MPGs)

DPS Description [1/]	
Threatened	Listed under Endangered Species Act (ESA) in 1999; reclassified as a DPS in 2006
Hatchery programs included in DPS	Touchet endemic; Yakima kelt programs in Toppenish, Satus Creek, Naches River, and Upper Yakima River; Umatilla; Deschutes
Current Major Population Groups	**Current Populations (Naturally Spawning)**
Yakima River Group	Satus Creek Toppenish Creek Naches River Yakima River upper mainstem
John Day River	John Day River lower mainstem Middle Fork John Day River South Fork John Day River John Day River upper mainstem North Fork John Day River
Cascades Eastern Slope Tributaries	Klickitat River Rock Creek Deschutes River - westside Deschutes River - eastside Fifteen Mile Creek (winter run)
Umatilla and Walla Walla River	Walla Walla River Touchet River Umatilla River

Notes:
[1/] 70 FR 37160; Interior Columbia Basin TRT 2003, 2005.

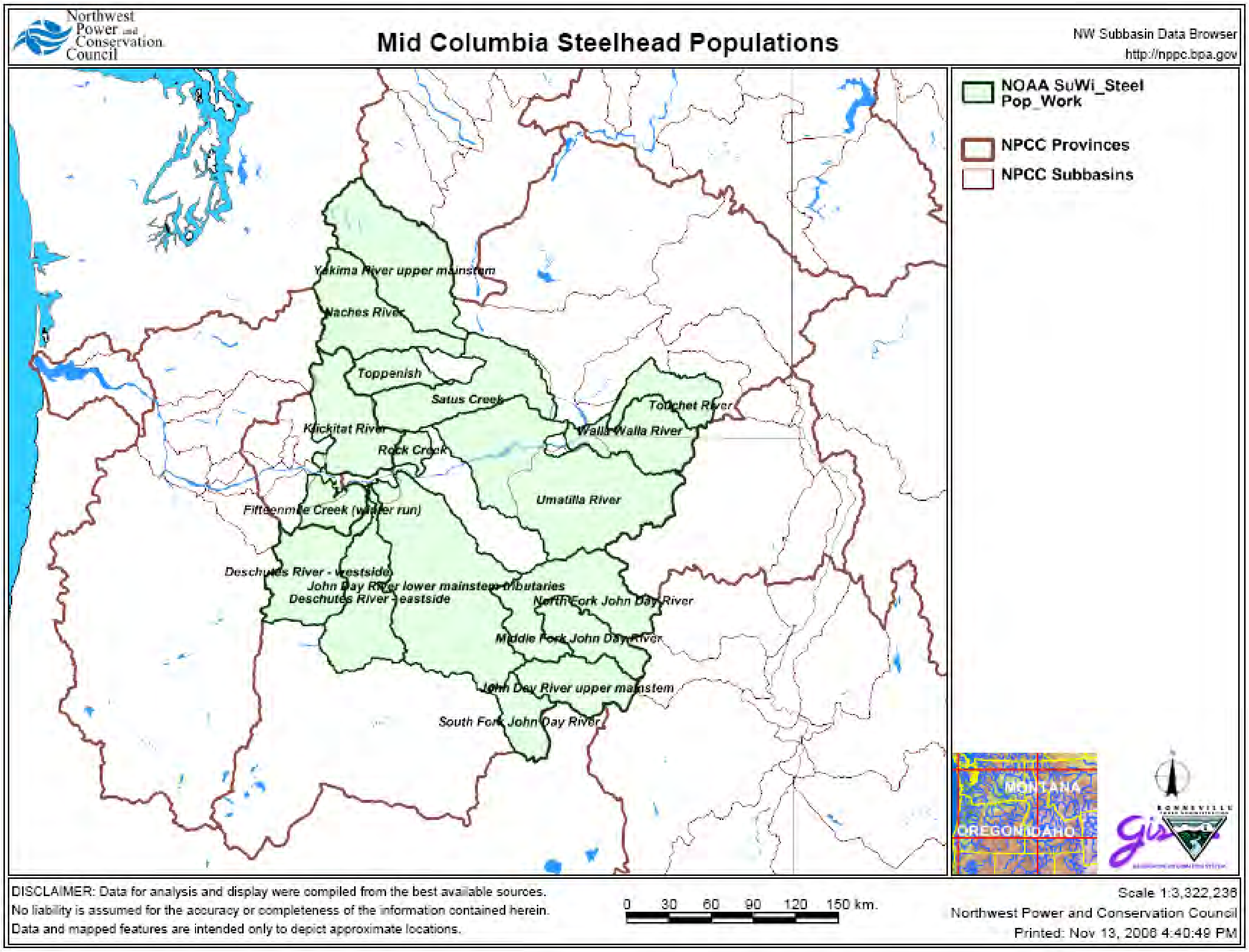

Figure 10-1. Middle Columbia River Steelhead DPS

Almost all of the metrics used in this analysis are estimates for individual populations within the DPS. The ESA is concerned with the status of a species, either a DPS or Evolutionarily Significant Unit (ESU). Individual populations and major population groups (where they exist) obviously contribute to DPS or ESU status. However, the status of the DPS or ESU is not wholly dependent upon the status of any of the individual components.

The Middle Columbia River Steelhead DPS includes steelhead populations in Oregon and Washington drainages upstream of the Hood and Wind river systems to and including the Yakima River. Snake River Steelhead are not included in this DPS. Major drainages in this DPS are the Deschutes, John Day, Umatilla, Walla Walla, Yakima, and Klickitat river systems. Almost all steelhead populations within this DPS are summer-run fish, with the exceptions of winter-run components returning to the Klickitat, and Fifteen Mile Creek watersheds. Most of the populations within this DPS are characterized by a balance between 1- and 2-year-old smolt outmigrants. Adults return after 1 or 2 years at sea.

The Interior Columbia Basin Technical Recovery Team (Interior Columbia Basin TRT) has identified four major population groups (MPGs): Cascade East Slopes, John Day, Walla Walla/Umatilla, and Yakima. The Cascade East Slopes MPG includes seven populations of which two are considered extirpated: White Salmon River (extirpated), Klickitat River, Deschutes River East, Deschutes River West, Crooked River (extirpated), Fifteen Mile Creek, and Rock Creek. The John Day MPG includes five populations: Lower John Day River, South Fork John Day River, Middle Fork John Day River, North Fork John Day River, and the Upper John Day River. The Walla Walla/Umatilla MPG include four populations of which one is considered extirpated: Willow Creek (extirpated), Umatilla River, Walla Walla River, and Touchet River. The Yakima MPG includes four populations: Satus Creek, Toppenish Creek, Naches River and Upper Yakima River.

Hatchery facilities are located in a number of drainages within the geographic area of this DPS, although there are also subbasins with little or no direct hatchery influence. The John Day River system, for example, has not been planted with hatchery steelhead. Similarly, hatchery production of steelhead in the Yakima River system was relatively limited historically and has been phased out since the early 1990s. The Umatilla and Deschutes river systems each have ongoing hatchery production programs based on locally derived broodstocks. Moreover, straying from out-of-basin production programs into the Deschutes River has been identified as a chronic occurrence. The Walla Walla River (three locations in Washington sections) historically received production releases of Lyons Ferry stock summer steelhead from the Lower Snake River Compensation Program (LSRCP). Mill Creek releases were halted after 1998 due to concerns associated with the then-pending listing of Middle Columbia River Steelhead under the ESA. A new endemic broodstock is under development for the Touchet River release site (beginning with the 1999/2000 return year). Production levels at the Touchet and Walla Walla river release sites have been reduced in recent years.

Hatchery programs included in the DPS include the Touchet River Endemic, Yakima River Kelt Reconditioning Program (in Satus Creek, Toppenish Creek, Naches River, and Upper Yakima River), Umatilla River, and Deschutes River steelhead hatchery programs. The average fraction of hatchery fish in the MPGs has varied over the years – a range of 2 to 6 percent in the Yakima, 8 to10 percent in the John Day, up to 39 percent in the Cascades, and up to 36 percent in the Umatilla/Walla Walla.

Harvest rate on Middle Columbia River Steelhead average about 4.5 to 10 percent, which is similar to that of A-run steelhead in the Snake River.

Blockages have prevented access to sizable steelhead production areas in the Deschutes River and the White Salmon River. In the Deschutes River, Pelton Dam blocks access to upstream habitat historically used by steelhead. Condit Dam, constructed in 1913, blocked access to all but 2 to 3 miles of habitat suitable for steelhead production in the Big White Salmon River. Substantial populations of resident trout exist in both areas.

Human impacts and current limiting factors for this DPS come from multiple sources: hydro passage, habitat degradation, hatchery effects, fishery management and harvest decisions, predation, and other sources.

10.1.1 Key Limiting Factors

Salmon and steelhead have been adversely affected over the last century by many activities including human population growth, introduction of exotic species, over fishing, developments of cities and other land uses in the floodplains, water diversions for all purposes, dams, mining, farming, ranching, logging, hatchery production, predation, ocean conditions, loss of habitat, and other causes (Lackey et al. 2006). Summarized in Table 10-2 are key limiting factors for this DPS identified by the National Marine Fisheries Service (NMFS, also called National Oceanic and Atmospheric Administration [NOAA] Fisheries) in the DPS Overviews for the Remand Collaboration (NMFS 2005e).

Table 10-2. Key Limiting Factors

Tributary Habitat and In-basin Hydro	Within the Yakima MPG, fish passage in Yakima tributaries is a limiting factor. At times in the Yakima mainstem, streamflows during juvenile outmigration are a limiting factor. Two hydro projects within the DPS block access to miles of upstream habitat: the Deschutes and the White Salmon. Cle Elum Dam, an irrigation storage facility in the Yakima, blocks access to 20-plus miles of upstream habitat. Current and legacy land uses continue to cause declines in steelhead survival in the tributaries. Of particular concern are reduced complexity of the stream system, water quantity during the summer, and water quality (largely temperature and sediment). In addition to current limiting factors and threats, we need to consider the potential loss of habitat resulting from future development, and the adequacy of regulatory mechanisms to address these threats. According to the Step 4 report, the estimated portion of the human impact attributable to combined habitat effects in the tributaries and the estuary is 20 to 26 percent. If the latent mortality hypothesis is included, the human impact associated with habitat degradation is 30 to 62 percent.
Mainstem Hydro	Fish passage is a limiting factor for Middle Columbia River Steelhead; they migrate through one to four mainstem Columbia River Dams as juveniles and as adults. Current juvenile mortality varies substantially, from an average of 16 to 53 percent, depending on the number of dams they pass. According to the Step 4 report, the estimated portion of the human impact attributable to the FCRPS dams (compared to natural river estimates) is 26 to 42 percent. If the latent mortality hypothesis is included, the range associated with the hydro system is 36 to 78 percent. Hydro impacts include volume, timing, and quality of flows that enter the geographic area, including flows from the Snake River at the toe of Hells Canyon Dam, which are impacted by the operation of U.S. Bureau of Reclamation's (Reclamation's) upper Snake River projects as well as non-Federal irrigation projects in the upper Snake River. Hydrosystem impacts within the geographic area also incorporate the mainstem effects of Reclamation's other projects within the Columbia River Basin and other non-Federal irrigation projects within the Columbia River Basin.
Predation	Predation has been noted as a factor limiting fish survival for steelhead at mainstem hydro facilities and in the Columbia estuary.
Hatcheries	A limiting factor for both the Deschutes and the John Day rivers comes from out-of-basin strays from Snake River hatcheries. In addition, five steelhead hatchery programs operate using the best management practices and are not considered major limiting factors for naturally spawning steelhead, but three are in need of some improvement. According to the Step 4 report, the estimated portion of the human impact attributable to hatchery effects is 1 to 2 percent. If the latent mortality hypothesis is included, the range associated with the hatchery system is 5 to 12 percent.
Estuary	Predation, levels of toxic substances, and conditions in the plume are limiting factors.
Harvest	As fisheries have become more stock-specific, direct commercial and recreational harvest of Middle Columbia natural-origin steelhead has been eliminated although catch-and-release mortality continues to be a factor. Remaining harvest is a result of tribal allocation and incidental catch from other fisheries, together resulting in 4.5 to 10 percent mortality**.** According to the Step 4 report, the estimated portion of the human impact attributable to combined Tribal and non-Tribal harvest effects is 2 to 25 percent. If the latent mortality hypothesis is included, the range associated with the combined harvest impacts is 17 to 33 percent.

10.2 BASE STATUS

This section summarizes the average status of this DPS during the base period, which for most populations is a 20-year period beginning in brood year 1979, 1980, or 1981, depending on the population. All of the analysis in this chapter relies on datasets supplied by the Interior Columbia Basin TRT. Those datasets do not include adult return information for the last 1 to 3 years, depending on the population.

10.2.1 DPS Abundance and Trends

Geometric mean abundance since 2001 has substantially increased for the DPS as a whole. Geomean abundance of natural-origin fish for the 2001 to most recent period was 17,553 compared to 7,228 for the 1996 to 2000 period, a 143 percent improvement (all abundance trend information from Fisher and Hinrichsen [2006]). The interim recovery abundance level identified by NMFS for the DPS as a whole is 55,400 (Lohn 2002). The sum of the Interior Columbia Basin TRT's minimum abundance thresholds for all populations in this DPS is 22,750 (Interior Columbia Basin TRT 2006).

The DPS-level abundance trend of natural-origin spawners for 1990 to 2002 indicates an increasing population over that time. (The slope of the trend line for the DPS as a whole is 1.06 for this period.) The 1980 to 2002 DPS-level trend indicates a declining trend over that time (trend line slope of .99 for the DPS). All but two populations in the DPS show increasing or steady population growth trends in the 1990 to recent period, although many populations show declines when the longer, 1980 to recent period is analyzed.

Abundance information on steelhead in the Middle Columbia is in general much better known than is the case for the Snake River populations. Ten-year geometric mean abundances of individual populations and the percent natural-origin spawner are summarized in Table 10-3. Abundances average over 1,000 fish per year in the Deschutes (eastside), the Lower John Day, the North Fork John Day, the Umatilla River and the Walla Walla River. With the exception of the Deschutes River (west- and east-side populations) and the Umatilla, the proportion of natural-origin spawners is relatively high, exceeding 90 percent.

Table 10-3. Ten-Year Geometric Mean Abundances and Percent Natural-Origin Fish

MPG	Population	10-year Geometric Mean Abundance	20-year Average Percent Natural-Origin Fish
E. Cascades	Klickitat	N/A	N/A
	Fifteen Mile Creek	593	100
	Deschutes (Westside)	470	77
	Deschutes (Eastside)	1,579	61
John Day River	L. John Day	1,800	94
	SF John Day	259	95
	MF John Day	756	95
	NF John Day	1,740	95
	U. John Day	524	95
Umatilla/Walla Walla	Umatilla	1,472	77
	Walla Walla	1,003	98
	Touchet	624	93
Yakima River	Satus Creek	568	94
	Toppenish	148	94
	Naches	462	94
	U. Yakima	92	98

Abundance and rolling 5-year geometric mean of abundance for the DPS are shown in Figure 10-2.

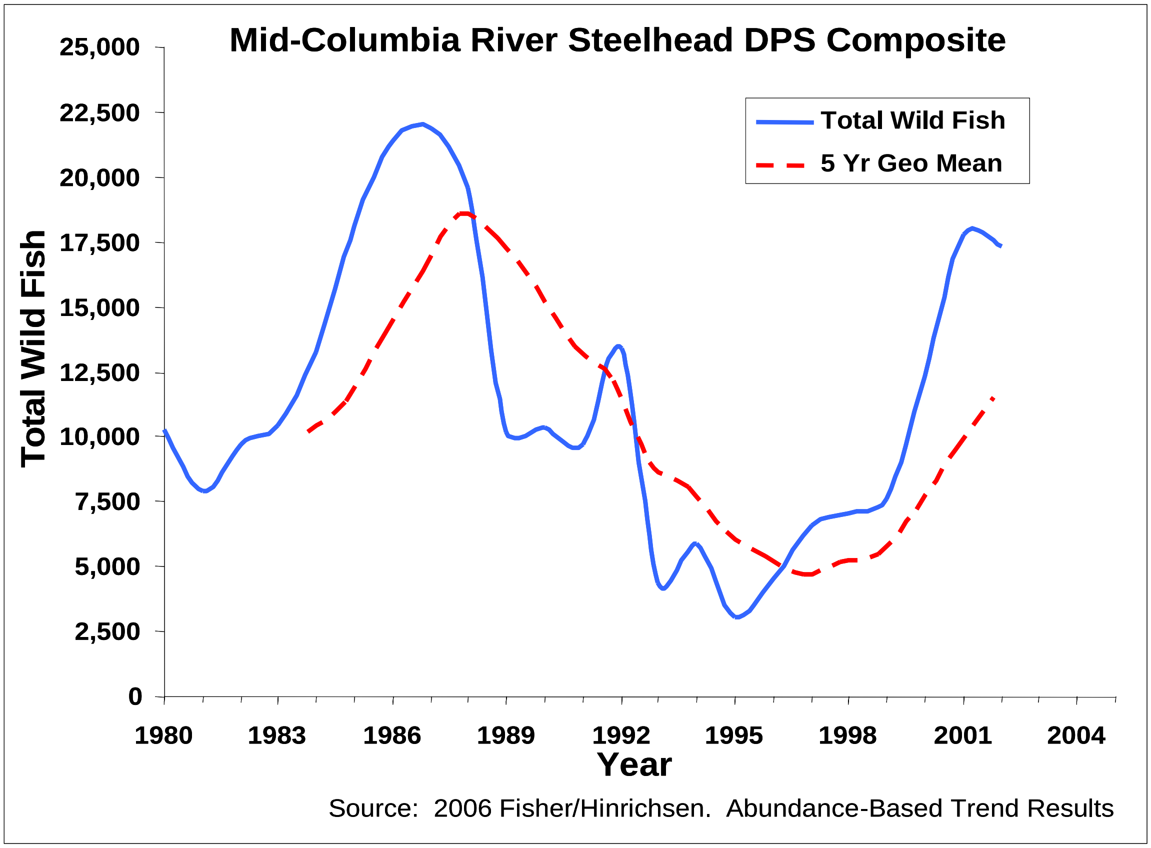

Figure 10-2. Middle Columbia River Steelhead Abundance Trends

10.2.2 Extinction Probability/Risk

The productivity and survival metrics for the 16 extant populations comprising the Middle Columbia River DPS are summarized in Table 10-4. Extinction probabilities for the Middle Columbia River Steelhead populations were estimated at quasi-extinction thresholds (QETs) of 1, 10, 30, and 50. Of the 14 Middle Columbia steelhead populations where adequate data exist to estimate extinction risk, 12 show low (< 5 percent at all QET sensitivities) risk of extinction over a 24-year time horizon. The three populations that fail to achieve this criterion are the Deschutes River (Eastside), Toppenish, and Upper Yakima. Extinction risk estimates at QET=1 were 43 percent and 3 percent, respectively.

10.2.3 Recruit-per-Spawner Productivity, Lambda, and Trends

Productivity, as reflected by estimates of recruits per spawner (R/S) using a 20-year time series of data, is less than 1.0 for six populations: Deschutes (Westside), South Fork John Day, Umatilla River, and three Yakima MPG populations (Satus Creek, Toppenish Creek, and Naches River). Median population growth rates (λ) estimated from a 20-year time series are uniformly greater than 1.0 for all populations. However, λ estimated from the most recent 10 years of return data are < 1.0 for four of the five John Day populations (Lower John Day, South Fork John Day, Middle Fork John Day, and Upper John Day). These same four John Day MPG population groups show a declining abundance trend based on a 1980-most recent record of return (generally either 2004 or 2005), but that trend largely becomes positive if estimated from the 1990 to most recent data series (the exception was the Middle Fork John Day population). All other populations show positive abundance trends based on both the longer- and shorter-term data sets. This mixed result is not surprising considering the biases inherent in the different metrics (see Appendix B). Table 10-4 also shows the 24-year extinction probabilities for the Middle Columbia River Steelhead DPS at QETs of 1, 10, 30, and 50. At QETs of 1 and 10 the 24-year risk was low (<5 percent) for all populations except the Deschutes River Eastside and the Upper Yakima. At a QET of 30 the estimated extinction risk of the Toppenish Creek population is 14 percent.

Table 10-4. Base Status Metrics

MPG	Population	20-yr. R/S	10-yr. R/S	20-yr. λ	12-yr. λ	1980-current Trend	1990-current Trend	Ext. Risk QET =1	Ext. Risk QET =10	Ext. Risk QET =30	Ext. Risk QET =50
E. Cascades	Klickitat	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Fifteen Mile Creek	1.21	-	1.04	1.10	1.04	1.11	0.00	0.00	0.00	0.00
	Deschutes (westside)	0.91	-	1.03	1.04	0.99	1.10	0.00	0.00	0.00	0.00
	Deschutes (eastside)	1.14	-	N/A	1.10	1.11	1.11	0.43	0.49	0.53	0.54
John Day River	L. John Day	1.24	1.55	1.02	0.97	0.98	1.04	0.00	0.00	0.00	0.00
	SF John Day	0.99	1.06	1.14	0.96	0.95	1.01	0.00	0.00	0.01	0.03
	MF John Day	1.17	1.04	1.02	0.97	0.97	0.98	0.00	0.00	0.00	0.00
	NF John Day	1.17	1.75	1.09	1.01	0.99	1.09	0.00	0.00	0.00	0.00
	U. John Day	1.07	0.83	1.14	0.96	0.95	0.96	0.00	0.00	0.00	0.00
Umatilla/ Walla Walla	Umatilla	0.94	0.93	1.06	1.07	1.01	1.07	0.00	0.00	0.00	0.00
	Walla Walla	N/A	0.92	N/A	1.14	1.04	1.04	0.00	0.00	0.00	0.00
	Touchet	N/A	0.86	N/A	N/A	N/A	0.98	N/A	N/A	N/A	N/A
Yakima River	Satus Creek	0.99	1.24	1.01	1.06	1.00	1.08	0.00	0.00	0.00	0.00
	Toppenish	0.99	1.27	1.01	1.06	1.01	1.09	0.00	0.02	0.14	0.33
	Naches	0.98	1.26	1.01	1.06	1.00	1.08	0.00	0.00	0.00	0.01
	U. Yakima	1.00	1.52	1.01	1.05	1.00	1.09	0.38	0.50	0.58	0.66

Note:
For R/S, lambda, and trend, a value >1.0 indicates a growing population; a value <1.0 indicates a population in decline. Extinction probabilities are expressed as percentages, e.g., a value of 0.11 indicates an 11 percent risk of extinction within 24 years.

Based on these base estimates of survival metrics for the Middle Columbia River MPGs, Table 10-5 summarizes the improvements in survival needed to bring the estimates in line with the proposed trending toward recovery and survival criteria. The model used to estimate extinction probabilities does not lend itself to the estimation of "gaps," or needed survival improvements to meet a given criterion. Therefore, "gap closure" is assessed qualitatively, as well as quantitatively, for all steelhead DPSs. A number below 1.0 reflects a positive condition, while a number above 1.0 reflects a gap. For example, a gap of 1.2 indicates that 20 percent productivity is needed in the future.

Table 10-5. Base Status Gaps

MPG	Population	20-year R/S Gap	20-year λ Gap	Long-term Trend Gap
E. Cascades	Klickitat	N/A	N/A	N/A
	Fifteen Mile Creek	0.83	0.84	0.84
	Deschutes (westside)	1.10	0.88	1.05
	Deschutes (eastside)	0.88	N/A	0.63
John Day River	L. John Day	0.81	0.91	1.10
	SF John Day	1.01	0.55	1.26
	MF John Day	0.85	0.91	1.15
	NF John Day	0.85	0.68	1.05
	U. John Day	0.93	0.55	1.26
Umatilla/Walla Walla	Umatilla	1.06	0.77	0.96
	Walla Walla	1.09	N/A	0.84
	Touchet	1.16	N/A	1.10
Yakima River	Satus Creek	1.01	0.96	1.00
	Toppenish	1.01	0.96	0.96
	Naches	1.02	0.96	1.00
	U. Yakima	1.00	0.96	1.00

Note: Gaps are expressed as multipliers. For example, a 1.10 gap indicates a 10 percent improvement is necessary to close gap. If gap is ≤ 1.0, no further improvement is necessary to close gap.

10.2.4 Spatial Structure and Biological Diversity

Conserving and rebuilding sustainable salmonid populations involves more than meeting abundance and productivity criteria. Accordingly, NMFS has developed a conceptual framework defining a Viable Salmonid Population, or VSP (McElhany et al. 2000). In this framework there is an explicit consideration of four key population characteristic or parameters for evaluating population viability status: abundance, productivity (or population growth rate), biological diversity, and population spatial structure. The reason that certain other parameters, such as habitat characteristics and ecological interactions, were not included among the key parameters is that their effects on populations are implicitly expressed in the four key parameters. Based on the current understanding of population attributes that lead to sustainability, the VSP construct is central to the goal of ESA recovery, and warrants consideration in a jeopardy determination. However, it must also be stressed that the ability to significantly improve either a species' biological diversity or its spatial structure and distribution is limited within the timeframe of the Action Agencies' Proposed RPA.

Spatial Structure – Spatial structure, as the term suggests, refers to the geographic distribution of individuals in a population unit and the processes that generate that distribution. Distributed populations that interact genetically are often referred to as metapopulation. Although the spatial distribution of a population, and thus its metapopulation structure, is influenced by many factors, none are perhaps as important as the quantity, quality, and distribution of habitat. One way to think about the importance or value of a broad geospatial distribution is that a population is less likely to go extinct from a localized catastrophic event or localized environmental perturbations.

Biological Diversity – Biological diversity within and among populations of salmonids is generally considered important for three reasons. First, diversity of life history patterns is associated with a use of a wider array of habitats. Second, diversity protects a species against short-term spatial and temporal changes in the environment. And third, genetic diversity is the so-called raw material for adapting to long-term environmental change. The latter two are often described as nature's way of hedging its bets – a mechanism for dealing with the inevitable fluctuations in environmental conditions – long and short term. With respect to diversity, more is better from an extinction-risk perspective.

The Middle Columbia River Steelhead DPS includes 18 extant populations that the Interior Columbia Basin TRT has clustered in four MPGs. Each of the populations contains at least three populations. Based on their Spatial Structure and Diversity (SSD) analyses and rating of 16 of the populations for which sufficient information were available, the Interior Columbia Basin TRT assigned a high risk to 6 populations, a moderate risk to 11 populations, and a high risk to only one population, moderate risk to 11, and low risk to five. Considering the wide geographic distribution of this DPS, the diversity of habitats utilized, and the preponderance of populations in the moderate SSD risk category, this DPS is currently at no greater than moderate risk for SSD, and this status will likely improve as a result of the recently implemented and proposed changes in the FCRPS including improvements to the volume and reliability of flow augmentation from the Bureau of Reclamation's upper Snake projects achieved in the Nez Perce Water Rights Settlement. Particularly significant will be the continuing improvements in hatchery management and the reduced straying expected with locally adapted broodstock.

10.3 BIOLOGICAL ANALYSIS OF ACTIONS: RECRUITS-PER-SPAWNER, LAMBDA, AND TRENDS WITH CURRENT AND PROSPECTIVE ADJUSTMENTS

The Base Status is the historical status of the DPS, defined as the status of the population based on the average of quantitative survival metrics estimated from a time series of abundance data beginning in about 1980. For the most part, longer-term averages (generally 20 years) were used where they were available. In the biological analysis, this is the starting point, shown in the tables above.

The next step is Current Status, an adjustment of the initial base estimates to reflect our best estimate of current survivals, as opposed to an average of survivals that prevailed over a period in the past. This would obviously include recent improvements already implemented but not fully reflected in the Base conditions. Current Status is defined as estimated survival metrics adjusted for recently implemented changes in hydropower configuration and operations, hatchery operations, tributary and estuarine habitat improvements, and reduced avian predation. These are actions that have recently been implemented, but their effects are not reflected in the time series of survival data that for the most part started in 1980.

The final step is Prospective Status, which adjusts Current to Prospective Status based on the estimated effects of future actions. The current-to-prospective adjustment is simply an adjustment of the current survival estimates to reflect survival improvements expected from the hydro, habitat, and hatchery changes included in the Proposed RPA, and in particular those that are expected to be implemented in the period 2007 to 2017. Refer to Section 1.3 of this Comprehensive Analysis for a discussion of Reclamation's qualitative analysis for the years 2017 through 2034.

This analysis assumes that future ocean and climate conditions will approximate the average conditions that prevailed during the 20-year base period used for our status assessments. For most populations, that period is about equivalent to the "recent" ocean period used by the Interior Columbia Basin TRT in its analyses. This period was characterized by relatively poor ocean conditions that presumably contributed to poor early ocean survival of salmonids. To illustrate, the Interior Columbia Basin TRT's "pessimistic" ocean condition scenario results in survivals that are about 15 percent lower for Snake River Spring/Summer Chinook Salmon than the "recent' ocean conditions scenario, and about 36 percent lower for Upper Columbia River Spring Chinook Salmon. Alternatively, Interior Columbia Basin TRT's "historic" ocean conditions scenario results in survivals that are about 39 percent higher for both Snake River Spring/Summer Salmon and Upper Columbia River Spring Chinook Salmon (Interior Columbia Basin TRT and Zabel 2006). This subject is treated at greater length in the discussion of the effects of potential climate change in Appendix H.

10.3.1 Current Status Analysis

The Action Agencies implemented multiple actions to improve fish survival relative to the base period prior to 2000. The percentage changes in lifecycle survival used in the base-to-current adjustments for the Middle Columbia River Steelhead DPS are summarized in Table 10-6. Actions are described in summary below:

Table 10-6. Estimated Survival Improvements Used in the Base-to-Current Adjustment

MPG	Population	Hydro	Habitat (tributary)	Habitat (estuary)	Avian predation	Harvest[1/]
Eastern Cascades	Klickitat	11.0%	4.0%	0.3%	-0.3%	8.0%
	Fifteen Mile Creek	12.0%	0.1%	0.3%	-0.3%	8.0%
	Deschutes (westside)	12.0%	0.2%	0.3%	-0.3%	8.0%
	Deschutes (eastside)	12.0%	1.0%	0.3%	-0.3%	8.0%
John Day River	L. John Day	6.0%	0.2%	0.3%	-0.3%	8.0%
	SF John Day	6.0%	0.7%	0.3%	-0.3%	8.0%
	MF John Day	6.0%	0.2%	0.3%	-0.3%	8.0%
	NF John Day	6.0%	0.3%	0.3%	-0.3%	8.0%
	U. John Day	6.0%	0.2%	0.3%	-0.3%	8.0%
Umatilla/Walla Walla	Umatilla	6.0%	4.0%	0.3%	-0.3%	8.0%
	Walla Walla	14.0%	4.0%	0.3%	-0.3%	8.0%
	Touchet	14.0%	4.0%	0.3%	-0.3%	8.0%
Yakima River	Satus Creek	14.0%	4.0%	0.3%	-0.3%	8.0%
	Toppenish	14.0%	4.0%	0.3%	-0.3%	8.0%
	Naches	14.0%	4.0%	0.3%	-0.3%	8.0%
	U. Yakima	14.0%	4.0%	0.3%	-0.3%	8.0%

Notes:
1/ Harvest adjustments represent estimated harvest decreases between the base and current periods. Estimates supplied by A. Nigro (ODFW) on behalf of an ad hoc *US v. OR* technical workgroup (Nigro 2007).

10.3.1.1 Hydropower Survival Improvements

Hydropower configuration and operational improvements implemented in recent years are estimated to have resulted in varying degrees of improved survival for all populations within the DPS depending on where each population enters the mainstem Columbia River (Table 10-6). These survival increases were estimated with Comprehensive Fish Passage (COMPASS) model using the 2006 hydrosystem configuration operating under the 2004 BiOp-specified operation for each dam. Specific configuration and operation improvements included in this estimate are:

- Bonneville Powerhouse I (PH1) minimum-gap turbine runner (MGR) installations (all MPGs);
- Bonneville PH1 juvenile bypass system (JBS) screen removal (all MPGs);
- Bonneville PH2 corner collector installation (all MPGs);
- Bonneville PH2 fish guidance efficiency (FGE) improvements (all MPGs);
- Bonneville PH2 operation as first priority (all MPGs);
- Bonneville spill operation improvements including five additional flow deflectors (all MPGs);
- The Dalles spill wall construction (all MPGs excluding Klickitat and Fifteen Mile populations);
- The Dalles spill pattern improvements (all MPGs excluding Klickitat and Fifteen Mile populations);

- The Dalles sluiceway operation improvements (all MPGs excluding Klickitat and Fifteen Mile populations);
- The Dalles adult collection channel improvements (all MPGs excluding Klickitat and Fifteen Mile populations);
- John Day spill operation improvements (John Day, Umatilla/Walla Walla, and Yakima MPGs);
- John Day South Fish Ladder improvements (John Day, Umatilla/Walla Walla, and Yakima MPGs);
- McNary spill operation improvements (Umatilla/Walla Walla [excluding Umatilla population] and Yakima MPGs);
- McNary end spillbay deflectors and hoists (Umatilla/Walla Walla [excluding Umatilla population] and Yakima MPGs);
- McNary full flow juvenile passive integrated transponder (PIT)-tag detections (Umatilla/Walla Walla [excluding Umatilla population] and Yakima MPGs);
- McNary juvenile transport facility bypass piping improvements (Umatilla/Walla Walla [excluding Umatilla population] and Yakima MPGs);
- McNary spare extended-length submerged base screen (Umatilla/Walla Walla [excluding Umatilla population] and Yakima MPGs);
- McNary improved juvenile bypass dewatering screens (Umatilla/Walla Walla [excluding Umatilla population] and Yakima MPGs);
- McNary adult PIT-tag detection in fish ladders (Umatilla/Walla Walla [excluding Umatilla population] and Yakima MPGs);
- McNary overhauling auxiliary water supply (AWS) pumps (Umatilla/Walla Walla [excluding Umatilla population] and Yakima MPGs); and
- McNary upgrading of adult fish ladders tilting weir controls (Umatilla/Walla Walla [excluding Umatilla population] and Yakima MPGs).

10.3.1.2 Tributary Habitat Survival Improvements

From 2000 to 2006, the Bonneville Power Administration (BPA) and Reclamation implemented actions to address limiting factors for populations of the John Day River MPG of this DPS. BPA also funded projects through the Northwest Power and Conservation Council (NPCC) Fish and Wildlife Program to implement habitat actions in the Deschutes, Fifteen Mile, Klickitat, Yakima, Walla Walla, and Umatilla subbasins that will improve survival of other Middle Columbia River Steelhead populations. BPA's annual expenditures for habitat projects in subbasins used by Middle Columbia River Steelhead averaged about $12 million for the 2001 to 2006 time frame. Reclamation spent over $3 million on technical assistance for habitat projects during this period.

During this time period the Action Agencies, in coordination with multiple partners, implemented the following actions for John Day River MPG populations:

- Increased streamflows through water acquisitions;
- Improved water quality and habitat conditions by protecting and enhancing riparian areas;
- Increased fish passage and access by removing passage barriers;
- Improved water quality;

- Addressed entrainment by installing or improving fish screens, and
- Improved channel habitat complexity and conditions.

Survival improvements estimated to result from tributary habitat actions implemented by the Action Agencies in this time period are shown in Table 10-6. The percentages indicate the incremental survival improvement estimated to accrue by 2006 from the suite of implemented actions. Survival improvements were estimated as described in Appendix C, Attachment C-1.

For the Eastern Cascades MPG, BPA funded habitat actions to address limiting factors for the Klickitat River, Fifteen Mile Creek, Westside and Eastside Deschutes, and Rock Creek populations. Actions to address limiting factors for all populations in the Yakima River Group and Walla Walla and Umatilla rivers MPGs were also implemented. Although estimates of survival improvements are shown for these populations, the actions will contribute to the recovery of this DPS. Additional detail on habitat actions implemented by BPA and Reclamation in the 2000 to 2006 time frame is available in the Action Agencies' Annual Progress Reports located at www.salmonrecovery.gov.

10.3.1.3 Estuary Habitat Survival Improvements

The estimated survival benefit for Snake River steelhead (stream-type life history) associated with the specific actions discussed above is about 0.3 percent. The Action Agencies implemented multiple habitat actions through 21 estuary habitat projects. Unrestricted fish passage and approximately 3 miles of access to quality habitat were provided via these specific actions:[1]

- Replaced three culverts with full-spanning bridges;
- Provided approximately 10 miles of improved tidal channel connectivity by installing a tide gate retrofit;
- Acquired approximately 473 acres of off-channel and riparian habitats;
- Restored and created 90 acres of marsh and tidal sloughs and approximately 100 acres of riparian forests;
- Protected approximately 55 acres of high-quality riparian and floodplain habitat;
- Restored and preserved approximately 154 acres of off-channel habitat;
- Protected 80 acres of high-value off-channel forested wetland habitat;
- Restored approximately 96 acres of tidal wetlands habitat by replacing undersized culvert that limited fish access;
- Conserved 155 acres of forested riparian and upland habitat;
- Provided partial tidal channel reconnection by tide gate retrofit (acreage unknown at this time);
- Provided integrated pest management (purple loosestrife);
- Reconnected and restored 183 acres of historical floodplain by dike removal;
- Restored 25 acres of historical floodplain by breaching a dike;

[1] A more thorough report detailing this evaluation process is: *Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary* (PC Trask & Associates 2007), which is included in Appendix D to this document.

- Provided fish passage access to 6 miles of stream habitat by removal of two culverts and replacement with bridges;
- Restored 310 acres of native hardwood riparian forest, 200 acres of seasonally wet slough, and 155 acres of degraded riparian habitats; increased circulation in approximately 92 acres of backwater and side-channel habitat by tide gate retrofit;
- Improved embayment circulation for 335-plus acres of marsh/swamp and shallow-water and flats habitat; and
- Preserved 35 acres of historical wetland habitat.

10.3.1.4 Predation Management Survival Improvements

Avian Predation

The estimated survival change for Middle Columbia River Steelhead from the baseline to current condition is -0.3 percent. This reflects a reduction in survival from the base-to-current condition, because the tern population was increasing over the base period. Averaging tern consumption of juvenile salmonids across the 20-year base period downplays the actual change in survival that resulted from relocating terns from Rice Island to East Sand Island in 1999. In 1999 tern consumption of juvenile salmonids was at its peak with an estimated 13,790,000 smolts consumed, compared to 8,210,000 in 2000 after relocation.

Piscivorous Predation

The ongoing Northern Pikeminnow Management Program (NPMP) has been responsible for reducing predation-related juvenile salmonid mortality since 1990. The improvement in lifecycle survival attributed to the NPMP is estimated at 2 percent for migrating juvenile salmonids (Friesen and Ward 1999). The northern pikeminnow has been responsible for approximately 8 percent predation-related mortality of juvenile salmonid migrants in the Columbia River Basin in the absence of the NPMP (2000 FCRPS BiOp at 9-106). The ongoing NPMP is already accounted for in the estimation of survival improvements modeled within the reservoir mortality life stage. This is because the modeling estimates are calibrated to empirical reach survival estimates that included the ongoing program.

10.3.1.5 Hatchery Management Survival Improvement

From 2000 to 2006, BPA implemented the following hatchery actions to benefit Middle Columbia River Steelhead:

- Funded a steelhead kelt reconditioning program to increase abundance and spatial structure of steelhead in the Yakima River. This provided a medium level of survival benefits for the Yakima River Upper Mainstem, Naches River, Toppenish, and Satus Creek populations of this DPS;
- Funded the Middle Columbia River Steelhead conservation program at the Umatilla hatchery to improve abundance and genetic diversity. This provided a high level of survival benefit for the Umatilla River population of this DPS; and
- Funded the development of Hatchery and Genetic Management Plans (HGMPs) for all Federally funded hatchery programs in the DPS. The objective was to develop the HGMPs for NMFS approval and identification of and prioritization of hatchery reform measures by NMFS. NMFS is expected to use the HGMPs in its hatchery program ESA Section 7 consultation to identify operational changes that will benefit listed populations. This planning process provided low benefits to the DPS.

10.3.2 Current Status Gaps

Based on these estimated improvements in the lifecycle survival from the above changes, the improvements still needed to achieve the survival criteria are summarized in Table 10-7. As noted earlier, gap closure for modeled extinction risks is assessed qualitatively.

Table 10-7. Current Status: Adjusted Gaps after Base–to-Current Adjustment

MPG	Population	Adjusted 20-year R/S Gap	Adjusted 20-year λ Gap	Adjusted Long-term Trend Gap
Eastern Cascades	Klickitat	N/A	N/A	N/A
	Fifteen Mile Creek	0.68	0.69	0.69
	Deschutes (Westside)	0.91	0.72	0.86
	Deschutes (Eastside)	0.72	N/A	0.51
John Day River	L. John Day	0.70	0.80	0.95
	SF John Day	0.88	0.48	1.09
	MF John Day	0.75	0.80	1.00
	NF John Day	0.74	0.59	0.91
	U. John Day	0.81	0.48	1.10
Umatilla/Walla Walla	Umatilla	0.89	0.65	0.80
	Walla Walla	0.85	N/A	0.65
	Touchet	0.91	N/A	0.86
Yakima River	Satus Creek	0.79	0.75	0.78
	Toppenish	0.79	0.75	0.75
	Naches	0.80	0.75	0.78
	U. Yakima	0.78	0.75	0.78

Note: Gaps are expressed as multipliers. For example, a 1.10 gap indicates a 10 percent improvement is necessary to close gap. If gap is ≤ 1.0, no further improvement is necessary to close gap.

10.3.3 Prospective Status Analysis

As noted above, the prospective status is the projected status of the population based on adjustment of the survival metrics for expected improvements associated with the Proposed RPA. As was the case for the base-to-current adjustment, the improvements for the current-to-prospective are divided into the categories of those expected from changes in hydropower operations and configuration (including Upper Snake River flow augmentation), changes in tributary habitat conditions attributable to actions implemented in the periods 2007 to 2009 and 2010 to 2017, changes in estuarine habitat, reduced impacts of avian predation, and improved hatchery operations.

Over this period the Action Agencies will implement multiple actions to improve fish survival relative to the current period. The percentage improvements in lifecycle survival used in the current-to-prospective adjustments for the Middle Columbia River Steelhead populations are summarized in Table 10-8. Actions are described in summary below.

Table 10-8. Current-to-Prospective Estimated Improvements in Lifecycle

MPG	Population	Hydro	2007-2017 Habitat (tributary)	Habitat (estuary)	Avian predati on	Pikeminnow predation
Eastern Cascades	Klickitat	0.3%	4.0%	5.7%	3.4%	1.0%
	Fifteen Mile Creek	5.0%	0.3%	5.7%	3.4%	1.0%
	Deschutes (Westside)	5.0%	< 1.0%	5.7%	3.4%	1.0%
	Deschutes (Eastside)	5.0%	3.1%	5.7%	3.4%	1.0%
John Day River	L. John Day	10.0%	< 1.0%	5.7%	3.4%	1.0%
	SF John Day	10.%	2.1%	5.7%	3.4%	1.0%
	MF John Day	10.0%	< 1.0%	5.7%	3.4%	1.0%
	NF John Day	10.0%	< 1.0%	5.7%	3.4%	1.0%
	U. John Day	10.0%	1.0%	5.7%	3.4%	1.0%
Umatilla/Walla Walla	Umatilla	10.0%	4.0%	5.7%	3.4%	1.0%
	Walla Walla	12.0%	4.0%	5.7%	3.4%	1.0%
	Touchet	12.0%	4.0%	5.7%	3.4%	1.0%
Yakima River	Satus Creek	12.0%	4.0%	5.7%	3.4%	1.0%
	Toppenish	12.0%	4.0%	5.7%	3.4%	1.0%
	Naches	12.0%	4.0%	5.7%	3.4%	1.0%
	U. Yakima	12.0%	4.0%	5.7%	3.4%	1.0%

10.3.3.1 Hydropower Survival Improvements

The estimated lifecycle survival benefit percentage increase attributable to the proposed hydropower operational and configuration improvement actions was estimated based on the difference between the estimated survival under the current operation (defined as the period 2001 to 2006) and estimated survival following implementation of the Proposed RPA. These increases in lifecycle survival range from 5.0 percent for most of the Eastern Cascades MPG up to 12.0 percent for the Yakima River MPG (Table 10-8). A detailed description of the methods used to generate these estimates can be found in Appendix B; these methods included the use of multiple data sources and the COMPASS model, and represent the "best estimates" of NMFS (see COMPASS tables in Appendix B). The configuration and operational improvement actions that contribute to these survival increases are organized into strategies. Specific actions contained within these strategies are listed in the Hydro Action Summary presented in Section 2 of the FCRPS Biological Assessment (BA). Not all of these specific actions apply to all populations in this DPS, as populations within this DPS enter the Columbia River at different locations above different dams.

Changes in the timing of Upper Snake River flow augmentation, as addressed in Reclamation's Upper Snake River BA, are also expected to improve conditions for survival.

10.3.3.2 Tributary Habitat Survival Improvements

Table 10-8 displays estimated population-level survival improvement percentages expected to result from Action Agency implementation of actions to address limiting factors in the tributary areas used by this DPS. The survival improvements identified represent an increase in Action Agency tributary habitat effort compared to efforts under the 2000 and 2004 FCRPS BiOps. Survival improvements were estimated as described in Appendix C, Attachment C-1.

2007 to 2017

BPA will fund projects that implement new actions to address key limiting factors and improve survival for this DPS. BPA will fund projects primarily through its Fish and Wildlife Program and Reclamation will provide technical assistance through annual Congressional appropriations.

Initial Actions

Consistent with its funding decisions for the NPCC 2007 to 2009 Fish and Wildlife Program, BPA will fund the implementation of 36 projects in the Deschutes, Fifteen Mile, John Day, Klickitat, Yakima, Walla Walla, and Umatilla subbasins where this DPS is present. BPA has also dedicated 70 percent of the Columbia Basin Water Transactions Program (CBWTP) $5 million annual budget to secure water acquisitions and riparian easements for anadromous fish, including populations of Middle Columbia River Steelhead. The BPA average annual planned budget (based on BPA Final Decision Letter) for the 36 projects is approximately $13.7 million (not including the CBWTP). The Action Agencies will work with multiple parties for the successful implementation of new actions. BPA will fund projects and Reclamation will provide technical assistance to:

- Increase instream flows;
- Remove passage barriers;
- Improve fish passage structures;
- Install fish screens;
- Increase channel complexity;
- Protect and enhance riparian habitat;
- Enhance floodplains, and
- Improve water quality.

Future Implementation

BPA funding decisions will be based on prioritized biological criteria and consistent with recovery plans. Reclamation will provide planning and design technical assistance for projects that: improve channel access and channel complexity, address entrainment, protect riparian areas, and increase streamflows for the John Day Middle Fork and John Day Upper Mainstem populations. Further detail about Reclamation's actions is available in Table 5 in Attachment B.2.2-2 to Appendix B of the FCRPS BA document; project-level detail of the BPA-funded projects is available in Table 2 in Attachment B.2.2-2.

10.3.3.3 Estuary Habitat Survival Improvements

2007 to 2009

The estimated survival benefit for Middle Columbia River Steelhead (stream-type life history) associated with the specific actions discussed below is 1.4 percent. The Action Agencies' estimated benefit for 2007 is based on actions that are or will be underway in the very near-term. For 2008 and 2009, the estimated benefit is based on the increased funding level identified in the BA.[2] Action Agencies are or will be implementing multiple habitat actions through approximately 35 estuary habitat projects. Specific estuary habitat actions are:

[2]A more thorough report detailing this evaluation process is: *Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary* (PC Trask & Associates 2007), which is included in Appendix D to this document.

- Restore partial tidal influence and access to several acres (exact amount unknown at this time) by a tide gate retrofit;
- Improve hydrologic flushing and salmonid access to a lake (Sturgeon Lake is approximately 3,200 acres);
- Acquire and protect 40 acres of critical floodplain habitat and 40 acres of riparian forest restoration; install six to eight engineered log-jams that will help to slow flood flows, reduce erosion, contribute to sediment storage, enhance fish habitat, and contribute wood into the project area; acquire and restore floodplain connectivity to 380 acres of off-channel rearing habitat for juveniles;
- Install fish-friendly tide gates to increase tidal flushing and fisheries access to approximately 110 acres;
- Complete riparian planting of up to 210 acres;
- Re-establish hydrologic connectivity to reclaim and improve floodplain wetland functions, increase off-channel rearing and refuge habitat on 5 acres, plant native vegetation along shoreline, and reconstruct slough channels on 2.5 acres of annually inundated off-channel habitat; as part of a long-term 1,500-acre restoration effort: breaching a dike and re-establishing flow to portion of original channel, planting vegetation on 50 acres, removing invasive weeds on 180 acres, planting wetland scrub shrub on 45 acres, and controlling and removing invasive wetland plants on 45 acres;
- Retrofit tide gates (acreage unknown at this time);
- Protect and restore approximately 5 to 10 acres of emergent wetland and riparian forest habitats;
- Reconnect 45 acres of floodplain by tide gate removal;
- Acquire 45 acres of floodplain with future dike removal;
- Reconnect 50 acres of floodplain;
- Acquire 320 acres of tidelands and 119 acres of riparian/upland forest; and
- Restore 30 acres of riparian habitat.

There will be approximately 15 to 20 additional projects and associated actions similar to actions listed above that are undergoing scoping and sponsor development (the number of projects and associated actions is based on the increased funding level described in the FCRPS BA).

2010 to 2017

The survival benefit for Middle Columbia River Steelhead (stream-type life history) associated with these actions is about 4.3 percent. The Action Agencies' estimated benefits for 2010 to 2017 are based on continuing the same level of effort as 2007 to 2009. However, the level of effort in this time period may increase depending on the outcome of a General Investigation study of Ecosystem Restoration opportunities, depending on Congressional appropriations, future funding scenarios, and results of actions. Specific projects have yet to be identified. Actions for this period will be similar in nature to actions implemented in previous periods discussed above. Actions will include protection and restoration of riparian areas, protection of remaining high-quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, and reduction of noxious weeds, among others.

10.3.3.4 Predation Management Survival Improvements

Avian Predation

The estimated survival increase from the current-to-future condition for Middle Columbia River Steelhead is 3.4 percent, and this benefit is carried out to 2017 and beyond. This improvement is expected to result through the reduction in estuary tern nesting habitat, and subsequent relocation of terns outside the Columbia River Basin. Although the base-to-current shows a reduction in survival, the overall benefit (base-to-future) is positive.

Piscivorous Predation

The percentage improvement in lifecycle survival attributable to the proposed continuation of the increase in incentives in the NPMP and resultant marginal increase in observed exploitation rate is estimated at 1.0 percent total from 2007 to 2017. This estimate was derived based on the difference between the estimated benefits from the base NPMP (defined as the period 1990 to 2003) and estimated survival benefits under the increased incentive program (defined as the period of 2004 to present). This rate would generally apply to all juvenile salmonids.

10.3.3.5 Hatchery Management Survival Improvements

2007 to 2017

The Action Agencies will implement the following hatchery actions to improve survival of Middle Columbia River Steelhead:

- BPA will continue to fund a steelhead kelt reconditioning program to increase abundance and spatial structure of steelhead in the Yakima River. This will provide a medium level of survival benefits for the Yakima River Upper Mainstem, Naches River, Toppenish, and Satus Creek populations of this DPS;
- BPA will continue to fund the Middle Columbia River Steelhead conservation program at the Umatilla hatchery to improve abundance and genetic diversity. This will provide a high level of survival benefit for the Umatilla River population of this DPS; and
- The Action Agencies will adopt programmatic criteria for funding decisions on mitigation programs for the FCRPS that incorporate best management practices as outlined in NMFS guidance on hatchery operation and as defined in final, NMFS-approved HGMPs completed during site-specific hatchery consultations to be initiated and conducted by hatchery operators with the Action Agencies as cooperating consulting parties.

10.3.4 Prospective Status

Comprehensive analyses of the changes in lifecycle survival resulting from the Proposed RPA and upper Snake actions and analysis of how they will change the survival metrics are summarized in Table 10-9.

Table 10-9. Prospective Status: Adjusted Future Productivity Trends after Current-to-Prospective Analysis

MPG	Population	Estimated Future R/S	Estimated Future λ	Estimated Future Trend
Eastern Cascades	Klickitat	N/A	N/A	N/A
	Fifteen Mile Creek	1.70	1.12	1.12
	Deschutes (westside)	1.29	1.11	1.07
	Deschutes (eastside)	1.66	N/A	1.21
John Day River	L. John Day	1.75	1.10	1.06
	SF John Day	1.41	1.23	1.03
	MF John Day	1.65	1.10	1.05
	NF John Day	1.65	1.18	1.07
	U. John Day	1.50	1.23	1.02
Umatilla/Walla Walla	Umatilla	1.41	1.16	1.11
	Walla Walla	1.52	N/A	1.16
	Touchet	1.42	N/A	1.10
Yakima River	Satus Creek	1.63	1.13	1.12
	Toppenish	1.63	1.13	1.13
	Naches	1.61	1.13	1.12
	U. Yakima	1.65	1.13	1.12

Note: Future productivity values represent estimates of future R/S, lambda, and trend after consideration of the effects of the Proposed RPA. A value >1.0 indicates a growing population; a value <1 indicates a population in decline.

10.3.5 Remand Conceptual Framework Analysis

The FCRPS BiOp Remand's Collaboration among the sovereigns developed a Conceptual Framework approach intended to help the Action Agencies develop the Proposed RPA. The Framework approach attempted to estimate the relative magnitude of mortality factors affecting Interior Columbia Basin salmonid populations. That assessment was intended to define the FCRPS's "relative expectation…for recovery" (FCRPS 2006). The collaboration's Framework working group developed high and low mortality estimates for all sources of mortality, including the FCRPS. The Collaboration's Policy Working Group has not determined where in that range the Action Agencies' Proposed RPA should be assessed. The range of "gaps" that the Framework approach would expect the FCRPS to fill was reviewed and the Action Agencies assessed whether the total survival improvements estimated in this biological analysis would "fill" those gaps. For the purposes of this comparison, the Interior Columbia Basin TRT gaps were used for "recent" ocean and "base hydro" conditions (corresponding to the base period used for R/S productivity estimation), and the Interior Columbia Basin TRT's 5 percent risk level.

The Conceptual Framework was intended, among other things, to "provide a clear and complementary link to ongoing recovery planning efforts" (FCRPS 2006). As such, it can be understood to represent the collaboration parties' view of the appropriate contribution of the FCRPS toward long-term recovery of the listed DPSs or ESUs in the Interior Columbia River Basin. Therefore, it provides another "metric" for use in considering the impacts of the Proposed RPA on a listed species' prospects for recovery. The results of this analysis are displayed in Table 10-10.

Table 10-10. Gap Calculations from the Conceptual Framework

MPG	Population	TRT Gap	FCRPS Relative Impact (high)	FCRPS Relative Impact (low)	TRT Gap (high hydro)	TRT Gap (low hydro)	Total Survival Change	Remaining Framework Gap (high)	Remaining Framework Gap (low)
E. Cascades	Klickitat		0.36	0.26			1.44		
	Fifteen Mile Creek	1.60	0.48	0.32	1.25	1.16	1.41	0.89	0.82
	Deschutes (westside)	1.75	0.48	0.32	1.31	1.20	1.41	0.92	0.85
	Deschutes (eastside)	0.86	0.48	0.32	0.93	0.95	1.46	0.64	0.65
John Day River	L. John Day	1.14	0.57	0.39	1.08	1.05	1.41	0.77	0.75
	SF John Day	1.32	0.57	0.39	1.17	1.11	1.42	0.82	0.78
	MF John Day	1.21	0.57	0.39	1.11	1.08	1.41	0.79	0.76
	NF John Day	0.53	0.57	0.39	0.70	0.78	1.41	0.49	0.55
	U. John Day	1.21	0.57	0.39	1.11	1.08	1.40	0.79	0.77
Umatilla Walla Walla	Umatilla	1.09	0.57	0.39	1.05	1.03	1.50	0.70	0.69
	Walla Walla	0.99	0.60	0.42	0.99	1.00	1.65	0.60	0.60
	Touchet		0.60	0.42			1.65		
Yakima River	Satus Creek	1.59	0.60	0.42	1.32	1.22	1.65	0.80	0.74
	Toppenish	1.57	0.60	0.42	1.31	1.21	1.65	0.80	0.73
	Naches	2.01	0.60	0.42	1.52	1.34	1.65	0.92	0.81
	U. Yakima	2.50	0.60	0.42	1.73	1.47	1.65	1.05	0.89

Notes:
1/ Interior Columbia Basin TRT gaps are expressed as multipliers. Gaps are for 5 percent risk, recent ocean/base hydro conditions. A "remaining" gap value <1.0 indicates that no further improvement is necessary. Total survival changes combine all estimated survival improvements for the base-to-current and current-to-prospective adjustment.
2/ FCRPS impacts are based on river flows that enter the FCRPS action area, including those that enter the Snake River at the toe of Hells Canyon Dam, which are affected by the operation of Reclamation's upper Snake Projects.

Briefly, the Proposed RPA (without considering either improvements in the environmental baseline or other actions reasonably certain to occur) fills Framework gaps at the low end of the range for all populations in this DPS, and leaves only very small gaps at the high end of the range for one of the 14 populations for which the Interior Columbia Basin TRT had calculated gaps in its Interim Gaps Report.

10.4 ADDITIONAL ACTIONS TO BENEFIT THE DPS

10.4.1 Other Reasonably Certain to Occur Actions[3]

Based on information developed by the Remand Collaboration, steelhead populations in the Middle Columbia River Steelhead DPS will benefit from a combined 253 non-Federal habitat actions in the Klickitat, Yakima (three Watershed Resource Inventory Areas), and Walla Walla subbasins. Though the benefits of these actions are not quantified, they would be expected to add to the benefits expected from the Action Agencies' Proposed RPA.

10.5 OBSERVATIONS

10.5.1 Eastern Cascades Major Population Group

There are seven populations in this MPG; however, two are considered by the Interior Columbia Basin TRT to be functionally extirpated (White River and Crooked River). Of the five remaining populations,

[3] Many of the actions listed above have a cost-share component with a variety of other Federal funding sources and therefore may be properly described as contributing to the status of the environmental baseline rather than cumulative effects.

data are available to estimate extinction risk and estimate productivity metrics for Fifteen Mile Creek, the Deschutes River (Westside), and the Deschutes River (Eastside). Data are lacking for Rock Creek and the Klickitat River.

Base period 24-year extinctions probabilities are negligible for the Fifteen Mile Creek and Deschutes River (Westside) populations at all modeled QETs. In contrast, the base 24-year extinction probabilities for the Deschutes River (Eastside) are above the less than 5 percent criterion at all QETs.

All metrics indicative of recovery are expected to be well above 1.0 after the effects of the action are considered. Conceptual Framework gaps are expected to be filled at both the high and low ends of the range.

10.5.2 John Day River Major Population Group

The John Day River MPG consists of five populations: the Lower John Day River, South Fork John Day River, Middle Fork John Day River, North Fork John Day River, and Upper John Day River. All were considered viable by the Interior Columbia Basin TRT, and results of extinction risk modeling demonstrate that all have a negligible risk of extinction at all tested QETs.

All metrics indicative of recovery are expected to be well above 1.0 after the effects of the action are considered. Conceptual Framework gaps are expected to be filled at both the high and low ends of the range.

10.5.3 Umatilla/Walla Walla Major Population Group

The Umatilla/Walla Walla MPG consists of four populations: Umatilla River, Walla Walla River, Touchet River, and Willow Creek. The Interior Columbia Basin TRT determined that the Willow Creek population was extirpated. Although the lack of spawner counts for several years limits the ability to estimate a full suite of survival and productivity metrics for all extant populations, estimates can be made in several instances. In the case of extinction risk, modeling indicates that both the Umatilla River and Walla Walla River populations are at negligible risk over 24 years at all tested QETs. Insufficient data are available to estimate extinction probability for the Touchet population.

Base 20-year R/S estimates for all three populations are less than 1.0, but a combination of current and prospective improvements in lifecycle survival is expected to raise these estimates to greater than 1.0. Where sufficient data are available, the base lambda estimates are all greater than 1.0. Likewise, the base long- and short-term trend estimates are greater than 1.0 for all three populations. Conceptual Framework gaps are expected to be filled at both the high and low ends of the range.

10.5.4 Yakima River Major Population Group

This MPG is composed of four populations: Satus Creek, Toppenish Creek, Naches River, and Upper Yakima River. Both the Satus Creek and Naches River populations are at negligible risk of extinction at all QETs modeled; however, the Toppenish Creek population is at increased 24-year risk of extinction when modeled at QETs 30 and 50; the Upper Yakima population is at elevated risk of extinction at all tested QETs.

Base 20-year R/S estimates for three of the four populations are less than 1.0, but 10-year estimates are all greater than 1.0. Expected improvements in lifecycle survival expected from recent improvements in the FCRPS (base-to-current adjustment) elevates the 20-year R/S estimates to well above 1.0. Both the base 12- and 20-year lambda estimates and the long- and short-term trend estimates are greater than 1.0.

Extinction risk probability modeling suggests that the Toppenish Creek and Upper Yakima River populations are at heightened risk of extinction, but all three productivity metrics for these populations indicate that they are rebuilding. Conceptual Framework gaps are expected to be filled at both the high and low ends of the range, except in the case of the Upper Yakima River population, where a 1 percent Framework gap exists at the high end of the range.

10.6 CONCLUSION

The DPS as a whole is likely to survive based on the preponderance of populations at low extinction risk at all QETs. The three populations with moderate to high risk levels show positive recent abundance trends, which are expected to continue and improve based on the estimated effects of the action. R/S productivity is also expected to be greater than 1.0 for these populations, suggesting that despite the modeled risk levels, these populations are likely to survive in the near term. Based on the estimates of remaining gaps summarized in Table 10-7, all 15 populations for which there is adequate data to estimate 20-year R/S, λ and abundance trends are expected to meet the criteria. The results of the Conceptual Framework analysis support this view. The Action Agencies have worked with the states and Tribes through the Remand Collaboration Process and other forums to identify actions intended to address the needs of listed salmon and steelhead as determined by quantitative and qualitative biological analyses. Acknowledging that NMFS will review the actions and the effects analyses contained herein to make a final jeopardy determination in the forthcoming biological opinions, the Action Agencies are making the following conclusions. Based on our assessment of the FCRPS and Upper Snake River actions and analysis of effects, considering the present and future human and natural context, the Action Agencies conclude that the net effects of the proposed actions, including the existence and operations of the dams with the proposed mitigation, meet or exceed the objectives of doing no harm and contributing to recovery with respect to this DPS.

Chapter 11
Columbia River Chum Salmon
Evolutionarily Significant Unit

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

11.1 INTRODUCTION

This chapter briefly summarizes the currently-available biological status and assessments for this Evolutionarily Significant Unit (ESU) related to extinction risk and the effects of the Federal Columbia River Power System (FCRPS) proposed Reasonable and Prudent Alternative (RPA) in the context of recovery plan actions. First, it summarizes current status information including key limiting factors and extinction risks. Second, it includes a biological assessment of the survival effects of recent and planned actions on current and prospective conditions, respectively. Finally, it identifies additional actions to benefit the ESU. Summary data for the ESU are presented in Table 11-1 and its geographic extent is shown in Figure 11-1.

This chapter is organized into six sections. Section 11.1 provides an overview of the ESU and the factors limiting its viability. Section 11.2 summarizes population-level status information during the 20-year base period used for this analysis. Section 11.3 provides the assessment of the current status and provides estimates of the "gaps," or needed lifecycle survival improvements for individual populations to meet certain biological criteria. It summarizes the improvements made to the hydropower (hydro) system and in other Hs (habitat, hatcheries and harvest) since about 2000 and estimates the salmonid survival benefits associated with those improvements. Section 11.4 describes the recovery goals and improvement objectives to be implemented into the future, and Section 11.5 describes additional actions that will benefit this ESU. Section 11.6 provides observations on the current and future status of this ESU, particularly with respect to the operation of the FCRPS.

Table 11-1. Columbia River Chum Salmon ESU Description and Major Population Groups (MPG)

ESU Description	
Threatened	Listed under ESA in 1999; reaffirmed in 2005[1]
Three major population groups	16 historical populations (13 of these currently at very high risk or functionally extirpated)
Hatchery programs included in ESU (3)[1/]	The Chinook River (Sea Resources Hatchery), Grays River, and Washougal River/Duncan Creek chum hatchery programs
Major Population Group	**Population**
Coast	Grays Elochoman, Mill Creek, Youngs Bay, Big Creek, Clatskanie, Scappoose
Cascade	Cowlitz, Kalama, Lewis, Salmon Creek, Washougal, Clackamas, Sandy
Gorge	Lower Gorge, Upper Gorge

[1/] Listing determination (64FR14507 and 70FR37106)

The Columbia River Chum Salmon ESU includes 16 historical populations of which 13 are functionally extirpated or at very high risk in Oregon and Washington between the mouth of the Columbia River and the Cascade crest (Myers et al. 2006). Almost all of the metrics used in this analysis are estimates for individual populations within the ESU. The Endangered Species Act (ESA) is concerned with the status of a species' Distinct Population Segment (DPS, an equivalent term often used for steelhead) or ESU. Individual populations and major population groups (where they exist) obviously contribute to ESU status. However, the status of the ESU is not wholly dependent upon the status of any of the ESU's individual components.

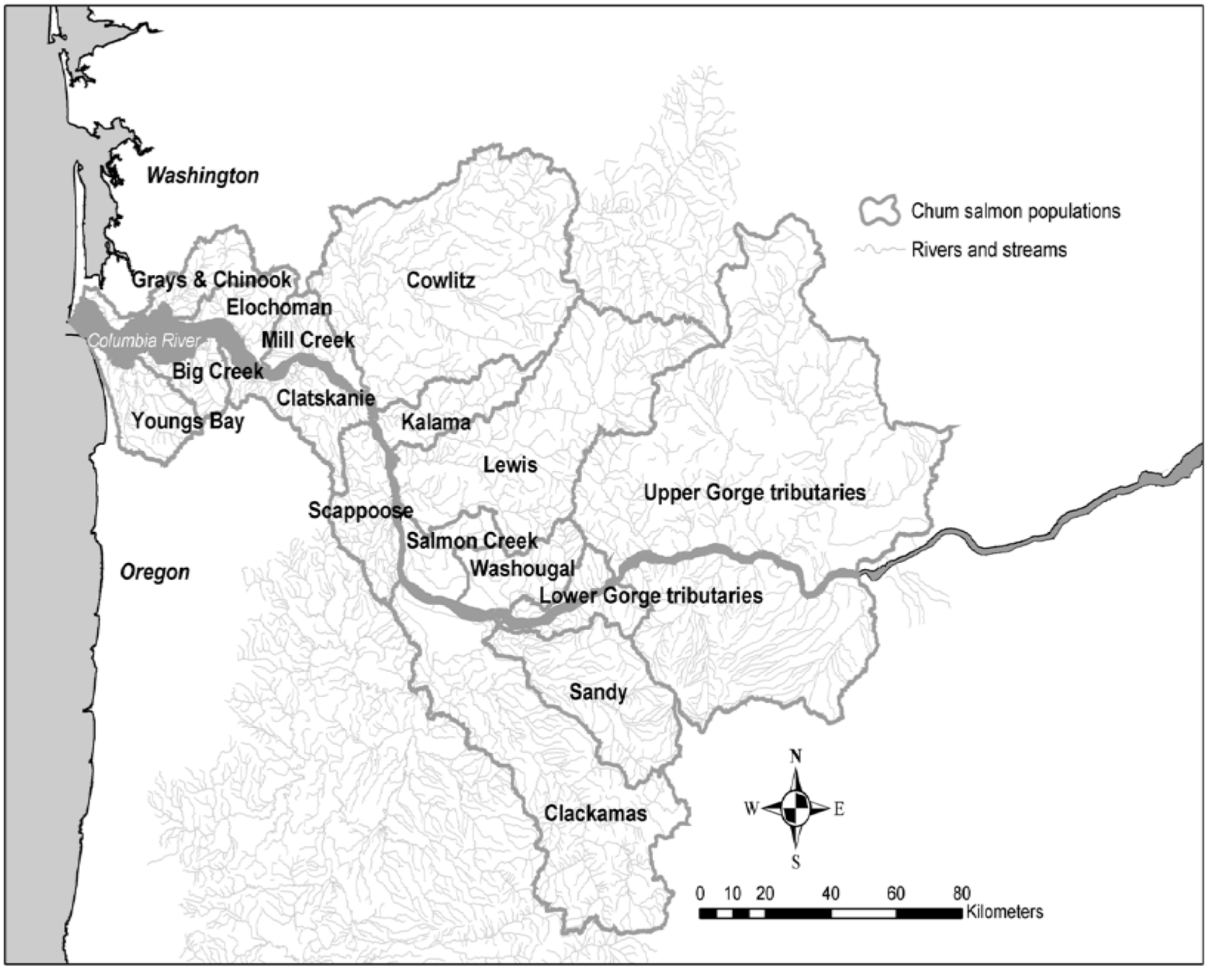

Figure 11-1. Historical Demographically Independent Chum Salmon Populations of the Columbia River ESU
Source: Myers et al. 2006

Chum salmon (*Oncorhynchus keta*) return to the Columbia River in late fall (mid-October to December). They spawn primarily in the lower reaches of rivers, digging their redds mostly along the edges of the mainstem and in tributaries or in side channels. Many spawning sites are located in areas of upwelling – either groundwater or mainstem flows.

Chum fry emigrate from March through May shortly after emergence in contrast to other species of *Oncorhynchus* (e.g., steelhead, coho salmon, and most Chinook salmon), which usually migrate to sea at a larger size after months or years of freshwater rearing. Juvenile chum salmon use estuaries to feed before beginning long-distance oceanic migration. The period of estuarine residence appears to be a critical life history phase and may play a major role in determining the size of the subsequent adult run back to fresh water.

11.1.1 Key Limiting Factors

The Lower Columbia River historically produced hundreds of thousands of chum, but only a few thousand remain. Chum salmon previously returned to tributaries as far upriver as the Walla Walla River, but only a handful are now counted at Bonneville Dam. After substantial declines in the 1950s, returns remained stable, but exceptionally low from 1956 to 2000. Slight improvement were detected in 2001 (i.e., Grays River and Hamilton Creek), but the levels still remain severely depressed compared with historical conditions. The average recent year runs are less than 1 percent of the historical run size.

Human impacts and limiting factors for this ESU are primarily related to habitat degradation and ecological factors including predation. Chum salmon spawning habitat has been substantially limited by loss of off-channel and side channel areas and inundation of some of the most productive historical spawning areas since 1938 by Bonneville pool.

Summarized below (Table 11-2) are key impacts and limiting factors for this ESU and recovery strategies to address those factors as described in the Lower Columbia Fish Recovery Board's (LCFRB) Washington Lower Columbia Recovery and Subbasin Plan (LCFRB 2004). The Oregon recovery planning process for Columbia River ESUs is in progress.

Table 11-2. Key Limiting Factors

Mainstem Hydro	FCRPS impacts are limited for Lower Columbia River ESUs. Direct mainstem hydro impacts on Lower Columbia River ESUs are most significant for gorge tributary populations upstream from Bonneville Dam and mainstem spawning populations immediately downstream from Bonneville Dam. Mainstem flows are known to be an important requirement to support chum spawning in Hamilton and Hardy creeks. Upper Gorge populations are affected by upstream and downstream passage at Bonneville Dam and inundation of spawning habitat in the lower reaches of gorge tributaries. This resulted in the loss of entire chum salmon populations known to spawn at the lower end of tributaries. Following the removal of Condit Dam, some degree of chum spawning habitat may be restored in the White Salmon River. Mainstem spawning populations in the lower gorge downstream from Bonneville Dam are affected by Bonneville operations. Impacts on other lower Columbia River populations originating in downstream subbasins are generally limited to effects on migration and habitat conditions in the lower Columbia River mainstem and estuary.
Predation	Avian predators are assumed to have minimal effect on chum salmon. The significance of fish and pinniped predation on chum is unclear.
Harvest	Harvest is limited to indirect fishery mortality. In the 1950s, due to severe population declines, commercial chum salmon fisheries were closed or drastically minimized. Now there are neither recreational nor commercial fisheries in the Columbia River. Although incidental takes occur in the gillnet fisheries, commercial chum landings have been less than 50 fish per year during the last 5 years.
Hatcheries	Columbia River chum populations have been influenced by hatchery production to only a limited extent conservation hatchery programs are currently a significant element of chum salmon protection and restoration efforts. Along with other state and Federal hatchery programs throughout the lower Columbia River, these are currently the subject of a series of comprehensive reviews for consistency with the recovery needs of listed salmonids. A variety of beneficial changes to hatchery programs have already been implemented and additional changes are anticipated.
Estuary	The estuary is a critical habitat for migrating salmonids from all Columbia River ESUs and is particularly important for local Columbia River Chum Salmon populations. Alterations in attributes of flow and diking have resulted in the loss of emergent marsh, tidal swamp and forested wetlands. These habitats are used extensively by smaller Columbia chum juveniles as they migrate from their natal areas soon after emergence (Fresh et al. 2005). Estuary limiting factors and recovery actions are addressed in detail in a comprehensive regional planning process (National Marine Fisheries Service [NMFS], also known as National Oceanic and Atmospheric Administration [NOAA] Fisheries 2006a).

Table 11-2. Key Limiting Factors

Habitat	Widespread development and land use activities have severely degraded stream habitats, water quality, and watershed processes affecting anadromous salmonids in most lower Columbia River subbasins, particularly in low to moderate elevation habitats. Ecosystem Diagnosis and Treatment (EDT) analyses indicate 50 to 100 percent reductions in habitat capacity for chum in Washington subbasins due to cumulative habitat effects (LCFRB 2004). The Washington Lower Columbia Recovery and Subbasin Plan (LCFRB 2004) identifies current habitat values, restoration potential, limiting factors, and habitat protection and restoration priorities for chum by reach in all Washington subbasins. Recovery and subbasin plans also identify a suite of beneficial actions for the protection and restoration of tributary subbasin habitats. Similar information is in development for Oregon subbasins.
Ocean and Climate	Analyses of Lower Columbia River salmon status generally assume that future ocean and climate conditions will approximate the average conditions that prevailed during the recent base period used for status assessments. Recent conditions have been less productive for most Columbia River salmonids than the long-term average and future trends are unclear. Under the adaptive management implementation approach of the Lower Columbia River recovery plan, further reductions in salmon production due to long-term ocean and climate trends will need to be addressed through additional recovery effort (LCFRB 2004).

11.1.2 Potentially-Manageable Impacts – LCFRB Analysis

As part of its recovery planning process, the LCFRB evaluated factors currently limiting Washington lower Columbia River salmon and steelhead populations based on a simple index of potentially manageable impacts. This effort was intended to help target recovery actions to the most significant and manageable human impacts. The impacts assessed were tributary habitat changes, estuary habitat changes, fishing, hydropower effects, hatchery effects, and predation by birds, fish, and marine mammals. Results are displayed for each population quantitatively in Table 11-3 and in the form of pie charts (Figure 11-2). Pie charts illustrate the relative significance of each factor based on independent estimates of the mortality or effect for each area of impact.

Table 11-3. Estimated Percentages of Total Manageable Impact by Sector

Major Population Group	Population	Baseline Impacts					
		Habitat (tributary)	Habitat (estuary)	Dams	Predators	Harvest	Hatcheries
Coast	Grays/Chinook	0.85	0.28	0.00	0.22	0.05	0.03
	Elochoman	0.86	0.28	0.00	0.23	0.05	0.03
	Mill	0.88	0.28	0.00	0.23	0.05	0.03
	Youngs	—	—	—	—	—	—
	Big Creek	—	—	—	—	—	—
	Clatskanie	—	—	—	—	—	—
	Scappoose	—	—	—	—	—	—
Cascade	Cowlitz	0.96	0.59	0.00[1]	0.23	0.05	0.11
	Kalama	0.92	0.51	0.00	0.24	0.05	0.03
	Lewis	0.93	0.58	0.00[1]	0.24	0.05	0.04
	Salmon	1.00	0.58	0.00	0.24	0.05	0.00
	Washougal	0.96	0.58	0.00	0.24	0.05	0.01
	Clackamas	—	—	—	—	—	—
	Sandy	—	—	—	—	—	—
Gorge	Lower Gorge	0.86	0.38	0.20[2]	0.25	0.05	0.01
	Upper Gorge	0.50	0.56	0.96[2]	0.27	0.05	0.07

1/ Non-Federal hydro impacts
2/ Federal hydro impacts
Source: LCFRB 2004.
Note: Percentages represent independent estimates of the mortality rate or reduction relative to the historical baseline for each factor (e.g., 70 percent loss of habitat, 50 percent fishing mortality rate).

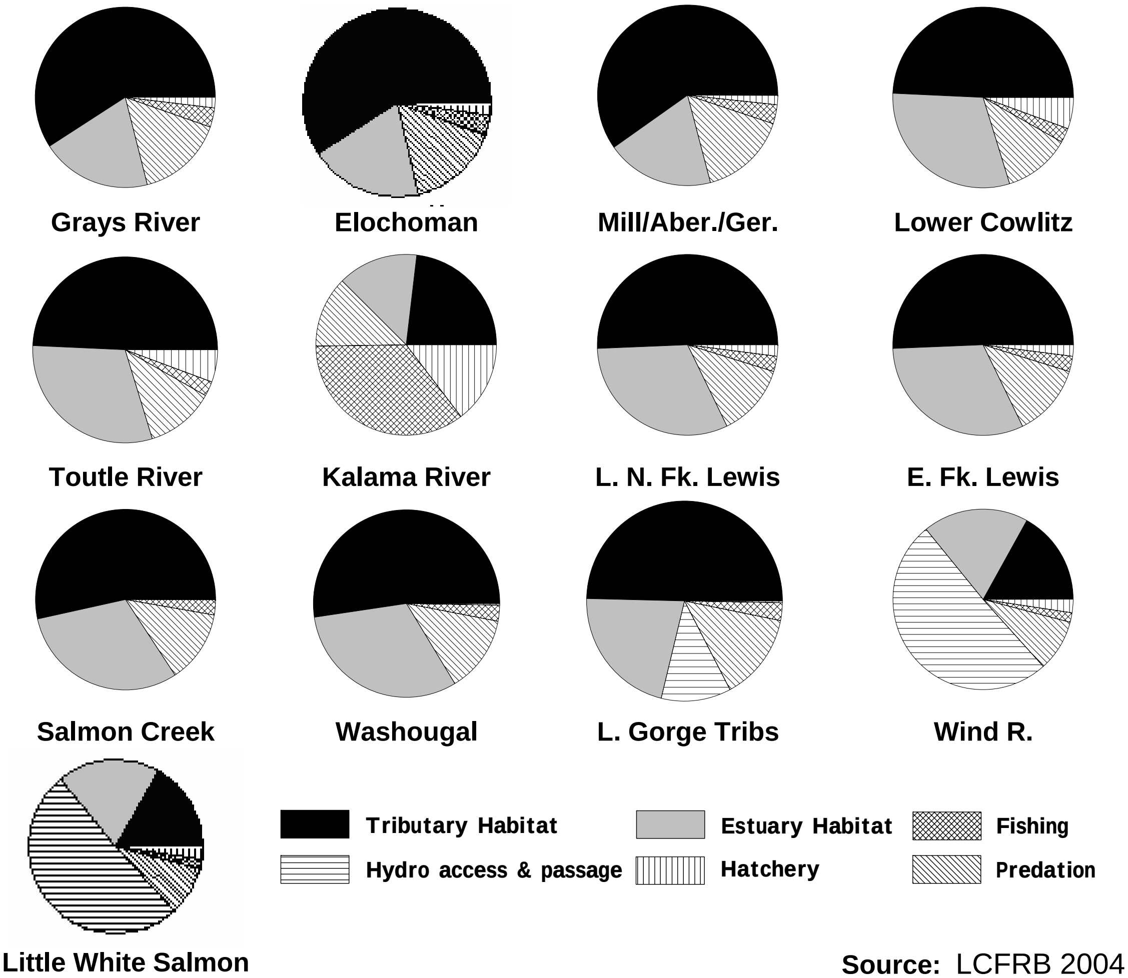

Figure 11-2. Estimated Percentages of Total Manageable Impacts for Each Sector for Columbia River Chum Salmon Populations

Tributary impacts and improvements are based on estimated changes in habitat capacity between historic and current conditions. Estuary values reflect habitat changes in the mainstem and estuary downstream from Bonneville Dam. Dam impacts and improvement increments identified in the Washington analysis included Federal and non-Federal access and passage effects. Access effects include habitat blockages in tributaries (White Salmon, Lewis, Cowlitz) as well as inundation of key spawning reaches in the lower portions of Bonneville Reservoir tributaries. Passage effects include juveniles and adults mortality at Bonneville Dam. Predation includes approximate total mortality rates by northern pikeminnow, birds, and marine mammals. Harvest in direct and indirect mortality in ocean and freshwater fisheries. Hatchery values are indexed based on proportion of natural spawning hatchery fish, relative productivity of hatchery fish, and interspecific effects resulting from predation by juvenile salmonids of other species. For additional detail on the analysis and application of these numbers, see the interim recovery plan approved by NMFS (LCFRB 2004; Vol. I, pp. 5-29—5-36; Appendix E, Chapter 10).

From these assessments, the recovery plan draws the general conclusion that current salmonid status is the result of large impacts distributed among several factors, and that substantial improvements in salmonid viability will require significant reductions in mortality in almost all limiting factors. The approach represents the relative order of magnitude of key limiting factors. It does not constitute a fine-scaled mechanistic analysis of limiting factors for every population. It does, however, provide a systematic basis for identifying which human impacts are most significant and focusing protection and recovery actions on significant problems. For instance, hydro impacts are estimated to be a relatively small fraction of total impacts for most populations. Significant hydro impacts in the Cowlitz, Lewis, and White Salmon rivers are a result of non-Federal facilities. Quantifiable FCRPS impacts are described only for gorge populations.

The mainstem hydro system has had the greatest impact in the lower Columbia River Gorge stratum. Of the 16 historical populations identified by the Interior Columbia Basin Technical Recovery Team (TRT), one populations spawns below Bonneville Dam in the lower gorge and one population spawns above Bonneville Dam in the upper Gorge. Although quantitative estimates of losses are not available, Bonneville operations affect spawning habitat availability and incubation survival of mainstem spawners of the lower gorge population. However, the upper gorge population has been largely extirpated by inundation of historical spawning and rearing habitat for the chum populations that spawns above Bonneville Dam (LCFRB 2004). Bonneville Dam counts of chum salmon have averaged less than 50 fish per year since the 1970s. What mainstem and tributary habitat that remains is moderately or severely impaired. Any fish produced upstream from Bonneville Dam would also experience passage mortality at Bonneville Dam, both as juveniles and as adults.

11.2 BASE STATUS

The base status is the historical status of the ESU, based on quantitative population metrics estimated from available time series of fish data. Long-term averages were used where they were available, although many of the available data time series are relatively recent.

11.2.1 Abundance, Productivity, and Trends

Base status information (Table 11-4) is reported for Columbia River Chum Salmon populations in the 2005 status review by NMFS. Many of the populations comprising this ESU are now small. Long- and short-term trends in abundance of individual populations are often negative, some severely so. Data are not available for most populations in this ESU.

11.2.2 Extinction Probability/Risk

Risk of extinction (Table 11-5) was qualified in recovery plan assessments based on risk categories and criteria identified by the Interior Columbia Basin TRT (McElhany et al. 2004). The rating system categorized extinction risk probabilities as very low (<1 percent), low (1-5 percent), medium (5-25 percent), high (26-60 percent),and very high (>60 percent) based on abundance, productivity, spatial structure and diversity characteristics. The risk assessment was based on a qualitative analysis of the best available data and anecdotal information for each population. Twelve of the 16 populations were categorized to be at very high risk, and many of these were assumed to be extirpated or nearly so.

Table 11-4. Abundance, Productivity, and Trends of Columbia River Chum Salmon Populations

Strata	Population	State	Recent Natural Spawners Years [1/]	Recent Natural Spawners No. [2/]	Recent Natural Spawners pHOS [3/]	Long-term trend Years	Long-term trend Value [4/]	Median growth rate Years	Median growth rate λ [5/]
Coast	Grays	W	96-00	331	N/A	90-00	0.904 [6/]	90-00	0.807 [6/]
	Elochoman	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Mill	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Youngs	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Big Creek	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Clatskanie	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Scappoose	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cascade	Cowlitz	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Kalama	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Lewis	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Salmon	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Washougal	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Clackamas	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Sandy	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Gorge	Lower Gorge	W	96-00	425	N/A	90-00	1.003	90-00	1.00
	Upper Gorge	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A

[1/] Years of data for recent means.
[2/] Geometric mean of total spawner.
[3/] Average recent proportion of hatchery origin spawners.
[4/] Long-term trend of total spawners.
[5/] Long-term median population growth rate (including both natural- and hatchery-origin spawners).
[6/] Hymer 2000 as cited in NMFS 2005b
Source: NMFS 2005b and McElhany et al. 2007
Note: Reported time series correspond to reported values in available information and may not correspond to reference periods identified in Biological Opinion (BiOp) analyses of other ESUs.

Table 11-5. Quasi-Extinction and Critical Population Risks Estimated for Columbia River Chum Salmon Effective at 1999 Reference Point (initial listing date of most Lower Columbia River ESUs)

Strata	Population	State	TRT [1/]
Coast	Grays	W	H
	Elochoman	W	H
	Mill Creek	W	VH
	Youngs Bay	O	VH
	Big Creek	O	VH
	Clatskanie	O	VH
	Scappoose	O	VH
Cascade	Cowlitz	W	VH
	Kalama	W	VH
	Lewis	W	VH
	Salmon	W	VH
	Washougal	W	H
	Clackamas	O	VH
	Sandy	O	VH
Gorge	Lower Gorge	W	M
	Upper Gorge	W	VH

[1/] Risk category estimated by the Interior Columbia Basin TRT from qualitative abundance, productivity, spatial structure and diversity criteria (VH=very high >60 percent, H=high 26-60 percent. M=moderate 5-25 percent, L=low 1-5 percent, VL=very low <1 percent).

11.2.3 Spatial Structure and Biological Diversity

Conserving and rebuilding sustainable salmonid populations involves more than meeting abundance and productivity criteria. Accordingly, NMFS has developed a conceptual framework defining a Viable Salmonid Population, or VSP (McElhany et al. 2000). In this framework there is an explicit consideration of four key population characteristic or parameters for evaluating population viability status: abundance, productivity (or population growth rate), biological diversity, and population spatial structure.

The reason that certain other parameters, such as habitat characteristics and ecological interactions, were not included among the key parameters is that their effects on populations are implicitly expressed in the four key parameters. Based on the current understanding of population attributes that lead to sustainability, the VSP construct is central to the goal of ESA recovery, and warrants consideration in a jeopardy determination. However, it must also be stressed that the ability to significantly improve either a species' biological diversity or its spatial structure and distribution is limited within the timeframe of the FCRPS Proposed RPA.

Spatial Structure

Spatial structure, as the term suggests, refers to the geographic distribution of individuals in a population unit and the processes that generate that distribution. Distributed populations that interact genetically are often referred to as metapopulation. Although the spatial distribution of a population, and thus its metapopulation structure, is influenced by many factors, none are perhaps as important as the quantity, quality, and distribution of habitat. One way to think about the importance or value of a broad geospatial distribution is that a population is less likely to go extinct from a localized catastrophic event or localized environmental perturbations.

Biological Diversity

Biological diversity within and among populations of salmonids is generally considered important for three reasons. First, diversity of life histories patterns is associated with a use of a wider array of habitats. Second, diversity protects a species against short-term spatial and temporal changes in the environment. And third, genetic diversity is the so-called raw material for adapting to long-term environmental change. The latter two are often described as nature's way of hedging its bets—a mechanism for dealing with the inevitable fluctuations in environmental conditions—long- and short-term. With respect to diversity, more is better from an extinction-risk perspective.

The Columbia River Chum Salmon ESU consists of three MPGs involving three to seven populations each. Most of these populations have been functionally extirpated or are present at very low levels. Spatial structure has been substantially reduced by habitat degradation.

11.3 BIOLOGICAL ASSESSMENT

This section includes:

1. an assessment of current status involving an adjustment of the initial base estimates to reflect recent improvements in mortality factors already implemented but not yet been evidenced in adult returns and
2. an assessment of prospective status involving benefits expected from planned actions.

The biological assessments of lower Columbia River salmonid populations are largely qualitative at this time due to a significant lack of biological data for most populations. In contrast to the interior ESUs where good long-term data sets are available on most populations, data is limited to only a few lower Columbia River populations and even that data is subject to a high degree of uncertainty. As a result, stepwise quantitative analyses of incremental benefits of specific actions like those completed for interior ESUs, are not included herein, nor were they included in recovery plans.

Base status is the historical status of the ESU, defined as the status of the population based on the *average* of quantitative survival metrics estimated from available time series of abundance data. In the biological analysis, this is the starting point, shown in the preceding section.

Current status is an adjustment of the initial base estimates to reflect our best estimate of current survivals, as opposed to an average of survivals that prevailed over a period in the past. This adjustment represents a comprehensive analysis of both beneficial and adverse actions already implemented but not yet biologically expressed. For this species, significant survival benefits are expected from recently implemented changes in tributary and estuarine habitat conditions and hatchery operations. However, effects of these actions are obviously not reflected in the time series of survival data that for the most part started in 1980.

Prospective status adjusts current to future status, based on the estimated effects of planned future actions to be implemented in the period 2007 to 2017. The current-to-prospective adjustment reflects survival improvements expected from the hydro, habitat, and predation, and hatchery changes included in the Proposed RPA.

This analysis assumes that future ocean and climate conditions will approximate the average conditions that prevailed during the base period used for our status assessments. For most populations, that period is about equivalent to the "recent" ocean period used by the Interior Columbia Basin TRT in its analyses. This period was characterized by relatively unproductive and extremely variable ocean conditions, which presumably contributed to poor early ocean survival of salmonids in most years. This subject is treated at greater length in the discussion of the effects of potential climate change in Appendix H.

11.3.1 Current Status

Over this period the Action Agencies have implemented several actions to improve fish survival relative to the base period prior to 2000. The percentage changes in lifecycle survival used in base-to-current adjustments for Columbia River Chum Salmon are summarized in Table 11-6. Actions are summarized below.

Table 11-6. Estimated Survival Improvements (net) Used in the Base-to-Current Adjustment

	Hydro	Habitat (tributary)	Habitat (estuary)	Predators (avian)	Predators (fish)	Hatchery	Harvest
Columbia River Chum	11.3%	N/A	0.7%	0%	N/A	N/A	0%

11.3.1.1 Hydropower Survival Improvements

The mainstem chum salmon populations downstream from Bonneville Dam benefit from operations to provide fall and winter tailwater elevations and flows to support spawning, incubation, and emergence in the Ives Island area and to provide access for chum spawning in Hamilton and Hardy creeks. However, stranding of juvenile chum can occur as a result of flow fluctuations.

11.3.1.2 Tributary Habitat Survival Improvements

A wide variety of actions with the potential to improve critical habitats have been implemented in Lower Columbia River subbasin tributaries since 2000, involving non-Federal and Federal parties. Actions range from beneficial land management practices, to improvements in access through culvert replacement, to fish reintroduction activities. Recently-completed subbasin and recovery plans provide extensive guidance for these actions. Effects of these actions are expected to accrue over the long-term. The magnitude of effects is uncertain and is expected to be addressed by monitoring activities and adaptive management.

11.3.1.3 Estuary Habitat Improvements

The estimated survival benefit for Columbia River Chum Salmon is assumed to be similar to or greater than that estimated for subyearling fall Chinook (0.7 percent). The Action Agencies implemented habitat actions through 21 estuary habitat projects. Unrestricted fish passage and approximately 3 miles of access to quality habitat was provided by the following specific actions[1]:

- Replaced three culverts with full-spanning bridges;
- Provided approximately 10 miles of improved tidal channel connectivity by installing a tide gate retrofit;
- Acquired approximately 473 acres of off-channel and riparian habitats;
- Restored and created 90 acres of marsh and tidal sloughs and approximately 100 acres of riparian forests;
- Protected approximately 55 acres of high-quality riparian and floodplain habitat;
- Restored and preserved approximately 154 acres of off-channel habitat;
- Protected 80 acres of high-value off-channel forested wetland habitat;
- Restored approximately 96 acres of tidal wetlands habitat by replacing undersized culvert that limited fish access;
- Conserved 155 acres of forested riparian and upland habitat;
- Provided partial tidal channel reconnection by tide gate retrofit (acreage unknown at this time);
- Provided integrated pest management (purple loosestrife);
- Reconnected and restored 183 acres of historic floodplain by dike removal;
- Restored 25 acres of historic floodplain by breaching a dike;
- Provided fish passage access to 6 miles of stream habitat by removal of two culverts and replacement with bridges;
- Restored 310 acres of native hardwood riparian forest, 200 acres of seasonally wet slough and 155 acres of degraded riparian habitats;
- Increased circulation in approximately 92 acres of backwater and side-channel habitat by tide gate retrofit;
- Improved embayment circulation for 335 plus acres of marsh/swamp and shallow-water and flats habitat; and
- Preserved 35 acres of historical wetland habitat.

11.3.1.4 Predation Management Survival Improvements

Avian predation. No avian predation management benefits are projected for chum salmon. Avian predators are assumed to have minimal effect on juvenile chum salmon.

Piscivorous predation. Chum salmon benefits of northern pikeminnow management were assumed in this analysis to be comparable to those for other salmon species. The ongoing Northern Pikeminnow Management Program (NPMP) has been responsible for reducing predation related juvenile salmonid mortality since 1990. The improvement in lifecycle survival attributed to the NPMP is estimated at 2

[1] A more thorough report detailing this evaluation process is: *Estimated Benefits for Federal Agency Habitat Projects in the Lower Columbia River and Estuary* (PC Trask & Associates 2007), which is included in Appendix D to this document.

percent for migrating juvenile salmonids including yearling and subyearling migrants (Friesen and Ward 1999). The northern pikeminnow has been responsible for approximately 8 percent predation-related mortality of all juvenile salmonid migrants in the Columbia River Basin in the absence of the NPMP (2000 FCRPS Biological Opinion at 9-106). The ongoing NPMP is already accounted for in the estimation of survival improvements modeled within the reservoir mortality life stage. This is because the modeling estimates are calibrated to empirical reach survival estimates that included the ongoing program.

11.3.1.5 Hatchery Survival Improvements

No chum production hatchery programs exist, but conservation hatchery programs are being used at a limited scale to supplement natural chum salmon production. The Action Agencies are proposing to evaluate the potential for reintroduction and/or additional supplementation of chum populations.

11.3.1.6 Harvest Survival Improvements

This analysis of status assumes a certain amount of annual take of natural adult fish based on recent harvest levels in the lower Columbia River coho fishery. Fishery impacts for chum salmon have been less than 5 percent for many years, including the pre-2000 base period.

11.3.2 Prospective Status

The prospective status is projected based expected survival improvements associated with actions in 2007 to 2009 and 2010 to 2017. Over this period the Action Agencies will implement multiple actions to improve fish survival relative to the current period. The percentage changes in lifecycle survival used in current-to-prospective adjustments are summarized in Table 11-7. Actions are summarized below.

Table 11-7. Estimated Improvements in Survival Used in the Current-to-Prospective Adjustment

	Hydro	Habitat (tributary)	Habitat (estuary)	Predators (avian)	Predators (fish)	Hatchery	Harvest
Columbia River Chum	N/A	N/A	9%	0%	1%	N/A	0%

11.3.2.1 Hydropower Survival Improvements

Passage improvements at Bonneville Dam are anticipated to directly benefit all populations of fish originating upriver from the dam and reservoir (Bonneville Lake). Potential chum survival improvements are unknown due to very low extant numbers and fry migrant life history of chum salmon.

11.3.2.2 Tributary Habitat Survival Improvements

A wide variety of actions (e.g., floodplain restoration, instream complexing and off-channel habitat creation) with the potential to improve critical habitats are expected to be implemented in lower Columbia River subbasin tributaries from 2007 through 2017, involving non-Federal and Federal parties. Recently-completed subbasin and recovery plans provide extensive guidance for these actions. Effects of these actions are expected to accrue over the long term, but the magnitude of effects is uncertain and is expected to be addressed by monitoring activities and adaptive management.

11.3.2.3 Estuary Habitat Survival Improvements

2007 to 2009. The estimated survival benefit for Columbia River Chum Salmon associated with the specific actions described below is assumed to be similar to or greater than that estimated fall Chinook (2.3 percent). The Action Agencies' estimated benefit for 2007 is based on actions that are or will be underway in the very near term. For 2008 and 2009 the Action Agencies estimated benefit is based on continuing at the same level of effort as 2007[2]. Action Agencies are or will be implementing multiple habitat actions through approximately 29 estuary habitat projects. Specific estuary habitat actions include:

- Restore partial tidal influence and access to several acres (exact amount unknown at this time) by a tide gate retrofit;
- Improve hydrologic flushing and salmonid access to a lake (Sturgeon Lake is approximately 3,200 acres);
- Acquire and protect 40 acres of critical floodplain habitat and 40 acres riparian forest restoration;
- Install 6 to 8 engineered log-jams that will help to slow flood flows, reduce erosion, contribute to sediment storage, enhance fish habitat and contribute wood into the project area;
- Acquire and restore floodplain connectivity to 380 acres of off-channel rearing habitat for juveniles;
- Install fish friendly tide gates to increase tidal flushing and fisheries access to approximately 110 acres;
- Complete riparian planting of up to 210 acres;
- Re-establish hydrologic connectivity to reclaim and improve floodplain wetland functions, increase off-channel rearing and refuge habitat on five acres, plant native vegetation along shoreline and reconstruct slough channels on 2.5 acres of annually inundated off-channel habitat;
- As part of a long-term 1,500 acres restoration effort, breach a dike and re-establish flow to a portion of original channel, planting vegetation on 50 acres, removing invasive weeds on 180 acres, planting wetland scrub shrub on 45 acres, and controlling and removing invasive wetland plants on 45 acres;
- Retrofit a tide gate (acreage unknown at this time);
- Protect and restore approximately 5 to 10 acres of emergent wetland and riparian forest habitats
- Reconnect 45 acres of floodplain by tide gate removal;
- Acquire 45 acres of floodplain with future dike removal;
- Reconnect 50 acres of floodplain;
- Acquire 320 acres of tidelands and 119 acres of riparian/upland forest; and
- Restore 30 acres of riparian habitat.

There will be approximately 15 additional projects and associated actions similar to actions listed above that are undergoing scoping and sponsor development (the number of projects and associated actions is based on the same level of effort as 2007).

2010 to 2017. The estimated survival benefit for Columbia River Chum Salmon associated with these actions is assumed to be similar to or greater than that estimated fall Chinook salmon (6.7 percent). The Action Agencies estimated benefits for 2010 to 2017 are based on continuing the same level of effort as 2007 to 2009. However, the level of effort in this time period may increase depending on the outcome of a General Investigation study of Ecosystem Restoration opportunities, depending on Congressional appropriations, future funding scenarios, and results of actions. Specific projects have yet to be

[2] A more thorough report detailing this evaluation process is: *Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary (PC Trask & Associates 2007)*, which is included in Appendix D to this document.

identified, but actions for this period will be similar in nature to actions implemented in previous periods discussed above. Actions will include protection and restoration of riparian areas, protection of remaining high quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, and reduction of noxious weeds, among others.

11.3.2.4 Predation Management Survival Improvements

Avian predation*:* No avian predation management benefits are projected for chum salmon. Avian predators are assumed to have minimal effect on juvenile chum salmon.

Piscivorous predation. Chum salmon benefits of pikeminnow management were assumed in this analysis to be comparable to those for other salmon species with subyearling life histories. The percentage improvement in lifecycle survival attributable to the proposed continuation of the increase in incentives in the NPMP and resultant marginal increase in observed exploitation rate is estimated at 1 percent total from 2007 to 2017. This estimate was derived based on the difference between the estimated benefits from the base NPMP (defined as the period 1990 to 2003) and estimated survival benefits under the increased incentive program (defined as the period of 2004 to present). This rate would generally apply to all juvenile yearling and subyearling salmonids.

11.3.2.5 Hatchery Survival Improvements

State and Federal hatchery programs throughout the lower Columbia River are currently subject to a series of comprehensive reviews for consistency with the protection and recovery of listed salmonids. A variety of changes to hatchery programs have already been implemented and additional changes are anticipated. The magnitude of effects is uncertain and is expected to be addressed by adaptive monitoring activities. No chum production hatchery programs exist, but conservation hatchery programs are being used at a limited scale to supplement natural chum production.

11.3.2.6 Harvest Survival Improvements

This analysis of status assumes a certain amount of annual take of natural adult fish based on recent harvest levels. Fishery impacts for chum salmon have been less than 5 percent for many years including the pre-2000 base period.

11.4 RECOVERY GOALS AND IMPROVEMENT OBJECTIVES

This section identifies recovery gaps needed to restore the ESU to viable levels as identified by the Willamette/Lower Columbia Technical Recovery Team (McElhany et al. 2006). Recovery goals and objectives are presented to acknowledge and provide a context for interpreting contributions of Federal actions relative to recovery. However, these are long term, multifaceted recovery goals and do not constitute a requirement for the FCRPS objective of avoiding jeopardy.

The Washington Lower Columbia River Recovery and Subbasin Plan (LCFRB 2004) described recovery goals for the ESU based on a recovery scenario where individual populations were targeted for different levels of improvement based on biological significance and feasibility of recovery (Figure 11-3).

Primary populations are targeted for restoration to high or very high viability (low or very low risk). Contributing populations are those for which some restoration will be needed to meet strata-wide average viability greater than moderate (less than 25 percent risk). Stabilizing populations are those that would be maintained at current levels until ESU-wide goals are achieved. Scenarios and goals are not yet available for Oregon populations. Recovery planning assessments indicated that effects of the FCRPS on recovery gap assessments would ideally compare expected improvements due to current and planned actions with

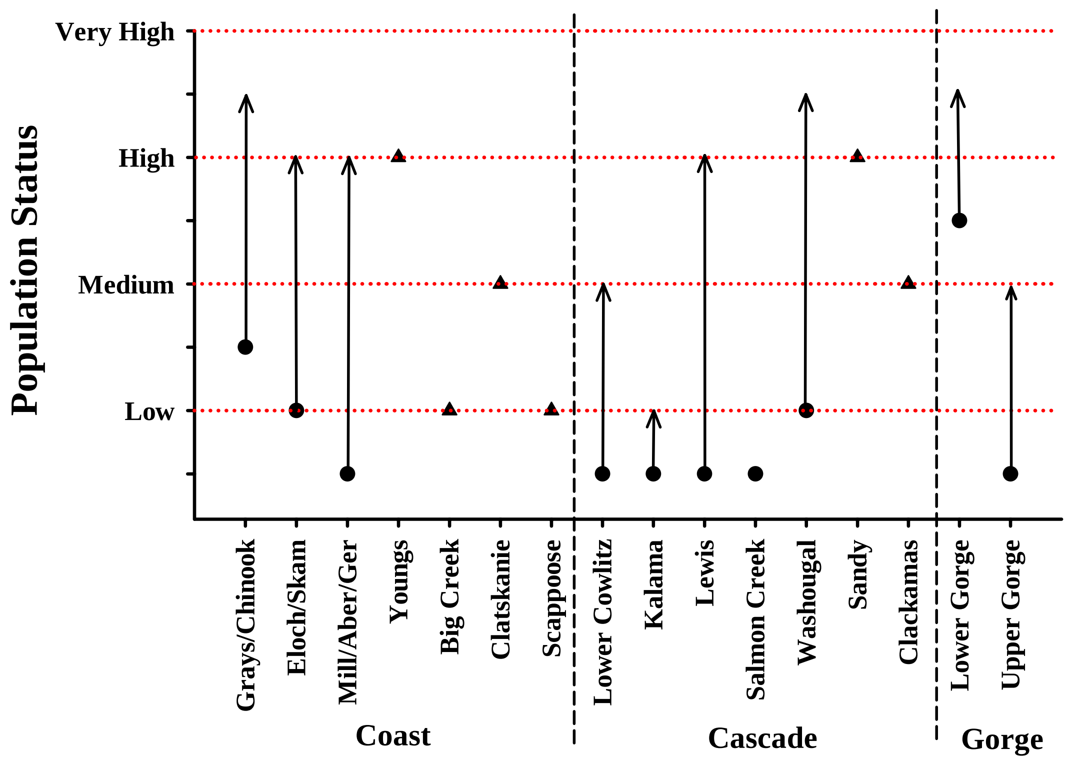

Figure 11-3. Improvements in Population Viability (inverse of risk) for Columbia River Chum Salmon Corresponding to Recovery Scenario Identified in the Washington Lower Columbia River Recovery and Subbasin Plan
Note: The recovery scenario for Oregon populations (displayed as ▲) is under development.
Source: LCFRB 2004.

improvement objectives identified by the Recovery Plan. However, this analysis is not available for lower Columbia River ESUs.

Owing to uncertainty in the scale of benefits of proposed actions, the Washington Lower Columbia River Recovery and Subbasin Plan adopted an adaptive management approach based on monitoring of implementation and effects of a comprehensive suite of beneficial actions. The Oregon recovery planning process for Lower Columbia River ESUs is in progress.

11.5 ADDITIONAL ACTIONS TO BENEFIT THE ESU

11.5.1 Other Reasonably Certain to Occur Actions

The State of Washington in the context of the collaboration among the sovereigns has identified 69 habitat-related actions and programs expected to provide benefit to portions of the four lower Columbia River ESUs (Chinook salmon, coho salmon, chum salmon, steelhead) most affected by the FCRPS (upper Columbia River gorge tributaries, Little White Salmon River, Wind River, lower Columbia River gorge and mainstem, and Washougal). Actions, geographic area, factors affected, timing, funding status, and responsible parties are described in detail in Chapter 17. All actions identified are either completed, ongoing, planned with high likelihood of implementation. These actions address protection and/or restoration of existing or degraded fish habitat in stream, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat.

Significant actions and programs include Growth Management Act and Shoreline Management Act program planning and regulation, a variety of stream and riparian habitat projects, watershed planning and plan implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, Habitat Conservation Plan implementation on state forest lands, hydraulic project permitting. Responsible entities include cities; counties; conservation districts; state and local weed controls boards; local fish enhancement groups; Washington Departments of Ecology, Natural Resources, Transportation, and Fish and Wildlife; and regional coordinating bodies such as the LCFRB. Significant funding sources include state and local general funds, various dedicated state accounts, the Salmon Recovery Funding Board, and private forest land owners.

Oregon has similarly identified 117 statewide and 260 focused habitat-related actions and programs affecting the four lower Columbia River ESUs (see Chapter 17). Oregon's habitat actions address a series of strategies focused on protection and/or restoration of natural ecological processes; floodplains and riparian conditions and connections; fish passage; critical stream flow; water quality; stream habitat structure and complexity; and watershed conditions and processes. Key implementing bodies include counties; cities; the Oregon Departments of Agriculture, Forestry, Water Resources, State Lands, Fish and Wildlife, Environmental Quality, Land Conservation and Development; the Oregon Watershed Enhancement Board; Conservation Districts; local watershed councils; and private forest land owners.

In addition, Washington and Oregon have implemented or are planning on implementing a variety of actions and programs aimed at reducing or regulating harvest and hatchery impacts. Hatchery programs throughout the region are undergoing a comprehensive management review and a variety of changes are being implemented or are expected including elimination of hatchery releases in critical natural production areas, increased acclimation of hatchery fish to reduce straying, and integration of natural broodstock into hatchery management.

11.5.2 Salmon Recovery Plan[3]

A wide suite of protection and restoration actions are currently being implemented throughout the lower Columbia River region under the guidance of the Salmon Recovery Plan. The Recovery Plan for the Washington Portion of this ESU was completed by the Washington LCFRB in 2005 and was adopted by as an Interim Regional Recovery Plan in February of 2006 (70 Federal Register 20531). The Oregon recovery planning process is underway and an Oregon plan for this ESU is expected in 2007. The Oregon and Washington plans will be combined for a complete ESA recovery plan for the Lower Columbia River Recovery Domain.

The Interim Washington Plan contains regional strategies, measures, and actions that address limiting factors and threats for tributary habitat, estuary and lower mainstem habitat, hydropower, harvest, hatcheries, and ecological Interactions. Approximately 650 specific actions are identified by the plan. The plan recognizes that existing tools are inadequate precisely evaluate the outcome of a full suite of recovery actions but instead identifies actions that are needed to achieve recovery and the level of effort that will be needed to achieve recovery objectives. Hence, the Plan takes a "directional approach," in which actions are directed toward reducing all of the human-caused factors limiting recovery. Information gained through an adaptive management program will help refine these approaches such that at some point in the future a more focused and theoretically more cost-effective approach may be taken.

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[3] Many of the actions listed above have a cost-share component with a variety of other Federal funding sources and therefore, may be properly described as contributing to the status of the environmental baseline rather than cumulative effects.

The institutional structure for Plan implementation involves oversight, implementation, and facilitation/coordination responsibilities. Key oversight bodies include NMFS, U.S. Fish and Wildlife Service, Tribal governments, the Washington Department of Fish and Wildlife, the Washington Governor's Office, and the Northwest Power and Conservation Council. The LCFRB, working with a steering committee, facilitates and coordinates efforts among oversight and implementing partners. The steering committee includes representatives of the oversight bodies and a cross-section of implementing partners. Facilitation/coordination involves setting priorities, evaluating progress, tracking implementation, inventorying and synthesizing monitoring results, developing implementation partnerships and agreements, and revising the Plan.

Implementation of the Plan includes an adaptive management framework that involves checkpoints at 2-year intervals to assess action implementation, at 6-year intervals to assess action effectiveness and threat reduction, and at 12-year intervals to assess fish and habitat status. Observed progress is evaluated against a series of benchmarks. In the first phase of implementation after completing the Plan, the LCFRB is now actively coordinating the implementation the specific strategies, measures and actions identified in the plan. The Board has authorized the Recovery Plan Implementation Committee to oversee implementation activities and to assist partnering groups in developing implementation work schedules, cost estimates and commitment necessary to receive assurances from NMFS

In 2005 the Committee launched the Salmon Partners Ongoing Tracking System (Salmon PORT) to facilitate developing Implementation Work Schedules. The system is designed as an interactive website displaying all 650 actions contained in the Salmon Recovery and Watershed Management plans. This system will provide the basis for a comprehensive evaluation of progress in action implementation as planned according to the plan implementation schedule.

11.5.3 Other Federal Actions that Have Completed ESA Consultation

The Action Agencies' review of Federal actions that have completed Section 7 consultations is not available at this time.

11.6 OBSERVATIONS

This ESU is currently threatened by a broad suite of habitat and ecological factors affecting populations distributed from the Columbia River mouth to the gorge upstream from Bonneville Dam. FCRPS impacts are significant to lower and upper gorge populations of this ESU. FCRPS impacts comprise only a limited portion of the threats affecting the other 14 historical populations in this ESU.

Because of the limited impact of the FCRPS on this ESU, the limited potential to improve most Lower Columbia River salmonid populations with improvements to FCRPS operations and configurations, and the diverse nature of impacts, the future status of this ESU will depend on a coordinated effort by many Federal and non-Federal parties. Further, the Interim Recovery Plan recognizes uncertain prospects for many gorge populations due to inherently limited historical and current habitat potential.

Recent and planned non-FCRPS and FCRPS actions are likely to result in continued improvements in the biological status of this ESU. The available information on the status of populations within this ESU is not currently adequate to complete a systematic quantitative analysis of the adequacy of implemented and planned actions.

11.7 CONCLUSION

This ESU is currently threatened by a broad suite of habitat and ecological factors affecting populations distributed from the Columbia River mouth to the gorge upstream from Bonneville Dam. Because of the limited impact of the proposed operation of the FCRPS and the Upper Snake River projects on this ESU, there is limited potential to improve LCR populations with FCRPS configuration changes or improvements to FCRPS or Upper Snake River operations; and, with the diverse nature of impacts affecting this ESU, the future status depends on a coordinated effort by many Federal and non-Federal parties, such as through recovery plan implementation.

The Remand Collaboration did not develop a method analogous to the Conceptual Framework for assessing the appropriate contribution of FCRPS effects to recovery of Lower Columbia River ESUs. Because the available information on the status of populations within this ESU is not sufficient to complete a systematic quantitative analysis of the adequacy of implemented and planned actions as was done for the Interior Columbia ESUs, our conclusions are based on a qualitative assessment of the prospect for survival and recovery of this ESU relying on best available information. We note that actions are being and will be implemented to address multiple threat sectors. These actions are likely to further reduce the risk of extinction and improve population trajectories for populations within the ESU, thus improving the ESU's prospects for recovery.

The Action Agencies have worked with the states and Tribes through the Remand Collaboration Process and other forums to identify actions intended to address the needs of listed salmon and steelhead as determined by quantitative and qualitative biological analyses. Acknowledging that NMFS will review the actions and the effects analyses contained herein to make a final jeopardy determination in the forthcoming biological opinions, the Action Agencies are making the following conclusions. Based on our assessment of the FCRPS and Upper Snake River actions and analysis of effects, considering the present and future human and natural context, the Action Agencies conclude that the net effects of the proposed actions, including the existence and operations of the dams with the proposed mitigation, meet or exceed the objectives of doing no harm and contributing to recovery with respect to this ESU.

Chapter 12
Lower Columbia River Chinook Salmon Evolutionarily Significant Unit

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

12.1 INTRODUCTION

This chapter briefly summarizes the currently-available biological status and assessments for the Lower Columbia River Chinook Salmon Evolutionarily Significant Unit (ESU) related to extinction risk and the effects of the Federal Columbia River Power System (FCRPS) proposed Reasonable and Prudent Alternative (RPA) in the context of recovery plan actions. First, it summarizes current status information including key limiting factors and extinction risks. Second, it includes a biological assessment of the survival effects of recent and planned actions on current and prospective conditions, respectively. Finally, it identifies additional actions to benefit the ESU. Summary data for the ESU are presented in Table 12-1 and its geographic extent is shown in Figure 12-1.

This chapter is organized into six sections. Section 12.1 provides an overview of the ESU and the factors limiting its viability. Section 12.2 summarizes population-level status information during the 20-year base period used for this analysis. Section 12.3 provides the assessment of the current status and provides estimates of the "gaps," or needed lifecycle survival improvements for individual populations to meet certain biological criteria. It summarizes the improvements made to the hydropower (hydro) system and in other Hs (habitat, hatcheries and harvest) since about 2000 and estimates the salmonid survival benefits associated with those improvements. Section 12.4 describes the recovery goals and improvement objectives to be implemented into the future, and Section 12.5 describes additional actions that will benefit this ESU. Section 12.6 provides observations on the current and future status of this ESU, particularly with respect to the operation of the FCRPS.

Almost all of the metrics used in this analysis are estimates for individual populations within the ESU. The Endangered Species Act (ESA) is concerned with the status of a species' Distinct Population Segment (DPS, an equivalent term often used for steelhead) or ESU. Individual populations and major population groups (where they exist) obviously contribute to ESU status. However, the status of the ESU is not wholly dependent upon the status of any of the ESU's individual components.

Table 12-1. Lower Columbia River Chinook Salmon ESU Description and Major Population Groups (MPGs)

ESU Description[1]	
Threatened	**Listed under ESA in 1999; reaffirmed in 2005**[1]
6 major population groups	32 historical populations
Hatchery programs included in ESU (17)[1]	Sea Resources Tule Chinook, Big Creek Tule Chinook, Astoria High School (STEP) Tule Chinook, Warrenton High School (STEP) Tule Chinook, Elochoman River Tule Chinook, Cowlitz Tule Chinook Program, North Fork Toutle Tule Chinook, Kalama Tule Chinook, Washougal River Tule Chinook, Spring Creek NFH Tule Chinook, Cowlitz spring Chinook (2 programs), Friends of Cowlitz spring Chinook, Kalama River spring Chinook, Lewis River spring Chinook, Fish First spring Chinook, Sandy River Hatchery (ODFW[2] stock #11)
Major Population Group	**Population**
Cascade Spring	Cowlitz (Upper), Cispus, Tilton, Toutle, Kalama, Lewis, Sandy
Gorge Spring	White Salmon, Hood
Coast Fall	Grays, Elochoman, Mill, Youngs Bay, Big Creek, Clatskanie, Scappoose
Cascade Fall	Lower Cowlitz, Upper Cowlitz, Toutle, Coweeman, Kalama, Lewis, Salmon Creek, Washougal, Clackamas, Sandy
Cascade L Fall	Lewis, Sandy
Gorge Fall	Lower Gorge, Upper Gorge, White Salmon, Hood

[1] Listing determination (64FR14308, reaffirmed 70FR37160)
[2] ODFW – Oregon Department of Fish and Wildlife

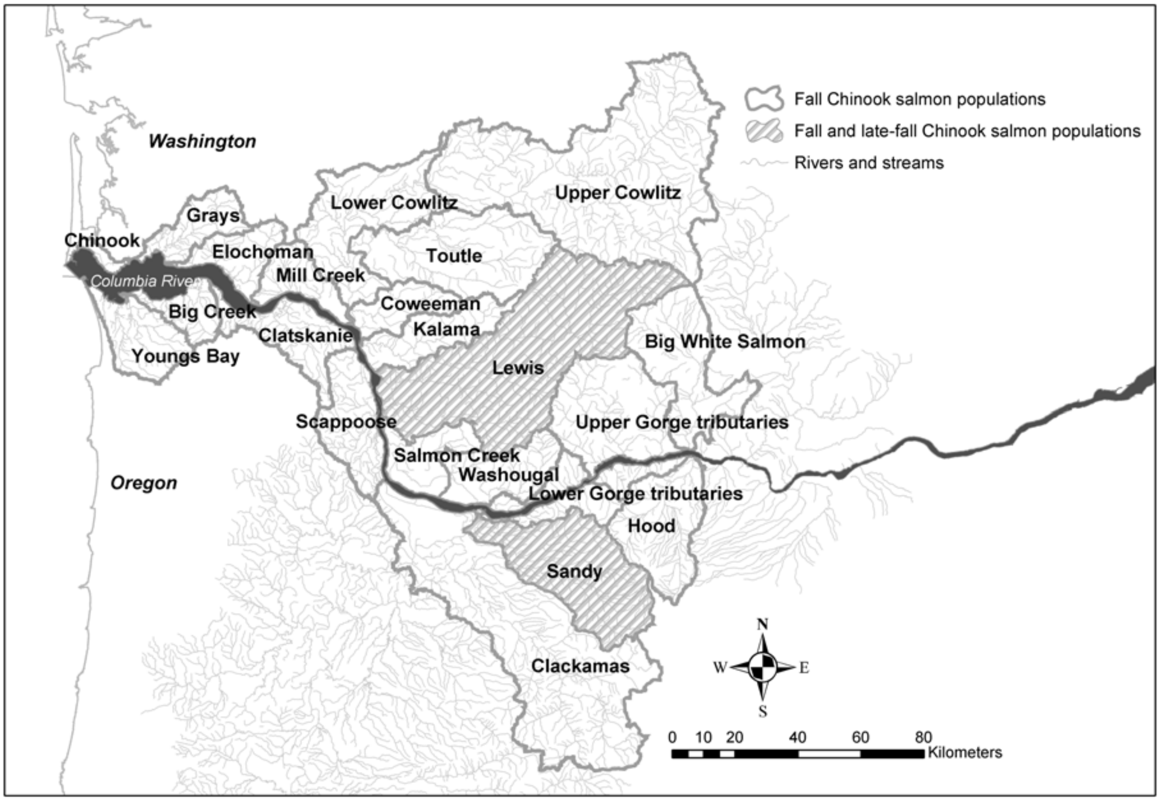


Figure 12-1. Historical Demographically Independent Chinook Salmon Populations of the Lower Columbia River ESU
Source: (Myers et al. 2006)

This paper briefly summarizes the currently-available biological assessments for this ESU related to extinction risk and the effects of the FCRPS action in the context of recovery plan actions. First, it summarizes current status information including key limiting factors and extinction risks. Second, it includes a biological assessment of the survival effects of recent and planned actions on current and prospective conditions, respectively. Finally, it identifies additional actions to benefit the ESU.

The Lower Columbia River Chinook Salmon ESU includes all naturally spawned populations of Chinook salmon from the Columbia River and its tributaries from its mouth at the Pacific Ocean upstream to a transitional point east of Hood River in Oregon and the White Salmon River in Washington. The historical site of Celilo Falls on the Columbia River is considered the transitional point for this ESU, since it may have been a migrational barrier to Chinook salmon at certain times of the year. The ESU includes Spring Chinook Salmon in the Willamette River up to Willamette Falls, Oregon, exclusive of Spring Chinook Salmon in the Clackamas River.

The Lower Columbia River Chinook Salmon ESU includes 32 historical populations of which seven are functionally extirpated or nearly so in Oregon and Washington between the mouth of the Columbia River and the Cascade crest (Myers et al. 2006). Myers et al. (2006) identified only 31 historical populations in this ESU, but based on input from the Washington Department of Fish and Wildlife (WDFW), the Willamette-Lower Columbia Technical Recovery Team (TRT) subsequently split the Lewis River fall run population into separate Lewis River fall run and Salmon Creek fall run populations (NMFS 2005f).
The ESU includes spring, fall (tule), and late fall (bright) type Chinook. Fall Chinook enter freshwater typically in August through October to spawn in large river mainstems and are an ocean type life history

that emigrates from freshwater as subyearlings. Spring Chinook enter fresh water typically in March through June to spawn in upstream tributaries of subbasins and are a stream type life history that generally emigrates from freshwater as yearlings. Exclusions from the ESU are stream-type Spring Chinook found in the Klickitat River (mid-Columbia River ESU), introduced Carson spring Chinook, and introduced bright fall Chinook occurring in the Wind, White Salmon, Klickitat, and mainstem Columbia rivers. Populations of Spring Chinook in the Willamette including the Clackamas are also in a separate ESU. Listed populations of the Lower Columbia River Chinook Salmon ESU are stratified for recovery into three major population groups.

12.1.1 Key Limiting Factors

Lower Columbia River Chinook Salmon populations began declining by the early 1900s because of habitat alterations and harvest rates that were unsustainable given the changing habitat conditions. Human impacts and limiting factors for this ESU come from multiple sources: habitat degradation, hatchery effects, fishery management and harvest decisions, and ecological factors including predation. Tributary habitat degradation is pervasive in this region due to extensive development and land use effects. Columbia River hatchery production of Chinook salmon is concentrated in the lower Columbia River region and many wild spawning populations are subject to a very high incidence of naturally-spawning hatchery fish. Lower Columbia River Chinook have also been subject to harvest rates of 50 percent or greater until recent years. Fall Chinook spawning and rearing habitat in tributary mainstems have been severely impacted by sedimentation, increased temperatures, and reduced habitat diversity. Spring Chinook access to subbasin headwaters has been widely restricted or eliminated by the construction of non-Federal dams without fish passage. Most lower Columbia River populations are subject to only limited FCRPS impacts involving habitat alterations in the Columbia River mainstem and estuary. Preservation and recovery of this ESU will clearly depend on significant efforts by many parties.

Summarized below (Table 12-2) are key impacts and limiting factors for this ESU and recovery strategies to address those factors as described in the Washington Lower Columbia Recovery and Subbasin Plan [Lower Columbia Fish Recovery Board (LCFRB) 2004]. The Oregon recovery planning process for Lower Columbia River ESUs is in progress.

Table 12-2. Key Limiting Factors

Mainstem Hydro	FCRPS impacts are limited for the lower Columbia River Chinook Salmon ESU. Direct mainstem hydro impacts on lower Columbia River ESUs are most significant for gorge tributary populations upstream from Bonneville Dam and mainstem spawning populations immediately downstream from Bonneville Dam. Upper Gorge populations are affected by to upstream and downstream passage at Bonneville Dam and inundation of spawning habitat in the lower reaches of gorge tributaries. Mainstem spawning populations in the lower gorge downstream from Bonneville Dam are affected by Bonneville operations. Impacts on other lower Columbia River populations originating in downstream subbasins are generally limited to effects on migration and habitat conditions in the lower Columbia River mainstem and estuary.
Predation	Piscivorous birds including Caspian terns and cormorants, fishes including pikeminnow, and marine mammals including seals and sea lions take significant numbers of juvenile or adult salmon and human activities are believed to have exacerbated effects of predation. Stream type juveniles are particularly vulnerable to bird predation in the estuary because they tend to use the deeper, less turbid channel areas located near habitat preferred by piscivorous birds (Fresh et al. 2005), and they are subject to pinniped predation when they return to the estuary as adults (NMFS 2006a). Caspian tern as well as cormorant predation may each be responsible for the mortality of up to 6 percent of the outmigrating stream-type juveniles in the Columbia River basin. [2006 and 1998 data, from Bonneville Power Administration (BPA), et al. 2004 and Roby 2006]. Pikeminnow are significant predators of both yearling and subyearling juvenile migrants (Friesen and Ward 1999). Ongoing actions to reduce predation effects include redistribution of avian predator nesting areas, a sport reward fishery to harvest pikeminnow, and exclusion and hazing of marine mammals near Bonneville Dam.

Table 12-2. Key Limiting Factors

Harvest	Harvest includes direct and indirect fishery mortality. Lower Columbia River Chinook Salmon are harvested in Columbia River and tributary freshwater fisheries and in Oregon, Washington, and Canadian ocean fisheries. Historical harvest rates on Chinook salmon typically reached 60 to 80 percent. Fishery impacts on the Lower Columbia River Chinook Salmon ESU have been reduced since listing. Harvest rates limits for fall run Chinook salmon have dropped from 65 to 49 percent. Lower Columbia River Spring Chinook Salmon harvest rates on wild fish have been reduced from 50 percent to 25 percent (LCFRB 2004).
Hatcheries	Hatchery programs that have used inappropriate management practices have reduced the diversity and productivity of natural populations throughout the Columbia River Basin. Domestication of hatchery fish erodes fitness in the wild and wild stock productivity is reduced when significant numbers of hatchery fish spawn with wild fish. Large hatchery releases can also have ecological effects due to increased competition or predation. Large numbers of hatchery fish also contribute to more intensive mixed stock fisheries, which can overexploit weak wild populations affected by habitat degradation. Wild-spawning hatchery fish are widely distributed among tule fall Chinook salmon populations. For spring Chinook salmon, virtually all production in the Washington lower Columbia River is of hatchery origin, and all Oregon populations of spring Chinook salmon are subject to significant hatchery influence. State and Federal hatchery programs throughout the lower Columbia River, are currently the subject of a series of comprehensive reviews for consistency with the recovery needs of listed salmonids. A variety of beneficial changes to hatchery programs have already been implemented and additional changes are anticipated.
Estuary	The estuary is a critical habitat for migrating salmonids from all Columbia River ESUs and is particularly important for local lower Columbia River populations. Alterations in attributes of flow and diking have resulted in the loss of emergent marsh, tidal swamp, and forested wetlands. These habitats are used extensively by smaller lower Columbia fall-run Chinook salmon subyearling juveniles. Ocean-type juvenile survival is potentially affected in the estuary by lack of habitat, changes in food availability, and the presence of contaminants. Changes in the seasonal hydrograph as a result of water use and reservoir storage throughout the basin have altered estuary habitat forming processes and changes in the shape, behavior, size, and composition of the plume relative to historical conditions. Characteristics of the plume are thought to be significant to spring-run yearling migrants during transition to the ocean phase of their lifecycle (Fresh 2004). Estuary limiting factors and recovery actions are addressed in detail in the estuary module of the comprehensive regional planning process (NMFS 2006a).
Habitat	Widespread development and land use activities have severely degraded stream habitats, water quality, and watershed processes affecting anadromous salmonids in most lower Columbia River subbasins, particularly in low to moderate elevation habitats where fall Chinook salmon spawn and rear. Most of the significant mainstem spawning habitats in large previously-productive systems such as the Cowlitz River have been extensively diked and filled. In addition to cumulative habitat effects, the construction of non-Federal hydropower facilities on Columbia River tributaries has partially or completely blocked higher elevation spawning. The Washington Lower Columbia Recovery and Subbasin Plan (LCFRB 2004) identifies current habitat values, restoration potential, limiting factors, and habitat protection and restoration priorities for Chinook by reach in all Washington subbasins. Recovery and subbasin plans also identify a suite of beneficial actions for the protection and restoration of tributary subbasin habitats. Similar information is in development for Oregon subbasins.
Ocean & Climate	Analyses of lower Columbia River salmon and steelhead status generally assume that future ocean and climate conditions will approximate the average conditions that prevailed during the recent base period used for status assessments. Recent conditions have been less productive for most Columbia River salmonids than the long-term average and future trends are unclear. Under the adaptive management implementation approach of the Lower Columbia River Recovery and Subbasin Plan, further reductions in salmon production due to long-term ocean and climate trends will need to be addressed through additional recovery effort (LCFRB 2004).

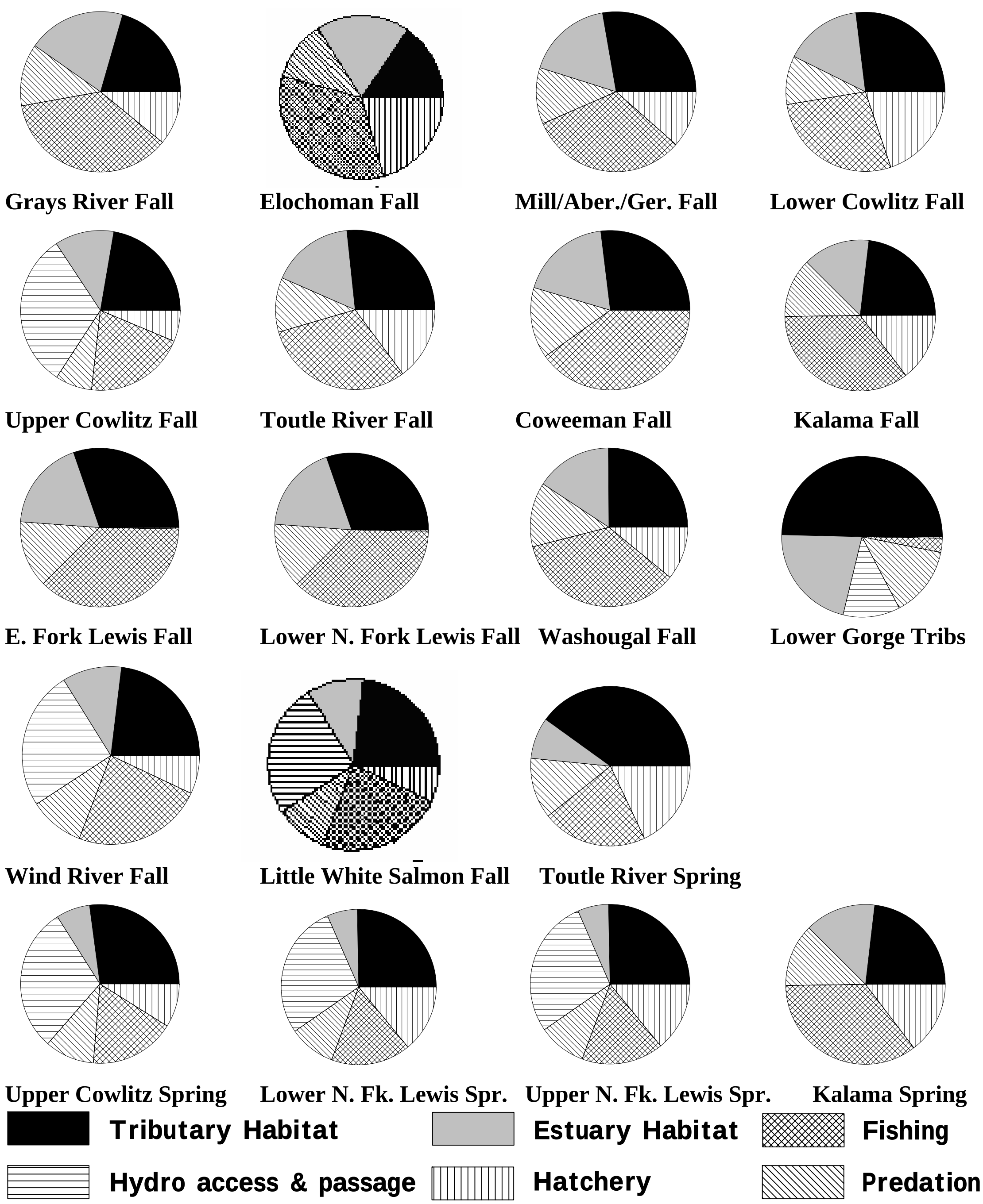
12.1.2 Potentially Manageable Impacts – LCFRB Analysis

As part of its recovery planning process, the LCFRB evaluated factors currently limiting Washington lower Columbia River salmon and steelhead populations based on a simple index of potentially manageable impacts. This effort was intended to help target recovery actions to the most significant and manageable human impacts. The impacts assessed were tributary habitat changes, estuary habitat changes, fishing, hydropower effects, hatchery effects, and predation by birds, fish, and marine mammals. Results are displayed for each population quantitatively in Table 12-3 and in the form of pie charts (Figure 12-2). Pie charts illustrate the relative significance of each factor based on independent estimates of the mortality or effect for each area of impact.

Table 12-3. Estimated Percentages of Total Manageable Impacts by Sector

Major Population Group	Population	Baseline Impacts					
		Habitat (tributary)	Habitat (estuary)	Dams	Predators	Harvest	Hatcheries
Coast Fall	Grays	0.37	0.35	0.00	0.22	0.65	0.19
	Elochoman	0.30	0.35	0.00	0.23	0.65	0.40
	Mill	0.56	0.35	0.00	0.23	0.65	0.24
	Youngs Bay	N/A	Na	N/A	N/A	N/A	N/A
	Big Creek	N/A	Na	N/A	N/A	N/A	N/A
	Clatskanie	N/A	Na	N/A	N/A	N/A	N/A
	Scappoose	N/A	Na	N/A	N/A	N/A	N/A
Cascade Fall	Lower Cowlitz	0.64	0.37	0.00	0.23	0.65	0.47
	Upper Cowlitz	0.71	0.38	1.00[1]	0.23	0.65	0.20
	Toutle	0.56	0.36	0.00	0.23	0.65	0.31
	Coweeman	0.44	0.30	0.00	0.23	0.65	0.00
	Kalama	0.43	0.27	0.00	0.24	0.65	0.27
	Lewis	0.53	0.32	0.00	0.24	0.65	0.01
	Salmon	1.00	0.32	0.00	0.24	0.65	0.00
	Washougal	0.47	0.29	0.00	0.24	0.65	0.20
	Clackamas	N/A	N/A	N/A	N/A	N/A	N/A
	Sandy	N/A	N/A	N/A	N/A	N/A	N/A
Cascade Late Fall	Lewis NF	0.16	0.39	0.07[1]	0.24	0.50	0.17
	Sandy	N/A	N/A	N/A	N/A	N/A	N/A
Cascade Spring	Upper Cowlitz	0.82	0.20	0.90[1]	0.31	0.53	0.27
	Cispus	0.88	0.20	1.00[1]	0.31	0.53	0.27
	Tilton	—	0.20	1.00[1]	0.31	0.53	0.27
	Toutle	1.00	0.20	0.00	0.31	0.53	0.45
	Kalama	0.92	0.20	0.00	0.31	0.53	0.45
	Lewis NF	0.81	0.20	0.90[1]	0.31	0.53	0.45
	Sandy	0.63	0.20	0.92[1]	0.34	0.53	0.70
Gorge Fall	Lower Gorge	0.45	0.29	0.20[2]	0.25	0.65	0.29
	Upper Gorge	0.63	0.30	0.60[2]	0.27	0.65	0.19
	White Salmon		0.30	0.60[2]	0.27	0.65	0.11
	Hood	N/A	N/A	N/A	N/A	N/A	N/A
Gorge Spring	White Salmon	—	0.20	0.92[1,2]	0.34	0.53	0.70
	Hood	N/A	N/A	N/A	N/A	N/A	N/A

[1/] Non-Federal hydro impacts
[2/] Federal hydro impacts
N/A = not available
Source: LCFRB 2004.
Note: Percentages represent independent estimates of the mortality rate or reduction relative to the historical baseline for each factor (e.g., 70 percent loss of habitat, 50 percent fishing mortality rate).



Source: LCFRB 2004

Figure 12-2. Pie Charts Showing Estimated Percentages of Total Manageable Impacts for Each Sector for Lower Columbia River Chinook Salmon Populations

Tributary impacts and improvements are based on estimated changes in habitat capacity between historical and current conditions. Estuary values reflect habitat changes in the mainstem and estuary downstream from Bonneville Dam. Dam impacts and improvement increments identified in the Washington analysis included Federal and non-Federal access and passage effects. Access effects include habitat blockages in tributaries (White Salmon, Lewis, and Cowlitz rivers) as well as inundation of key spawning reaches in the lower portions of Bonneville Reservoir tributaries. Passage effects include juveniles and adult mortality at Bonneville Dam. Predation includes approximate total mortality rates by northern pikeminnow, birds, and marine mammals. Harvest includes direct and indirect mortality in ocean and freshwater fisheries. Hatchery values are indexed based on proportion of natural spawning hatchery fish, relative productivity of hatchery fish, and interspecific effects resulting from predation by juvenile salmonids of other species. For additional detail on the analysis and application of these numbers, see the interim recovery plan approved by NMFS (LCFRB 2004; Vol. I, pp. 5-29—5-36; Appendix E, Chapter 10).

From these assessments, the recovery plan draws the general conclusion that current salmonid status is the result of large impacts distributed among several factors, and that substantial improvements in salmonid viability will require significant reductions in mortality in almost all limiting factors. The approach represents the relative order of magnitude of key limiting factors. It does not constitute a fine-scaled mechanistic analysis of limiting factors for every population. It does, however, provide a systematic basis for identifying which human impacts are most significant and focusing protection and recovery actions on significant problems. For instance, hydro impacts are estimated to be a relatively small fraction of total impacts for most populations. Significant hydro impacts in the Cowlitz, Lewis, and White Salmon rivers are a result of non-Federal facilities. Quantifiable FCRPS impacts are described only for gorge populations and typically account for less than one third of the net impact.

The mainstem hydro system has had the greatest impact in the Lower Columbia River Gorge stratum. Of the 32 historical populations identified by the Technical Recovery Team (TRT), 5 spawn above Bonneville Dam in the White Salmon River, Hood River, and Upper Gorge tributaries. The majority of spawners are thought to be of hatchery-origin and, as such, population diversity and productivity is presumed to be significantly depressed in the Gorge stratum (McElhany 2004 et al.).

The native population of spring-run Chinook salmon in the White Salmon River was extirpated by the construction of PacifiCorp's Condit Dam (McElhany 2004). The dam is slated for removal October 2008-2009 and is the subject of ESA Section 7 consultation (NMFS 2006b). The native spring Chinook population in the Hood River was extirpated by development and water use in that basin. Although quantitative estimates of losses are not available, the Bonneville Reservoir has inundated significant portions of historical spawning and rearing habitat for fall chinook populations that spawn above Bonneville Dam (LCFRB 2004).

What mainstem and tributary habitat that remains is moderately or severely impaired. Gorge populations upstream from Bonneville Dam also experience passage mortality at Bonneville Dam, both as juveniles and as adults. Passage survival rates at Bonneville Dam (2004 to present), including hatchery stock, are estimated as follows: yearling smolts - 0.9 (NMFS 2004 Table 6.5), subyearling smolts – 0.86 (NMFS 2004 Table 6.5), spring-run adults - 0.965 (based on Bjornn et al. 2000), and fall-run adults – 0.98 (estimate based on a per project survival rate in NMFS 2004).

12.2 BASE STATUS

The base status is the historical status of the ESU, based on quantitative population metrics estimated from available time series of fish data. Long-term averages were used where they were available although many of the available data time series are relatively recent.

Table 12-4. Abundance, Productivity, and Trends of Lower Columbia River Chinook Salmon Populations

				Recent Natural Spawners			Long-term trend		Median growth rate	
	Strata	**Population**	**State**	**Years[a]**	**No.[b]**	**pHOS[c]**	**Years**	**Value[d]**	**Years**	**λ[e]**
Spring	**Cascade**	Cowlitz	W	na	na	na	80-01[f]	0.994[f]	na	na
		Cispus	W	2001[f]	1,787[f]	na	na	na	na	na
		Tilton	W	na	na	na	na	na	na	na
		Toutle	W	na	na	na	na	na	na	na
		Kalama	W	97-01[f]	98[f]	na	80-01[f]	0.945[f]	na	na
		Lewis NF	W	97-01[f]	347[f]	na	80-01[f]	0.935[f]	na	na
		Sandy	O	90-04[g]	959[g]	52%[g]	90-04[g]	1.047[g]	90-04[g]	0.834[g]
	Gorge	White Salmon	W	na	na	na	na	na	na	na
		Hood	O	94-98[g]	51	na	na	na	na	na
Fall	**Coast**	Grays	W	97-01[f]	59[f]	38%[f]	64-01[f]	0.965[f]	80-01[f]	0.844[f]
		Elochoman	W	97-01[f]	186[f]	68%[f]	64-01[f]	1.019[f]	80-01[f]	0.800[f]
		Mill	W	97-01[f]	362[f]	47%[f]	80-01[f]	0.965[f]	80-01[f]	0.829[f]
		Youngs Bay	O	na	na	na	na	na	na	na
		Big Creek	O	na	na	na	na	na	na	na
		Clatskanie	O	90-04[g]	41[g]	15%[g]	90-04[g]	1.077[g]	90-04[g]	1.152[g]
		Scappoose	O	na	na	na	na	na	na	na
	Cascade	Lower Cowlitz	W	96-01[f]	463[f]	62%[f]	64-00[f]	0.951[f]	80-01[f]	0.682[f]
		Upper Cowlitz	W	na	na	na	na	na	na	na
		Toutle	W	na	na	na	na	na	na	na
		Coweeman	W	97-01[f]	274[f]	0%[f]	64-01[f]	1.046[f]	80-01[f]	1.091[f]
		Kalama	W	97-01[f]	655[f]	67%[f]	64-01[f]	0.994[f]	80-01[f]	0.818[f]
		Lewis	W	97-01[f]	256[f]	0%[f]	80-01[f]	0.981[f]	80-01[f]	0.979[f]
		Salmon	W	na	na	na	na	na	na	na
		Washougal	W	97-01[f]	1,130[f]	58%[f]	64-01[f]	1.088[f]	80-01[f]	0.815[f]
		Clackamas	O	98-01[g]	40[g]	na	67-01[g]	0.937[g]	na	na
		Sandy	O	97-01[g]	183[g]	na	na	na	na	na
	Gorge	Lower Gorge	W/O	na	na	na	na	na	na	na
		Upper Gorge	W	97-01[f]	109[f]	13%[f]	64-01[f]	0.935[f]	80-01[f]	0.955[f]
		White Salmon	W	97-01[f]	218[f]	21%[f]	67-01[f]	0.941[f]	80-01[f]	0.945[f]
		Hood River	O	00-04[g]	36[g]	na	na	na	na	na
Late Fall	**Cascade**	Lewis NF	W	97-01[f]	6,818[f]	13%[f]	64-01[f]	0.992[f]	80-01[f]	0.948[f]
		Sandy	O	90-04[g]	2,771[g]	5%[g]	81-04[g]	0.983[g]	81-04[g]	0.997[g]

a Years of data for recent means.
b Geometric mean of total spawners.
c Average recent proportion of hatchery origin spawners (or total abundance where hatchery fraction unavailable).
d Long-term trend of natural spawners (regression of log-transformed spawner indices against time).
e Long-term median population growth rate after accounting for hatchery spawners (equal spawning success assumption).
f NMFS 2005b
g McElhany et al. 2007
Note: Reported time series correspond to reported values in available information and may not correspond to reference periods identified in Biological Opinion (BiOp) assessments of other ESUs.

12.2.1 Abundance, Productivity and Trends

Base status information (Table 12-4) is reported for Lower Columbia River Chinook Salmon populations in the 2005 status review by the National Marine Fisheries Service (NMFS, also called National Oceanic and Atmospheric Administration [NOAA] Fisheries). Draft status assessments were updated for Oregon populations in 2007 co-authored in a review document (McElhany et al. 2007). Many of the populations comprising this ESU are small. Long- and short-term trends in abundance of individual populations are often negative, some severely so. In many cases natural runs have been extensively replaced by hatchery production. Data are not available for many populations in this ESU.

12.2.2 Extinction Probability/Risk

Risk of extinction (Table 12-5) was qualified in recovery plan assessments based on risk categories and criteria identified by the TRT (McElhany et al. 2004). The rating system categorized extinction risk probabilities as very low (<1 percent), low (1 to 5 percent), medium (5 to 25 percent), high (26 to 60 percent),and very high (>60 percent) based on abundance, productivity, spatial structure and diversity characteristics. The risk assessment was based on a qualitative analysis of the best available data and anecdotal information for each population.

Table 12-5. Lower Columbia River Chinook Salmon Risk Categories Identified for Washington Populations in the Washington Lower Columbia Recovery Plan (LCFRB 2004) and for Oregon Populations by McElhany et al. (2007)

Type	Strata	Population	State	TRT Category [a]
Spring	**Cascade**	Cowlitz	W	H
		Cispus	W	H
		Tilton	W	VH
		Toutle	W	VH
		Kalama	W	VH
		Lewis NF	W	VH
		Sandy	O	M
	Gorge	White Salmon	W	VH
		Hood	O	VH
Fall	**Coast**	Grays/Chinook	W	H
		Elochoman/Skamokawa	W	H
		Mill/Abernathy/Germany	W	H
		Youngs Bay	O	VH
		Big Creek	O	VH
		Clatskanie	O	H
		Scappoose	O	VH
	Cascade	Lower Cowlitz	W	H
		Upper Cowlitz	W	VH
		Toutle	W	H
		Coweeman	W	M
		Kalama	W	H
		Lewis	W	M
		Salmon	W	VH
		Washougal	W	H
		Clackamas	O	VH
		Sandy	O	VH
	Gorge	Lower Gorge	W/O	H
		Upper Gorge	W	H
		White Salmon	W	H
		Hood River	O	H
Late Fall	**Cascade**	NF Lewis	W	M
		Sandy	O	L

[a] Risk category estimated by the TRT from qualitative abundance, productivity, spatial structure and diversity criteria (VH=very high >60 percent, H=high 26 to 60 percent. M=moderate 5 to 25 percent, L=low 1-5 percent, VL=very low <1 percent).

12.2.3 Spatial Structure and Biological Diversity

Conserving and rebuilding sustainable salmonid populations involves more than meeting abundance and productivity criteria. Accordingly, NMFS has developed a conceptual framework defining a Viable Salmonid Population, or VSP (McElhany et al. 2000). In this framework there is an explicit consideration of four key population characteristic or parameters for evaluating population viability status: abundance, productivity (or population growth rate), biological diversity, and population spatial structure. The reason that certain other parameters, such as habitat characteristics and ecological interactions, were not included among the key parameters is that their effects on populations are implicitly expressed in the four key parameters. Based on the current understanding of population attributes that lead to sustainability, the VSP construct is central to the goal of ESA recovery, and warrants consideration in a jeopardy determination. However, it must also be stressed that the ability to significantly improve either a species' biological diversity or its spatial structure and distribution is limited within the timeframe of the FCRPS Proposed RPA.

Spatial Structure

Spatial structure, as the term suggests, refers to the geographic distribution of individuals in a population unit and the processes that generate that distribution. Distributed populations that interact genetically are often referred to as metapopulation. Although the spatial distribution of a population, and thus its metapopulation structure, is influenced by many factors, none are perhaps as important as the quantity, quality, and distribution of habitat. One way to think about the importance or value of a broad geospatial distribution is that a population is less likely to go extinct from a localized catastrophic event or localized environmental perturbations.

Biological Diversity

Biological diversity within and among populations of salmonids is generally considered important for three reasons. First, diversity of life histories patterns is associated with a use of a wider array of habitats. Second, diversity protects a species against short-term spatial and temporal changes in the environment. And third, genetic diversity is the so-called raw material for adapting to long-term environmental change. The latter two are often described as nature's way of hedging its bets—a mechanism for dealing with the inevitable fluctuations in environmental conditions – long- and short-term. With respect to diversity, more is better from an extinction-risk perspective.

The Lower Columbia River Chinook Salmon ESU comprises 6 MPGs consisting of from 2 to 9 populations each. Spatial structure of Coast and Cascade Fall Chinook Salmon populations is generally similar to the historical condition. Spatial structure of Upper Gorge Fall Chinook Salmon populations has been substantially reduced by habitat inundation or blockage. Spatial structure of many spring Chinook salmon populations has been significantly reduced by non-Federal tributary hydropower development, particularly among Washington populations. Diversity of all major population groups have been significantly eroded by large hatchery influences and periodic low effective population sizes.

12.3 BIOLOGICAL ASSESSMENT

This section includes:

1. an assessment of current status involving an adjustment of the initial base estimates to reflect recent improvements in mortality factors already implemented but not yet been evidenced in adult returns, and
2. an assessment of prospective status involving benefits expected from planned actions.

The biological assessments of Lower Columbia salmonid populations are largely qualitative at this time due to a lack of biological data for many populations. In contrast to the interior ESUs where good long-term data sets are available on most populations, data is limited to only a few lower Columbia River populations and even that data is subject to a high degree of uncertainty. In particular, a high incidence of hatchery fish has confounded the ability to make accurate assessments of natural population abundance and productivity of Lower Columbia River Chinook Salmon. As a result, stepwise quantitative analyses of incremental benefits of specific actions like those completed for interior ESUs, are not included herein, nor were they included in recovery plans.

Base status is the historical status of the ESU, defined as the status of the population based on the *average* of quantitative survival metrics estimated from a time series of abundance data beginning in about 1980. For the most part, longer-term averages are used where they are available. In the biological assessment, this is the starting point, shown in the preceding section.

Current status considers both beneficial and adverse actions already implemented, but not yet biologically expressed. Survival benefits are expected from recently implemented changes in hydropower configuration and operation, tributary and estuarine habitat conditions, predation by birds and other fishes, hatchery operations, and harvest management changes relative to the base period. However, effects of these actions are obviously not reflected in the time series of survival data that for the most part started in 1980.

Prospective status considers survival improvements expected from the hydro, habitat, predation, and hatchery changes included in the Proposed RPA, as well as actions likely to be implemented by others.

This assessment assumes that future ocean and climate conditions will approximate the average conditions that prevailed during the 20 year base period used for our status assessments. For most populations, that period is about equivalent to the “recent” ocean period used by the TRT in its analyses. This period was characterized by relatively unproductive and extremely variable ocean conditions, which presumably contributed to poor early ocean survival of salmonids in most years. This subject is treated at greater length in the discussion of the effects of potential climate change in Appendix H.

12.3.1 Current Status

Over this period the Action Agencies have implemented multiple actions to improve fish survival relative to the base period prior to 2000. The percentage changes in lifecycle survival used in base-to-current adjustments for Lower Columbia River Chinook salmon are summarized in Table 12-6. Actions are summarized below. The most significant survival effects of actions since the base period involve harvest rate reductions for fall and spring Chinook salmon in fresh water and ocean fisheries. This change has significantly increased spawning escapement of Lower Columbia River Chinook Salmon relative to the base period. Actions have been implemented in all factors but full benefits of these actions have not yet realized. This is particularly true for habitat actions, whose effects accrue at the stream scale over long periods of time.

Table 12-6. Estimated Survival Improvements (net) Used in the Base-to-Current Adjustment

	Hydro	Habitat (tributary)	Habitat (estuary)	Predators (avian)	Predators (fish)	Hatchery	Harvest
LCR[1] Fall Chinook	11.3%	N/A	0.7%	2.0%	2%	N/A	16%
LCR Spring Chinook	11.3%	N/A	0.3%	-0.3%	2%	N/A	25%

[1/] LCR – Lower Columbia River
[2/] Benefits of Bonneville passage improvements benefit only upstream portions of the ESU.

12.3.1.1 Hydropower Survival Improvements

Several hydropower configuration and operational improvements implemented in 2000 to 2006 are estimated to have resulted in an increase in survival for fall and spring Chinook salmon that pass through the dam. However, in that most populations of Lower Columbia River Chinook Salmon, Steelhead, Coho Salmon, and Columbia River Chum Salmon occur downstream of the project, only portions of those ESUs are anticipated to benefit by actions at Bonneville Dam. Improvements during this period included:

- Bonneville Powerhouse II (PH2) Corner Collector installation
- Bonneville Powerhouse 1 (PH1) Minimum Gap Runners (MGR) (partial installation)
- Bonneville PH2 Fish Guidance Efficiency (FGE) improvements (partial installation)
- Bonneville spill operation improvements
- Bonneville PH2 as first priority powerhouse
- Bonneville PH1 juvenile bypass system screen removal

12.3.1.2 Tributary Habitat Survival Improvements

A wide variety of actions with the potential to improve critical habitats have been implemented in lower Columbia River subbasin tributaries since 2000, involving non-Federal and Federal parties. Actions range from beneficial land management practices through improvements in access through culvert replacement through fish reintroduction activities above non-Federal dams. Recently-completed subbasin and recovery plans provide extensive guidance for these actions. Effects of many of these actions are expected to accrue over the long term, falling outside of the period addressed by this assessment. The magnitude of effects is uncertain and is expected to be addressed by monitoring activities and adaptive management.

12.3.1.3 Estuary Habitat Improvements

The estimated survival benefit for Lower Columbia River Fall Chinook Salmon (ocean-type life history) associated with the specific actions discussed above is 0.7 percent. Survival benefit for Lower Columbia River Spring Chinook Salmon (stream-type life history) associated with the specific actions discussed below was 0.3 percent. The Action Agencies implemented habitat actions on 21 estuary habitat projects. Unrestricted fish passage and approximately 3 miles of access to quality habitat was provided by the following specific actions[1]:

- Replaced 3 culverts with full-spanning bridges;
- Provided approximately 10 miles of improved tidal channel connectivity by installing a tide gate retrofit;
- Acquired approximately 473 acres of off-channel and riparian habitats;
- Restored and created 90 acres of marsh and tidal sloughs and approximately 100 acres of riparian forests
- Protected approximately 55 acres of high-quality riparian and floodplain habitat
- Restored and preserved approximately 154 acres of off-channel habitat;
- Protected 80 acres of high-value off-channel forested wetland habitat;

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[1] A more thorough report detailing this evaluation process is: *Estimated Benefits of Federal Habitat Projects in the Lower Columbia River and Estuary* (PC Trask & Associates 2007), which is included in Appendix D to this document.

- Restored approximately 96 acres of tidal wetlands habitat by replacing undersized culvert that limited fish access;
- Conserved 155 acres of forested riparian and upland habitat;
- Provided partial tidal channel reconnection by tide gate retrofit (acreage unknown at this time);
- Provided integrated pest management (purple loosestrife);
- Reconnected and restored 183 acres of historic floodplain by dike removal;
- Restored 25 acres of historic floodplain by breaching a dike;
- Provided fish passage access to 6 miles of stream habitat by removal of two culverts and replacement with bridges;
- Restored 310 acres of native hardwood riparian forest, 200 acres of seasonally wet slough and 155 acres of degraded riparian habitats;
- Increased circulation in approximately 92 acres of backwater and side-channel habitat by tide gate retrofit;
- Improved embayment circulation for 335 plus acres of marsh/swamp and shallow-water and flats habitat; and
- Preserved 35 acres of historic wetland habitat.

12.3.1.4 Predation Management Survival Improvements

Avian predation. The estimated change in survival from baseline to current for Lower Columbia River Fall Chinook Salmon is 2.0 percent. This underestimates the survival increase from the base to current condition, because the tern population was increasing over the base period and there was no Federal action affecting this increase. The estimated relative baseline to current survival of Lower Columbia River Spring Chinook Salmon is -0.3 percent. This reflects a reduction in survival from the base to current condition, because the tern population was increasing over the base period. Averaging tern consumption of juvenile salmonids across the 20-year base period downplays the actual change in survival that resulted from relocating terns from Rice Island to East Sand Island in 1999. In 1999 tern consumption of juvenile salmonids was at its peak with an estimated 13,790,000 smolts consumed, compared to 8,210,000 in 2000 after relocation.

Piscivorous predation. The ongoing Northern Pikeminnow Management Program (NPMP) has been responsible for reducing predation related juvenile salmonid mortality since 1990. The improvement in lifecycle survival attributed to the NPMP is estimated at 2 percent for migrating juvenile salmonids including yearling and subyearling migrants (Friesen and Ward 1999). The northern pikeminnow has been responsible for approximately 8 percent predation-related mortality of all juvenile salmonid migrants in the Columbia River Basin in the absence of the NPMP (2000 FCRPS BiOp at 9-106). The ongoing NPMP is already accounted for in the estimation of survival improvements modeled within the reservoir mortality life stage. This is because the modeling estimates are calibrated to empirical reach survival estimates that included the ongoing program.

12.3.1.5 Hatchery Survival Improvements

State and Federal hatchery programs throughout the lower Columbia River are currently subject to a series of comprehensive reviews for consistency with the protection and recovery of listed salmonids. A variety of changes to hatchery programs have already been implemented and additional changes are anticipated. The magnitude of effects is uncertain and is expected to be addressed by adaptive monitoring activities.

12.3.1.6 Harvest Survival Improvements

This assessment of status assumes a certain amount of annual take of natural adult fish based on recent harvest levels. Fishery impacts for Lower Columbia River Tule Fall Chinook Salmon in combined ocean and freshwater fisheries have been reduced from 65 percent in the pre-2000 base period to 49 percent currently. This reduction involved increased restrictions of ocean and freshwater fisheries and was implemented subsequent to listing in order to protect weak populations and provide adequate opportunity for restoration. Fishery impacts for Lower Columbia River Bright Fall Chinook Salmon in combined ocean and freshwater fisheries are typically limited to less than 50 percent based on escapement goals and other fishery constraints. Fishery impacts for Lower Columbia River Spring Chinook Salmon in combined ocean and freshwater fisheries have been reduced from 50 percent in the pre-2000 base period to 25 percent currently. This reduction was implemented to protect weak listed populations and was largely achieved by the implementation of mark-selective sport and commercial fisheries, as well as increased used of terminal fisheries to target hatchery spring Chinook salmon.

12.3.2 Prospective Status

The prospective status is projected based expected survival improvements associated with actions in 2007 to 2009 and 2010 to 2017. Over this period the Action Agencies will implement multiple actions to improve fish survival relative to the current period. The percentage changes in lifecycle survival used in current-to-prospective adjustments are summarized in Table 12-7.

12.3.2.1 Hydropower Survival Improvements

Passage improvements at Bonneville Dam are anticipated to directly benefit all populations of fish originating upriver from the dam and reservoir (Bonneville Lake). However, because most populations of Lower Columbia River Chinook Salmon, Steelhead, Coho Salmon, and Columbia River Chum Salmon occur downstream of the project, only portions of those ESUs are anticipated to benefit by actions at Bonneville Dam.

Table 12-7. Estimated Improvements in Survival Used in the Current-to-Prospective Adjustment

	Hydro	Habitat (tributary)	Habitat (estuary)	Predators (avian)	Predators (fish)	Hatchery	Harvest
Lower Columbia River Fall Chinook Salmon	.3%	N/A	9%	0.7%	1%	N/A	—
Lower Columbia River Spring Chinook Salmon	.3%	N/A	5.7%	2%	1%	N/A	—

2007 to 2009. Actions that will be implemented during this timeframe include complete implementation of minimum gap runners at Bonneville PH1, complete installation of PH2 FGE improvements, and improve PH1 sluiceway fish guidance efficiency and conveyance. Collectively these modifications are expected to increase the survival of yearling (spring) and subyearling (fall) Chinook salmon that pass through Bonneville Dam by 1 percent.

2010 to 2017. Spillway survival improvements during this time period are expected to increase the passage survival through Bonneville Dam of yearling (spring) Chinook salmon by an additional 0.5 percent and of subyearling (fall) Chinook salmon by an additional 3.9 percent.

12.3.2.2 Tributary Habitat Survival Improvements

A wide variety of actions (e.g., floodplain restoration, instream complexing and off-channel habitat creation) with the potential to improve critical habitats are expected to be implemented in lower Columbia River subbasin tributaries from 2007 through 2017, involving non-Federal and Federal parties. Recently-completed subbasin and recovery plans provide extensive guidance for these actions. Effects of these actions are expected to accrue over the long term, but the magnitude of effects is uncertain and is expected to be addressed by adaptive monitoring activities and adaptive management.

12.3.2.3 Estuary Habitat Survival Improvements

2007 to 2009. The estimated survival benefit for Lower Columbia River Fall Chinook Salmon associated with the specific actions described below is less than 2.3 percent. Estimated survival benefits for Lower Columbia River Spring Chinook Salmon associated with the specific actions discussed above is 1.4 percent. The Action Agencies' estimated benefit for 2007 is based on actions that are or will be underway in the very near-term. For 2008 and 2009, the Action Agencies estimated benefit is based on continuing at the same level of effort as 2007[2]. Action Agencies are or will be implementing multiple habitat actions through approximately 29 estuary habitat projects. Specific estuary habitat actions include:

- Restore partial tidal influence and access to several acres (exact amount unknown at this time) by a tide gate retrofit;
- Improve hydrologic flushing and salmonid access to a lake (Sturgeon Lake is approximately 3,200 acres);
- Acquire and protect 40 acres of critical floodplain habitat and 40 acres riparian forest restoration;
- Install 6 to 8 engineered log-jams that will help to slow flood flows, reduce erosion, contribute to sediment storage, enhance fish habitat and contribute wood into the project area;
- Acquire and restore floodplain connectivity to 380 acres of off-channel rearing habitat for juveniles;
- Install fish friendly tide gates to increase tidal flushing and fisheries access to approximately 110 acres;
- Complete riparian planting of up to 210 acres;
- Re-establish hydrologic connectivity to reclaim and improve floodplain wetland functions, increase off-channel rearing and refuge habitat on five acres, plant native vegetation along shoreline and reconstruct slough channels on 2.5 acres of annually inundated off-channel habitat;
- As part of a long-term 1,500 acres restoration effort: breach a dike and re-establish flow to portion of original channel, planting vegetation on 50 acres, removing invasive weeds on 180 acres, planting wetland scrub shrub on 45 acres, and controlling and removing invasive wetland plants on 45 acres;
- Retrofit a tide gate (acreage unknown at this time);
- Protect and restore approximately 5 to 10 acres of emergent wetland and riparian forest habitats;
- Reconnect 45 acres of floodplain by tide gate removal;
- Acquire 45 acres of floodplain with future dike removal;

[2] A more thorough report detailing this evaluation process is: *Estimated Benefits of Federal Habitat Projects in the Lower Columbia River and Estuary* (PC Trask & Associates 2007), which is included in Appendix D to this document.

- Reconnect 50 acres of floodplain;
- Acquire 320 acres of tidelands and 119 acres of riparian/upland forest; and
- Restore 30 acres of riparian habitat.

There will be approximately 15 additional projects and associated actions similar to actions listed above that are undergoing scoping and sponsor development (the number of projects and associated actions is based on the same level of effort as 2007).

2010 to 2017. The survival benefit for Lower Columbia River Fall Chinook Salmon associated with these actions is 6.7 percent. Estimated survival benefit for Lower Columbia River Spring Chinook Salmon associated with these actions is less than 4.3 percent. The Action Agencies estimated benefits for 2010 to 2017 are based on continuing the same level of effort as 2007 to 2009. However, the level of effort in this time period may increase depending on the outcome of a General Investigation study of Ecosystem Restoration opportunities, depending on Congressional appropriations, future funding scenarios and results of actions. Specific projects have yet to be identified, but actions for this period will be similar in nature to actions implemented in previous periods discussed above. Actions will include protection and restoration of riparian areas, protection of remaining high quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, and reduction of noxious weeds, among others.

12.3.2.4 Predation Management Survival Improvements

Avian predation. Survival attributed to improved management of Caspian tern populations in the Lower Columbia are estimated at 2.1 percent for yearling Chinook salmon and 0.7 percent for subyearling Chinook salmon. The benefit is carried out to 2017 and beyond; there are no further actions, and therefore, no further benefits. This improvement is expected to result through the reduction in estuary tern nesting habitat, and subsequent relocation of terns outside the Columbia River Basin. Although the base to current shows a reduction in survival, the overall benefit (base to future) is positive.

Piscivorous predation. The percentage improvement in lifecycle survival attributable to the proposed continuation of the increase in incentives in the NPMP and resultant marginal increase in observed exploitation rate is estimated at 1 percent total from 2007 to 2017. This estimate was derived based on the difference between the estimated benefits from the base NPMP (defined as the period 1990 to 2003) and estimated survival benefits under the increased incentive program (defined as the period of 2004 to present). This rate would generally apply to all juvenile yearling and subyearling salmonids.

12.3.2.5 Hatchery Survival Improvements

State and Federal hatchery programs throughout the Lower Columbia River are currently subject to a series of comprehensive reviews for consistency with the protection and recovery of listed salmonids. A variety of changes to hatchery programs have already been implemented and additional changes are anticipated. The magnitude of effects is uncertain and is expected to be addressed by adaptive monitoring activities.

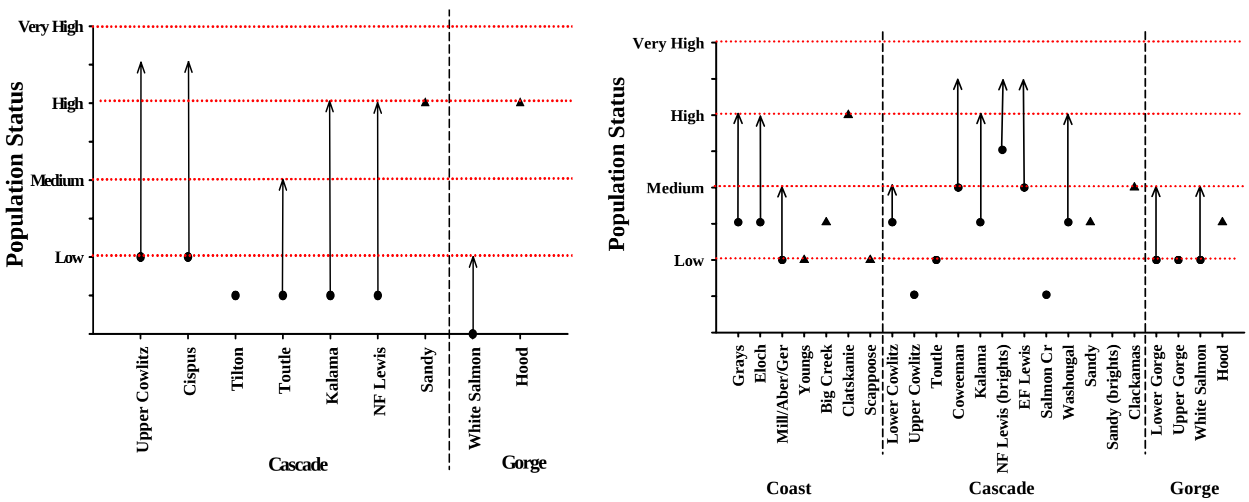
12.3.2.6 Harvest Survival Improvements

The assessment of status assumes a certain amount of annual take of natural adult fish based on current harvest levels.

12.4 RECOVERY GOALS AND IMPROVEMENT OBJECTIVES

This section identifies recovery gaps needed to restore the ESU to viable levels as identified by the Willamette/Lower Columbia River Technical Recovery Team (McElhany et al. 2006). Recovery goals and objectives are presented to acknowledge and provide a context for interpreting contributions of Federal actions relative to recovery. However, these are long term, multifaceted recovery goals and do not constitute a requirement for the FCRPS objective of avoiding jeopardy.

The Washington Lower Columbia River Recovery and Subbasin Plan described recovery goals for the ESU based on a recovery scenario where individual populations were targeted for different levels of improvement based on biological significance and feasibility of recovery (Figure 12-3)). Primary populations are targeted for restoration to high or very high viability (low or very low risk). Contributing



Note: The recovery scenario for Oregon populations (displayed as ▲) is under development.
Source: LCFRB 2004

Figure 12-3. Improvements in Population Viability (inverse of risk) for Lower Columbia River Spring Chinook (left) and Fall Chinook (right) Corresponding to Recovery Scenario Identified in the Washington Lower Columbia River Recovery and Subbasin Plan
Source: LCFRB 2004.

populations are those for which some restoration will be needed to meet strata-wide average viability greater than moderate (<25 percent risk). Stabilizing populations are those that would be maintained at current levels until ESU-wide goals are achieved. Scenarios and goals are not yet available for Oregon populations. Recovery planning assessments indicated that effects of the FCRPS on recovery gap assessments would ideally compare expected improvements due to current and planned actions with improvement objectives identified by the Recovery Plan. However, this analysis is not available for lower Columbia River ESUs. Owing to uncertainty in the scale of benefits of Proposed Actions, the Washington Lower Columbia River Recovery and Subbasin Plan adopted an adaptive management approach based on monitoring of implementation and effects of a comprehensive suite of beneficial actions. The Oregon recovery planning process for lower Columbia River ESUs is in progress.

12.5 ADDITIONAL ACTIONS TO BENEFIT THE ESU

12.5.1 Other Reasonably Certain to Occur Actions

The State of Washington in the context of the collaboration among the sovereigns has identified 69 habitat-related actions and programs expected to provide benefit to portions of the four Lower Columbia River ESUs (Chinook Salmon, Coho Salmon, Chum Salmon, Steelhead) most affected by the FCRPS (Upper Columbia River gorge tributaries, Little White Salmon River, Wind River, Lower Columbia River gorge and mainstem, and Washougal). Actions, geographic area, factors affected, timing, funding status, and responsible parties are described in detail in Chapter 17.

All actions identified are either completed, ongoing, planned with high likelihood of implementation. These actions address protection and/or restoration of existing or degraded fish habitat in stream, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include Growth Management Act and Shoreline Management Act program planning and regulation, a variety of stream and riparian habitat projects, watershed planning and plan implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, Habitat Conservation Plan implementation on state forest lands, hydraulic project permitting. Responsible entities include cities; counties; conservation districts; state and local weed controls boards; local fish enhancement groups; Washington Departments of Ecology, Natural Resources, Transportation, and Fish and Wildlife; and regional coordinating bodies such as the Lower Columbia River Fish Recovery Board. Significant funding sources include state and local general funds, various dedicated state accounts, the Salmon Recovery Funding Board, and private forest land owners.

Oregon has similarly identified 117 statewide and 260 focused habitat-related actions and programs affecting the four lower Columbia River ESUs (Chapter 17). Oregon’s habitat actions address a series of strategies focused on protection and/or restoration of natural ecological processes; floodplains and riparian conditions and connections; fish passage; critical stream flow; water quality; stream habitat structure and complexity; and watershed conditions and processes. Key implementing bodies include cities, counties; the Oregon Departments of Agriculture, Forestry, Water Resources, State Lands, Fish and Wildlife, Environmental Quality, Land Conservation and Development; the Oregon Watershed Enhancement Board; conservation districts; local watershed councils; and private forest land owners.

In addition, Washington and Oregon have implemented or are planning on implementing a variety of actions and programs aimed at reducing or regulating harvest and hatchery impacts. Ongoing harvest actions have included mass marking of hatchery fish and institution of mark-selective fisheries for spring chinook and coho (steelhead programs were previously implemented). Hatchery programs throughout the region are undergoing a comprehensive management review and a variety of changes are being implemented or are expected including elimination of hatchery releases in critical natural production areas, increased acclimation of hatchery fish to reduce straying, and integration of natural broodstock into hatchery management.

12.5.2 Salmon Recovery Plan[3]

A wide suite of protection and restoration actions are currently being implemented throughout the lower Columbia River region under the guidance of the Salmon Recovery Plan. The Recovery Plan for the Washington Portion of this ESU was completed by the Washington Lower Columbia Fish Recovery Board in 2005 and was adopted by as an Interim Regional Recovery Plan in February of 2006 (70 FR 20531). The Oregon recovery planning process is underway and an Oregon plan for this ESU is expected in 2007. The Oregon and Washington plans will be combined for a complete ESA recovery plan for the Lower Columbia River Recovery Domain.

The Interim Washington Plan contains regional strategies, measures, and actions that address limiting factors and threats for tributary habitat, estuary and lower mainstem habitat, hydropower, harvest, hatcheries, and ecological Interactions. Approximately 650 specific actions are identified by the plan. The plan recognizes that existing tools are inadequate precisely evaluate the outcome of a full suite of recovery actions but instead identifies actions that are needed to achieve recovery and the level of effort that will be needed to achieve recovery objectives. Hence, the Plan takes a “directional approach,” in which actions are directed toward reducing all of the human-caused factors limiting recovery. Information gained through an adaptive management program will help refine these approaches such that at some point in the future a more focused and theoretically more cost-effective approach may be taken.

The institutional structure for Plan implementation involves oversight, implementation, and facilitation/coordination responsibilities. Key oversight bodies include NMFS, U.S. Fish and Wildlife Service, Tribal governments, the Washington Department of Fish and Wildlife, the Washington Governor’s Office, and the Northwest Power and Conservation Council. The LCRFRB, working with a steering committee, facilitates and coordinates efforts among oversight and implementing partners. The steering committee includes representatives of the oversight bodies and a cross-section of implementing partners. Facilitation/coordination involves setting priorities, evaluating progress, tracking implementation, inventorying and synthesizing monitoring results, developing implementation partnerships and agreements, and revising the Plan.

Implementation of the Plan includes an adaptive management framework that involves checkpoints at 2-year intervals to assess action implementation, at 6-year intervals to assess action effectiveness and threat reduction, and at 12-year intervals to assess fish and habitat status. Observed progress is evaluated against a series of benchmarks. In the first phase of implementation after completing the Plan, the LCFRB is now actively coordinating the implementation the specific strategies, measures and actions identified in the plan. The Board has authorized the Recovery Plan Implementation Committee to oversee implementation activities and to assist partnering groups in developing implementation work schedules, cost estimates and commitment necessary to receive assurances from NMFS.

In 2005, the Committee launched the Salmon Partners Ongoing Tracking System (Salmon PORT) to facilitate developing Implementation Work Schedules. The system is designed as an interactive website displaying all 650 actions contained in the Salmon Recovery and Watershed Management plans. This system will provide the basis for a comprehensive evaluation of progress in action implementation as planned according to the plan implementation schedule.

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[3] Many of the actions listed above have a cost-share component with a variety of other Federal funding sources and therefore, may be properly described as contributing to the status of the environmental baseline rather than cumulative effects.

12.5.3 Other Federal Actions that Have Completed ESA Consultation

The Action Agencies' review of Federal actions that have completed Section 7 ESA consultations is not available at this time.

12.6 CONCLUSION

This ESU is currently threatened by a broad suite of habitat and ecological factors affecting populations distributed from the Columbia River mouth to the gorge upstream from Bonneville Dam. Because of the limited impact of the proposed operation of the FCRPS and the Upper Snake River projects on this ESU, there is limited potential to improve lower Columbia River populations with FCRPS configuration changes or improvements to FCRPS or Upper Snake River operations; and, with the diverse nature of impacts affecting this ESU, the future status depends on a coordinated effort by many Federal and non-Federal parties, such as through recovery plan implementation.

The Remand Collaboration did not develop a method analogous to the Conceptual Framework for assessing the appropriate contribution of FCRPS effects to recovery of Lower Columbia River ESUs. Because the available information on the status of populations within this ESU is not sufficient to complete a systematic quantitative analysis of the adequacy of implemented and planned actions as was done for the Interior Columbia River ESUs, our conclusions are based on a qualitative assessment of the prospect for survival and recovery of this ESU relying on best available information. We note that actions are being and will be implemented to address multiple threat sectors. These actions are likely to further reduce the risk of extinction and improve population trajectories for populations within the ESU, thus improving the ESU's prospects for recovery.

The Action Agencies have worked with the states and Tribes through the Remand Collaboration Process and other forums to identify actions intended to address the needs of listed salmon and steelhead as determined by quantitative and qualitative biological analyses. Acknowledging that NMFS will review the actions and the effects analyses contained herein to make a final jeopardy determination in the forthcoming biological opinions, the Action Agencies are making the following conclusions. Based on our assessment of the FCRPS and Upper Snake River actions and analysis of effects, considering the present and future human and natural context, the Action Agencies conclude that the net effects of the proposed actions, including the existence and operations of the dams with the proposed mitigation, meet or exceed the objectives of doing no harm and contributing to recovery with respect to this ESU.

Chapter 13
Lower Columbia River Coho Salmon
Evolutionarily Significant Unit

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

13.1 INTRODUCTION

This chapter briefly summarizes the currently available biological status and assessments for this Evolutionarily Significant Unit (ESU) related to extinction risk and the effects of the Federal Columbia River Power System (FCRPS) Proposed Reasonable and Prudent Alternative (RPA) in the context of recovery plan actions. First, it summarizes current status information including key limiting factors and extinction risks. Second, it includes a biological assessment of the survival effects of recent and planned actions on current and prospective conditions, respectively. Finally, it identifies additional actions to benefit the ESU. Summary data for the ESU are presented in Table 13-1 and its geographic extent is shown in Figure 13-1.

This chapter is organized into six sections. Section 13.1 provides an overview of the ESU and the factors limiting its viability. Section 13.2 summarizes population-level status information during the 20-year base period used for this analysis. Section 13.3 provides the assessment of the current status and provides estimates of the "gaps," or needed lifecycle survival improvements for individual populations to meet certain biological criteria. It summarizes the improvements made to the hydropower (hydro) system and in other Hs (habitat, hatcheries and harvest) since about 2000 and estimates the salmonid survival benefits associated with those improvements. Section 13.4 describes the recovery goals and improvement objectives to be implemented into the future, and Section 13.5 describes additional actions that will benefit this ESU. Section 13.6 provides observations on the current and future status of this ESU, particularly with respect to the operation of the FCRPS.

Table 13-1. Lower Columbia River Coho ESU Description and Major Population Groups (MPGs)

ESU Description	
Threatened	Listed under ESA in 2005[1/]
Three major population groups	24 historical populations (Many of these including upper gorge population currently at very low levels or functionally extinct)
Hatchery programs included in ESU and also listed as essential for recovery (25)[1]	The 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, 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, Washougal River Type-N Coho Program, Eagle Creek NFH, Sandy Hatchery, and the Bonneville/ Cascade/Oxbow complex coho hatchery programs.
Major Population Group	**Population**
Coast	Grays, Elochoman, Mill Creek, Youngs Bay, Big Creek, Clatskanie, Scappoose
Cascade	Lower Cowlitz, Coweeman, SF Toutle, NF Toutle, Upper Cowlitz, Cispus, Tilton, Kalama, NF Lewis, EF Lewis, Salmon, Washougal, Clackamas, Sandy
Gorge	Columbia River Lower Gorge, Washington Upper Gorge and Big White Salmon River, Oregon Upper Gorge and Hood River

[1/] Listing notice (70 FR37160)

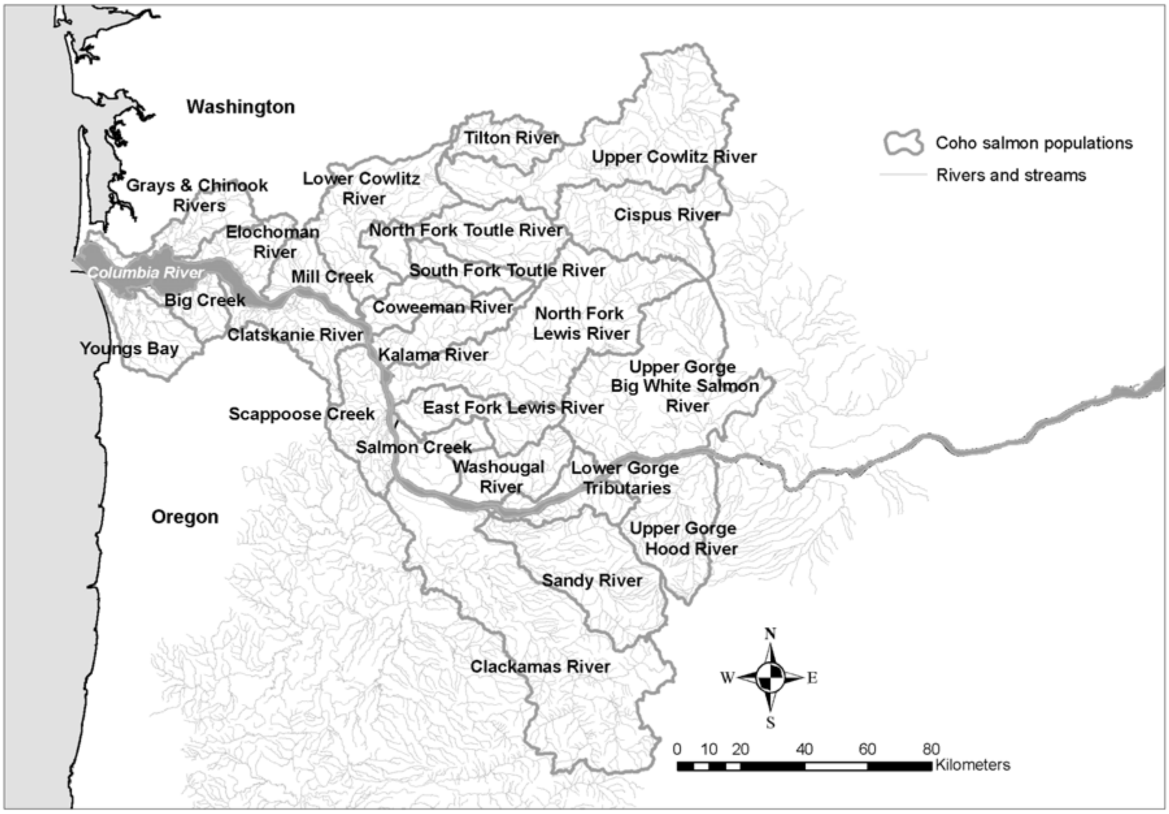


Figure 13-1. Historical Demographically Independent Coho Salmon Populations of the Lower Columbia River ESU
Sources: Myers et al. 2006, LCFRB 2004

The Lower Columbia River Coho Salmon ESU includes 24 historical populations, of which 4 are functionally extirpated or nearly so in Oregon and Washington between the mouth of the Columbia River and the Cascade crest (Myers et al. 2006). Almost all of the metrics used in this analysis are estimates for individual populations within the ESU. The Endangered Species Act (ESA) is concerned with the status of a species' Distinct Population Segment (DPS) or ESU. Individual populations and major population groups (where they exist) obviously contribute to ESU status. However, the status of the ESU is not wholly dependent upon the status of any of the ESU's individual components.

Although run time variation is considered to be inherent to overall coho life history, the ESU includes two distinct runs: early-returning (Type S) coho salmon and late-returning (Type N) coho salmon. With an ocean migration generally south of the Columbia, Type S coho salmon enter fresh water in mid-August, tributaries in early September and have spawning peaks from mid-October to early November. In contrast, the northern ocean distributions of Type N coho salmon pass through the lower Columbia River from late September through December and enter tributaries from October through January. Most Type N spawning occurs from November to January, but some spawning ranges to February and as late as March [Lower Columbia Fish Recovery Board (LCFRB) 2004].

13.1.1 Key Limiting Factors

Human impacts and limiting factors for the Lower Columbia River Coho Salmon ESU come from multiple sources: habitat degradation, habitat blockage by non-Federal dams in several subbasins, harvest, extensive hatchery effects, ecological factors including predation, and Bonneville Dam passage (upper gorge population only). Coho salmon populations began declining by the early 1900s because of habitat alterations (starting in the 1850s) and harvest rates (Columbia River commercial catch peak in 1925) that were unsustainable given the changing habitat conditions (Lichatowich et al. 1995). Coho salmon winter rearing habitat has been particularly impacted by loss of off-channel and side channel areas. Furthermore, access to upstream tributaries in several large subbasins has been restricted or eliminated by the construction of non-Federal dams.

Summarized below (Table 13-2) are key impacts and limiting factors for this ESU and recovery strategies to address those factors as described in the Washington Lower Columbia Recovery and Subbasin Plan (LCFRB 2004). The Oregon recovery planning process for lower Columbia River ESUs is in progress.

Table 13-2. Key Limiting Factors

Mainstem Hydropower	FCRPS impacts are limited for Lower Columbia River coho. Direct mainstem hydro impacts on Lower Columbia River coho are most significant for gorge tributary populations upstream from Bonneville Dam.. Upper Gorge populations are affected by upstream and downstream passage at Bonneville Dam. Impacts on other Lower Columbia River coho originating in downstream subbasins are generally limited to effects on migration and habitat conditions in the Lower Columbia River mainstem and estuary.
Predation	Piscivorous birds including Caspian terns and cormorants, fishes including northern pikeminnow, and marine mammals including seals and sea lions take significant numbers of juvenile or adult salmon and human activities are believed to have exacerbated effects of predation. Stream type juveniles are particularly vulnerable to bird predation in the estuary because they tend to use the deeper, less turbid channel areas located near habitat preferred by piscivorous birds (Fresh et al. 2005). Coho salmon are also subject to pinniped predation when they return to the estuary as adults (NMFS 2006a). Caspian tern as well as cormorant predation may each be responsible for the mortality of up to 6 percent of the outmigrating stream-type juveniles in the Columbia River Basin (2006 and 1998 data, from Bonneville Power Administration, et al. 2004 and Roby 2006). Pikeminnow are significant predators of both yearling and subyearling juvenile migrants (Friesen and Ward 1999). Ongoing actions to reduce predation effects include redistribution of avian predator nesting areas, a sport reward fishery to harvest pikeminnow, and exclusion and hazing of marine mammals near Bonneville Dam.
Harvest	Harvest includes direct and indirect fishery mortality. Lower Columbia River Coho Salmon are harvested in ocean fisheries and in Columbia River and tributary freshwater fisheries of Oregon and Washington. Fishery impacts on lower Columbia River ESUs have been significantly reduced since listing by implementation of mark selective fisheries for hatchery fish. However, harvest impacts are still significant for this ESU. The exploitation rate of coho prior to the 1990s fluctuated from approximately 60 to 90 percent but now the exploitation rate of wild coho is about 15 to 25 percent, while the exploitation of hatchery coho has remained similar to the 1990s rate of approximately 50 percent (LCFRB 2004).
Hatcheries	Hatchery programs that have used inappropriate management practices have reduced the diversity and productivity of natural populations throughout the Columbia River Basin. Domestication of hatchery fish erodes fitness in the wild and wild stock productivity is reduced when significant numbers of hatchery fish spawn with wild fish. Large hatchery releases can also have ecological effects due to increased competition or predation. Large numbers of hatchery fish also contribute to more intensive mixed stock fisheries which can overexploit weak wild populations affected by habitat degradation. Most Lower Columbia River coho populations have been heavily influenced by hatchery production over the years (Washington Department of Fisheries et al. 1993, Weitkamp et al. 1995, Fuss et al. 1998). State and Federal hatchery programs throughout the Lower Columbia River are currently subject to a series of comprehensive reviews for consistency with the protection and recovery of listed salmonids. A variety of beneficial changes to hatchery programs have already been implemented and additional changes are anticipated.

Table 13-2. Key Limiting Factors

Estuary	The estuary is a critical habitat for migrating salmonids from all Columbia River ESUs and is particularly important for local lower Columbia River populations. Due to a short residency time in the estuary, stream-type juveniles such as coho have limited mortality associated with a lack of habitat, changes in food availability, and the presence of contaminants. However, they are vulnerable to bird and pinniped predation in the estuary (Fresh et al. 2005). Furthermore, coho salmon are believed to be affected by flow and sediment delivery changes in the plume (Casillas 1999). Estuary limiting factors and recovery actions are addressed in detail in a comprehensive regional planning process (NMFS 2006b).
Habitat	Widespread development and land use have severely degraded stream habitats, water quality, and watershed processes affecting anadromous salmonids in most Lower Columbia River subbasins, particularly in low to moderate elevation habitats. EDT analyses indicate 32-92 percent reductions in habitat capacity for coho in Washington subbasins due to cumulative habitat effects and passage restrictions from non-federal hydropower facilities on the Columbia River tributaries (LCFRB 2004). The LCFRB Recovery and Subbasin Plan (LCFRB 2004) identifies current habitat values, restoration potential, limiting factors, and habitat protection and restoration priorities by reach in all Washington subbasins. Recovery and subbasin plans also identify a suite of beneficial actions for the protection and restoration of tributary subbasin habitats. Similar information is in development for Oregon subbasins.
Ocean & Climate	Analyses of Lower Columbia River salmon status generally assume that future ocean and climate conditions will approximate the average conditions that prevailed during the recent base period used for status assessments. Recent conditions have been less productive for most Columbia River salmonids than the long-term average and future trends are unclear. Under the adaptive management implementation approach of the Lower Columbia River Recovery Plan, further reductions in salmon production due to long-term ocean and climate trends will need to be addressed through additional recovery effort (LCFRB 2004).

13.1.2 Potentially Manageable Impacts – LCFRB Analysis

As part of its recovery planning process, the LCFRB evaluated factors currently limiting Washington lower Columbia River salmon and steelhead populations based on a simple index of potentially manageable impacts. This effort was intended to help target recovery actions to the most significant and manageable human impacts. The impacts assessed were tributary habitat changes, estuary habitat changes, fishing, hydropower effects, hatchery effects, and predation by birds, fish, and marine mammals. Results are displayed for each population quantitatively in Table 13-3 and in the form of pie charts in Figure 13-2. Pie charts illustrate the relative significance of each factor based on independent estimates of the mortality or effect for each area of impact.

Tributary impacts and improvements are based on estimated changes in habitat capacity between historical and current conditions. Estuary values reflect habitat changes in the mainstem and estuary downstream from Bonneville Dam. Dam impacts and improvement increments identified in the Washington analysis included Federal and non-Federal access and passage effects. Access effects include habitat blockages in tributaries (White Salmon, Lewis, and Cowlitz rivers) as well as inundation of key spawning reaches in the lower portions of Bonneville Reservoir tributaries. Passage effects include juveniles and adults mortality at Bonneville Dam. Predation includes approximate total mortality rates by northern pikeminnow, birds, and marine mammals. Harvest involves direct and indirect mortality in ocean and freshwater fisheries. Hatchery values are indexed using a proportion of natural spawning hatchery fish, relative productivity of hatchery fish, and interspecific effects resulting from predation by juvenile salmonids of other species. For additional detail on the analysis and application of these numbers, see the interim recovery plan approved by NMFS (LCFRB 2004; Vol. I, pp. 5-29:5-36; App. E, Ch. 10).

Table 13-3. Estimated Percentages of Total Manageable Impact by Sector

Major Population Group	Population	Baseline Impacts: Habitat (tributary)	Habitat (estuary)	Dams	Predators	Harvest	Hatcheries
Coast	Grays	0.715	0.287	0	0.224	0.510	0.477
	Elochoman	0.790	0.179	0	0.230	0.510	0.508
	Mill Creek	0.766	0.179	0	0.233	0.510	0.440
	Youngs Bay	—	—	—	—	—	—
	Big Creek	—	—	—	—	—	—
	Clatskanie	—	—	—	—	—	—
	Scappoose	—	—	—	—	—	—
Cascade	Lower Cowlitz	0.765	0.179	0	0.235	0.510	0.321
	Coweeman	0.778	0.179	0	0.235	0.510	0.114
	S.F. Toutle	0.888	0.179	0	0.235	0.510	0.258
	N.F. Toutle	0.888	0.179	0	0.235	0.510	0.271
	Upper Cowlitz	0.239	0.179	1.000[1]	0.235	0.510	0.288
	Cispus	0.423	0.191	1.000[1]	0.235	0.510	0.288
	Tilton	0.942	0.194	1.000[1]	0.235	0.510	0.288
	Kalama	0.629	0.194	0	0.236	0.510	0.311
	NF Lewis	0.607	0.194	0.952[1]	0.239	0.510	0.245
	EF Lewis	0.751	0.194	0	0.239	0.510	0.235
	Salmon	0.853	0.194	0	0.243	0.510	0.201
	Washougal	0.790	0.194	0	0.243	0.510	0.463
	Clackamas	—	—	—	—	—	—
	Sandy	—	—	—	—	—	—
Gorge	Lower Gorge	0.798	0.194	0[2]	0.246	0.510	0.455
	Upper Gorge	0.558	0.194	0.154[2]	0.273	0.510	0.448
	White Salmon	0.558	0.194	1.000[1,2]	0.273	0.510	0.448
	Hood River	—	—	—	—	—	—

[1/] Non-Federal hydro impacts
[2/] Federal hydro impacts
Source: LCFRB 2004
Note: Percentages represent independent estimates of the mortality rate or reduction relative to the historical baseline for each factor (e.g., 70 percent loss of habitat, 50 percent fishing mortality rate).

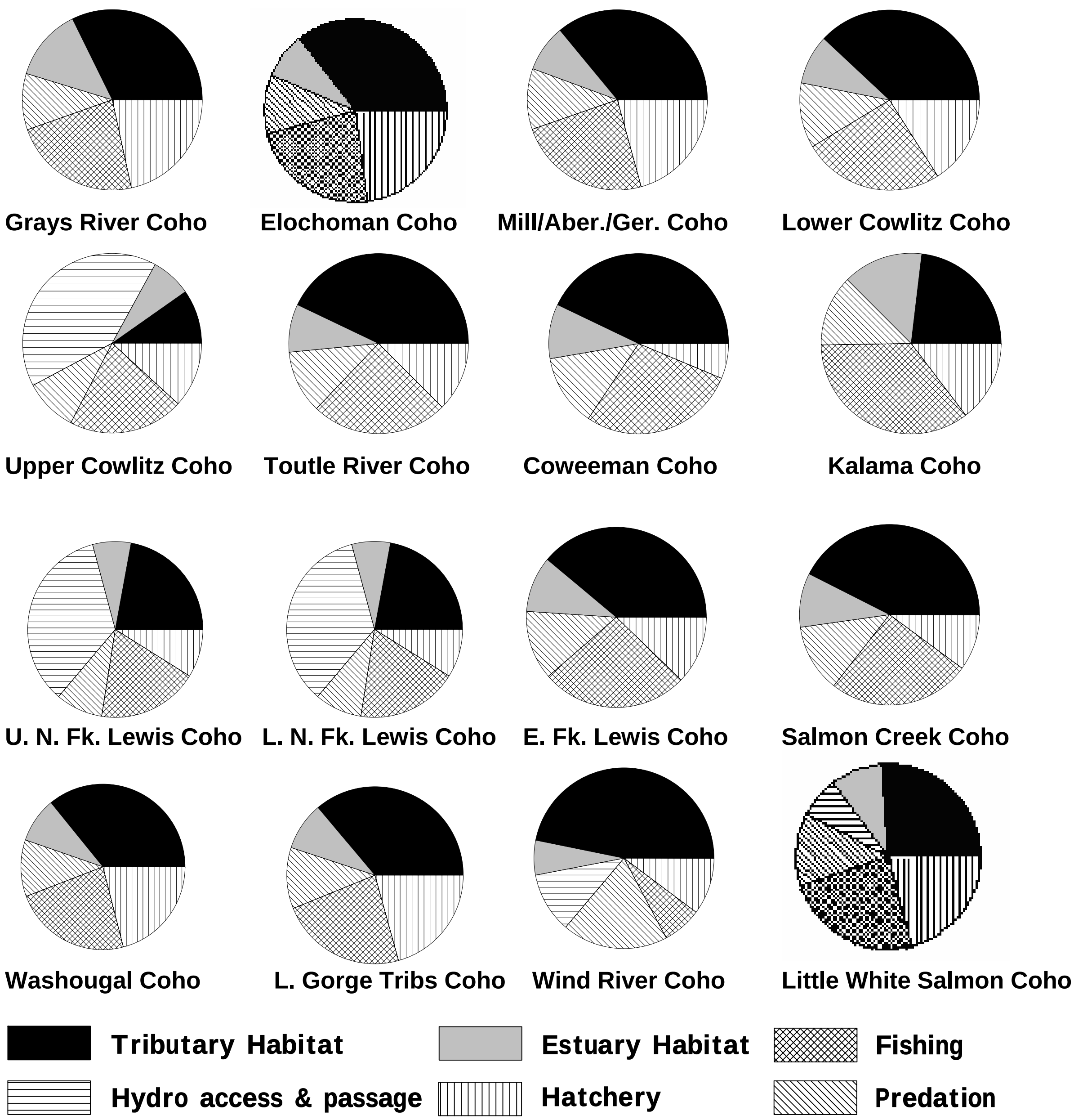


Figure 13-2. Estimated Percentages of Total Manageable Impacts for Each Sector for Lower Columbia River Coho Populations
Source: LCFRB 2004

From these assessments, the recovery plan draws the general conclusion that current salmonid status is the result of large impacts distributed among several factors, and that substantial improvements in salmonid viability will require significant reductions in mortality in almost all limiting factors. The approach represents the relative order of magnitude of key limiting factors. It does not constitute a fine-scaled mechanistic analysis of limiting factors for every population. It does, however, provide a systematic basis for identifying which human impacts are most significant and focusing protection and recovery actions on significant problems. For instance, hydro impacts are estimated to be a relatively small fraction of total impacts for most populations. Significant hydro impacts in the Cowlitz, Lewis, and White Salmon rivers are a result of non-Federal facilities. Quantifiable FCRPS impacts are described only for gorge populations and typically account for less than one-third of the net impact.

The mainstem hydro system has had the greatest impact in the Lower Columbia River Gorge stratum. Of the 24 historical populations identified by the Willamette-Lower Columbia River Technical Recovery Team (TRT), 3 spawn above Bonneville Dam in the White Salmon River, Hood River, and Lower Gorge tributaries. The majority of spawners are thought to be of hatchery-origin and, as such, population diversity is presumed to be significantly depressed in the Gorge stratum (McElhany et al. 2004).

The native population of coho salmon in the White Salmon River was extirpated by the construction of PacifiCorp's Condit Dam (McElhany et al. 2004). The dam is slated for removal October 2008-2009 and is the subject of ESA Section 7 consultation (NMFS 2006c). The White Salmon, Hood River, and Lower Gorge (Eagle Creek) populations experience passage mortality at Bonneville Dam both as juveniles and adults. Passage survival rates at Bonneville Dam (2004 to present), including hatchery stock, are estimated as follows: yearling smolts – not available, early-run adults (Type S) – 0.98 (estimate based on a per project survival rate in NMFS 2004).

13.2 BASE STATUS

The base status is the historical status of the ESU, based on quantitative population metrics estimated from available time series of fish data. Long-term averages were used where they were available although many of the available data time series are relatively recent.

13.2.1 Abundance, Productivity & Trends

Data on Lower Columbia River Coho Salmon ESU status are very limited. As indicated in Table 13-4, population-specific abundance estimates were available only for four populations and trend estimates are only available for two populations in this ESU. Base status information is reported for Lower Columbia River Coho Salmon populations in the 2005 status review by the National Marine Fisheries Service (NMFS, also called National Oceanic and Atmospheric Administration [NOAA] Fisheries). Most of the populations comprising this ESU are very small. In many cases natural runs have been extensively replaced by hatchery production. Coho salmon time series data are not available for Washington populations.

Table 13-4. Abundance, Productivity, and Trends of Lower Columbia River Coho Salmon Populations

			Recent Natural Spawners			Long-term trend		Median growth rate	
Strata	**Population**	**St.**	**Years[1]**	**No.[2]**	**pHOS[3]**	**Years**	**Value[4]**	**Years**	**λ^5**
Coast	Grays	W	N/A[6]	N/A	N/A	N/A	N/A	N/A	N/A
	Elochoman	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Mill Creek	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Youngs Bay	O	2002	4,473	91%	N/A	N/A	N/A	N/A
	Clatskanie	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Scappoose	O	2002	458	0 %	N/A	N/A	N/A	N/A
Cascade	Lower Cowlitz	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Coweeman	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	S.F. Toutle	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	N.F. Toutle	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Upper Cowlitz	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Cispus	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Tilton	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Kalama	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	NF Lewis	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	EF Lewis	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Salmon	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Washougal	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Clackamas	O	90-05	482	25%	90-05	1.029	90-05	1.01
	Sandy	O	90-05	482	17%	90-05	1.029	90-05	1.01
Gorge	Lower Gorge	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Upper Gorge	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	White Salmon	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Hood River	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A

1/ Years of data for recent means.
2/ Geometric mean of total spawner.
3/ Average recent proportion of hatchery origin spawners.
4/ Long-term trend of total spawners.
5/ Long-term median population growth rate
6/ Not available.
Source: NMFS 2005e
Note: Reported time series correspond to reported values in available information and may not correspond to reference periods identified in Biological Opinion (BiOp) analyses of other ESUs.

13.2.2 Extinction Probability/Risk

Risk of extinction (Table 13-5) was qualified in recovery plan assessments based on risk categories and criteria identified by the TRT (McElhany et al. 2004). The rating system categorized extinction risk probabilities as very low (less than 1 percent), low (1 to 5 percent), medium (5 to 25 percent), high (26 to 60 percent), and very high (greater than 60 percent) based on abundance, productivity, spatial structure and diversity characteristics. The risk assessment was based on a qualitative analysis of the best available data and anecdotal information for each population.

Table 13-5. Quasi-Extinction and Critical Population Risks Estimated for Lower Columbia River Coho Salmon effective at 1999 Reference Point (initial listing date of most Lower Columbia River ESUs)

Strata	Population	State	TRT[1]
Coast	Grays	W	H
	Elochoman	W	H
	Mill Creek	W	H
	Youngs Bay	O	VH
	Big Creek	O	VH
	Clatskanie	O	H
	Scappoose	O	H
Cascade	Lower Cowlitz	W	H
	Coweeman	W	H
	Toutle (NF & SF)	W	H
	Upper Cowlitz	W	H
	Cispus	W	VH
	Tilton	W	VH
	Kalama	W	VH
	NF Lewis	W	H
	EF Lewis	W	H
	Salmon	W	H
	Washougal	W	VH
	Clackamas	O	L
	Sandy	O	H
Gorge	L Gorge	W	H
	U Gorge	W	VH

[1/] Risk category estimated by the TRT from qualitative abundance, productivity, spatial structure and diversity criteria (VH=very high >60 percent, H=high 26-60 percent. M=moderate 5-25 percent, L=low 1-5 percent, VL=very low <1percent).

13.2.3 Spatial Structure and Biological Diversity

Conserving and rebuilding sustainable salmonid populations involves more than meeting abundance and productivity criteria. Accordingly, NMFS has developed a conceptual framework defining a Viable Salmonid Population, or VSP (McElhany et al. 2000). In this framework there is an explicit consideration of four key population characteristic or parameters for evaluating population viability status: abundance, productivity (or population growth rate), biological diversity, and population spatial structure.

The reason that certain other parameters, such as habitat characteristics and ecological interactions, were not included among the key parameters is that their effects on populations are implicitly expressed in the four key parameters. Based on the current understanding of population attributes that lead to sustainability, the VSP construct is central to the goal of ESA recovery, and warrants consideration in a jeopardy determination. However, it must also be stressed that the ability to significantly improve either a species' biological diversity or its spatial structure and distribution is limited within the timeframe of the Action Agencies' [BPA, U.S. Bureau of Reclamation (Reclamation), and U.S. Army Corps of Engineers)] Proposed RPA.

Spatial Structure

Spatial structure, as the term suggests, refers to the geographic distribution of individuals in a population unit and the processes that generate that distribution. Distributed populations that interact genetically are often referred to as metapopulation. Although the spatial distribution of a population, and thus its metapopulation structure, is influenced by many factors, none are perhaps as important as the quantity, quality, and distribution of habitat. One way to think about the importance or value of a broad geospatial distribution is that a population is less likely to go extinct from a localized catastrophic event or localized environmental perturbations.

Biological Diversity

Biological diversity within and among populations of salmonids is generally considered important for three reasons. First, diversity of life histories patterns is associated with a use of a wider array of habitats. Second, diversity protects a species against short-term spatial and temporal changes in the environment. And third, genetic diversity is the so-called raw material for adapting to long-term environmental change. The latter two are often described as nature’s way of hedging its bets—a mechanism for dealing with the inevitable fluctuations in environmental conditions—long- and short-term. With respect to diversity, more is better from an extinction-risk perspective.

The Lower Columbia River Coho Salmon ESU consists of 3 MPGs involving 3 to 14 populations each. Spatial structure has been substantially reduced by the loss of access to the upper portions of some Washington basins due to non-Federal tributary hydro development and reduced habitat availability within many subbasins due to habitat degradation. Diversity of all major population groups have been significantly eroded by large hatchery influences and periodic low effective population sizes.

13.3 BIOLOGICAL ASSESSMENT

This section includes:

1. an assessment of current status involving an adjustment of the initial base estimates to reflect recent improvements in mortality factors already implemented but not yet been evidenced in adult returns, and
2. an assessment of prospective status involving benefits expected from planned actions.

The biological assessments of lower Columbia River salmonid populations are largely qualitative at this time due to a significant lack of biological data for most populations. In contrast to the interior ESUs where good long-term data sets are available on most populations, data for the Lower Columbia River Coho Salmon populations are severely limited and subject to a high degree of uncertainty. In particular, a high incidence of hatchery fish has confounded the ability to make accurate assessments of natural population abundance and productivity of Lower Columbia River Coho Salmon. As a result, stepwise quantitative analyses of incremental benefits of specific actions like those completed for interior ESUs, are not included herein, nor were they included in recovery plans.

Base status is the historical status of the ESU, defined as the status of the population based on the *average* of quantitative survival metrics estimated from a time series of abundance data beginning in about 1980. For the most part, longer-term averages are used where they are available. In the biological assessment, this is the starting point, shown in the preceding section.

Current status considers both beneficial and adverse actions already implemented, but not yet biologically expressed. Survival benefits are expected from recently implemented changes in hydropower configuration and operation, tributary and estuarine habitat conditions, predation by birds and other fishes, hatchery operations, and harvest management changes relative to the base period. However, effects of these actions are obviously not reflected in the time series of survival data that for the most part started in 1980.

Prospective status considers survival improvements expected from the hydro, habitat, predation, and hatchery changes included in the Proposed RPA, as well as actions likely to be implemented by others.

This assessment assumes that future ocean and climate conditions will approximate the average conditions that prevailed during the 20-year base period used for our status assessments. For most populations, that period is about equivalent to the “recent” ocean period used by the TRT in its analyses. This period was characterized by relatively unproductive and extremely variable ocean conditions, which presumably contributed to poor early ocean survival of salmonids in most years. This subject is treated at greater length in the discussion of the effects of potential climate change in Appendix H.

13.3.1 Current Status

Over this period the Action Agencies have implemented multiple actions to improve fish survival relative to the base period prior to 2000. The percentage changes in lifecycle survival used in base-to-current adjustments for Lower Columbia River Coho Salmon are summarized in Table 13-6. Actions are summarized below. The most significant survival effects of actions since the base period involve harvest rate reductions for coho in freshwater and ocean fisheries. This change has significantly increased spawning escapement of Lower Columbia River Coho Salmon relative to the base period. Actions have been implemented in all factors, but full benefits of these actions have not yet realized. This is particularly true for habitat actions whose effects accrue at the stream scale over long periods of time.

Table 13-6. Estimated Survival Improvements (net) Used in the Base-to-Current Adjustment

	Hydro	Habitat (tributary)	Habitat (estuary)	Predators (avian)	Predators (fish)	Hatchery	Harvest
Lower Columbia River Coho	11.3%[1/]	N/A	0.3%	-4.0%	2%	N/A	25%

[1/]Benefits of Bonneville passage improvements benefit only upstream portions of the ESU.

13.3.1.1 Hydropower Survival Improvements

Several hydropower configuration and operational improvements implemented in 2000 to 2006 are estimated to have resulted in an increase in survival for coho that pass through the dam. However, in that most populations of Lower Columbia River Chinook Salmon, Steelhead, Coho Salmon, and Columbia River Chum Salmon occur downstream of the project, only portions of those ESUs are anticipated to benefit by actions at Bonneville Dam. Improvements during this period included:

- Bonneville Powerhouse II (PH2) Corner Collector installation
- Bonneville Powerhouse I (PH1) Minimum Gap Runners (MGRs) (partial installation)
- Bonneville PH2 fish guidance efficiency (FGE) improvements (partial installation)
- Bonneville spill operation improvements
- Bonneville PH2 as first priority powerhouse
- Bonneville PH1 juvenile bypass system screen removal

13.3.1.2 Tributary Habitat Survival Improvements

A wide variety of actions with the potential to improve critical habitats have been implemented in Lower Columbia River subbasin tributaries since 2000, involving non-Federal and Federal parties. Actions range from beneficial land management practices through improvements in access through culvert replacement through fish reintroduction activities above non-Federal dams. Recently-completed subbasin and recovery plans provide extensive guidance for these actions. Effects of many of these actions are expected to accrue over the long term, falling outside of the period addressed by this assessment. The magnitude of effects is uncertain and is expected to be addressed by monitoring activities and adaptive management.

13.3.1.3 Estuary Habitat Improvements

The estimated survival benefit for Lower Columbia River Coho Salmon associated with the specific actions discussed below was 0.3 percent. The Action Agencies implemented habitat actions through 21 estuary habitat projects. Unrestricted fish passage and approximately 3 miles of access to quality habitat was provided by the following specific actions[1]:

- Replaced 3 culverts with full-spanning bridges;
- Provided approximately 10 miles of improved tidal channel connectivity by installing a tide gate retrofit;
- Acquired approximately 473 acres of off-channel and riparian habitats;
- Restored and created 90 acres of marsh and tidal sloughs and approximately 100 acres of riparian forests;
- Protected approximately 55 acres of high-quality riparian and floodplain habitat;
- Restored and preserved approximately 154 acres of off-channel habitat;
- Protected 80 acres of high-value off-channel forested wetland habitat;
- Restored approximately 96 acres of tidal wetlands habitat by replacing undersized culvert that limited fish access;
- Conserved 155 acres of forested riparian and upland habitat;
- Provided partial tidal channel reconnection by tide gate retrofit (acreage unknown at this time);
- Provided integrated pest management (purple loosestrife);
- Reconnected and restored 183 acres of historical floodplain by dike removal;
- Restored 25 acres of historical floodplain by breaching a dike;
- Provided fish passage access to 6 miles of stream habitat by removal of two culverts and replacement with bridges;
- Restored 310 acres of native hardwood riparian forest, 200 acres of seasonally wet slough and 155 acres of degraded riparian habitats;
- Increased circulation in approximately 92 acres of backwater and side-channel habitat by tide gate retrofit;
- Improved embayment circulation for 335 plus acres of marsh/swamp and shallow-water and flats habitat; and
- Preserved 35 acres of historical wetland habitat.

[1] A more thorough report detailing this evaluation process is: *Estimated Benefits of Federal Habitat Projects in the Lower Columbia River and Estuary* (PC Trask & Associates 2007), which is included in Appendix D to this document.

13.3.1.4 Predation Management Survival Improvements

Avian predation. The estimated change in survival from baseline to current for Lower Columbia River Coho Salmon is -4.0 percent. This reflects a reduction in survival from the base to current condition, because the tern population was increasing over the base period. Averaging tern consumption of juvenile salmonids across the 20-year base period downplays the actual change in survival that resulted from relocating terns from Rice Island to East Sand Island in 1999. In 1999 tern consumption of juvenile salmonids was at its peak with an estimated 13,790,000 smolts consumed, compared to 8,210,000 in 2000 after relocation.

Piscivorous predation. The ongoing Northern Pikeminnow Management Program (NPMP) has been responsible for reducing predation related juvenile salmonid mortality since 1990. The improvement in life cycle survival attributed to the NPMP is estimated at 2 percent for migrating juvenile salmonids including yearling and subyearling migrants (Friesen and Ward 1999). The northern pikeminnow has been responsible for approximately 8 percent predation-related mortality of all juvenile salmonid migrants in the Columbia River Basin in the absence of the NPMP (2000 FCRPS BiOp at 9-106). The ongoing NPMP is already accounted for in the estimation of survival improvements modeled within the reservoir mortality life stage. This is because the modeling estimates are calibrated to empirical reach survival estimates that included the ongoing program.

13.3.1.5 Hatchery Survival Improvements

State and Federal hatchery programs throughout the Lower Columbia River are currently subject to a series of comprehensive reviews for consistency with the protection and recovery of listed salmonids. A variety of changes to hatchery programs have already been implemented and additional changes are anticipated. The magnitude of effects is uncertain and is expected to be addressed by adaptive monitoring activities.

13.3.1.6 Harvest Survival Improvements

This analysis of status assumes a certain amount of annual take of natural adult fish based on recent harvest levels. Fishery impacts for Lower Columbia River Coho Salmon in combined ocean and freshwater fisheries have been reduced from 50 percent in the pre-2000 base period to 25 percent currently. This reduction involved increased restrictions of ocean and freshwater fisheries and was implemented subsequent to listing in order to protect weak populations and provide adequate opportunity for restoration. The reduction was implemented to protect weak listed populations and included implementation of mark-selective sport fisheries.

13.3.2 Prospective Status

The prospective status is projected based expected survival improvements associated with actions in 2007 to 2009 and 2010 to 2017. Over this period the Action Agencies will implement multiple actions to improve fish survival relative to the current period. The percentage changes in lifecycle survival used in current-to-prospective adjustments are summarized in Table 13-7. Actions are summarized below.

Table 13-7. Estimated Improvements in Survival Used in the Current-to-Prospective Adjustment

	Hydro	Habitat (tributary)	Habitat (estuary)	Predators (avian)	Predators (fish)	Hatchery	Harvest
Lower Columbia River Coho	0.3%	N/A	5.7%	7.8%	1%	N/A	—

13.3.2.1 Hydropower Survival Improvements

Passage improvements at Bonneville Dam are anticipated to directly benefit all populations of fish originating upriver from the dam and reservoir (Bonneville Lake). However, because most populations of Lower Columbia River Chinook Salmon , Steelhead, Coho Salmon, and Columbia River Chum Salmon occur downstream of the project, only portions of those ESUs are anticipated to benefit by actions at Bonneville Dam.

2007 to 2009. Actions that will be implemented during this timeframe include complete implementation of minimum gap runners at Bonneville PH1, complete installation of PH2 FGE improvements, and improve PH1 sluiceway FGE and conveyance.

2010 to 2017. Spillway survival improvements during this time period are expected to increase the passage survival through Bonneville Dam of yearling juveniles.

13.3.2.2 Tributary Habitat Survival Improvements

A wide variety of actions with the potential to improve critical habitats are expected to be implemented in lower Columbia River subbasin tributaries from 2007 through 2017, involving non-Federal and Federal parties. Recently completed subbasin and recovery plans provide extensive guidance for these actions. Effects of these actions are expected to accrue over the long term, but the magnitude of effects is uncertain and is expected to be addressed by adaptive monitoring activities.

13.3.2.3 Estuary Habitat Survival Improvements

2007 to 2009. The estimated survival benefits for Lower Columbia River Coho Salmon associated with the specific actions discussed above is 1.4 percent. The Action Agencies' estimated benefit for 2007 is based on actions that are or will be underway in the very near-term. For 2008 and 2009, the Action Agencies estimated benefit is based on continuing at the same level of effort as 2007[2]. Action Agencies are or will be implementing multiple habitat actions through approximately 29 estuary habitat projects. Specific estuary habitat actions:

- Restore partial tidal influence and access to several acres (exact amount unknown at this time) by a tide gate retrofit;
- Improve hydrologic flushing and salmonid access to a lake (Sturgeon Lake is approximately 3,200 acres);
- Acquire and protect 40 acres of critical floodplain habitat and 40 acres riparian forest restoration;
- Install 6 to 8 engineered log-jams that will help to slow flood flows, reduce erosion, contribute to sediment storage, enhance fish habitat and contribute wood into the project area;
- Acquire and restore floodplain connectivity to 380 acres of off-channel rearing habitat for juveniles;
- Install fish friendly tide gates to increase tidal flushing and fisheries access to approximately 110 acres;
- Complete riparian planting of up to 210 acres;

[2] A more thorough report detailing this evaluation process is: *Estimated Benefits of Federal Habitat Projects in the Lower Columbia River and Estuary* (PC Trask & Associates 2007), which is included in Appendix D to this document.

- Re-establish hydrologic connectivity to reclaim and improve floodplain wetland functions, increase off-channel rearing and refuge habitat on 5 acres, plant native vegetation along shoreline, and reconstruct slough channels on 2.5 acres of annually inundated off-channel habitat;
- As part of a long-term 1,500 acres restoration effort: breach a dike and re-establish flow to portion of original channel, planting vegetation on 50 acres, removing invasive weeds on 180 acres, planting wetland scrub shrub on 45 acres, and controlling and removing invasive wetland plants on 45 acres;
- Retrofit a tide gate (acreage unknown at this time);
- Protect and restore approximately 5 to 10 acres of emergent wetland and riparian forest habitats
- Reconnect 45 acres of floodplain by tide gate removal;
- Acquire 45 acres of floodplain with future dike removal;
- Reconnect 50 acres of floodplain;
- Acquire 320 acres of tidelands and 119 acres of riparian/upland forest; and
- Restore 30 acres of riparian habitat.

There will be approximately 15 additional projects and associated actions similar to actions listed above that are undergoing scoping and sponsor development (the number of projects and associated actions is based on the same level of effort as 2007).

2010 to 2017. Estimated survival benefit for Lower Columbia River Coho Salmon associated with these actions is 4.3 percent. The Action Agencies estimated benefits for 2010-2017 are based on continuing the same level of effort as 2007 to 2009. However, the level of effort in this time period may increase depending on the outcome of a General Investigation study of Ecosystem Restoration opportunities, depending on Congressional appropriations, future funding scenarios and results of actions. Specific projects have yet to be identified, but actions for this period will be similar in nature to actions implemented in previous periods discussed above. Actions will include protection and restoration of riparian areas, protection of remaining high quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, and reduction of noxious weeds, among others.

13.3.2.4 Predation Management Survival Improvements

Avian predation. Survival attributed to improved management of Caspian tern populations in the Lower Columbia River are estimated at 7.8 percent for coho salmon. The benefit is carried out to 2017 and beyond; there are no further actions, and therefore, no further benefits. This improvement is expected to result through the reduction in estuary tern nesting habitat, and subsequent relocation of terns outside the Columbia River Basin. Although the base to current shows a reduction in survival, the overall benefit (base to future) is positive.

Piscivorous predation. The percentage improvement in lifecycle survival attributable to the proposed continuation of the increase in incentives in the NPMP and resultant marginal increase in observed exploitation rate is estimated at 1percent total from 2007 to 2017. This estimate was derived based on the difference between the estimated benefits from the base NPMP (defined as the period 1990 to 2003) and estimated survival benefits under the increased incentive program (defined as the period of 2004 to present). This rate would generally apply to all juvenile yearling and subyearling salmonids.

13.3.2.5 Hatchery Survival Improvements

State and Federal hatchery programs throughout the lower Columbia River are currently subject to a series of comprehensive reviews for consistency with the protection and recovery of listed salmonids. A variety of changes to hatchery programs have already been implemented and additional changes are anticipated. The magnitude of effects is uncertain and is expected to be addressed by adaptive monitoring activities.

13.3.2.6 Harvest Survival Improvements

The analysis of status assumes a certain amount of annual take of natural adult fish based on current harvest levels.

13.4 RECOVERY GOALS AND IMPROVEMENT OBJECTIVES

This section identifies recovery gaps needed to restore the ESU to viable levels as identified by the Willamette/Lower Columbia Technical Recovery Team (McElhany et al. 2006). Recovery goals and objectives are presented to acknowledge and provide a context for interpreting contributions of Federal actions relative to recovery. However, these are long term, multifaceted recovery goals and do not constitute a requirement for the FCRPS objective of avoiding jeopardy.

The Washington Lower Columbia River Recovery and Subbasin Plan described recovery goals for the ESU based on a recovery scenario where individual populations were targeted for different levels of improvement based on biological significance and feasibility of recovery (Figure 13-3).

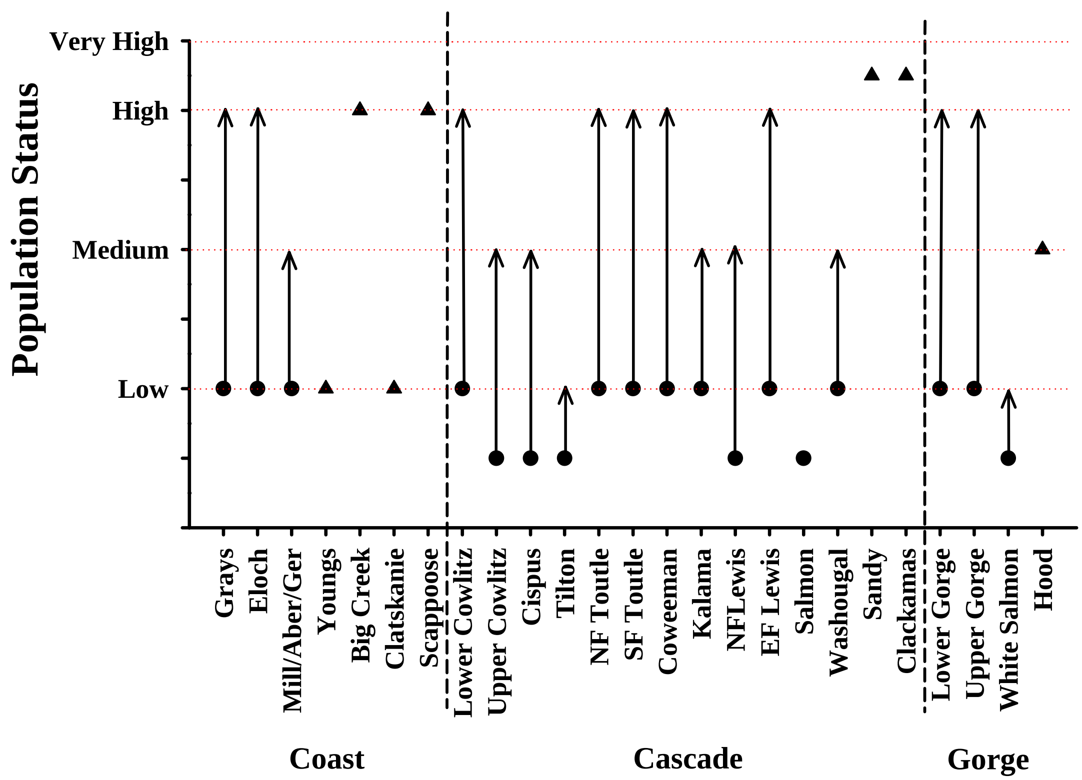


Figure 13-3. Improvements in Population Viability (inverse of risk) for Lower Columbia River Coho Salmon Corresponding to Recovery Scenario Identified in the Washington Lower Columbia River Recovery and Subbasin Plan

Note: The recovery scenario for Oregon populations (displayed as ▲) is under development.
Source: LCFRB 2004.

Primary populations are targeted for restoration to high or very high viability (low or very low risk). Contributing populations are those for which some restoration will be needed to meet strata-wide average viability greater than moderate (<25 percent risk). Stabilizing populations are those that would be maintained at current levels until ESU-wide goals are achieved. Scenarios and goals are not yet available for Oregon populations. Recovery planning assessments indicated that effects of the FCRPS on recovery gap assessments would ideally compare expected improvements due to current and planned actions with improvement objectives identified by the Recovery Plan. However, this analysis is not available for Lower Columbia River ESUs. Owing to uncertainty in the scale of benefits of proposed actions, the Washington Lower Columbia River Recovery and Subbasin Plan adopted an adaptive management approach based on monitoring of implementation and effects of a comprehensive suite of beneficial actions. The Oregon recovery planning process for Lower Columbia River ESUs is in progress.

13.5 ADDITIONAL ACTIONS TO BENEFIT THE ESU

13.5.1 Other Reasonably Certain to Occur Actions

The State of Washington in the context of the collaboration among the sovereigns has identified 69 habitat-related actions and programs expected to provide benefit to portions of the four Lower Columbia River ESUs (Chinook Salmon, Coho Salmon, Chum Salmon, Steelhead) most affected by the FCRPS (Upper Columbia River gorge tributaries, Little White Salmon River, Wind River, Lower Columbia River gorge and mainstem, and Washougal). Actions, geographic area, factors affected, timing, funding status, and responsible parties are described in detail in Chapter 17. All actions identified are either completed, ongoing, planned with high likelihood of implementation. These actions address protection and/or restoration of existing or degraded fish habitat in stream, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat.

Significant actions and programs include Growth Management Act and Shoreline Management Act program planning and regulation, a variety of stream and riparian habitat projects, watershed planning and plan implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, Habitat Conservation Plan implementation on state forest lands, hydraulic project permitting. Responsible entities include cities; counties; conservation districts; state and local weed controls boards; local fish enhancement groups; Washington Departments of Ecology, Natural Resources, Transportation, and Fish and Wildlife; and regional coordinating bodies such as the Lower Columbia River Fish Recovery Board. Significant funding sources include state and local general funds, various dedicated state accounts, the Salmon Recovery Funding Board, and private forest land owners.

Oregon has similarly identified 117 statewide and 260 focused habitat-related actions and programs affecting the four Lower Columbia River ESUs (Chapter 17). Oregon's habitat actions address a series of strategies focused on protection and/or restoration of natural ecological processes; floodplains and riparian conditions and connections; fish passage; critical stream flow; water quality; stream habitat structure and complexity; and watershed conditions and processes. Key implementing bodies include cities; counties; the Oregon Departments of Agriculture, Forestry, Water Resources, State Lands, Fish and Wildlife, Environmental Quality, Land Conservation and Development; the Oregon Watershed Enhancement Board; conservation districts; local watershed councils; and private forest land owners.

In addition, Washington and Oregon have implemented or are planning on implementing a variety of actions and programs aimed at reducing or regulating harvest and hatchery impacts. Ongoing harvest actions have included mass marking of hatchery fish and institution of mark-selective fisheries for spring Chinook and coho salmon (steelhead programs were previously implemented). Hatchery programs throughout the region are undergoing a comprehensive management review and a variety of changes are being implemented or are expected including elimination of hatchery releases in critical natural production areas, increased acclimation of hatchery fish to reduce straying, and integration of natural broodstock into hatchery management.

13.5.2 Salmon Recovery Plan[3]

A wide suite of protection and restoration actions are currently being implemented throughout the lower Columbia River region under the guidance of the Salmon Recovery Plan. The Recovery Plan for the Washington Portion of this ESU was completed by the Washington Lower Columbia Fish Recovery Board in 2005 and was adopted by as an Interim Regional Recovery Plan in February of 2006 (70 FR 20531). The Oregon recovery planning process is underway and an Oregon plan for this ESU is expected in 2007. The Oregon and Washington plans will be combined for a complete ESA recovery plan for the Lower Columbia River Recovery Domain.

The Interim Washington Plan contains regional strategies, measures, and actions that address limiting factors and threats for tributary habitat, estuary and lower mainstem habitat, hydropower, harvest, hatcheries, and ecological interactions. Approximately 650 specific actions are identified by the plan. The plan recognizes that existing tools are inadequate precisely evaluate the outcome of a full suite of recovery actions but instead identifies actions that are needed to achieve recovery and the level of effort that will be needed to achieve recovery objectives. Hence, the plan takes a “directional approach,” in which actions are directed toward reducing all of the human-caused factors limiting recovery. Information gained through an adaptive management program will help refine these approaches such that at some point in the future a more focused and theoretically more cost-effective approach may be taken.

The institutional structure for recovery plan implementation involves oversight, implementation, and facilitation/coordination responsibilities. Key oversight bodies include NMFS, U.S. Fish and Wildlife Service, Tribal governments, the Washington Department of Fish and Wildlife, the Washington Governor’s Office, and the Northwest Power and Conservation Council. The LCFRB, working with a steering committee, facilitates and coordinates efforts among oversight and implementing partners. The steering committee includes representatives of the oversight bodies and a cross-section of implementing partners. Facilitation/coordination involves setting priorities, evaluating progress, tracking implementation, inventorying and synthesizing monitoring results, developing implementation partnerships and agreements, and revising the plan.

Implementation of the plan includes an adaptive management framework that involves checkpoints at 2-year intervals to assess action implementation, at 6-year intervals to assess action effectiveness and threat reduction, and at 12-year intervals to assess fish and habitat status. Observed progress is evaluated against a series of benchmarks. In the first phase of implementation after completing the plan, the LCFRB is now actively coordinating the implementation the specific strategies, measures and actions identified in the plan. The Board has authorized the Recovery Plan Implementation Committee to oversee

[3] Many of the actions listed above have a cost-share component with a variety of other Federal funding sources and therefore, may be properly described as contributing to the status of the environmental baseline rather than cumulative effects.

implementation activities and to assist partnering groups in developing implementation work schedules, cost estimates, and commitment necessary to receive assurances from NMFS.

In 2005, the Committee launched the Salmon Partners Ongoing Tracking System (Salmon PORT) to facilitate developing Implementation Work Schedules. The system is designed as an interactive website displaying all 650 actions contained in the Salmon Recovery and Watershed Management plans. This system will provide the basis for a comprehensive evaluation of progress in action implementation as planned according to the plan implementation schedule.

13.5.3 Other Federal Actions that Have Completed ESA Consultation

The Action Agencies' review of Federal actions that have completed Section 7 ESA consultations is not available at this time.

13.6 CONCLUSION

This ESU is currently threatened by a broad suite of habitat and ecological factors affecting populations distributed from the Columbia River mouth to the gorge upstream from Bonneville Dam. Because of the limited impact of the proposed operation of the FCRPS and the Upper Snake River projects on this ESU, there is limited potential to improve lower Columbia River populations with FCRPS configuration changes or improvements to FCRPS or Upper Snake River operations; and, with the diverse nature of impacts affecting this ESU, the future status depends on a coordinated effort by many Federal and non-Federal parties, such as through recovery plan implementation.

The Remand Collaboration did not develop a method analogous to the Conceptual Framework for assessing the appropriate contribution of FCRPS effects to recovery of Lower Columbia River ESUs. Because the available information on the status of populations within this ESU is not sufficient to complete a systematic quantitative analysis of the adequacy of implemented and planned actions as was done for the Interior Columbia ESUs, our conclusions are based on a qualitative assessment of the prospect for survival and recovery of this ESU relying on best available information. We note that significant actions are being and will be implemented to address multiple threat sectors. These actions are likely to further reduce the risk of extinction and improve population trajectories for populations within the ESU, thus improving the ESU's prospects for recovery.

The Action Agencies have worked with the states and Tribes through the Remand Collaboration Process and other forums to identify actions intended to address the needs of listed salmon and steelhead as determined by quantitative and qualitative biological analyses. Acknowledging that NMFS will review the actions and the effects analyses contained herein to make a final jeopardy determination in the forthcoming biological opinions, the Action Agencies are making the following conclusions. Based on our assessment of the FCRPS and Upper Snake River actions and analysis of effects, considering the present and future human and natural context, the Action Agencies conclude that the net effects of the proposed actions, including the existence and operations of the dams with the proposed mitigation, meet or exceed the objectives of doing no harm and contributing to recovery with respect to this ESU.

Chapter 14
Lower Columbia River Steelhead Distinct Population Segment

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

14.1 INTRODUCTION

This chapter briefly summarizes the current biological status of the Lower Columbia River Steelhead Distinct Population Segment (DPS) related to extinction risk and the effects of the Federal Columbia River Power System (FCRPS) proposed Reasonable and Prudent Alternative (RPA) in the context of recovery plan actions. First, it summarizes current status information including key limiting factors and extinction risks. Second, it includes a biological assessment of the survival effects of recent and planned actions on current and prospective conditions, respectively. Finally, it identifies additional actions to benefit the DPS. Summary data for the DPS are presented in Table 14-1. The geographic extent of the DPS is shown in Figures 14-1 and 14-2, respectively, for winter and spring steelhead populations.

This chapter is organized into six sections. Section 14.1 provides an overview of the DPS and the factors limiting its viability. Section 14.2 summarizes population-level status information during the 20-year base period used for this analysis. Section 14.3 provides the assessment of the current status and provides estimates of the "gaps," or needed lifecycle survival improvements for individual populations to meet certain biological criteria. It summarizes the improvements made to the hydropower (hydro) system and in other Hs (habitat, hatcheries and harvest) since about 2000 and estimates the salmonid survival benefits associated with those improvements. Section 14.4 describes the recovery goals and improvement objectives to be implemented into the future, and Section 14.5 describes additional actions that will benefit this DPS. Section 14.6 provides observations on the current and future status of this DPS, particularly with respect to the operation of the FCRPS.

Table 14-1. Lower Columbia River Steelhead DPS Description and Major Population Groups (MPGs)

DPS Description	
Threatened	Listed under the Endangered Species Act (ESA) in 1998 and reaffirmed in 2006[1]
Four major population groups	23 historical populations
Hatchery programs included in DPS and listed as essential to recovery (10) [1/]	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.
Major Population Groups	**Population**
Cascade Summer	Kalama, N.F. Lewis, E.F. Lewis, Washougal
Gorge Summer	Wind, Hood
Cascade Winter	Lower Cowlitz, Coweeman, S.F. Toutle, N.F. Toutle, Upper Cowlitz, Cispus, Tilton, Kalama, N.F. Lewis, E.F. Lewis, Salmon, Washougal, Clackamas, Sandy
Gorge Winter	Columbia River Lower Gorge, Columbia River Upper Gorge, Hood

[1/] Listing determination (63FR13347), reaffirmed (71FR834); FR = Federal Register

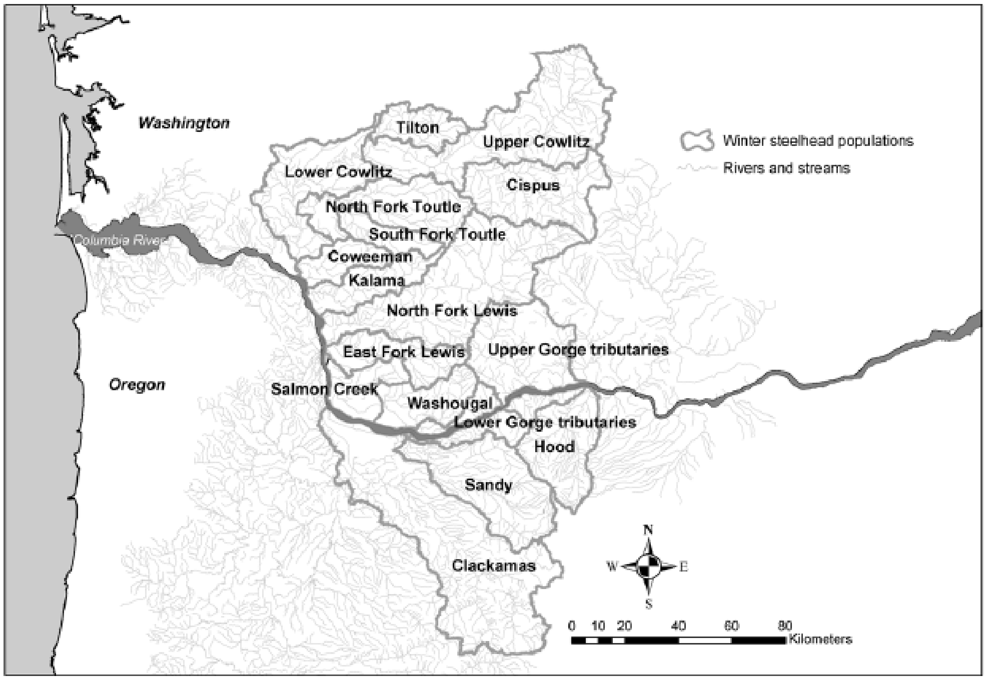


Figure 14-1. Historical Demographically Independent Winter Steelhead Populations of the Lower Columbia River DPS
Source: Myers et al. 2006

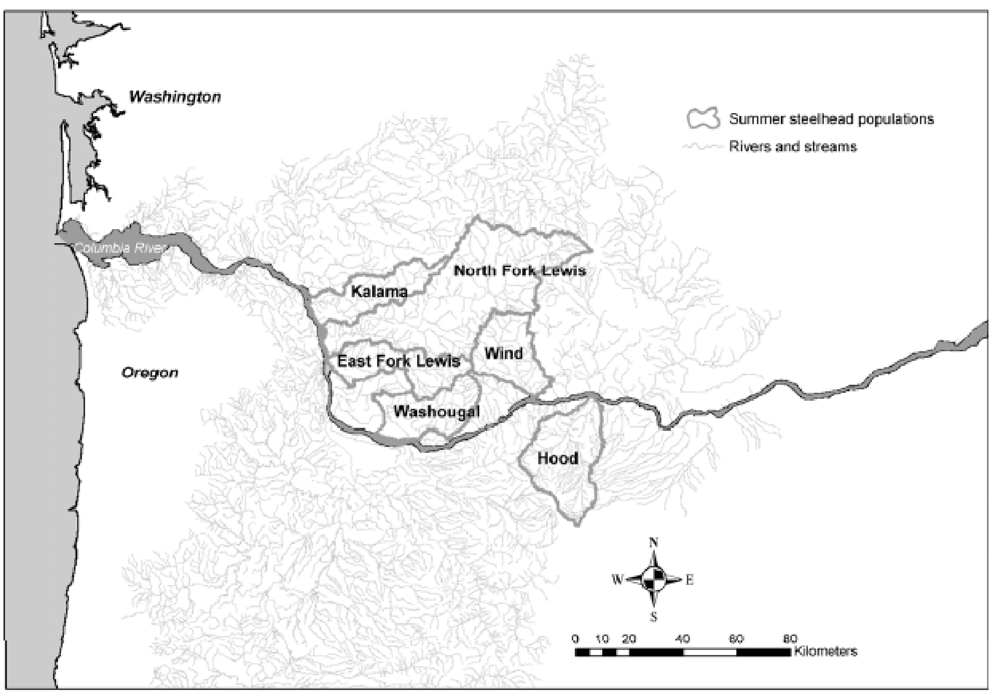


Figure 14-2. Historical Demographically Independent Spring Steelhead Populations of the Lower Columbia River DPS
Source: Myers et al. 2006

Almost all of the metrics used in this analysis are estimates for individual populations within the DPS. The ESA is concerned with the status of a species' DPS or Evolutionarily Significant Unit (ESU, an equivalent term used for salmon). Individual populations and major population groups (where they exist) obviously contribute to DPS status. However, the status of the DPS is not wholly dependent upon the status of any of the DPS's individual components.

The Lower Columbia River Steelhead DPS includes 17 historical populations, of which 3 are functionally extirpated or nearly so in Oregon and Washington between the mouth of the Columbia River and the Cascade crest (Myers et al. 2006). The DPS includes summer and winter runs. Summer steelhead return from the ocean between May and November and generally spawn between January and June. Winter steelhead return to fresh water between November and April and generally spawn sometime during the months of March to June. Summer steelhead tend to spawn higher in the watershed than winter steelhead.

Headwater areas are often inaccessible to winter steelhead because of natural barriers that are not passable during high flows common during winter steelhead migration. These barriers are often passable during the lower flow conditions when summer steelhead are migrating upstream.

Listed populations of the Lower Columbia River Steelhead DPS are stratified for recovery into three major population groups: 1) Southwest Washington: Grays and Elochoman rivers. Skamokawa, Mill, Abernathy, and Germany creeks; 2) Lower Columbia: Cowlitz, Kalama, Lewis, Washougal, and Wind rivers. Salmon and Hardy creeks; and 3) Middle Columbia: Little White Salmon and Big White Salmon rivers.

Human impacts and current limiting factors for this DPS come from multiple sources: hydro passage, habitat degradation, hatchery effects, fishery management and harvest decisions, predation, and other sources.

14.1.1 Key Limiting Factors

Naturally producing Lower Columbia River Steelhead populations remain in most subbasins, but numbers have been substantially reduced. Human impacts and limiting factors for this DPS come from multiple sources: habitat degradation, hatchery effects, fishery management and harvest decisions, hydro passage for some populations, and ecological factors including predation.

Tributary habitat degradation is pervasive in this region due to extensive development and land use effects. Steelhead spawning and rearing habitat in tributary streams has been severely impacted by increased temperatures and reduced habitat diversity. Steelhead access to subbasin headwaters has been widely restricted or eliminated by the construction of non-Federal dams without fish passage. Most Lower Columbia River Steelhead populations are subject to only limited FCRPS impacts involving habitat alterations in the Columbia River mainstem and estuary. Preservation and recovery of this DPS will clearly depend on significant efforts by many parties.

Summarized below (Table 14-2) are key impacts and limiting factors for this DPS and recovery strategies to address those factors as described in the Washington Lower Columbia Recovery and Subbasin Plan [Lower Columbia Fish Recovery Board (LCFRB) 2004]. The Oregon recovery planning process for lower Columbia River DPSs is in progress.

Table 14-2. Key Limiting Factors

Mainstem Hydro	FCRPS impacts are limited for Lower Columbia River Steelhead DPSs. Direct mainstem hydro impacts on Lower Columbia River Steelhead DPSs are most significant for gorge tributary populations upstream from Bonneville Dam. Upper Gorge populations are affected by upstream and downstream passage at Bonneville Dam and inundation of spawning habitat in the lower reaches of gorge tributaries. Impacts on other Lower Columbia River Steelhead populations originating in downstream subbasins are generally limited to effects on migration and habitat conditions in the lower Columbia River mainstem and estuary.
Predation	Piscivorous birds including Caspian terns and cormorants, fishes including pikeminnow, and marine mammals including seal and sea lions take significant numbers of juvenile or adult salmon and human activities are believed to have exacerbated effects of predation. Stream type juveniles, especially steelhead smolts, are particularly vulnerable to bird predation in the estuary because they tend to use the deeper, less turbid channel areas located near habitat preferred by piscivorous birds (Fresh et al. 2005), and they are subject to pinniped predation when they return to the estuary as adults (NMFS 2006a). Caspian tern as well as cormorant predation may each be responsible for the mortality of up to 6 percent of the outmigrating stream-type juveniles in the Columbia River basin [2006 and 1998 data, from Bonneville Power Administration (BPA) et al. 2004 and Roby 2002]. Pikeminnow are significant predators of both yearling and subyearling juvenile migrants (Friesen and Ward 1999). Ongoing actions to reduce predation effects include redistribution of avian predator nesting areas, a sport reward fishery to harvest pikeminnow, and exclusion and hazing of marine mammals near Bonneville Dam.
Harvest	Harvest includes direct and indirect fishery mortality. Lower Columbia River steelhead are harvested in Columbia River and tributary freshwater fisheries of Oregon and Washington. Fishery impacts on wild Lower Columbia River steelhead have been limited to less than 10 percent since the implementation of mark-selective fisheries during the 1980s.
Hatcheries	Hatchery programs that have used inappropriate management practices have reduced the diversity and productivity of natural populations throughout the Columbia basin. Domestication of hatchery fish erodes fitness in the wild and wild stock productivity is reduced when significant numbers of hatchery fish spawn with wild fish. Large hatchery releases can also have ecological effects due to increased competition or predation. Large numbers of hatchery fish also contribute to more intensive mixed stock fisheries, which can overexploit weak wild populations affected by habitat degradation. Most Lower Columbia River steelhead populations have been heavily influenced by hatchery production over the years. State and Federal hatchery programs throughout the lower Columbia River are currently subject to a series of comprehensive reviews for consistency with the protection and recovery of listed salmonids. A variety of beneficial changes to hatchery programs have already been implemented and additional changes are anticipated.
Estuary	The estuary is a critical habitat for migrating salmonids from all Columbia River DPSs or ESUs and is particularly important for local lower Columbia River populations. Due to a short residency time in the estuary, stream-type juveniles such as steelhead have limited mortality associated with a lack of habitat, changes in food availability, and the presence of contaminants. However, they are particularly vulnerable to bird and pinniped predation in the estuary (Fresh et al. 2005). Furthermore, steelhead are believed to be affected by flow and sediment delivery changes in the plume (Casillas 1999). Estuary limiting factors and recovery actions are addressed in detail in a comprehensive regional planning process (NMFS 2006a).

Table 14-2. Key Limiting Factors

Habitat	Widespread development and land use activities have severely degraded stream habitats, water quality, and watershed processes affecting anadromous salmonids in most lower Columbia River subbasins, particularly in low to moderate elevation habitats. Ecosystem Diagnosis and Treatment (EDT) analyses indicate 35 to 79 percent reductions in habitat capacity for summer steelhead in Washington subbasins due to cumulative habitat effects (LCFRB 2004). Even greater habitat impacts are apparent for Lower Columbia River Winter Steelhead populations (44-90 percent), many of which have been blocked from higher elevation spawning habitats by construction of non-Federal hydropower facilities on Columbia River tributaries. Major hydro projects in the Cowlitz and Lewis basins have blocked access to approximately 80 percent of the historical steelhead spawning and rearing habitat within both basins (LCFRB 2004). The Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan. (LCFRB 2004) identifies current habitat values, restoration potential, limiting factors, and habitat protection and restoration priorities for steelhead by reach in all Washington subbasins. Recovery and subbasin plans also identify a suite of beneficial actions for the protection and restoration of tributary subbasin habitats. Similar information is in development for Oregon subbasins.
Ocean and Climate	Analyses of lower Columbia River salmon status generally assume that future ocean and climate conditions will approximate the average conditions that prevailed during the recent base period used for status assessments. Recent conditions have been less productive for most Columbia River salmonids than the long-term average and future trends are unclear. Under the adaptive management implementation approach of the Lower Columbia River Recovery Plan, further reductions in salmon production due to long-term ocean and climate trends will need to be addressed through additional recovery effort (LCFRB 2004).

14.1.2 Potentially-Manageable Impacts – LCFRB Analysis

As part of its recovery planning process, the LCFRB evaluated factors currently limiting Washington lower Columbia River salmon and steelhead populations based on a simple index of potentially manageable impacts. This effort was intended to help target recovery actions to the most significant and manageable human impacts. The impacts assessed were tributary habitat changes, estuary habitat changes, fishing, hydropower effects, hatchery effects, and predation by birds, fish, and marine mammals. Results are displayed for each population quantitatively in tables (Table 14-3) and in the form of pie charts (Figure 14-3). Pie charts illustrate the relative significance of each factor based on independent estimates of the mortality or effect for each area of impact.

Tributary impacts and improvements are based on estimated changes in habitat capacity between historical and current conditions. Estuary values reflect habitat changes in the mainstem and estuary downstream from Bonneville Dam. Dam impacts and improvement increments identified in the Washington analysis included Federal and non-Federal access and passage effects. Access effects include habitat blockages in tributaries (White Salmon, Lewis, Cowlitz) as well as inundation of key spawning reaches in the lower portions of Bonneville reservoir tributaries. Passage effects include juveniles and adults passage mortality at Bonneville Dam. Predation includes approximate total mortality rates by northern pikeminnow, birds, and marine mammals. Harvest in direct and indirect mortality in ocean and freshwater fisheries. Hatchery values are indexed based on proportion of natural spawning hatchery fish, relative productivity of hatchery fish, and interspecific effects resulting from predation by juvenile salmonids of other species. For additional detail on the analysis and application of these numbers, see the interim recovery plan approved by NMFS (LCFRB 2004; Vol. I, pp. 5-29—5-36; Appendix E, Chapter 10).

From these assessments, the recovery plan draws the general conclusion that current salmonid status is the result of large impacts distributed among several factors, and that substantial improvements in salmonid viability will require significant reductions in mortality in almost all limiting factors. The approach represents the relative order of magnitude of key limiting factors. It does not constitute a fine-scaled mechanistic analysis of limiting factors for every population. It does, however, provide a systematic basis

Table 14-3. Estimated Percentages of Total Manageable Impact by Sector

Major Population Group	Population	Baseline impacts					
		Habitat (tributary)	Habitat (estuary)	Dams	Predators	Harvest	Hatcheries
Cascade Winter							
	Lower Cowlitz	0.885	0.109	0.000	0.235	0.100	0.276
	Coweeman	0.730	0.150	0.000	0.235	0.100	0.161
	S.F. Toutle	0.820	0.112	0.000	0.235	0.100	0.006
	N.F. Toutle	0.900	0.112	0.000	0.235	0.100	0.000
	Upper Cowlitz	0.498	0.137	1.000[1]	0.235	0.100	0.300
	Cispus	0.520	0.136	1.000[1]	0.235	0.100	0.300
	Tilton	0.854	0.137	1.000[1]	0.235	0.100	0.300
	Kalama	0.497	0.127	0.000	0.236	0.100	0.031
	N.F. Lewis	0.586	0.104	0.952[1]	0.239	0.100	0.231
	E.F. Lewis	0.749	0.132	0.000	0.239	0.100	0.357
	Salmon	0.869	0.132	0.000	0.243	0.100	0.357
	Washougal	0.743	0.124	0.000	0.243	0.100	0.350
	Clackamas	--	--	--	--	--	--
	Sandy	--	--	--	--	--	--
Cascade Summer							
	Kalama	0.348	0.043	0.000	0.236	0.100	0.035
	N.F. Lewis	0.586	0.586	0.500[1]	0.239	0.100	0.651
	E.F. Lewis	0.790	0.043	0.000	0.239	0.100	0.189
	Washougal	0.707	0.049	0.000	0.243	0.100	0.175
Columbia River Gorge – Winter							
	Lower Gorge	0.561	0.134	0.000[2]	0.246	0.100	0.007
	Upper Gorge	0.750	0.106	0.154[2]	0.273	0.100	0.000
	Hood River	--	--	--	--	--	--
Columbia River Gorge – Summer							
	Wind River	0.673	0.090	0.154[2]	0.273	0.100	0.147
	Hood River	--	--	--	--	--	--

[1/] Non-Federal hydro impacts
[2/] Federal hydro impacts
Source: LCFRB 2004
Percentages represent independent estimates of the mortality rate or reduction relative to the historical baseline for each factor .

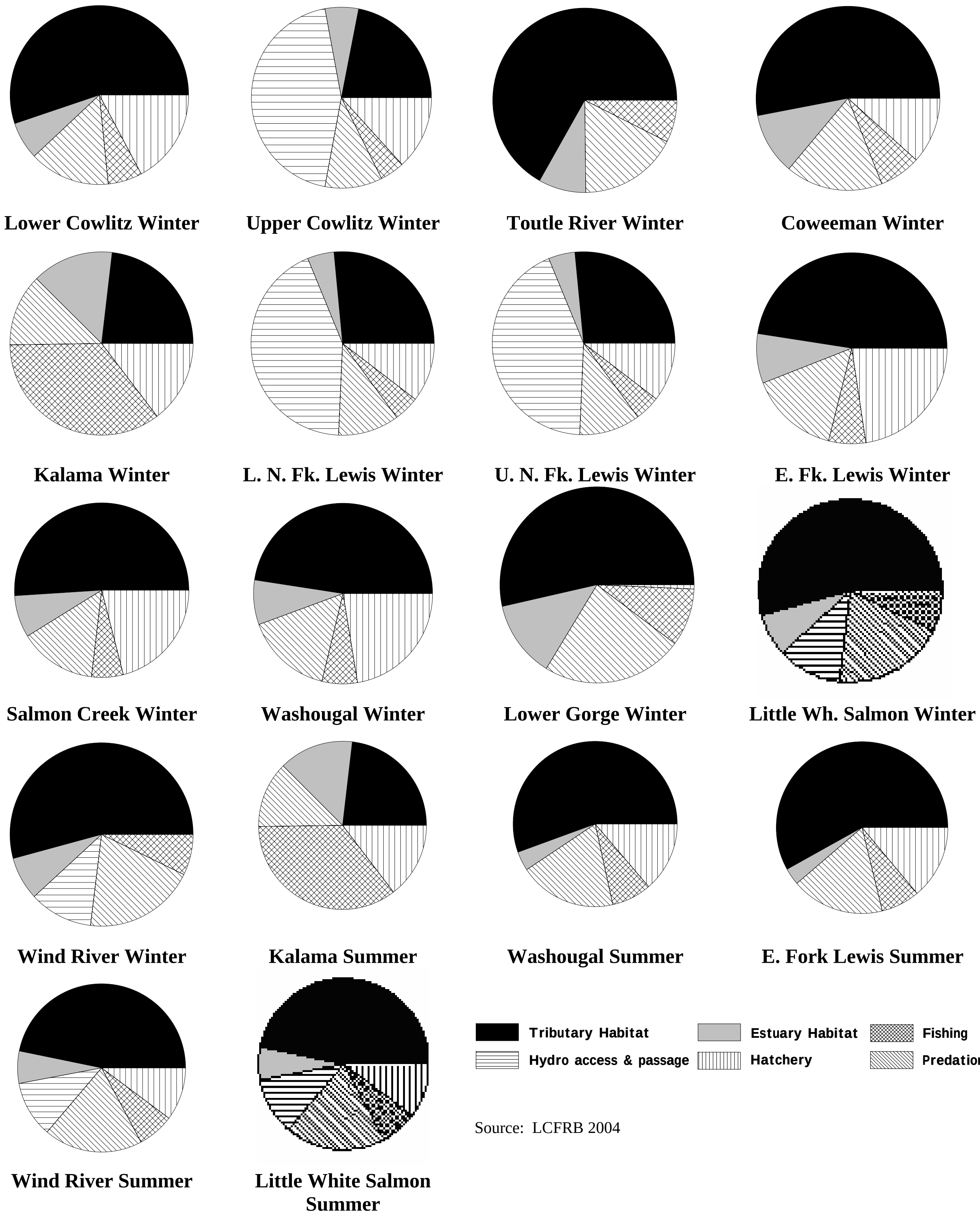


Figure 14-3. Estimated Percentages of Total Manageable Impacts for Each Sector for Lower Columbia River Steelhead Populations

for identifying which human impacts are most significant and focusing protection and recovery actions on significant problems. For instance, hydro impacts are estimated to be a relatively small fraction of total impacts for most populations. Significant hydro impacts in the Cowlitz, Lewis, and White Salmon rivers are a result of non-Federal facilities. Quantifiable FCRPS impacts are described only for gorge populations and typically account for less than one-third of the net impact.

The mainstem hydro system has had the greatest impact in the Lower Columbia River Gorge stratum. Of the 23 populations identified by the Willamette-Lower Columbia River Technical Recovery Team (TRT), 3 spawn above Bonneville Dam and experience passage mortality at the dam both as juveniles and adults. The native population of steelhead in the White Salmon River was extirpated by the construction of PacifiCorp's Condit Dam (McElhany et al. 2004). The dam is slated for removal October 2008-2009 and is the subject of ESA Section 7 consultation (NMFS 2006c). Passage survival rates at Bonneville Dam (2004 to present), including hatchery stock, are estimated as follows: yearling smolts - 0.8 (NMFS 2004 Table 6.5), winter and summer-run adults - 0.97 (Keefer et al. 2004).

14.2 BASE STATUS

The base status is the historical status of the DPS, based on quantitative population metrics estimated from available time series of fish data. Long-term averages were used where they were available although many of the available data time series are relatively recent.

14.2.1 DPS Abundance, Productivity and Trends

Base status information (Table 14-4) is reported for Lower Columbia River Steelhead populations in the 2005 status review by the National Marine Fisheries Service (NMFS, also called National Oceanic and Atmospheric Administration [NOAA] Fisheries). Many of the populations comprising this DPS are small. Long- and short-term trends in abundance of individual populations are often negative, some severely so. A significant number of natural runs have been replaced by hatchery production. Data are not available for many populations in this DPS.

Table 14-4. Abundance, Productivity, and Trends of Lower Columbia River Steelhead Populations

	Strata	Population	St.	Recent Natural Spawners			Long-term trend		Median growth rate	
				Years[1]	**No.[2]**	**pHOS[3]**	**Years**	**Value[4]**	**Years**	**λ^5**
Summer	**Cascade**	Kalama	W	99-03	474	32%	77-03	0.928	77-03	0.712
		N.F. Lewis	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E.F. Lewis	W	99-03	434	25%	N/A	N/A	N/A	N/A
		Washougal	W	99-03	264	8%	86-03	0.991	86-03	0.996
	Gorge	Wind	W	99-03	472	5%	N/A	N/A	N/A	N/A
		Hood	O	93-05	195	11.4%	93-05	0.995	93-05	0.811
Winter	**Cascade**	Lower Cowlitz	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Coweeman	W	98-02	466	50%	87-02	0.916	87-02	0.782
		S.F. Toutle	W	98-02	504	2%	84-02	0.917	84-02	0.933
		N.F. Toutle	W	98-02	196	0%	89-02	1.135	89-02	1.062
		Upper Cowlitz	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Cispus	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Tilton	W	2002	2,787	73%	N/A	N/A	N/A	N/A
		Kalama	W	98-02	726	0%	77-02	0.998	77-02	0.916
		N.F. Lewis	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E.F. Lewis	W	[6]	[6]	[6]	N/A	N/A	N/A	N/A
		Salmon	W	N/A[7]	N/A	N/A	N/A	N/A	N/A	N/A
		Washougal	W	98-02	323	0%				
		Clackamas	O	90-05	1168	16.2%	90-05	1.03	90-05	0.976
		Sandy	O	90-05	1040	11%	90-05	0.95	90-05	0.923
	Columbia River Gorge	Lower Gorge	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Upper Gorge	W	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Hood River	O	96-00	756	52%	N/A	N/A	N/A	N/A

[1] Years of data for recent means.
[2] Geometric mean of total spawner provided by the total series.
[3] Average recent proportion of hatchery origin spawners.
[4] Long-term trend of total spawners.
[5] Long-term median population growth rate.
[6] Index data only, no abundance means available
[7] N/A = not available.
Source: NMFS 2005b
Note: Reported time series correspond to reported values in available information and may not correspond to reference periods identified in Biological Opinion (BiOp) analyses of other DPSs or ESUs.

14.2.2 Extinction Probability/Risk

Risk of extinction (Table 14-5) was qualified in recovery plan assessments based on risk categories and criteria identified by the TRT (McElhany et al. 2004). The rating system categorized extinction risk probabilities as very low (less than 1 percent), low (1 to 5 percent), medium (5 to 25 percent), high (26 to 60 percent), and very high (greater than 60 percent) based on abundance, productivity, spatial structure and diversity characteristics. The risk assessment was based on a qualitative analysis of the best available data and anecdotal information for each population.

Table 14-5. Quasi-Extinction and Critical Population Risks Estimated for Lower Columbia River Steelhead Effective at a 1999 Reference Point (initial listing date of most Lower Columbia River DPSs or ESUs)

Type	Strata	Population	State	TRT Category[1]
Summer	**Cascade**	Kalama	W	L
		N.F. Lewis	W	M
		E.F. Lewis	W	VH
		Washougal	W	L
	Gorge	Wind	W	VL
		Hood	O	VH
Winter	**Cascade**	Lower Cowlitz	W	H
		Coweeman	W	H
		Toutle (NF & SF)	W	M
		Upper Cowlitz	W	H
		Cispus	W	H
		Tilton	W	H
		Kalama	W	VH
		N.F. Lewis	W	M
		E.F. Lewis	W	H
		Salmon	W	H
		Washougal	W	H
		Clackamas	O	L
		Sandy	O	H
	Columbia River Gorge	Lower Gorge	W	H
		Upper Gorge	W	H
		Hood	O	M

[1] Risk category estimated by the TRT from qualitative abundance, productivity, spatial structure and diversity criteria (VH=very high >60 percent, H=high 26-60 percent. M=moderate 5-25 percent, L=low 1-5 percent, VL=very low <1 percent).

14.2.3 Spatial Structure and Biological Diversity

Conserving and rebuilding sustainable salmonid populations involves more than meeting abundance and productivity criteria. Accordingly, NMFS has developed a conceptual framework defining a Viable Salmonid Population, or VSP (McElhany et al. 2000). In this framework there is an explicit consideration of four key population characteristic or parameters for evaluating population viability status: abundance, productivity (or population growth rate), biological diversity, and population spatial structure.

The reason that certain other parameters, such as habitat characteristics and ecological interactions, were not included among the key parameters is that their effects on populations are implicitly expressed in the four key parameters. Based on the current understanding of population attributes that lead to sustainability, the VSP construct is central to the goal of ESA recovery, and warrants consideration in a jeopardy determination. However, it must also be stressed that the ability to significantly improve either a species' biological diversity or its spatial structure and distribution is limited within the timeframe of the Action Agencies' [BPA, Reclamation, and U.S. Army Corps of Engineers (Corps)] Proposed RPA.

Spatial Structure

Spatial structure, as the term suggests, refers to the geographic distribution of individuals in a population unit and the processes that generate that distribution. Distributed populations that interact genetically are often referred to as metapopulation. Although the spatial distribution of a population, and thus, its metapopulation structure, is influenced by many factors, none are perhaps as important as the quantity, quality, and distribution of habitat. One way to think about the importance or value of a broad geospatial distribution is that a population is less likely to go extinct from a localized catastrophic event or localized environmental perturbations.

Biological Diversity

Biological diversity within and among populations of salmonids is generally considered important for three reasons. First, diversity of life history patterns is associated with a use of a wider array of habitats. Second, diversity protects a species against short-term spatial and temporal changes in the environment. And third, genetic diversity is the so-called raw material for adapting to long-term environmental change. The latter two are often described as nature's way of hedging its bets—a mechanism for dealing with the inevitable fluctuations in environmental conditions – long- and short-term. With respect to diversity, more is better from an extinction-risk perspective.

The Lower Columbia River DPS consists of 4 MPGs consisting of from 2 to 14 populations each. Spatial structure has been substantially reduced by the loss of access to the upper portions of some Washington basins due to non-Federal tributary hydro development and reduced habitat availability within many subbasins due to habitat degradation. Diversity of some populations has been significantly eroded by large hatchery influences and periodic low effective population sizes.

14.3 BIOLOGICAL ASSESSMENT

This section includes:

1. an assessment of current status involving an adjustment of the initial base estimates to reflect recent improvements in mortality factors already implemented but not yet been evidenced in adult returns, and
2. an assessment of prospective status involving benefits expected from planned actions.

The biological assessments of lower Columbia River salmonid populations are largely qualitative at this time due to a significant lack of biological data for most populations. In contrast to the interior DPSs or ESUs where good long-term data sets are available on most populations, data are limited to only a few lower Columbia River populations and even those data are subject to a high degree of uncertainty. In particular, a high incidence of hatchery fish has confounded the ability to make accurate assessments of natural population abundance and productivity of Lower Columbia River Steelhead. As a result, stepwise quantitative analyses of incremental benefits of specific actions like those completed for interior DPSs or ESUs, are not included herein, nor were they included in recovery plans.

Base status is the historical status of the DPS, defined as the status of the population based on the *average* of quantitative survival metrics estimated from a time series of abundance data beginning in about 1980. For the most part, longer-term averages are used where they are available. In the biological assessment, this is the starting point, shown in the preceding section.

Current status considers both beneficial and adverse actions already implemented, but not yet biologically expressed. Survival benefits are expected from recently implemented changes in hydropower configuration and operation, tributary and estuarine habitat conditions, predation by birds and other fishes, hatchery operations, and harvest management changes relative to the base period. However, effects of these actions are obviously not reflected in the time series of survival data that for the most part started in 1980.

Prospective status considers survival improvements expected from the hydro, habitat, and predation, and hatchery changes included in the Proposed RPA, as well as actions likely to be implemented by others.

This assessment assumes that future ocean and climate conditions will approximate the average conditions that prevailed during the 20 year base period used for our status assessments. For most populations, that period is about equivalent to the "recent" ocean period used by the Interior Columbia Basin TRT in its analyses. This period was characterized by relatively unproductive and extremely variable ocean conditions, which presumably contributed to poor early ocean survival of salmonids in most years. This subject is treated at greater length in the discussion of the effects of potential climate change in Appendix H.

14.3.1 Current Status

Over this period the Action Agencies have implemented multiple actions to improve fish survival relative to the base period prior to 2000. The percentage changes in lifecycle survival used in base-to-current adjustments for Lower Columbia River Steelhead are summarized in Table 14-6. Actions are summarized below.

Table 14-6. Estimated Survival Improvements (net) Used in the Base-to-Current Adjustment

	Hydro	Habitat (tributary)	Habitat (estuary)	Predators (avian)	Predators (fish)	Hatchery	Harvest
Lower Columbia River Steelhead	—[1]	N/A	0.3%	-0.3%	2%	na	0%

[1/] Benefits of Bonneville passage improvements benefit only upstream portions of the DPS.

14.3.1.1 Hydropower Survival Improvements

Several hydropower configuration and operational improvements implemented in 2000 to 2006 are estimated to have resulted in an increase in survival for steelhead that pass through the dam. However, in that most populations of Lower Columbia River Chinook Salmon, Steelhead, Coho Salmon and Columbia River Chum Salmon occur downstream of the project, only portions of those DPSs or ESUs are anticipated to benefit by actions at Bonneville Dam. Improvements during this period included:

- Bonneville Powerhouse 2 (PH2) Corner Collector installation
- Bonneville Powerhouse 1 (PH1) Minimum Gap Runners (partial installation)
- Bonneville PH2 Fish Guidance Efficiency (FGE) improvements (partial installation)
- Bonneville spill operation improvements
- Bonneville PH2 as first priority powerhouse
- Bonneville PH1 juvenile bypass system screen removal

14.3.1.2 Tributary Habitat Survival Improvements

A wide variety of actions with the potential to improve critical habitats have been implemented in lower Columbia River subbasin tributaries since 2000, involving non-Federal and Federal parties. Actions range from beneficial land management practices through improvements in access through culvert replacement through fish reintroduction activities above non-Federal dams. Recently-completed subbasin and recovery plans provide extensive guidance for these actions. Effects of many of these actions are expected to accrue over the long term, falling outside of the period addressed by this assessment. The magnitude of effects is uncertain and is expected to be addressed by monitoring activities and adaptive management.

14.3.1.3 Estuary Habitat Survival Improvements

The estimated survival benefit for Lower Columbia River Steelhead associated with the specific actions discussed above is 0.3 percent. The Action Agencies implemented habitat actions through 21 estuary habitat projects. Unrestricted fish passage and approximately 3 miles of access to quality habitat was provided by the following specific actions[1]:

- Replaced 3 culverts with full-spanning bridges;
- Provided approximately 10 miles of improved tidal channel connectivity by installing a tide gate retrofit;
- Acquired approximately 473 acres of off-channel and riparian habitats;
- Restored and created 90 acres of marsh and tidal sloughs and approximately 100 acres of riparian forests;
- Protected approximately 55 acres of high-quality riparian and floodplain habitat;
- Restored and preserved approximately 154 acres of off-channel habitat;
- Protected 80 acres of high-value off-channel forested wetland habitat;
- Restored approximately 96 acres of tidal wetlands habitat by replacing undersized culvert that limited fish access;
- Conserved 155 acres of forested riparian and upland habitat;
- Provided partial tidal channel reconnection by tide gate retrofit (acreage unknown at this time);
- Provided integrated pest management (purple loosestrife);
- Reconnected and restored 183 acres of historical floodplain by dike removal;
- Restored 25 acres of historical floodplain by breaching a dike;
- Provided fish passage access to 6 miles of stream habitat by removal of two culverts and replacement with bridges;
- Restored 310 acres of native hardwood riparian forest, 200 acres of seasonally wet slough and 155 acres of degraded riparian habitats;
- Increased circulation in approximately 92 acres of backwater and side-channel habitat by tide gate retrofit;
- Improved embayment circulation for 335 plus acres of marsh/swamp and shallow-water and flats habitat; and
- Preserved 35 acres of historical wetland habitat.

14.3.1.4 Predation Management Survival Improvements

Avian predation. The estimated change in survival from baseline to current for Lower Columbia River Steelhead is -0.3 percent. This reflects a reduction in survival from the base to current condition, because the tern population was increasing over the base period. Averaging tern consumption of juvenile salmonids across the 20-year base period downplays the actual change in survival that resulted from relocating terns from Rice Island to East Sand Island in 1999. In 1999, tern consumption of juvenile

[1] A more thorough report detailing this evaluation process is: Estimated Benefits for Federal Habitat Projects in the Columbia River Estuary for *NWF v. NMFS* Remand - Sovereign Collaboration Process.

salmonids was at its peak with an estimated 13,790,000 smolts consumed, compared to 8,210,000 in 2000 after relocation.

Piscivorous predation. The ongoing Northern Pikeminnow Management Program (NPMP) has been responsible for reducing predation related juvenile salmonid mortality since 1990. The improvement in lifecycle survival attributed to the NPMP is estimated at 2 percent for migrating juvenile salmonids including yearling and subyearling migrants (Friesen and Ward 1999).

The northern pikeminnow has been responsible for approximately 8 percent predation-related mortality of all juvenile salmonid migrants in the Columbia River basin in the absence of the NPMP (2000 FCRPS BiOp at 9-106). The ongoing NPMP is already accounted for in the estimation of survival improvements modeled within the reservoir mortality life stage. This is because the modeling estimates are calibrated to empirical reach survival estimates that included the ongoing program.

14.3.1.5 Hatchery Survival Improvements

State and Federal hatchery programs throughout the lower Columbia River are currently subject to a series of comprehensive reviews for consistency with the protection and recovery of listed salmonids. A variety of changes to hatchery programs have already been implemented and additional changes are anticipated. The magnitude of effects is uncertain and is expected to be addressed by adaptive monitoring activities.

14.3.1.6 Harvest Survival Improvements

This assessment of status assumes a certain amount of annual take of natural adult fish based on recent harvest levels. Fishery impacts for Lower Columbia River Steelhead in combined ocean and freshwater fisheries are estimated to be 10 percent.

14.3.2 Prospective Status

The prospective status is projected based expected survival improvements associated with actions in 2007 to 2009 and 2010 to 2017. Over this period the Action Agencies will implement multiple actions to improve fish survival relative to the current period. The percentage changes in lifecycle survival used in current-to-prospective adjustments are summarized in Table 14-7. Actions are summarized below.

Table 14-7. Estimated Improvements in Survival Used in the Current-to-Prospective Adjustment

	Hydro	Habitat (tributary)	Habitat (estuary)	Predators (avian)	Predators (fish)	Hatchery	Harvest
Lower Columbia River Steelhead	0.3%	N/A[1]	5.7%	3.4%	1%	N/A	—

14.3.2.1 Hydropower Survival Improvements

Passage improvements at Bonneville Dam are anticipated to directly benefit all populations of fish originating upriver from the dam and reservoir (Bonneville Lake). However, in that most populations of Lower Columbia River Chinook Salmon, Steelhead, Coho Salmon and Columbia River Chum Salmon occur downstream of the project, only portions of those DPSs or ESUs are anticipated to benefit by actions at Bonneville Dam.

2007 to 2009. Actions that will be implemented during this timeframe include complete implementation of minimum gap runners at PH1, complete installation of PH2 FGE improvements, and improve PH1 sluiceway FGE and conveyance.

2010 to 2017. Spillway survival improvements during this time period are expected to further increase the passage survival through Bonneville Dam.

14.3.2.2 Tributary Habitat Survival Improvements

A wide variety of actions with the potential to improve critical habitats are expected to be implemented in lower Columbia River subbasin tributaries from 2007 through 2017, involving non-Federal and Federal parties. Recently-completed subbasin and recovery plans provide extensive guidance for these actions. Effects of these actions are expected to accrue over the long term but the magnitude of effects is uncertain and is expected to be addressed by adaptive monitoring activities.

14.3.2.3 Estuary Habitat Survival Improvements

2007 to 2009. The estimated survival benefit for Lower Columbia River Steelhead associated with the specific actions is 1.4 percent. The Action Agencies' estimated benefit for 2007 is based on actions that are or will be underway in the very near-term. For 2008 and 2009, the Action Agencies' estimated benefit is based on continuing at the same level of effort as 2007[2]. The Action Agencies are or will be implementing multiple habitat actions through approximately 29 estuary habitat projects. Specific estuary habitat actions include:

- Restore partial tidal influence and access to several acres (exact amount unknown at this time) by a tide gate retrofit;
- Improve hydrologic flushing and salmonid access to a lake (Sturgeon Lake is approximately 3,200 acres);
- Acquire and protect 40 acres of critical floodplain habitat and 40 acres riparian forest restoration;
- Install 6 to 8 engineered log-jams that will help to slow flood flows, reduce erosion, contribute to sediment storage, enhance fish habitat and contribute wood into the project area;
- Acquire and restore floodplain connectivity to 380 acres of off-channel rearing habitat for juveniles;
- Install fish friendly tide gates to increase tidal flushing and fisheries access to approximately 110 acres;
- Complete riparian planting of up to 210 acres;
- Re-establish hydrologic connectivity to reclaim and improve floodplain wetland functions, increase off-channel rearing and refuge habitat on five acres, plant native vegetation along shoreline, and reconstruct slough channels on 2.5 acres of annually inundated off-channel habitat;
- As part of a long-term 1,500 acres restoration effort: breach a dike and re-establish flow to portion of original channel, planting vegetation on 50 acres, removing invasive weeds on 180 acres, planting wetland scrub shrub on 45 acres, and controlling and removing invasive wetland plants on 45 acres;
- Retrofit a tide gate (acreage unknown at this time);
- Protect and restore approximately 5 to 10 acres of emergent wetland and riparian forest habitats
- Reconnect 45 acres of floodplain by tide gate removal;
- Acquire 45 acres of floodplain with future dike removal;

[2] A more thorough report detailing this evaluation process is: *Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary(PC Trask & Associates 2007)*, which is included in Appendix D to this document.

- Reconnect 50 acres of floodplain;
- Acquire 320 acres of tidelands and 119 acres of riparian/upland forest; and
- Restore 30 acres of riparian habitat.

There will be approximately 15 additional projects and associated actions similar to actions listed above that are undergoing scoping and sponsor development. (The number of projects and associated actions is based on the same level of effort as 2007.)

2010 to 2017. The survival benefit for Lower Columbia River Steelhead associated with these actions is 4.3 percent. The Action Agencies estimated benefits for 2010 to 2017 are based on continuing the same level of effort as 2007-2009. However, the level of effort in this time period may increase depending on the outcome of a general investigation study of ecosystem restoration opportunities, depending on Congressional appropriations, future funding scenarios and results of actions. Specific projects have yet to be identified, but actions for this period will be similar in nature to actions implemented in previous periods discussed above. Actions will include protection and restoration of riparian areas, protection of remaining high quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, and reduction of noxious weeds, among others.

14.3.2.4 Predation Management Survival Improvements

Avian predation. Survival attributed to improved management of Caspian tern populations in the lower Columbia River are estimated at 3.4 percent for steelhead. The benefit is carried out to 2017 and beyond; there are no further actions, and therefore, no further benefits. This improvement is expected to result through the reduction in estuary tern nesting habitat, and subsequent relocation of terns outside the Columbia River Basin. Although the base to current shows a reduction in survival, the overall benefit (base to prospective) is positive.

Piscivorous predation. The percentage improvement in lifecycle survival attributable to the proposed continuation of the increase in incentives in the NPMP and resultant marginal increase in observed exploitation rate is estimated at 1 percent total from 2007 to 2017. This estimate was derived based on the difference between the estimated benefits from the base NPMP (defined as the period 1990 to 2003) and estimated survival benefits under the increased incentive program (defined as the period of 2004 to present). This rate would generally apply to all juvenile yearling and subyearling salmonids.

14.3.2.5 Hatchery Survival Improvements

State and Federal hatchery programs throughout the lower Columbia River are currently subject to a series of comprehensive reviews for consistency with the protection and recovery of listed salmonids. A variety of changes to hatchery programs have already been implemented and additional changes are anticipated. The magnitude of effects is uncertain and is expected to be addressed by adaptive monitoring activities.

14.3.2.6 Harvest Survival Improvements

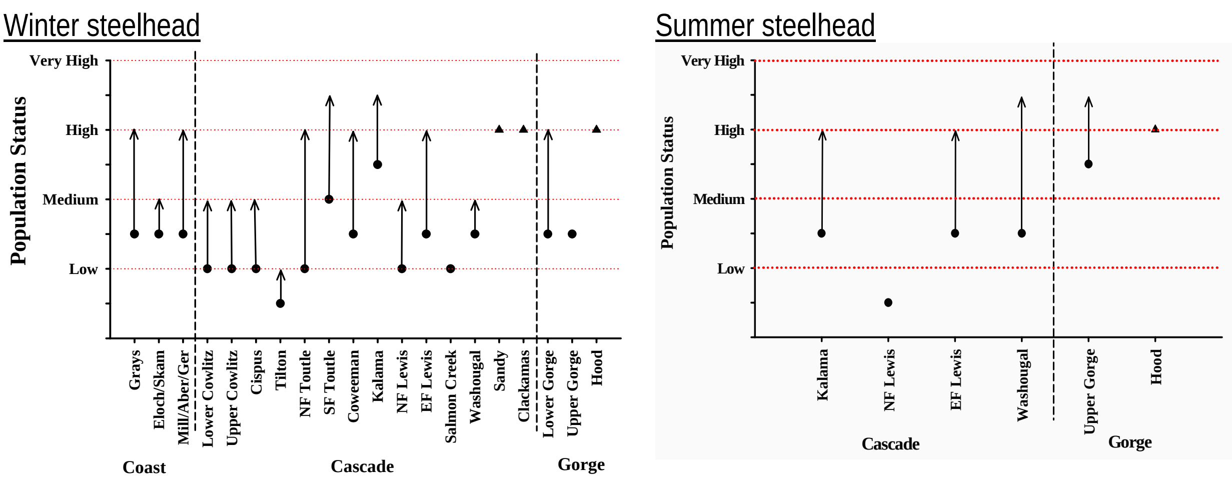
The analysis of status assumes a certain amount of annual take of natural adult fish based on current harvest levels. As requested in the Remand Collaboration, a sensitivity analysis showing the additional effects of more selective harvests that minimize take of natural adult fish is presented in Appendix A.

14.4 RECOVERY GOALS AND IMPROVEMENT OBJECTIVES

This section identifies recovery gaps needed to restore the DPS to viable levels as identified by the Willamette-Lower Columbia Technical Recovery Team (McElhany et al. 2006). Recovery goals and objectives are presented to acknowledge and provide a context for interpreting contributions of Federal actions relative to recovery. However, these are long term, multifaceted recovery goals and do not constitute a requirement for the FCRPS objective of avoiding jeopardy.

The Washington Lower Columbia River Recovery and Subbasin Plan described recovery goals for the DPS based on a recovery scenario where individual populations were targeted for different levels of improvement based on biological significance and feasibility of recovery (Figure 14-4). Primary populations are targeted for restoration to high or very high viability (low or very low risk). Contributing populations are those for which some restoration will be needed to meet strata-wide average viability greater than moderate (<25 percent risk). Stabilizing populations are those that would be maintained at current levels until DPS-wide goals are achieved.

Scenarios and goals are not yet available for Oregon populations. Recovery planning assessments indicated that effects of the FCRPS on recovery gap assessments would ideally compare expected improvements due to current and planned actions with improvement objectives identified by the Recovery Plan. However, this analysis is not available for lower Columbia River DPSs or ESUs. Owing to uncertainty in the scale of benefits of proposed actions, the Washington Lower Columbia River Recovery and Subbasin Plan adopted an adaptive management approach based on monitoring of implementation and effects of a comprehensive suite of beneficial actions. The Oregon recovery planning process for lower Columbia River DPSs or ESUs is in progress.



Note: The recovery scenario for Oregon populations (displayed as ▲) is under development.

Source: LCFRB 2004

Figure 14-4. Improvements in Population Viability (inverse of risk) for Lower Columbia River Winter Steelhead (left) and Summer Steelhead (right) Corresponding to Recovery Scenario Identified in the Washington Lower Columbia River Recovery and Subbasin Plan

14.5 ADDITIONAL ACTIONS TO BENEFIT THE DPS

14.5.1 Other Reasonably Certain to Occur Actions

The State of Washington in the context of the collaboration among the sovereigns has identified 69 habitat-related actions and programs expected to provide benefit to portions of the four lower Columbia River DPSs or ESUs (Chinook Salmon, Coho Salmon , Chum Salmon, Steelhead) most affected by the FCRPS (Upper Columbia River gorge tributaries, Little White Salmon River, Wind River, Lower

Columbia River gorge and mainstem, and Washougal). Actions, geographic area, factors affected, timing, funding status, and responsible parties are described in detail in Chapter 17.

All actions identified are either completed, ongoing, planned with high likelihood of implementation. These actions address protection and/or restoration of existing or degraded fish habitat in stream, instream flows, water quality, fish passage and access, and watershed or floodplain conditions that affect stream habitat. Significant actions and programs include Growth Management Act and Shoreline Management Act program planning and regulation, a variety of stream and riparian habitat projects, watershed planning and plan implementation, acquisition of water rights and sensitive areas, instream flow rules, stormwater and discharge regulation, Total Maximum Daily Load (TMDL) implementation, Habitat Conservation Plan implementation on state forest lands, hydraulic project permitting. Responsible entities include cities; counties; conservation districts; state and local weed controls boards; local fish enhancement groups; Washington Departments of Ecology, Natural Resources, Transportation, and Fish and Wildlife; and regional coordinating bodies such as the LCFRB. Significant funding sources include state and local general funds, various dedicated state accounts, the Salmon Recovery Funding Board, and private forest land owners.

Oregon has similarly identified 117 statewide and 260 focused habitat-related actions and programs affecting the four lower Columbia River DPSs and ESUs (see Chapter 17). Oregon's habitat actions address a series of strategies focused on protection and/or restoration of natural ecological processes; floodplains and riparian conditions and connections; fish passage; critical stream flow; water quality; stream habitat structure and complexity; and watershed conditions and processes. Key implementing bodies include counties; cities; the Oregon Departments of Agriculture, Forestry, Water Resources, State Lands, Fish and Wildlife, Environmental Quality, Land Conservation and Development; the Oregon Watershed Enhancement Board; Conservation Districts; local watershed councils; and private forest land owners.

In addition, Washington and Oregon have implemented or are planning on implementing a variety of actions and programs aimed at reducing or regulating harvest and hatchery impacts. Ongoing harvest actions have included mass marking of hatchery fish and institution of mark-selective fisheries for spring Chinook and coho salmon (steelhead programs were previously implemented). Hatchery programs throughout the region are undergoing a comprehensive management review and a variety of changes are being implemented or are expected including elimination of hatchery releases in critical natural production areas, increased acclimation of hatchery fish to reduce straying, and integration of natural broodstock into hatchery management.

14.5.2 Salmon Recovery Plan[3]

A wide suite of protection and restoration actions are currently being implemented throughout the lower Columbia River region under the guidance of the Salmon Recovery Plan. The Recovery Plan for the Washington Portion of this DPS was completed by the LCFRB in 2005 and was adopted by as an Interim Regional Recovery Plan in February of 2006 (70 Federal Register 20531). The Oregon recovery planning process is underway and an Oregon plan for this DPS is expected in 2007. The Oregon and Washington plans will be combined for a complete ESA recovery plan for the Lower Columbia River Recovery Domain.

[3] Many of the actions listed above have a cost-share component with a variety of other Federal funding sources and therefore, may be properly described as contributing to the status of the environmental baseline rather than cumulative effects.

The Interim Washington Plan contains regional strategies, measures, and actions that address limiting factors and threats for tributary habitat, estuary and lower mainstem habitat, hydropower, harvest, hatcheries, and ecological interactions. Approximately 650 specific actions are identified by the plan. The plan recognizes that existing tools are inadequate precisely evaluate the outcome of a full suite of recovery actions but instead identifies actions that are needed to achieve recovery and the level of effort that will be needed to achieve recovery objectives. Hence the Plan takes a "directional approach," in which actions are directed toward reducing all of the human-caused factors limiting recovery. Information gained through an adaptive management program will help refine these approaches such that at some point in the future, a more focused and theoretically more cost-effective approach may be developed.

The institutional structure for Plan implementation involves oversight, implementation, and facilitation/coordination responsibilities. Key oversight bodies include NMFS, U.S. Fish and Wildlife Service, Tribal governments, the Washington Department of Fish and Wildlife, the Washington Governor's Office, and the Northwest Power and Conservation Council. The LCFRB, working with a steering committee, facilitates and coordinates efforts among oversight and implementing partners. The steering committee includes representatives of the oversight bodies and a cross-section of implementing partners. Facilitation/coordination involves setting priorities, evaluating progress, tracking implementation, inventorying and synthesizing monitoring results, developing implementation partnerships and agreements, and revising the Plan.

Implementation of the Plan includes an adaptive management framework that involves checkpoints at 2-year intervals to assess action implementation, at 6-year intervals to assess action effectiveness and threat reduction, and at 12-year intervals to assess fish and habitat status. Observed progress is evaluated against a series of benchmarks. In the first phase of implementation after completing the Plan, the LCFRB is now actively coordinating the implementation the specific strategies, measures and actions identified in the plan. The Board has authorized the Recovery Plan Implementation Committee to oversee implementation activities and to assist partnering groups in developing implementation work schedules, cost estimates and commitment necessary to receive assurances from NMFS.

In 2005, the Committee launched the Salmon Partners Ongoing Tracking System (Salmon PORT) to facilitate developing Implementation Work Schedules. The system is designed as an interactive website displaying all 650 actions contained in the Salmon Recovery and Watershed Management plans. This system will provide the basis for a comprehensive evaluation of progress in action implementation as planned according to the plan implementation schedule.

14.5.3 Other Federal Actions that Have Completed ESA Consultation

The Action Agencies' review of Federal actions that have completed Section 7 ESA consultations is not available at this time.

14.6 CONCLUSION

This DPS is currently threatened by a broad suite of habitat and ecological factors affecting populations distributed from the Columbia River mouth to the gorge upstream from Bonneville Dam. Because of the limited impact of the proposed operation of the FCRPS and the Upper Snake River projects on this DPS, there is limited potential to improve LCR populations with FCRPS configuration changes or improvements to FCRPS or Upper Snake River operations; and, with the diverse nature of impacts affecting this DPS, the future status depends on a coordinated effort by many Federal and non-Federal parties, such as through recovery plan implementation.

The Remand Collaboration did not develop a method analogous to the Conceptual Framework for assessing the appropriate contribution of FCRPS effects to recovery of lower Columbia River ESUs/DPSs. Because the available information on the status of populations within this DPS is not sufficient to complete a systematic quantitative analysis of the adequacy of implemented and planned actions as was done for the Interior Columbia DPSs, our conclusions are based on a qualitative assessment of the prospect for survival and recovery of this DPS relying on best available information. We note that actions are being and will be implemented to address multiple threat sectors. These actions are likely to further reduce the risk of extinction and improve population trajectories for populations within the DPS, thus improving the DPS' prospects for recovery.

The Action Agencies have worked with the states and Tribes through the Remand Collaboration Process and other forums to identify actions intended to address the needs of listed salmon and steelhead as determined by quantitative and qualitative biological analyses. Acknowledging that NMFS will review the actions and the effects analyses contained herein to make a final jeopardy determination in the forthcoming biological opinions, the Action Agencies are making the following conclusions. Based on our assessment of the FCRPS and Upper Snake River actions and analysis of effects, considering the present and future human and natural context, the Action Agencies conclude that the net effects of the proposed actions, including the existence and operations of the dams with the proposed mitigation, meet or exceed the objectives of doing no harm and contributing to recovery with respect to this DPS.

Chapter 15 – Upper Willamette River Chinook Salmon Evolutionarily Significant Unit

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

15.1 INTRODUCTION

This chapter briefly summarizes the current biological assessment of the Upper Willamette River Chinook Salmon Evolutionarily Significant Unit (ESU). It provides an overview of the ESU and life history, describes the factors limiting its viability, and summarizes available population-level status information. In addition, it describes how the operation of the Federal Columbia River Power System (FCRPS) is anticipated to affect this ESU. The Action Agencies believe that the actions conducted under the FCRPS Proposed Actions will affect only that portion of the lifecycle from when the juvenile fish exit the mouth of the Willamette River to the Pacific Ocean, and when the adults enter the mouth of the Columbia River to the mouth of the Willamette River. The effects of the FCRPS were assumed to affect all populations of Chinook salmon in the Willamette River similarly.

This chapter is organized into four sections. Section 15.1 is the introduction to the chapter. It provides an overview of the ESU and the factors limiting its viability. Section 15.2 summarizes population-level status information during the 20-year base period used for this analysis. Section 15.3 provides the biological assessment of the current and prospective status of this ESU. It also summarizes the improvements made to the hydropower (hydro) system and in other Hs (habitat, hatcheries, and harvest) since about 2000 and estimates the salmonid survival benefits associated with those improvements. Section 15.4 describes additional proposed actions that will benefit the ESU.

15.1.1 ESU Description

All naturally spawned populations of spring (“spring-run”) Chinook salmon residing in the Clackamas River and above Willamette Falls, but below impassable natural barriers (e.g., long-standing, natural waterfalls) are considered to be members of the Upper Willamette River Spring Chinook Salmon ESU. Natural spawning historically occurred in five subbasins (Figure 15-1). Of these, only the local populations occurring in the upper Clackamas River and the upper McKenzie River have significant numbers of naturally produced returning spawners. Other local naturally spawning populations are very small and primarily composed of hatchery strays. The National Marine Fisheries Service (NMFS, also known as the National Oceanic and Atmospheric Administration [NOAA] Fisheries) included five primary hatchery stocks in this ESU, including those from the Middle Fork Willamette (Oakridge), McKenzie, South Santiam, North Santiam, and Clackamas systems (Table 15-1). These hatchery stocks have been included in the ESU listing and are considered necessary for recovery (64 FR 14308).

Upper Willamette River Spring Chinook Salmon are different from other Columbia River Basin Chinook salmon according to both genetic and life history data (Schreck et al. 1986; Utter et al. 1989; Shaklee 1991; Waples et al. 1991; Myers et al. 1998). For example, Upper Willamette River Spring Chinook Salmon exhibit an earlier time of entry into the Columbia River and estuary than inland spring Chinook salmon (Myers et al. 1998). Allozyme analyses indicate that wild spring Chinook salmon from the upper Willamette River Basin are similar genetically to hatchery fish from the Dexter, McKenzie, Marion Forks, and Clackamas hatcheries (Lindsay et al. 1999).

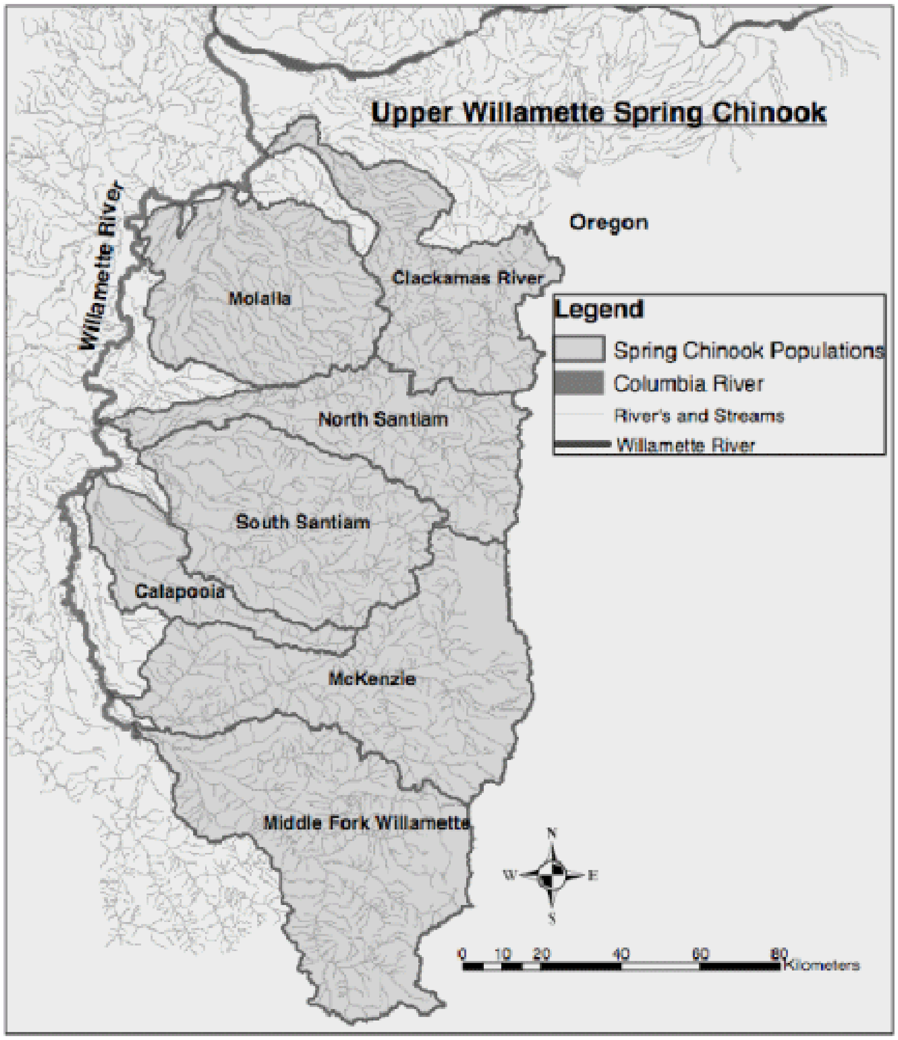


Figure 15-1. Historical Demographically/Independent Spring Chinook Salmon Populations of the Upper Willamette River ESU
Source: Myers et al. 2006.

Table 15-1. ESU Description and Major Population Groups (MPGs)

ESU Description	
Threatened	Listed under ESA in 1999; reaffirmed 2005[1]
1 current major population groups	7 historical populations
Hatchery programs included in ESU	McKenzie River Hatchery, Marion Forks/North Fork Santiam River, South Santiam Hatchery, South Santiam Hatchery in the Calapooia River, South Santiam Hatchery in the Molalla River, Willamette Hatchery, and Clackamas hatchery.
Major Population Groups	**Populations**
Willamette	Clackamas, Molalla, NF Santiam, SF Santiam Calapooia, McKenzie, MF Willamette

[1] Listing determination (64 FR 14208, 70 FR 37160)

Because the Willamette River enters the Columbia River well downstream of Bonneville Dam, adult or juvenile fish in this ESU may only incidentally encounter any of the mainstem FCRPS dams. However, some of the actions in the FCRPS Proposed Action are expected to have some direct and indirect effects on this ESU including those in the estuary (flow effects on habitat and the plume), those related to predation, and those related to hydrologic effects (flow, temperature, total dissolved gas [TDG]). Although there are multiple populations for this ESU, for the purposes of this consultation, these populations were considered in aggregate.

15.1.2 Life History

Wild spring Chinook salmon adults begin entering the Willamette River in February with the run peaking in April and completing by the end of May (Myers et al. 2006). Fish begin entering tributaries as early as middle to late April and hold in pools of cool water until they spawn from late August to early October. All spring Chinook salmon at Willamette River hatcheries are spawned concurrently during September.

After spawning, spring Chinook salmon eggs remain buried in the gravel for 1 to 4 months, depending on stream temperatures. Naturally produced juvenile Chinook salmon emigrate soon after emergence in late winter and spring to mainstem areas of major subbasins, including sections of the Willamette River, to rear until smoltification (ODFW 1990). Mattson (1962) reported three distinct migrations of juvenile spring Chinook salmon in the lower Willamette River (Lake Oswego area) that included a late winter-spring movement as fry, a late fall-early winter movement of fingerlings, and a second spring movement (late winter-spring) of yearlings. Passage of juvenile salmonids at the hydropower plant located at Willamette Falls (Figure 15-2) shows the average proportion of hatchery and “natural” spring Chinook salmon passing each month during 1992 through 1994.

Upper Willamette River Spring Chinook Salmon are "Gulf of Alaska" migrants. They migrate to the north upon ocean entry and are subject to harvest in British Columbia and Southeast Alaska ocean fisheries. Unlike upriver Columbia spring Chinook salmon, Upper Willamette River Spring Chinook Salmon appear to be highly vulnerable to ocean fisheries. Few adult Upper Willamette River Spring

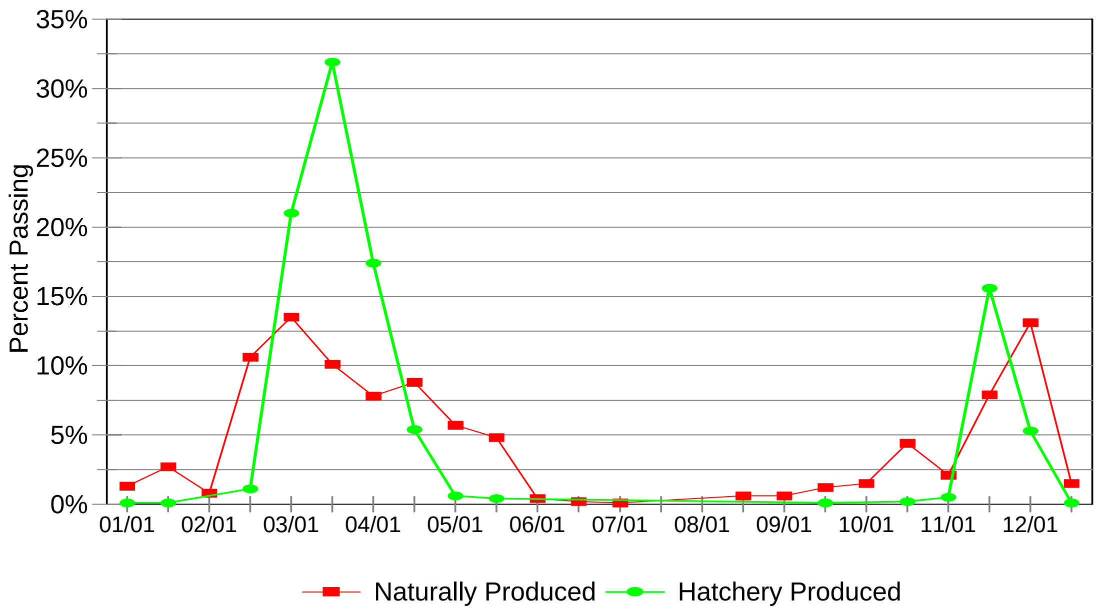


Figure 15-2. Passage Time of Juvenile Chinook Salmon Passing Willamette Falls over the Period 1992 to 1994
Source: Willis et al. 1995.

Chinook Salmon are caught in Oregon or California ocean fisheries (Garrison et al. 1994; Smith et al. 1985).

15.1.3 Key Limiting Factors

Willamette salmon have been adversely affected over the last century by many activities including human population growth, introduction of exotic species, overfishing, developments of cities and other land uses in the floodplains, water diversions for all purposes, dams, mining, farming, ranching, logging, hatchery production, predation, ocean conditions, loss of habitat, and other causes (Lackey et al. 2006) (Table 15-2). Spring Chinook salmon access to subbasin headwaters has been widely restricted or eliminated by the construction of dams without fish passage. Hatcheries were built to mitigate for this lost production, and extensive hatchery transfers have likely eroded the historical genetic diversity (Myers et al. 2006). Upper Willamette River populations are subject to only limited FCRPS impacts involving habitat alterations in the Columbia River mainstem and estuary. Preservation and recovery of this ESU will clearly depend on significant efforts by many other parties.

Table 15-2 summarizes current key limiting factors for this ESU identified in part by the Interior Columbia Basin Technical Recovery Team (TRT).

Table 15-2. Key Limiting Factors

Hydropower	There has been substantial development of flood control, irrigation and power producing projects in the Willamette River Basin. This has altered temperatures and flows, blocked up to 80% of spawning habitat in some tributaries (in that passage is not provided at many of the projects), and altered habitats downstream of the projects. FCRPS effects on Willamette migrants when they reach the mainstem Columbia River include those related to hydrologic effects (flow, temperature, TDG).
Hatcheries	Hatcheries have been used as a management tool in the Willamette River Basin for over 100 years. In some basins, hatchery fish predominate and many hatchery introductions came from outside individual basins but within the ESU. Considerable hatchery influence followed construction of hydropower projects, as hatchery production was used to mitigate losses of production due to blocking of habitat. Hatchery programs can present significant risks and hazards for native fish populations. Hazards associated with artificial production can be classified into four major categories – genetic, ecological, demographic, and facility (Busack et al. 2004).
Habitat	Urbanization and agriculture have resulted in moderate to severe degradation in the lower reaches of tributaries and the mainstem Willamette River. Conditions in the upper basins, although not pristine, remain relatively good. Riparian conditions in the lower portions of tributaries can be severely degraded.
Harvest	Upper Willamette River Spring Chinook Salmon are subject to ocean and in-river fisheries (Cramer et al. 1996) and a large share of the run entering freshwater is captured in sport and commercial fisheries. Catch numbers in the recreational fisheries below Willamette Falls have generally followed the run size passing Willamette Falls. Harvest rates on Upper Willamette River Spring Chinook Salmon in the ocean and river combined during 1975 to 1990 were estimated to range between 62 and 70 percent on average for the 1984 to 1989 brood years. High harvest rates coupled with low ocean survival may have resulted in substantial over harvest of Upper Willamette River Spring Chinook Salmon in many years. In recent years, overall harvest rates have been reduced, and legal harvest is now restricted to the take of marked hatchery fish.,
Predation	Predation by birds, marine mammals and other fishes has been noted as a factor limiting fish survival in the lower Willamette and Columbia mainstems and estuary. Predation by introduced fishes also occurs in altered habitats of the upper Willamette mainstem, but the significance of the effect is unknown.

Table 15-2. Key Limiting Factors

Estuary	The estuary is a critical habitat for migrating salmonids from all Columbia and Willamette River ESUs. Predation, levels of toxic substances, and habitat conditions in the estuary and plume are potential limiting factors. Alterations in attributes of flow and diking have resulted in the loss of emergent marsh, tidal swamp, and forested wetlands. These habitats are used extensively by subyearling migrant juveniles. Ocean-type juvenile survival is potentially affected in the estuary by lack of habitat, changes in food availability, and the presence of contaminants. Changes in the seasonal hydrograph as a result of water use and reservoir storage throughout the basin have altered estuary habitat forming processes and changes in the shape, behavior, size, and composition of the plume relative to historical conditions. Characteristics of the plume are thought to be significant to spring-run yearling migrants during transition to the ocean phase of their lifecycle (Fresh et al. 2005). Estuary limiting factors and recovery actions are addressed in detail in the estuary module of the comprehensive regional planning process (NMFS 2006a).
Ocean and Climate	Analyses of upper Willamette River salmon and steelhead status generally assume that future ocean and climate conditions will approximate the average conditions that prevailed during the recent base period used for status assessments. Recent conditions have been less productive for most Columbia River salmonids than the long-term average, and future trends are unclear. Additional consideration of the effects of long-term ocean and climate trends on salmon production will need to be addressed in regional recovery efforts.

15.1.4 Potentially Manageable Impacts

Most impacts have not yet been formally quantified for Willamette ESUs. Additional advancement of the biological assessment is likely to occur in the ongoing Oregon recovery planning process. However, the process involves long-term data collection, analysis, and management being conducted by multiple entities and stakeholders. Although work is ongoing, written documentation is not currently available for the Oregon recovery planning.

15.2 BASE STATUS

The base status is the historical status of the ESU, based on quantitative population metrics estimated from available time series of fish data. Long-term averages were used where available, although some of the available data time series are relatively recent.

15.2.1 Abundance, Productivity, and Trends

Base status information is reported for Upper Willamette River Spring Chinook salmon in the co-authored draft 2007 status assessment (McElhany et al. 2007) (Table 15-3). Many of the populations comprising this ESU are very small. Hatchery production has been largely substituted for natural runs. Data is not available for many populations in this ESU because significant numbers of natural spawners do not exist.

Fish have been counted as they pass through the fish ladders at Willamette Falls since 1946. The following population trends reflect combined abundances of hatchery and naturally produced fish. Counts of adult spring Chinook salmon over Willamette Falls were relatively steady, at approximately 26,000 fish during the 1950s, increasing to approximately 32,000 to 34,000 fish during the 1960s and 1970s, and increasing again up to an average of approximately 63,000 fish during the late 1980s and early 1990s. Recent estimates of spring Chinook salmon abundance from 2001 to 2006 as counted at Willamette Falls Dam ranged from 35,453 to 95,968 and averaged 64,828 for those 6 years (Figure 15-3).

Table 15-3. Abundance, Productivity, and Trends of Upper Willamette River Spring Chinook Salmon Population

Population	Recent Natural Spawners			Long-Term Trend		Median Growth Rate	
	Years[1/]	No. [2/]	pHOS[3/]	Years	Value[4/]	Years	λ[5/]
Clackamas	90-05	1656	16%	58-05	1.044	58-05	0.967
Mollala	na	na	na	na	na	na	na
NF Santiam	na	na	na	na	na	na	na
SF Santiam	na	na	na	na	na	na	na
Calapooia	na	na	na	na	na	na	na
McKenzie	90-05	2104	16%	70-05	1.017	70-05	0.927
MF Willamette	na	na	na	na	na	na	Na

Note: Reported time series correspond to reported values in available information and may not correspond to reference periods identified in BiOp analyses of other ESUs.
1/ Years of data for recent means.
2/ Geometric mean of total spawners.
3/ Average recent proportion of hatchery origin spawners
4/ Long-term trend of natural spawners (regression of log-transformed spawner indices against time).
5/ Long-term median population growth rate after accounting for hatchery spawners (equal spawning success assumption).
na = not available
Source: McElhany et al. 2007.

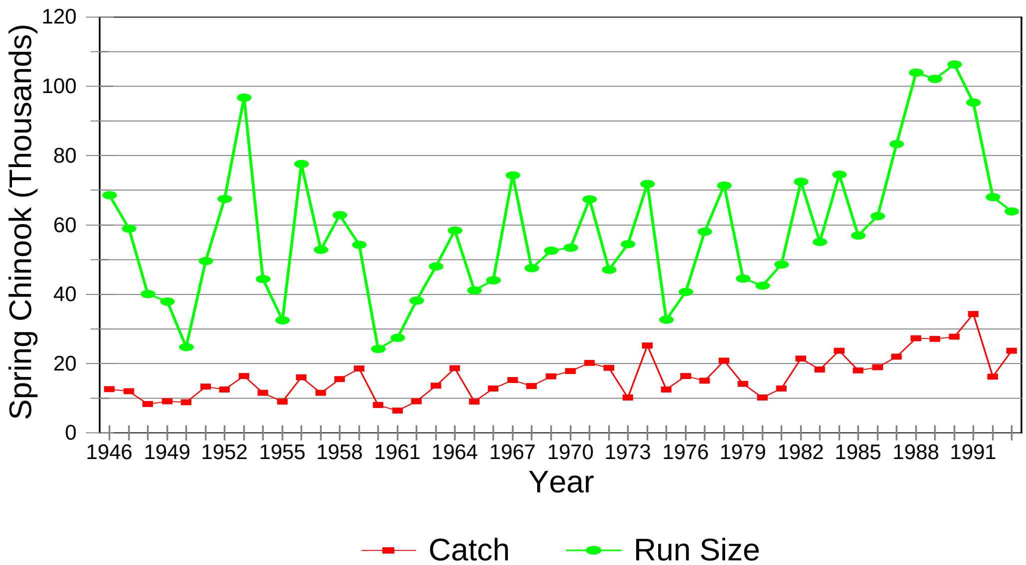


Figure 15-3. Number of Hatchery and Wild Spring Chinook Salmon Entering the Willamette River and Catch in Recreational Fisheries of the Lower Willamette and Lower Clackamas Rivers, 1946 to 1993
Source: from Cramer et al. 1996.

Long-term trends in escapement of hatchery and wild spring Chinook salmon to the Upper Willamette River ESU have been mixed, ranging from slightly upward to moderately downward (Figures 15-3 and 15-4). The overall size of the Upper Willamette River Spring Chinook Salmon run has fluctuated annually, but has not changed significantly on average since 1946. The goal of 100,000 spring Chinook salmon of Willamette River origin returning to the Columbia River was first achieved in 1988, largely as the result of increased hatchery production, improved hatchery practices, and good levels of ocean productivity.

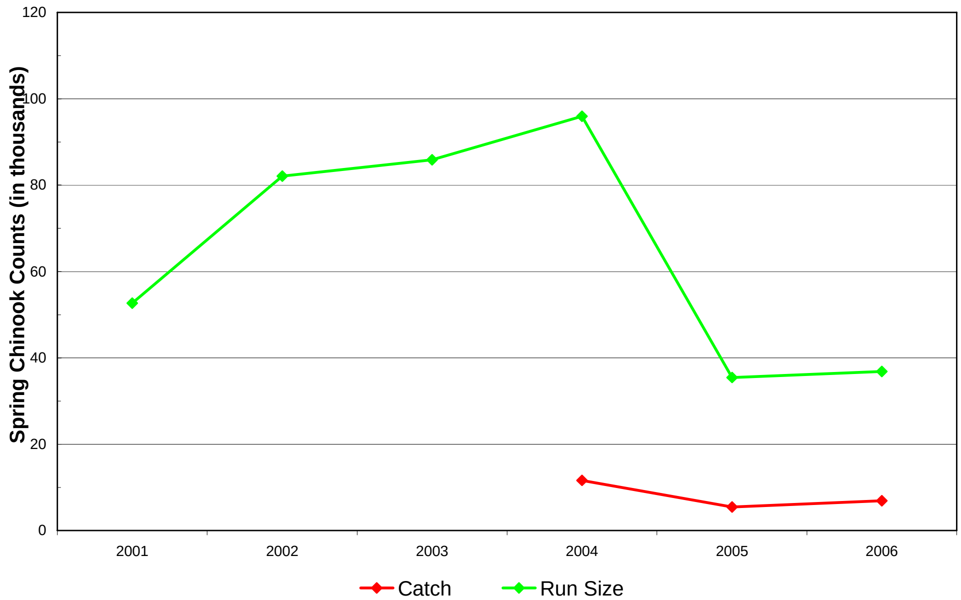


Figure 15-4. Adult Counts of Upper Willamette River Chinook Salmon at Willamette Falls Dam from 2001 to 2006 and Harvest Rates below Willamette Falls

The high proportion of hatchery fish in the total return and on spawning grounds indicates that most populations of Chinook salmon in the ESU are not self-sustaining. The Oregon Department of Fish and Wildlife (ODFW) identified spring Chinook salmon in the McKenzie River as the only remaining, naturally reproducing subpopulation upstream from Willamette Falls (64 FR 14322). Most naturally spawning Chinook salmon in other areas above Willamette Falls appear to have been influenced heavily by hatchery fish. A significant natural population also occurs in the Clackamas River, which enters the Willamette River downstream from Willamette Falls.

15.2.2 Extinction Probability/Risk

Risk of extinction was qualified in recovery plan assessments based on risk categories and criteria identified by the Willamette-Lower Columbia TRT (McElhany et al. 2004). A summary of these risks is provided in Table 15-4. The rating system categorized extinction risk probabilities as very low (<1 percent), low (1-5 percent), medium (5-25 percent), high (26-60 percent),and very high (>60 percent) based on abundance, productivity, spatial structure, and diversity characteristics. The risk assessment was based on a qualitative analysis of the best available data and anecdotal information for each population. Individual attributes were evaluated using criteria the Willamette-Lower Columbia TRT developed to determine viability (McElhany et al. 2003; Willamette-Columbia Columbia TRT 2003, 2004). In order to conduct the evaluations, biologists at the Northwest Fisheries Science Center (NWFSC), with the help of others, compiled data available on each attribute for each population. These data included time series of abundance with associated abundance and productivity risk metrics, maps of spatial distribution, tables on hatchery stocking history, analyses of watershed habitat processes, and so on. These data were compiled into population data reports, habitat atlases, and general methods reports (NWFSC 2003a–j). In addition to data provided in the reports, individual TRT members relied on personal knowledge of factors affecting population extinction risk. The Willamette-Columbia Columbia TRT approach was also intended to capture the uncertainty associated with the evaluation process.

Table 15-4. Quasi-Extinction and Critical Population Risks Estimated for Upper Willamette River Spring Chinook Salmon

Population	TRT Category[a]
Clackamas	L
Molalla	VH
NF Santiam	VH
SF Santiam	VH
Calapooia	VH
McKenzie	M
MF Willamette	VH

[a] Risk category estimated by the Willamette-Lower Columbia TRT from qualitative abundance, productivity, spatial structure and diversity criteria (VH=very high >60 percent, H=high 26-60 percent. M=moderate 5-25 percent, L=low 1-5 percent, VL=very low <1 percent).

15.2.3 Spatial Structure and Biological Diversity

Conserving and rebuilding sustainable salmonid populations involves more than meeting abundance and productivity criteria. Accordingly, NMFS has developed a conceptual framework defining a Viable Salmonid Population, or VSP (McElhany et al. 2000). In this framework there is an explicit consideration of four key population characteristic or parameters for evaluating population viability status: abundance, productivity (or population growth rate), biological diversity, and population spatial structure. The reason that certain other parameters, such as habitat characteristics and ecological interactions, were not included among the key parameters is that their effects on populations are implicitly expressed in the four key parameters. Based on the current understanding of population attributes that lead to sustainability, the VSP construct is central to the goal of Endangered Species Act (ESA) recovery, and warrants consideration in a jeopardy determination. However, it must also be stressed that the ability to significantly improve either a species' biological diversity or its spatial structure and distribution is limited within the timeframe of the Action Agencies' proposed action.

Spatial Structure—Spatial structure, as the term suggests, refers to the geographic distribution of individuals in a population unit and the processes that generate that distribution. Distributed populations that interact genetically are often referred to as metapopulation. Although the spatial distribution of a population, and thus its metapopulation structure, is influenced by many factors, none are perhaps as important as the quantity, quality, and distribution of habitat. One way to think about the importance or value of a broad geospatial distribution is that a population is less likely to go extinct from a localized catastrophic event or localized environmental perturbations.

Biological Diversity—Biological diversity within and among populations of salmonids is generally considered important for three reasons. First, diversity of life histories patterns is associated with a use of a wider array of habitats. Second, diversity protects a species against short-term spatial and temporal changes in the environment. Third, genetic diversity is the so-called raw material for adapting to long-term environmental change. The latter two reasons are often described as nature's way of hedging its bets—a mechanism for dealing with the inevitable fluctuations in environmental conditions—long- and short-term. With respect to diversity, more is better from an extinction-risk perspective.

The Upper Willamette River Spring Chinook Salmon ESU consists of seven populations. Spatial structure has been substantially reduced by the loss of access to the upper portions of the North Fork Santiam, South Fork Santiam, and Middle Fork Willamette River basins due to tributary hydropower development. Habitat availability has also been significantly reduced in the Molalla and Calapooia subbasins due to habitat degradation. Diversity of most populations has been significantly eroded by large hatchery influences and periodic low, effective population sizes.

15.3 BIOLOGICAL ASSESSMENT

This section includes: 1) an assessment of current status involving an adjustment of the initial base estimates to reflect recent improvements in mortality factors already implemented but not yet evidenced in adult returns, and 2) an assessment of prospective status involving benefits expected from planned actions. The biological assessments of upper Willamette River salmonid populations are largely qualitative at this time due to a lack of biological data for many populations. In contrast to the interior Columbia River ESUs where good long-term data sets are available on most populations, data are limited to only a few upper Willamette River populations and even those data are subject to a high degree of uncertainty. In particular, a high incidence of hatchery fish has confounded the ability to make accurate assessments of natural population abundance and productivity of Upper Willamette River Spring Chinook Salmon. As a result, stepwise quantitative analyses of incremental benefits of specific actions like those completed for interior ESUs are not included herein, nor were they included in recovery plans.

Base Status is the historical status of the ESU, defined as the status of the population based on the *average* of quantitative survival metrics estimated from a time series of abundance data beginning in about 1980. For the most part, longer-term averages are used where they are available. In the biological assessment, this is the starting point, shown in the preceding section.

Current Status considers both beneficial and adverse actions already implemented but not yet biologically expressed. Survival benefits are expected from recently implemented changes in hydropower configuration and operation, tributary and estuarine habitat conditions, predation by birds and other fishes, hatchery operations, and harvest management changes relative to the base period. However, effects of these actions are obviously not reflected in the time series of survival data that for the most part started in 1980.

Prospective Status considers survival improvements expected from the hydropower, habitat, and predation, and hatchery changes included in the Proposed Reasonable and Prudent Alternative (RPA), as well as actions likely to be implemented by others.

This assessment assumes that future ocean and climate conditions will approximate the average conditions that prevailed during the 20-year base period used for our status assessments. For most populations, that period is about equivalent to the “recent” ocean period used by the Willamette-Lower Columbia TRT in its analyses. This period was characterized by relatively unproductive and extremely variable ocean conditions that presumably contributed to poor early ocean survival of salmonids in most years. This subject is treated at greater length in the discussion of the effects of potential climate change in Appendix H.

15.3.1 Current Status

Over this period, the Action Agencies have implemented multiple actions to improve fish survival relative to the base period prior to 2000. The percentage changes in lifecycle survival used in base-to-current adjustments are summarized in Table 15-5. Actions are summarized below. The most significant survival effects of actions since the base period involve harvest rate reductions in freshwater and ocean fisheries. This change has significantly increased spawning escapement of Chinook salmon relative to the base period. Actions have been implemented in all factors but full benefits of these actions have not yet been realized. This is particularly true for habitat actions whose effects accrue at the stream scale over long periods of time.

Table 15-5. Estimated Survival Improvements (Net) Used in the Base-to-Current adjustment

	Habitat (tributary)	Habitat (estuary)	Predators (avian)	Predators (fish)	Hatchery	Harvest
Upper Willamette River Spring Chinook Salmon	Na[1]	0.3%	-0.4%	2%	Na[1/]	25%

[1] Not available.

15.3.1.1 Tributary Habitat Survival Improvements

A wide variety of actions with the potential to improve critical habitats has been implemented in Willamette River subbasin tributaries since 2000, involving non-Federal and Federal parties. Actions range from beneficial land management practices through improvements in access, through culvert replacement, and through fish reintroduction activities above non-federal dams. Recently completed subbasin and recovery plans provide extensive guidance for these actions. Effects of many of these actions are expected to accrue over the long term, falling outside of the period addressed by this assessment. The magnitude of effects is uncertain and is expected to be addressed by monitoring activities and adaptive management.

15.3.1.2 Estuary Habitat Survival Improvements

Survival benefit for Upper Willamette River Spring Chinook Salmon (ocean-type life history) associated with the specific actions discussed below was likely nominal. The Action Agencies implemented habitat actions through 21 estuary habitat projects. Unrestricted fish passage and approximately 3 miles of access to quality habitat was provided by the following specific actions[1]:

- Replaced three culverts with full-spanning bridges;
- Provided approximately 10 miles of improved tidal channel connectivity by installing a tide gate retrofit;
- Acquired approximately 473 acres of off-channel and riparian habitats;
- Restored and created 90 acres of marsh and tidal sloughs and approximately 100 acres of riparian forests;
- Protected approximately 55 acres of high-quality riparian and floodplain habitat; restored and preserved approximately 154 acres of off-channel habitat; protected 80 acres of high-value off-channel forested wetland habitat;
- Restored approximately 96 acres of tidal wetlands habitat by replacing undersized culvert that limited fish access;
- Conserved 155 acres of forested riparian and upland habitat; provided partial tidal channel reconnection by tide gate retrofit (acreage unknown at this time);
- Provided integrated pest management (purple loosestrife);
- Reconnected and restored 183 acres of historical floodplain by dike removal;
- Restored 25 acres of historical floodplain by breaching a dike;
- Provided fish passage access to 6 miles of stream habitat by removal of two culverts and replacement with bridges;

[1] A more thorough report detailing this evaluation process is *Estimated Benefits for Federal Agency Habitat Projects in the Lower Columbia River and Estuary* (PC Trask & Associates 2007), which is included in Appendix D to this document..

- Restored 310 acres of native hardwood riparian forest, 200 acres of seasonally wet slough, and 155 acres of degraded riparian habitats;
- Increased circulation in approximately 92 acres of backwater and side-channel habitat by tide gate retrofit; and
- Improved embayment circulation for 335-plus acres of marsh/swamp and shallow-water and flats habitat, and preserved 35 acres of historical wetland habitat.

15.3.1.3 Predation Management Survival Improvements

Avian Predation. The estimated change from baseline to current survival of upper Willamette River Chinook salmon is -0.4 percent. This reflects a reduction in survival from the base-to-current condition, because the tern population was increasing over the base period. Averaging tern consumption of juvenile salmonids across the 20-year base period downplays the actual change in survival that resulted from relocating terns from Rice Island to East Sand Island in 1999. In 1999, tern consumption of juvenile salmonids was at its peak with an estimated 13,790,000 smolts consumed, compared to 8,210,000 in 2000 after relocation.

Piscivorous Predation. The ongoing Northern Pikeminnow Management Program (NPMP) has been responsible for reducing predation related juvenile salmonid mortality since 1990. The northern pikeminnow has been responsible for approximately 8 percent predation-related mortality of juvenile salmonid migrants in the Columbia River Basin in the absence of the NPMP (2000 FCRPS BiOp at 9-106). The improvement in lifecycle survival attributed to the NPMP is estimated at 2 percent for migrating juvenile salmonids (Friesen and Ward 1999).

15.3.1.4 Hatchery Survival Improvements

Hatchery programs in the upper Willamette River are currently subject to a series of comprehensive reviews for consistency with the protection and recovery of listed salmonids. A variety of changes to hatchery programs have already been implemented and additional changes are anticipated. For instance, hatchery-origin fish are now excluded from the upper portions of the Clackamas and McKenzie rivers. The magnitude of effects is uncertain and is expected to be addressed by adaptive monitoring activities.

15.3.1.5 Harvest Survival Improvements

This assessment of status assumes a certain amount of annual take of natural adult fish based on recent harvest levels. Fishery impacts for spring Chinook salmon in combined ocean and freshwater fisheries have been reduced from 50 percent in the pre-2000 base period to 25 percent currently. This reduction was implemented to protect weak listed populations and was largely achieved by the implementation of mark-selective sport and commercial fisheries, as well as increased used of terminal fisheries to target hatchery spring chinook salmon. Harvest reductions result in immediate benefits to spawning escapement and corresponding reductions in extinction risks, particularly during low run-size years. As requested in the Remand Collaboration, a sensitivity analysis showing the additional effects of more selective harvests that minimize take of natural adult fish is presented in Appendix A.

15.3.2 Prospective Status

The prospective status is projected based on expected survival improvements associated with actions in 2007-2009 and 2010-2017. Over this period, the Action Agencies will implement multiple actions to improve fish survival relative to the current period. The percentage changes in lifecycle survival used in current-to-prospective adjustments are summarized in Table 15-6. Actions are summarized below.

Table 15-6. Estimated Improvements in Survival Used in the Current-to-Prospective Adjustment

	Habitat (tributary)	Habitat (estuary)	Predators (avian)	Predators (fish)	Hatchery	Harvest
Spring Chinook Salmon						
2007-2009	N/A	1.4%	2.1%	1%	N/A	—
2010-2017	N/A	4.3%	—	—	N/A	—

N/A = Not available.

15.3.2.1 Tributary Habitat Survival Improvements

A wide variety of actions (e.g., floodplain restoration, instream complexing, and off-channel habitat creation) with the potential to improve critical habitats are expected to be implemented in Willamette River subbasin tributaries from 2007 through 2017, involving non-Federal and Federal parties. Recently completed subbasin and recovery plans provide extensive guidance for these actions. Effects of these actions are expected to accrue over the long term but the magnitude of effects is uncertain and is expected to be addressed by adaptive monitoring activities and adaptive management.

15.3.2.2 Estuary Habitat Survival Improvements

2007 to 2009. Estimated survival benefits for Upper Willamette Spring Chinook Salmon (ocean-type life history) associated with the specific actions discussed above is 2.3 percent. The Action Agencies' estimated benefit for 2007 is based on actions that are or will be underway in the very near term. For 2008 and 2009, the Action Agencies' estimated benefit is based on the increased funding level identified in the FCRPS Biological Assessment (BA)[2]. The Action Agencies are or will be implementing multiple habitat actions through approximately 29 estuary habitat projects. Specific estuary habitat actions:

- Restore partial tidal influence and access to several acres (exact amount unknown at this time) by a tide gate retrofit;
- Improve hydrologic flushing and salmonid access to a lake (Sturgeon Lake is approximately 3,200 acres);
- Acquire and protect 40 acres of critical floodplain habitat and 40 acres riparian forest restoration;
- Install six to eight engineered log-jams that will help to slow flood flows, reduce erosion, contribute to sediment storage, enhance fish habitat, and contribute wood into the project area;
- Acquire and restore floodplain connectivity to 380 acres of off-channel rearing habitat for juveniles;
- Install fish-friendly tide gates to increase tidal flushing and fisheries access to approximately 110 acres;
- Perform riparian planting of up to 210 acres;
- Re-establish hydrologic connectivity to reclaim and improve floodplain wetland functions, increase off-channel rearing and refuge habitat on 5 acres, plant native vegetation along shoreline, and reconstruct slough channels on 2.5 acres of annually inundated off-channel habitat;
- As part of a long-term 1,500-acre restoration effort: breach a dike and re-establish flow to a portion of original channel, plant vegetation on 50 acres, remove invasive weeds on 180 acres,

[2] A more thorough report detailing this evaluation process is *Estimated Benefits for Federal Agency Habitat Projects in the Lower Columbia River and Estuary* (PC Trask & Associates 2007), which is included in Appendix D to this document..

plant wetland scrub shrub on 45 acres, and control and remove invasive wetland plants on 45 acres;

- Retrofit a tide gate (acreage unknown at this time);
- Protect and restore approximately 5 to 10 acres of emergent wetland and riparian forest habitats
- Reconnect 45 acres of floodplain by tide gate removal;
- Acquire 45 acres of floodplain with future dike removal;
- Reconnect 50 acres of floodplain;
- Acquire 320 acres of tidelands and 119 acres of riparian/upland forest; and
- Restore 30 acres of riparian habitat.

There will be approximately 15 to 20 additional projects and associated actions similar to actions listed above that are undergoing scoping and sponsor development (the number of projects and associated actions is based on the increased funding level identified in the FCRPS BA).

2010 to 2017. Estimated survival benefit for Lower Columbia River Spring Chinook Salmon (ocean-type life history) associated with these actions is 6.7 percent. The Action Agencies estimated benefits for 2010 to 2017 are based on continuing the same level of effort as 2007-2009. However, the level of effort in this period may increase depending on the outcome of a general investigation study of ecosystem restoration opportunities, depending on congressional appropriations, future funding scenarios, and results of actions. Specific projects have yet to be identified, but actions for this period will be similar in nature to actions implemented in previous periods discussed above. Actions will include protection and restoration of riparian areas, protection of remaining high quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, and reduction of noxious weeds, among others.

15.3.2.3 Predation Management Survival Improvements

Avian predation. Survival attributed to improved management of Caspian tern populations in the lower Columbia River are estimated at 2.1 percent for yearling Chinook salmon. The benefit is carried out to 2017 and beyond; there are no further actions, and therefore no further benefits. This improvement is expected to result through the reduction in estuary tern nesting habitat, and subsequent relocation of terns outside the Columbia River Basin. Although the base-to-current status shows a reduction in survival, the overall benefit (base to future) is positive.

Piscivorous predation. The percentage improvement in lifecycle survival attributable to the proposed continuation of the increase in incentives in the NPMP and resultant marginal increase in observed exploitation rate is estimated at 1 percent total from 2007 to 2017. This estimate was derived based on the difference between the estimated benefits from the base NPMP (defined as the period 1990 to 2003) and estimated survival benefits under the increased incentive program (defined as the period of 2004 to present). This rate would generally apply to all juvenile yearling and subyearling salmonids.

15.3.2.4 Hatchery Survival Improvements

Hatchery programs throughout the lower Columbia River region are currently subject to a series of comprehensive reviews for consistency with the protection and recovery of listed salmonids. A variety of changes to hatchery programs have already been implemented and additional changes are anticipated. The magnitude of effects is uncertain and is expected to be addressed by adaptive monitoring activities.

15.3.2.5 Harvest Survival Improvements

The assessment of status assumes a certain amount of annual take of natural adult fish based on current harvest levels. As requested in the Remand Collaboration, a sensitivity analysis showing the additional effects of more selective harvests that minimize take of natural adult fish is presented in Appendix A.

15.4 ADDITIONAL ACTIONS TO BENEFIT THE ESU

15.4.1 Other Actions Reasonably Certain to Occur

The State of Oregon, in the context of the collaboration among the sovereigns, has identified 117 statewide and a number of focused habitat-related actions and programs affecting the two upper Willamette River ESUs (see Chapter 17). Oregon's habitat actions address a series of strategies focused on protection and/or restoration of natural ecological processes; floodplains and riparian conditions and connections; fish passage; critical stream flow; water quality; stream habitat structure and complexity; and watershed conditions and processes. Key implementing bodies include counties; cities; the Oregon Departments of Agriculture, Forestry, Water Resources, State Lands, Fish and Wildlife, Environmental Quality, Land Conservation and Development; the Oregon Watershed Enhancement Board; conservation districts; local watershed councils; and private forest land owners.

In addition, Oregon has implemented, or is planning on implementing, a variety of actions and programs aimed at reducing or regulating harvest and hatchery impacts. Ongoing harvest actions have included mass marking of hatchery fish and institution of mark-selective fisheries for spring Chinook salmon (steelhead programs were previously implemented). Hatchery programs throughout the region are undergoing a comprehensive management review, and a variety of changes are being implemented or are expected including elimination of hatchery releases in critical natural production areas, increased acclimation of hatchery fish to reduce straying, and integration of natural broodstock into hatchery management.

15.4.2 Salmon Recovery Plan

A wide suite of protection and restoration actions will be implemented throughout the upper Willamette region under the guidance of a Salmon Recovery Plan currently under development by State, Federal, and other parties. The Oregon recovery planning process is underway, and an Oregon plan for this ESU is expected in 2007. The plan will contain regional strategies, measures, and actions that address limiting factors and threats for tributary habitat, estuary and lower mainstem habitat, hydropower, harvest, hatcheries, and ecological interactions. The institutional structure for plan implementation will involve oversight, implementation, and facilitation/coordination responsibilities. Key oversight bodies include NMFS, USFWS, tribal governments, the ODFW, and the Oregon Governor's Office. Implementation of the plan will include an adaptive management framework that involves checkpoints to assess action implementation, action effectiveness and threat reduction, and fish and habitat status. Observed progress will be evaluated against a series of benchmarks.

15.4.3 Other Federal Actions undergoing ESA Consultation

The separate ESA Section 7 consultation regarding continuing operation of the Willamette Project (i.e., 13 flood management and multi-purpose dams and reservoirs, and hatchery mitigation activities) will address the majority of Action Agency program effects on Upper Willamette River Spring Chinook Salmon. In comparison, effects associated with the FCRPS, which are limited to the lower Columbia River and estuary environments, are expected to be minor.

15.5 CONCLUSIONS

This ESU is currently threatened by a broad suite of habitat and ecological factors affecting all populations. The FCRPS Proposed RPA and Upper Snake River Proposed Action affect only that portion of the Upper Willamette River Spring Chinook Salmon ESUs lifecycle from when the juvenile fish exit the mouth of the Willamette River in their migration to the Pacific Ocean, and when the adults enter the mouth of the Columbia River to the mouth of the Willamette River. These impacts comprise only a very limited portion of the threats affecting these populations. With the diverse nature of impacts affecting this ESU, the future status depends on a coordinated effort by many Federal and non-Federal parties – through the current ESA consultation on the effects of the U.S. Army Corps of Engineers' Willamette River projects, and recovery plan implementation. For instance, the Action Agencies' proposal for continued operation of the FCRPS has the potential to improve survival, productivity, and quality of critical habitat for Upper Willamette River Spring Chinook Salmon migrating and rearing in the lower Columbia River and estuary through habitat restoration and predator management. Recent and planned non-FCRPS and FCRPS actions have improved status and are likely to result in continued improvements in the biological status of this ESU.

The available information on the status of populations within this ESU is not currently adequate to complete a systematic quantitative analysis of the adequacy of implemented and planned actions. The Remand Collaboration did not develop a method analogous to the Conceptual Framework for assessing the appropriate contribution of the FCRPS effects to recovery of lower Columbia River ESUs. Because the available information on the status of populations within this ESU is not sufficient to complete a systematic quantitative analysis of the adequacy of implemented and planned actions as was done for the Interior Columbia ESUs, our conclusions are based on a qualitative assessment of the prospect for survival and recovery of this ESU relying on best available information. We note that actions are being and will be implemented in the estuary to address multiple threat sectors.

The Action Agencies have worked with the states and Tribes through the Remand Collaboration Process and other forums to identify actions intended to address the needs of listed salmon and steelhead as determined by quantitative and qualitative biological analyses. Acknowledging that NMFS will review the actions and the effects analyses contained herein to make a final jeopardy determination in the forthcoming biological opinions, the Action Agencies are making the following conclusions. Based on our assessment of the FCRPS and Upper Snake River actions and analysis of effects, considering the present and future human and natural context, the Action Agencies conclude that the net effects of the proposed actions, including the existence and operations of the dams with the proposed mitigation, meet or exceed the objectives of doing no harm and contributing to recovery with respect to this ESU.

Chapter 16 – Upper Willamette River Steelhead Distinct Population Segment

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

16.1 INTRODUCTION

This chapter briefly summarizes the current biological assessment of this Distinct Population Segment (DPS). It provides an overview of the DPS and life history, describes the factors limiting its viability, and summarizes available population-level status information. The lifecycle effects of hydropower operations on the Upper Willamette River Steelhead DPS are presently being considered in another ESA consultation. A Biological Assessment (BA) was submitted to the National Marine Fisheries Service (NMFS, also known as the National Oceanic and Atmospheric Administration [NOAA] Fisheries). In addition it describes how the operation of the Federal Columbia River Power System (FCRPS) is anticipated to affect the DPS. The Action Agencies believe that the actions conducted under the FCRPS Proposed Reasonable and Prudent Alternative (RPA) will affect only that portion of the lifecycle from when the juvenile fish exit the mouth of the Willamette River to the Pacific Ocean, and when the adults enter the mouth of the Columbia River to the mouth of the Willamette River. The effects of the FCRPS were assumed to affect all populations in the Willamette River similarly.

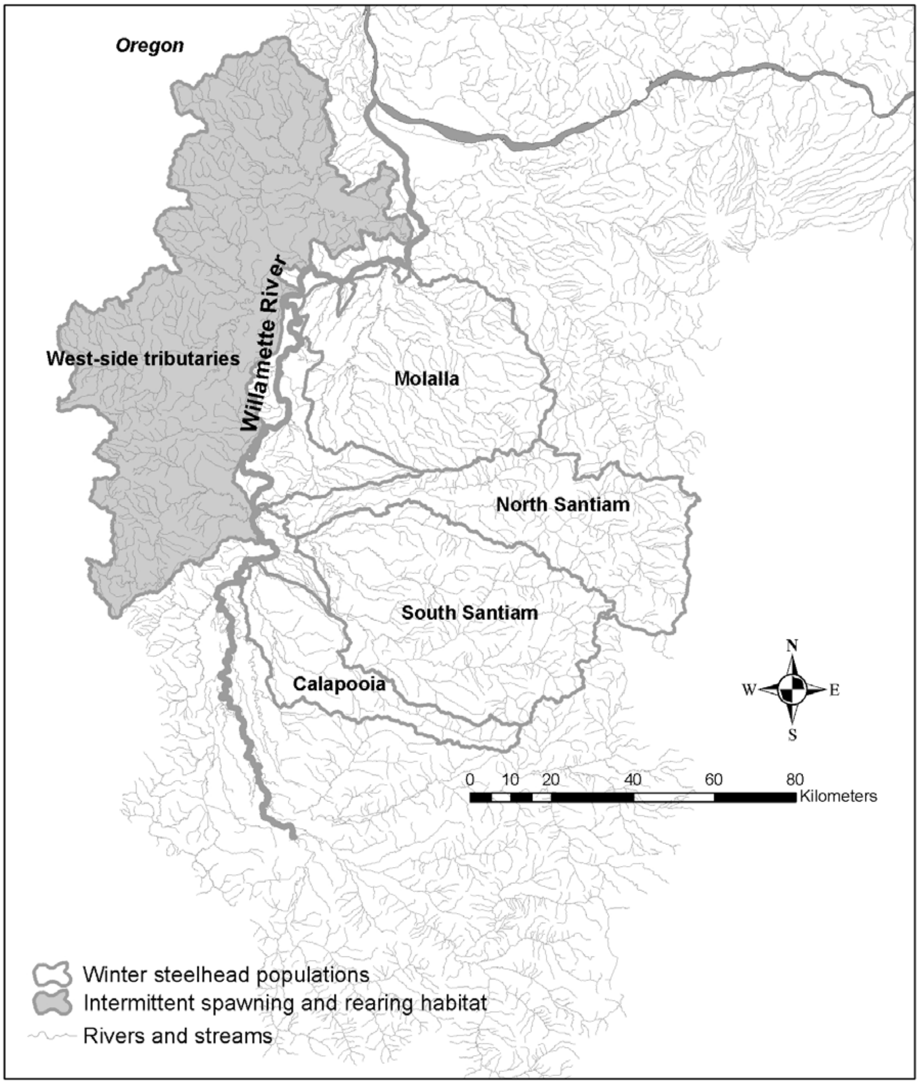
This chapter is organized into six sections. Section 16.1 is the introduction. Section 16.2 provides an overview of the DPS and the factors limiting its viability. Section 16.3 summarizes population-level status information during the 20-year base period used for this analysis. Section 16.4 provides the analysis of the current status and provides estimates of the “gaps” or needed lifecycle survival improvements for individual populations to meet certain biological criteria. It summarizes the improvements made to the hydropower (hydro) system and in other Hs (habitat, hatcheries, and harvest) since about 2000 and estimates the salmonid survival benefits associated with those improvements. Section 16.5 describes the actions proposed to be implemented into the future. Section 16.6 provides a description of additional proposed actions that will benefit this DPS.

16.2 DPS DESCRIPTION

The Upper Willamette River Steelhead DPS occupies the Willamette River and its tributaries, upstream from Willamette Falls, but only up to and including the Calapooia River (Table 16-1 and Figure 16-1). The winter-run steelhead reproduce primarily in the Molalla, North Santiam, South Santiam, and Calapooia subbasins (Busby et al. 1996). It is unclear whether west-side tributaries historically supported significant independent winter steelhead production. Designated critical habitat for upper Willamette River winter steelhead presently includes reaches and tributaries of the Willamette River upstream to, and including, the Calapooia River. In the Santiam River subbasin, critical habitat extends up to the base of Big Cliff and Green Peter dams (65 FR 7764). Three stocks of steelhead have been propagated and released in the upper Willamette River basin, but only the Willamette River winter steelhead stock reared at Marion Forks Hatchery (North Santiam River) was found by NMFS to qualify for inclusion in the DPS (discontinued production in 1998). The two stocks not qualifying for inclusion in the DPS are the Big Creek winter steelhead stock and the Skamania summer steelhead stock (NMFS 1999).

Table 16-1. DPS Description and Major Population Groups (MPG)

DPS Description	
Threatened	Listed under ESA in 1999; reaffirmed 2006
1 major population group	4 historical populations
Hatchery programs included in DPS	None
Major Population Groups	**Populations**
Upper Willamette River Steelhead	Molalla, NF Santiam, SF Santiam, Calapooia, (West Side Tributaries)



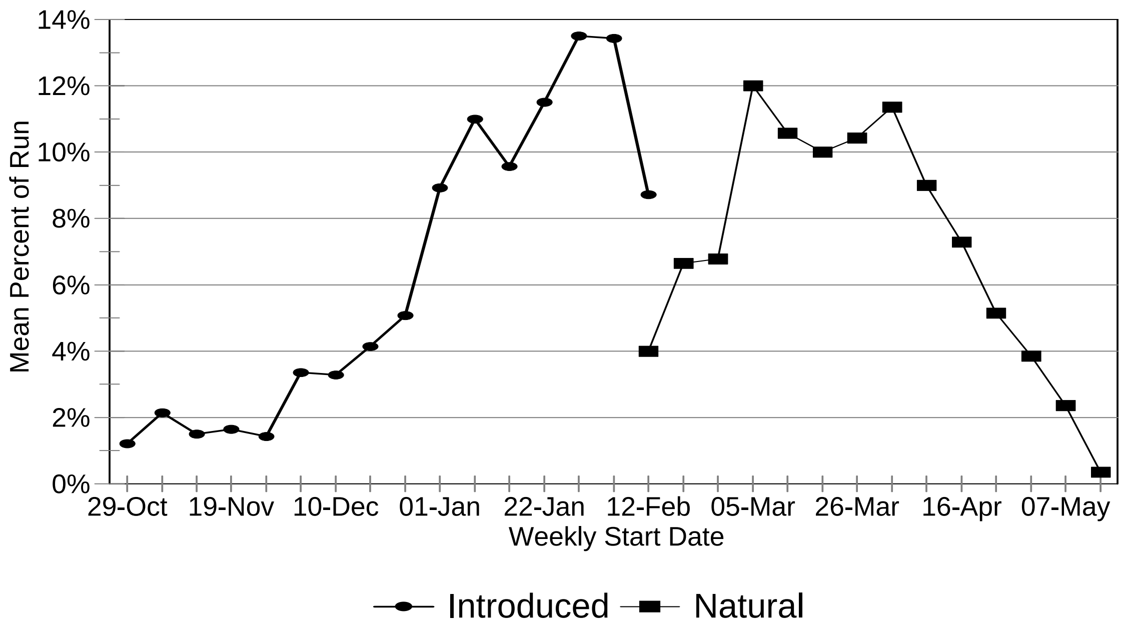
Source: Myers et al. 2006.

Figure 16-1. Historical Demographically Independent Steelhead Salmon Populations of the Upper Willamette River DPS

16.2.1 Life History

Production of winter steelhead does not occur in the mainstem Willamette River; all spawning occurs in tributaries (ODFW 1990). Data on juvenile rearing distributions are limited, but indicate that juvenile steelhead reside both within their native tributaries and in the mainstem Willamette River.
The native steelhead of this basin are late-migrating winter steelhead, entering fresh water primarily in March and April (Howell et al. 1985), whereas most other populations of west coast winter steelhead enter fresh water beginning in November or December. Passage over Willamette Falls begins in early February, peaks in March, and ends in late May.

Figure 16-2 demonstrates that passage of introduced Big Creek winter steelhead stock overlaps passage of the early portion of the native run, but there is relatively little overlap with the introduced Skamania summer run that begins in late May. Peak returns to the Minto collection facility on the North Santiam River occur during April (Wevers et al. 1992a) and on the South Santiam River, counts over Foster Dam



Note: Introduced and natural runs are distinguished by February 15 as a cutoff date, and percentages are calculated relative to each run's total size

Figure 16-2. Percentage of the Annual Steelhead Run that Crossed Willamette Falls each Week, Averaged for 1984 to 1998

peak in mid-April (Wevers et al. 1992a). Spawning activity peaks in April in tributaries to the west side, and in May in tributaries draining the Cascade range to the east (ODFW 1990; Wevers et al. 1992a).

Incubation rates vary with water temperature with eggs hatching anywhere between 18 and 101 days (Emmett et al. 1991). Fry emergence of Willamette winter steelhead is thought to occur predominantly in June, but may extend into July in cooler tributaries. Emigration of native steelhead smolts occurs from late March to late May, generally after their second winter in freshwater (Wevers et al. 1992a, 1992b). Smolt migration of Willamette winter steelhead past Willamette Falls begins in early April and extends through early June (Howell et al. 1985), with peak migration occurring in early to mid-May. Radio telemetry studies found median migration rates during 1989 and 1990 were 11.1 to 10.3 miles per day. Steelhead smolts were generally further from shore and migrated more often through Multnomah Channel than out the mouth of the Willamette River.

Most Upper Willamette River Steelhead spend 2 years (2-ocean) in the ocean before entering fresh water to spawn (Busby et al. 1996). About 65 percent of adults in the Upper Willamette River Steelhead DPS are 2-ocean and 35 percent are 3-ocean in the Molalla River (Wevers et al. 1992b). Steelhead in the Upper Willamette River Steelhead DPS generally spawn once or twice over their life span; a few fish may spawn three times based on patterns found in the Lower Columbia River Steelhead DPS. Repeat spawners are predominantly female and generally account for less than 10 percent of the total run size (Busby et al. 1996).

16.2.2 Key Limiting Factors

Salmon and steelhead have been adversely affected over the last century by many activities including human population growth, introduction of exotic species, overfishing, development of cities and other land uses in the floodplains, water diversions, dams, mining, farming, ranching, logging, hatchery production, predation, ocean conditions, loss of habitat, and other causes (Lackey et al. 2006). Access to subbasin headwaters has been widely restricted or eliminated by the construction of dams without fish passage. Upper Willamette River Steelhead populations are subject to only limited FCRPS impacts involving habitat alterations in the Columbia River mainstem and estuary. Preservation and recovery of this DPS will clearly depend on significant efforts by many other parties. Summarized below in Table 16-2 are current key limiting factors for this DPS.

Table 16-2. Key Limiting Factors

Hydrosystem	There has been substantial development of flood control, irrigation, and power producing projects in the Willamette River Basin. This has altered temperature regimes, blocked spawning habitat, and altered habitats downstream of the projects. Major habitat blockages resulted circa 1952 from Big Cliff Dam on the North Santiam River, and circa 1967 from Green Peter Dam on the South Santiam River. These dams, along with Dexter Dam, Dorena Dam, and Cougar Dam were identified by NMFS as the upper limit of winter steelhead distribution (64 FR 5750). Hydrosystem effects originating in the Willamette River Basin are presently being considered in another separate ESA consultation. FCRPS effects affecting Willamette River migrants when they reach the mainstem Columbia River include those related to hydrologic effects (flow, temperature, TDG).
Hatcheries	Historical hatchery practices represent a significant threat to the genetic integrity of steelhead in this DPS. While there is some separation in run timing between hatchery and wild steelhead, genetic introgression from non-local hatchery stocks has the potential to occur. An additional effect of hatchery production may be competition with non-native hatchery steelhead.
Habitat	Urbanization and agriculture have resulted in moderate to severe degradation in the lower reaches of tributaries and in the mainstem Willamette River. Conditions in the upper tributary basins, although not pristine, are relatively good. Riparian conditions in the lower portions of tributaries can be severely degraded and numerous passage barriers exist in the basin on smaller tributaries.
Harvest	Harvest in the Willamette River is typically limited to hatchery summer steelhead. Incidental take of native winter steelhead is thought to be low. Historical harvest rates were more significant.
Predation	Predation by birds, marine mammals, and other fishes has been noted as a factor limiting fish survival in the lower Willamette and Columbia mainstems and estuary. Predation by introduced fishes also occurs in altered habitats of the upper Willamette mainstem but the significance of the effect is unknown.
Estuary	The estuary is a critical habitat for migrating salmonids from all Columbia and Willamette ESUs and DPSs. Predation, levels of toxic substances, and habitat conditions in the estuary and plume are potential limiting factors. Alterations in attributes of flow and diking have resulted in the loss of emergent marsh, tidal swamp and forested wetlands. Changes in the seasonal hydrograph as a result of water use and reservoir storage throughout the basin have altered estuary habitat forming processes and changes in the shape, behavior, size and composition of the plume relative to historical conditions. Characteristics of the plume are thought to be significant to yearling migrants during transition to the ocean phase of their lifecycle (Fresh 2004). Estuary limiting factors and recovery actions are addressed in detail in the estuary module of the comprehensive regional planning process (NMFS 2006a).
Ocean and Climate	Analyses of upper Willamette River salmon and steelhead status generally assume that future ocean and climate conditions will approximate the average conditions that prevailed during the recent base period used for status assessments. Recent conditions have been less productive for most Columbia River salmonids than the long-term average and future trends are unclear. Additional consideration of the effects of long-term ocean and climate trends on salmon production will need to be addressed in regional recovery efforts.

16.2.3 Potentially Manageable Impacts

Most impacts have not yet been formally quantified for Willamette River ESUs/DPSs. Additional advancement of the biological assessment is likely to occur in the ongoing Oregon recovery planning process. However the process involves long-term data collection, analysis and management being conducted by multiple entities and stakeholders. Although work is ongoing, written documentation is not currently available for the Oregon recovery planning effort.

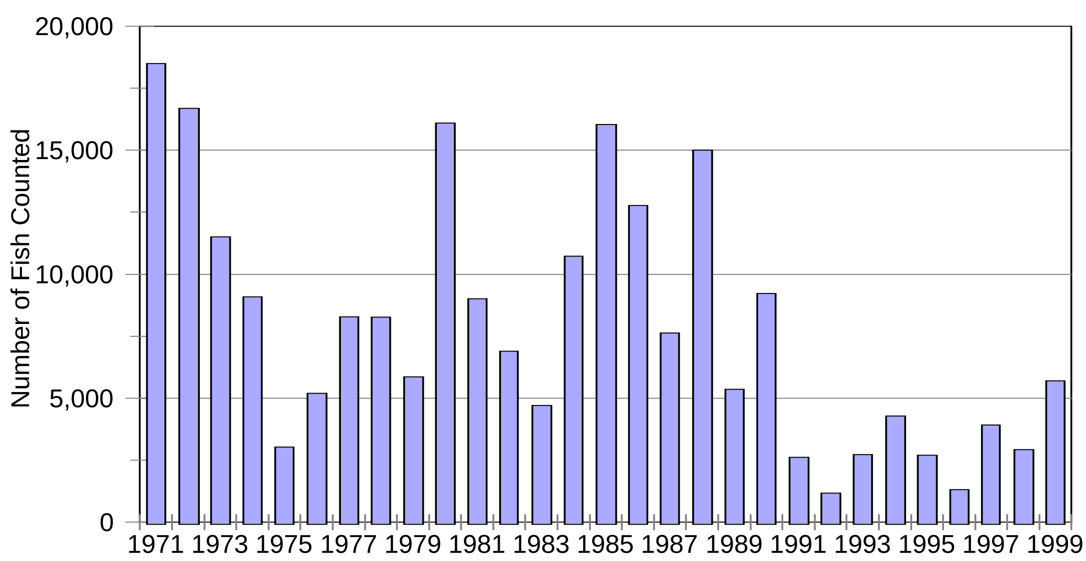
16.3 BASE STATUS

The Base Status is the historical status of the DPS, based on quantitative population metrics estimated from available time series of fish data. Long-term averages were used where available, although some of the available data time series are relatively recent.

16.3.1 Abundance, Productivity & Trends

Base status information is reported for Upper Willamette River Steelhead in the co-authored draft 2007 status assessment (McElhany et al. 2007). Many of the populations comprising this DPS are small or widely fluctuating. Natural runs have been largely replaced by hatchery production.

Native winter steelhead abundance is determined from counts of fish passing the fish ladders at Willamette Falls (Figure 16-3). The difference in run timing between native winter steelhead and introduced Big Creek and Skamania stocks was used as a means of estimating run size of native steelhead passing Willamette Falls (Busby et al. 1996). Total abundance of winter steelhead has fluctuated over the past several decades over a range of approximately 2,000 to 18,000 spawners. Abundance during 1991-1998 was below 5,000 fish, and the run in 1992 was the lowest in 30 years. NMFS estimated from angler catch data that approximate average escapements of winter steelhead were Molalla River, 2,300; North Santiam River, 2,000; and South Santiam River, 550. Abundance of winter steelhead returning to the tributaries is currently indexed primarily from redd counts in April and May.



Note: Counts are from February 16 to May 15 Each Year

Figure 16-3. Estimated Number of Hatchery and Naturally Produced Winter Steelhead Passing Willamette Falls Each Year, 1971 to 1999

Large numbers of hatchery winter and summer steelhead were historically released into upper Willamette subbasins but the scope of this effort has been considerably reduced in order to protect native populations. More than two million hatchery-origin winter steelhead were released (Busby et al. 1996). Hatchery releases of summer steelhead between 1980 and 1994 numbered more than five million in the Santiam River system, two million in the McKenzie River system, and nearly two million in the Willamette River. All stocking of winter steelhead ceased in the Santiam River subbasin after 1998, and in the Molalla River after 1997. Stocking of steelhead has never occurred in the Calapooia River. Stocking of Skamania summer steelhead has been discontinued in the Molalla River, but continues in the North and South Santiam rivers. Summer steelhead collected at the Minto Facility weir are returned downstream to the recreational fishery, to avoid interbreeding with native steelhead. However, hatchery fish have been widespread and have escaped to spawn naturally throughout the DPS during the past two decades (Table 16-3). Both summer steelhead and early-run winter steelhead have been introduced into the basin and are thought to spawn naturally in substantial numbers. There continues to be widespread production of hatchery steelhead within the range of this DPS, predominantly of non-native summer fish. It is unknown to what degree interaction has occurred between hatchery and natural stocks within the DPS overall, in part because the quality of available data is generally low.

16.3.2 Extinction Probability/Risk

Risk of extinction was qualified in recovery plan assessments based on risk categories and criteria identified by the Willamette-Lower Columbia Technical Recovery Team (TRT; McElhany et al. 2004). As shown in Table 16-4, the rating system categorized extinction risk probabilities as very low (<1 percent), low (1-5 percent), medium (5 to 25 percent), high (26 to 60 percent), and very high (>60 percent) based on abundance, productivity, spatial structure and diversity characteristics. The risk assessment was based on a qualitative analysis of the best available data and anecdotal information for each population. Individual attributes were evaluated using criteria the Willamette-Lower Columbia TRT developed to determine viability (McElhany et al. 2003 and Willamette-Lower Columbia TRT 2003). In order to conduct the evaluations, biologists at the Northwest Fisheries Science Center (NWFSC), with the help of others, compiled data available on each attribute for each population. These data included time

Table 16-3. Abundance, Productivity, and Trends of Upper Willamette River Steelhead Population

Population	Recent Natural Spawners			Long-term trend		Median growth rate	
	Years[1/]	**No. [2/]**	**pHOS[3/]**	**Years**	**Value[4/]**	**Years**	**Λ[5/]**
Molalla	90-05	914	0%[6/]	80-05	0.966	80-05	0.988
NF Santiam	90-05	2109	11%	80-05	0.98	80-05	1.035
SF Santiam	90-05	2149	0% [6/]	68-05	1.054	68-05	1.052
Calapooia	90-05	339	0% [6/]	80-05	1.13	80-05	1.128
West Side Tributaries	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note: Reported time series correspond to reported values in available information and may not correspond to reference periods identified in BiOp analyses of other ESUs and DPSs.
1/ Years of data for recent means.
2/ Geometric mean of total spawner provided by the total series.
3/ Average recent proportion of hatchery origin spawners
4/ Long-term trend of natural spawners (regression of log-transformed spawner indices against time).
5/ Long term median population growth rate after accounting for hatchery spawners (equal spawning success assumption).
6/ Current hatchery fractions reflect termination of hatchery winter steelhead releases in natural production areas during the 1990s.
N/A not available
Source: McElhany et al. 2007

Table 16-4. Quasi-Extinction and Critical Population Risks Estimated for Upper Willamette River Steelhead Effective at 1999 Reference Point (Initial Listing Date)

Population	TRT Category[1/]
Molalla	M
NF Santiam	M
SF Santiam	L
Calapooia	M
West Side Tributaries	--

[1/] Risk category estimated by the Willamette-Lower Columbia TRT from qualitative abundance, productivity, spatial structure, and diversity criteria (VH=very high >60%, H=high 26-60%, M=moderate 5-25%, L=low 1-5%, VL=very low <1%).

series of abundance with associated abundance and productivity risk metrics, maps of spatial distribution, tables on hatchery stocking history, analyses of watershed habitat processes, and so on. These data were compiled into population data reports, habitat atlases, and general methods reports (NWFSC 2003a–k). In addition to data provided in the reports, individual Willamette-Lower Columbia TRT members relied on personal knowledge of factors affecting population extinction risk. The Willamette-Lower Columbia TRT approach was also intended to capture the uncertainty associated with the evaluation process.

16.3.3 Spatial Structure and Biological Diversity

Conserving and rebuilding sustainable salmonid populations involves more than meeting abundance and productivity criteria. Accordingly, NMFS has developed a conceptual framework defining a Viable Salmonid Population, or VSP (McElhany et al. 2000). In this framework there is an explicit consideration of four key population characteristic or parameters for evaluating population viability status: abundance, productivity (or population growth rate), biological diversity, and population spatial structure. The reason that certain other parameters, such as habitat characteristics and ecological interactions, were not included among the key parameters is that their effects on populations are implicitly expressed in the four key parameters. Based on the current understanding of population attributes that lead to sustainability, the VSP construct is central to the goal of ESA recovery, and warrants consideration in a jeopardy determination. However, it must also be stressed that the ability to significantly improve either a species' biological diversity or its spatial structure and distribution is limited within the timeframe of the Action Agencies' proposed action.

Spatial Structure—Spatial structure, as the term suggests, refers to the geographic distribution of individuals in a population unit and the processes that generate that distribution. Distributed populations that interact genetically are often referred to as metapopulation. Although the spatial distribution of a population, and thus its metapopulation structure, is influenced by many factors, none are perhaps as important as the quantity, quality, and distribution of habitat. One way to think about the importance or value of a broad geospatial distribution is that a population is less likely to go extinct from a localized catastrophic event or localized environmental perturbations.

Biological Diversity—Biological diversity within and among populations of salmonids is generally considered important for three reasons. First, diversity of life histories patterns is associated with a use of a wider array of habitats. Second, diversity protects a species against short-term spatial and temporal changes in the environment. And third, genetic diversity is the so-called raw material for adapting to long-term environmental change. The latter two are often described as nature's way of hedging its bets—a mechanism for dealing with the inevitable fluctuations in environmental conditions—long- and short-term. With respect to diversity, more is better from an extinction-risk perspective.

The Upper Willamette River Steelhead DPS consists of five historical populations. Spatial structure has been substantially reduced by the loss of access to the upper portions of most basins due to tributary hydrosystem development and habitat degradation in many lower elevation areas. Diversity of some populations has been significantly eroded by large hatchery influences and periodic low effective population sizes.

16.4 BIOLOGICAL ASSESSMENT

This section includes: 1) an assessment of current status involving an adjustment of the initial base estimates to reflect recent improvements in mortality factors already implemented but not yet been evidenced in adult returns and 2) an assessment of prospective status involving benefits expected from planned actions. The biological assessments of upper Willamette salmonid populations are largely qualitative at this time due to a lack of biological data for many populations. In contrast to the interior Columbia River ESUs where good long-term data sets are available on most populations, data are limited to only a few lower upper Willamette populations and even that data are subject to a high degree of uncertainty. In particular, a high incidence of hatchery fish has confounded the ability to make accurate assessments of natural population abundance and productivity of many populations. As a result, stepwise quantitative analyses of incremental benefits of specific actions like those completed for interior ESUs, are not included herein, nor were they included in recovery plans.

Base Status is the historical status of the ESU or DPS, defined as the status of the population based on the *average* of quantitative survival metrics estimated from a time series of abundance data beginning in about 1980. For the most part, longer-term averages are used where available. In the biological assessment, this is the starting point, shown in the preceding section.

Current Status considers both beneficial and adverse actions already implemented but not yet biologically expressed. Survival benefits are expected from recently implemented changes in hydropower configuration and operation, tributary and estuarine habitat conditions, predation by birds and other fishes, hatchery operations, and harvest management changes relative to the base period. However, effects of these actions are obviously not reflected in the time series of survival data that for the most part started in 1980.

Prospective Status considers survival improvements expected from the hydrosystem, habitat, and predation, and hatchery changes included in the FCRPS Proposed RPA and Upper Snake River Proposed Action, as well as actions likely to be implemented by others.

This assessment assumes that future ocean and climate conditions will approximate the average conditions that prevailed during the 20 year base period used for our status assessments. For most populations, that period is about equivalent to the “recent” ocean period used by the Interior Columbia Basin TRT in its analyses. This period was characterized by relatively unproductive and extremely variable ocean conditions, which presumably contributed to poor early ocean survival of salmonids in most years. This subject is treated at greater length in the discussion of the effects of potential climate change in Appendix H.

16.4.1 Current Status

Over this period the action agencies have implemented multiple actions to improve fish survival relative to the base period prior to 2000. The percentage changes in lifecycle survival used in base-to-current adjustments are summarized in Table 16-5. Actions are summarized below. The most significant survival effects of actions since the base period involve harvest rate reductions in freshwater and ocean fisheries. This change has significantly increased spawning escapement relative to the base period. Actions have

Table 16-5. Estimated Survival Improvements (net) Used in the Base-to-Current Adjustment

	Habitat (tributary)	Habitat (estuary)	Predators (avian)	Predators (fish)	Hatchery	Harvest
Upper Willamette River Winter Steelhead	na[1]	0.3%	-0.3%	2%	N/A	0%

N/A = not available

been implemented in all factors but full benefits of these actions have not yet realized. This is particularly true for habitat actions whose affects accrue at the stream scale over long periods of time.

16.4.1.1 Tributary Habitat Survival Improvements

A wide variety of actions with the potential to improve critical habitats have been implemented in Willamette River subbasin tributaries since 2000, involving non-Federal and Federal parties. Actions range from beneficial land management practices through improvements in access through culvert replacement through fish reintroduction activities above nonfederal dams. Recently completed subbasin and recovery plans provide extensive guidance for these actions. Effects of many of these actions are expected to accrue over the long term, falling outside of the period addressed by this assessment. The magnitude of effects is uncertain and is expected to be addressed by monitoring activities and adaptive management.

16.4.1.2 Estuary Habitat Survival Improvements

Survival benefit for Upper Willamette River Steelhead (stream-type life history) associated with the specific actions discussed below was likely nominal. Action Agencies implemented habitat actions through 21 estuary habitat projects. Unrestricted fish passage and approximately 3 miles of access to quality habitat was provided by the following specific actions:[1]:

- Replaced three culverts with full-spanning bridges;
- Provided approximately 10 miles of improved tidal channel connectivity by installing a tide gate retrofit;
- Acquired approximately 473 acres of off-channel and riparian habitats;
- Restored and created 90 acres of marsh and tidal sloughs and approximately 100 acres of riparian forests;
- Protected approximately 55 acres of high-quality riparian and floodplain habitat; restored and preserved approximately 154 acres of off-channel habitat; protected 80 acres of high-value off-channel forested wetland habitat;
- Restored approximately 96 acres of tidal wetlands habitat by replacing undersized culvert that limited fish access;
- Conserved 155 acres of forested riparian and upland habitat; provided partial tidal channel reconnection by tide gate retrofit (acreage unknown at this time);
- Provided integrated pest management (purple loosestrife);
- Reconnected and restored 183 acres of historical floodplain by dike removal;

[1] A more thorough report detailing this evaluation process is *Estimated Benefits for Federal Agency Habitat Projects in the Lower Columbia River and Estuary* (PC Trask & Associates 2007), which is included in Appendix D to this document.

- Restored 25 acres of historical floodplain by breaching a dike.;
- Provided fish passage access to 6 miles of stream habitat by removal of two culverts and replacement with bridges;
- Restored 310 acres of native hardwood riparian forest, 200 acres of seasonally wet slough, and 155 acres of degraded riparian habitats;
- Increased circulation in approximately 92 acres of backwater and side-channel habitat by tide gate retrofit; and
- Improved embayment circulation for 335-plus acres of marsh/swamp and shallow-water and flats habitat, and preserved 35 acres of historical wetland habitat.

16.4.1.3 Predation Management Survival Improvements

Avian predation. The estimated change from baseline to current survival of Upper Willamette River Steelhead is -0.3 percent. This reflects a reduction in survival from the base-to-current condition, because the tern population was increasing over the base period. Averaging tern consumption of juvenile salmonids across the 20-year base period downplays the actual change in survival that resulted from relocating terns from Rice Island to East Sand Island in 1999. In 1999, tern consumption of juvenile salmonids was at its peak with an estimated 13,790,000 smolts consumed, compared to 8,210,000 in 2000 after relocation.

Piscivorous predation. The ongoing Northern Pikeminnow Management Program (NPMP) has been responsible for reducing predation related juvenile salmonid mortality since 1990. The northern pikeminnow has been responsible for approximately 8 percent predation-related mortality of juvenile salmonid migrants in the Columbia River Basin in the absence of the NPMP (2000 FCRPS BiOp at 9-106). The improvement in lifecycle survival attributed to the NPMP is estimated at 2 percent for migrating juvenile salmonids (Friesen and Ward 1999).

16.4.1.4 Hatchery Survival Improvements

Hatchery programs in the Upper Willamette River are currently subject to a series of comprehensive reviews for consistency with the protection and recovery of listed salmonids. A variety of changes to hatchery programs have already been implemented and additional changes are anticipated. The magnitude of effects is uncertain and is expected to be addressed by adaptive monitoring activities.

16.4.1.5 Harvest Survival Improvements

This assessment of status assumes a certain amount of annual take of natural adult fish based on recent harvest levels. Fishery impacts for Lower Columbia River Steelhead in combined ocean and freshwater fisheries are 10 percent. As requested in the Remand Collaboration, a sensitivity analysis showing the additional effects of more selective harvests that minimize take of natural adult fish is presented in Appendix A.

16.5 PROSPECTIVE STATUS

The prospective status is projected based expected survival improvements associated with actions in 2007 to 2009 and 2010 to 2017. Over this period the action agencies will implement multiple actions to improve fish survival relative to the current period. The percentage changes in lifecycle survival used in current-to-prospective adjustments are summarized in Table 16-6. Actions are summarized in the subsections below.

Table 16-6. Estimated Improvements in Survival Used in the Current-to-Prospective Adjustment

	Habitat (tributary)	Habitat (estuary)	Predators (avian)	Predators (fish)	Hatchery	Harvest
Upper Willamette River Steelhead						
2007 to 2009	N/A	1.4%	3.4%	1%	N/A	—
2010 to 2017	N/A	4.3%	—	—	N/A	—

N/A = not available

16.5.1 Tributary Habitat Survival Improvements

A wide variety of actions (e.g., floodplain restoration, instream complexing and off-channel habitat creation) with the potential to improve critical habitats are expected to be implemented in Willamette subbasin tributaries from 2007 through 2017, involving non-Federal and Federal parties. Recently completed subbasin and recovery plans provide extensive guidance for these actions. Effects of these actions are expected to accrue over the long term, but the magnitude of effects is uncertain and is expected to be addressed by adaptive monitoring activities and adaptive management.

16.5.2 Estuary Habitat Survival Improvements

2007 to 2009. Estimated survival benefit for steelhead associated with the specific actions discussed above is 1.4 percent. The Action Agencies' estimated benefit for 2007 is based on actions that are or will be underway in the very near-term. For 2008 and 2009, the Action Agencies estimated benefit is based on the increased funding level described in the FCRPS BA[2]. Action Agencies are or will be implementing multiple habitat actions through approximately 35 estuary habitat projects. Specific estuary habitat actions:

- Restore partial tidal influence and access to several acres (exact amount unknown at this time) by a tide gate retrofit;
- Improve hydrologic flushing and salmonid access to a lake (Sturgeon Lake is approximately 3,200 acres);
- Acquire and protect 40 acres of critical floodplain habitat and 40 acres riparian forest restoration;
- Install six to eight engineered log-jams that will help to slow flood flows, reduce erosion, contribute to sediment storage, enhance fish habitat, and contribute wood into the project area;
- Acquire and restore floodplain connectivity to 380 acres of off-channel rearing habitat for juveniles;
- Install fish friendly tide gates to increase tidal flushing and fisheries access to approximately 110 acres;
- Complete riparian planting of up to 210 acres;
- Re-establish hydrologic connectivity to reclaim and improve floodplain wetland functions, increase off-channel rearing and refuge habitat on 5 acres, plant native vegetation along shoreline, and reconstruct slough channels on 2.5 acres of annually inundated off-channel habitat;
- As part of a long-term 1,500 acre restoration effort: breaching a dike and re-establishing flow to portion of original channel, planting vegetation on 50 acres, removing invasive weeds on 180

[2] A more thorough report detailing this evaluation process is *Estimated Benefits for Federal Agency Habitat Projects in the Lower Columbia River and Estuary* (PC Trask & Associates 2007), which is included in Appendix D to this document.

acres, planting wetland scrub shrub on 45 acres, and controlling and removing invasive wetland plants on 45 acres;

- Retrofit a tide gate (acreage unknown at this time);
- Protect and restore approximately 5 to 10 acres of emergent wetland and riparian forest habitats;
- Reconnect 45 acres of floodplain by tide gate removal;
- Acquire 45 acres of floodplain with future dike removal;
- Reconnect 50 acres of floodplain;
- Acquire 320 acres of tidelands and 119 acres of riparian/upland forest; and
- Restore 30 acres of riparian habitat.

There will be approximately 15 to 20 additional projects and associated actions similar to actions listed above that are undergoing scoping and sponsor development (the number of projects and associated actions is based on the increased level of funding identified in the FCRPS BA).

2010 to 2017. Estimated survival benefit for steelhead associated with these actions is 4.3 percent. The action agencies estimated benefits for 2010 to 2017 are based on the increased funding level identified in the FCRPS BA. However the level of effort in this time period may increase depending on the outcome of a General Investigation study of Ecosystem Restoration opportunities, depending on Congressional appropriations, future funding scenarios and results of actions. Specific projects have yet to be identified, but actions for this period will be similar in nature to actions implemented in previous periods discussed above. Actions will include protection and restoration of riparian areas, protection of remaining high quality off-channel habitat, breaching or lowering dikes and levees to improve access to off-channel habitat, and reduction of noxious weeds, among others.

16.5.3 Predation Management Survival Improvements

Avian predation. Survival attributed to improved management of Caspian tern populations in the lower Columbia River mainstem are estimated at 3.4 percent for juvenile steelhead. The benefit is carried out to 2017 and beyond; there are no further actions, and therefore no further benefits. This improvement is expected to result through the reduction in estuary tern nesting habitat, and subsequent relocation of terns outside the Columbia River Basin. Although the base-to-currentshows a reduction in survival, the overall benefit (base to future) is positive.

Piscivorous predation. The percentage improvement in lifecycle survival attributable to the proposed continuation of the increase in incentives in the NPMP and resultant marginal increase in observed exploitation rate is estimated at 1 percent total from 2007-2017. This estimate was derived based on the difference between the estimated benefits from the base NPMP (defined as the period 1990 to 2003) and estimated survival benefits under the increased incentive program (defined as the period of 2004 to present). This rate would generally apply to all juvenile yearling and subyearling salmonids.

16.5.4 Hatchery Survival Improvements

Hatchery programs throughout the upper Willamette River region are currently subject to a series of comprehensive reviews for consistency with the protection and recovery of listed salmonids. A variety of changes to hatchery programs have already been implemented and additional changes are anticipated. The magnitude of effects is uncertain and is expected to be addressed by adaptive monitoring activities.

16.5.5 Harvest Survival Improvements

The assessment of status assumes a certain amount of annual take of natural adult fish based on current harvest levels. As requested in the Remand Collaboration, a sensitivity analysis showing the additional effects of more selective harvests that minimize take of natural adult fish is presented in Appendix A.

16.6 ADDITIONAL ACTIONS TO BENEFIT THE DPS

16.6.1 Other Reasonably Certain to Occur Actions

The State of Oregon in the context of the collaboration among the sovereigns has identified 117 statewide and a number of focused habitat-related actions and programs affecting the two upper Willamette River ESUs/DPSs (Chapter 17). Oregon's habitat actions address a series of strategies focused on protection and/or restoration of natural ecological processes; floodplains and riparian conditions and connections; fish passage; critical stream flow; water quality; stream habitat structure and complexity; and watershed conditions and processes. Key implementing bodies include counties; cities; the Oregon Departments of Agriculture, Forestry, Water Resources, State Lands, Fish and Wildlife, Environmental Quality, Land Conservation and Development; the Oregon Watershed Enhancement Board; Conservation Districts; local watershed councils; and private forest land owners.

In addition, Oregon has implemented or is planning on implementing a variety of actions and programs aimed at reducing or regulating harvest and hatchery impacts. Ongoing harvest actions have included mass marking of hatchery fish and institution of mark-selective fisheries for steelhead. Hatchery programs throughout the region are undergoing a comprehensive management review and a variety of changes are being implemented or are expected including elimination of hatchery releases in critical natural production areas, increased acclimation of hatchery fish to reduce straying, and integration of natural broodstock into hatchery management.

16.6.2 Salmon Recovery Plan

A wide suite of protection and restoration actions will be implemented throughout the upper Willamette region under the guidance of a Salmon Recovery Plan currently under development by State, Federal, and other parties. The Oregon recovery planning process is underway and an Oregon plan for this DPS is expected in 2007. The plan will contain regional strategies, measures, and actions that address limiting factors and threats for tributary habitat, estuary and lower mainstem habitat, hydropower, harvest, hatcheries, and ecological interactions. The institutional structure for plan implementation will involve oversight, implementation, and facilitation/coordination responsibilities. Key oversight bodies include NMFS, USFWS, tribal governments, the Oregon Department of Fish and Wildlife, and the Oregon Governor's Office. Implementation of the plan will include an adaptive management framework that involves checkpoints to assess action implementation, action effectiveness and threat reduction, and fish and habitat status. Observed progress will be evaluated against a series of benchmarks.

16.6.2.1 Other Federal Actions undergoing ESA Consultation

The separate ESA Section 7 consultation regarding continuing operation of the Willamette Project (i.e., 13 flood management and multi-purpose dams and reservoirs, and hatchery mitigation activities) will address the majority of Action Agency program effects on Upper Willamette River Steelhead. In comparison, effects associated with the FCRPS, which are limited to the lower Columbia River and estuary environments, are expected to be minor.

16.7 CONCLUSIONS

This DPS is currently threatened by a broad suite of habitat and ecological factors affecting all populations. The FCRPS Proposed RPA and Upper Snake River Proposed Action affect only that portion of the upper Willamette River Steelhead DPS lifecycle from when the juvenile fish exit the mouth of the Willamette River in their migration to the Pacific Ocean, and when the adults enter the mouth of the Columbia River to the mouth of the Willamette River. These impacts comprise only a very limited portion of the threats affecting these populations. With the diverse nature of impacts affecting this DPS, the future status depends on a coordinated effort by many Federal and non-Federal parties – through the current ESA consultation on the effects of the Corps' Willamette River projects, and recovery plan implementation. For instance, the Action Agencies' proposal for continued operation of the FCRPS has the potential to improve survival, productivity, and quality of critical habitat for Upper Willamette River Steelhead migrating and rearing in the Lower Columbia River and estuary through habitat restoration and predator management. Recent and planned non-FCRPS and FCRPS actions have improved status and are likely to result in continued improvements in the biological status of this DPS.

The available information on the status of populations within this DPS is not currently adequate to complete a systematic quantitative analysis of the adequacy of implemented and planned actions. The Remand Collaboration did not develop a method analogous to the Conceptual Framework for assessing the appropriate contribution of FCRPS effects to recovery of lower Columbia River ESUs. Because the available information on the status of populations within this DPS is not sufficient to complete a systematic quantitative analysis of the adequacy of implemented and planned actions as was done for the Interior Columbia River ESUs, our conclusions are based on a qualitative assessment of the prospect for survival and recovery of this DPS relying on best available information. We note that actions are being and will be implemented in the estuary to address multiple threat sectors.

The Action Agencies have worked with the states and Tribes through the Remand Collaboration Process and other forums to identify actions intended to address the needs of listed salmon and steelhead as determined by quantitative and qualitative biological analyses. Acknowledging that NMFS will review the actions and the effects analyses contained herein to make a final jeopardy determination in the forthcoming biological opinions, the Action Agencies are making the following conclusions. Based on our assessment of the FCRPS and Upper Snake River actions and analysis of effects, considering the present and future human and natural context, the Action Agencies conclude that the net effects of the proposed actions, including the existence and operations of the dams with the proposed mitigation, meet or exceed the objectives of doing no harm and contributing to recovery with respect to this DPS.

Chapter 17
Cumulative Effects

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (CONTINUED)

ACRONYMS AND ABBREVIATIONS

BiOp	Biological Opinion
BMPs	Best Management Practices
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FCRPS	Federal Columbia River Power System
RPA	Reasonable and Prudent Alternative
WRIA	Water Resource Inventory Area

17. CUMULATIVE EFFECTS

17.1 INTRODUCTION

Cumulative effects, as defined in 50 CFR Section 402.02, "are those effects of future state or private activities, not involving Federal activities that are reasonably certain to occur within the action area." Future Federal actions require separate consultations pursuant to Section 7 of the Endangered Species Act (ESA) and are considered separately.

A broad-based recovery effort for Evolutionarily Significant Unit (ESU)-listed salmon and steelhead is underway in the Columbia River Basin and recovery plans are being developed with extensive State and Tribal participation. The States and Tribes participating in the Biological Opinion (BiOp) Remand Collaboration Process are implementing a range of salmon restoration and recovery activities. All parties to the Remand Process wanted to identify and account for those State and Tribal actions Therefore, the BiOp Remand framework provided that the effects of the Proposed Reasonable and Prudent Alternative (RPA) (Step 5a) would be combined with the effects of the non-Federal actions (Step 5b), or the cumulative effects. Step 6 of the Remand framework was a determination by the parities of the certainty of implementation of these actions, referred to as reasonably certain to occur non-Federal actions.

As a part of the BiOp Remand Collaboration Process, the States of Washington, Oregon, and Idaho provided extensive information on their recovery actions that were reasonably certain to occur in areas where ESA-listed salmonids affected by the Federal Columbia River Power System (FCRPS) are present. The Action Agencies have evaluated this information and included the qualitative effects of these reasonably certain to occur actions in the biological analyses for each of the affected ESUs.

17.2 REASONABLY CERTAIN TO OCCUR NON-FEDERAL PROJECTS

The following presents each sovereign's information. Tables 17-1 through 17-6 list various ongoing and future existing or expected projects in the States of Idaho, Washington, and Oregon that are reasonably certain to occur and will likely positively affect recovery efforts in the FCRPS. These mainly include non-Federal actions involving, for example, fish passage improvements, habitat restoration, screening of water supply intakes, Best Management Practices (BMPs), water quality improvements, and culvert replacement.

17.2.1 State of Idaho

The State of Idaho has separated its projects into three categories:

- Screening Program
- State Habitat Projects
- Projects on Private Lans

Screening Program. In Tables 17-1a and 17-1b, existing or expected projects are presented for two periods:

- 2000 to 2006
- 2007 to 2009

State Habitat Projects. In Tables 17-2a through 17-2j, the State presents projects involving habitat-related activities. These are presented for the following areas:

- East Fork Salmon River (Table 17-2a)
- Lemhi River (Table 17-2b)
- Little Salmon River (Table 17-2c)
- Lolo Creek (Table 17-2d)
- Lower Clearwater River (Table 17-2e)
- Pahsimeroi River (Table 17-2f)
- Lower Mainstem Salmon River (Table 17-2g)
- Upper Mainstem Salmon River (Table 17-2h)
- South Fork Clearwater River (Table 17-2i)
- Valley Creek (Table 17-2j)

Projects on Private Lands. In Tables 17-3a and 17-3b, the State presents information on projects involving private lands in the following areas:

- Mountain Snake Province Clearwater Subbasin (Table 17-3a)
- Mountain Snake Province Salmon Subbasin (Table 17-3b)

17.2.2 State of Washington

The State of Washington has identified existing and expected projects for each of the subbasins that likely affect salmon or steelhead in the FCRPS (Tables 17-4a through 17-4n). This series of tables includes the following subbasins:

- Asotin Subbasin (Table 17-4a)
- Columbia Gorge (Tributaries) and Little White Salmon Subbasins (Table 17-4b)
- Entiat Subbasin (Table 17-4c)
- Klickitat Subbasin (Table 17-4d)
- Methow Subbasin (Table 17-4e)
- Yakima Subbasin - Lower Yakima Water Resource Inventory Area (WRIA) 37 (Table 17-4f)
- Yakima Subbasin - Naches WRIA 38 (Table 17-4g)
- Yakima Subbasin - Upper Yakima WRIA 39 (Table 17-4h)
- Okanogan Subbasin (Table 17-4i)
- Tucannon Subbasin (Table 17-4j)
- Walla Walla Subbasin (Table 17-4k)
- Washougal Subbasin (Table 17-4l)
- Wenatchee Subbasin (Table 17-4m)

- Wind Subbasin (Table 17-4n)

17.2.3 State of Oregon

The State of Oregon presents the existing or reasonably expected to occur information in two ways:

- Comprehensive Programs
- Specific Habitat Strategies

Comprehensive Programs. The State of Oregon has identified comprehensive State and Federal programs that are likely to positively affect salmon and steelhead recovery efforts in the FCRPS (Table 17-5) (Oregon Department of Fish and Wildlife [ODFW] 2006)[1]. These are described by recovery area, population, limiting factor/effect on fish or habitat, management strategy, agency and program.

Habitat Management. In a second series of tables, the State describes specific habitat management strategies and actions that exist or will be conducted that will likely positively affect salmon and steelhead in the FCRPS. These are presented by river system (Tables 17-6a through 17-6h) and include a summary of the overall primary limiting factors and primary threats. River systems include:

- Deschutes River (Table 17-6a)
- Fifteenmile Creek (Table 17-6b)
- Middle John Day River (Table 17-6c)
- North Fork John Day River (Table 17-6d)
- South Fork John Day River (Table 17-6e)
- Umatilla River (Table 17-6f)
- Walla Walla River (Table 17-6g)
- Upper Mainstem John Day River (Table 17-6h)

All of these involve habitat management or other recovery efforts for tributary steelhead populations.

17.3 PRIVATE, LOCAL, STATE, AND TRIBAL ACTIONS

There are a wide range of actions by non-Federal parties that have, and will continue to impact ESA listed salmonids in the Columbia River Basin. These actions, performed by a variety of private parties, local, State, and Tribal governments, will have both positive and detrimental impacts. The diversity represented geographically, as well as politically, throughout the region makes the cumulative effects of these non-Federal actions highly unpredictable and very difficult to assess. As the population of the Pacific Northwest continues to increase, the quantity and magnitude of these effects will likely continue to increase as well. While State, Tribal, and many local governments have developed many programs to benefit ESA-listed salmonids in the Columbia River Basin, the overall impact of these actions remain difficult to quantify.

[1] Note: the reader is referred to the source document (ODFW 2006) for full references for the citations in Tables 17-5 and 17-6.a through 17-6h.

Table 17-1a. State of Idaho Screen Program Projects that May Affect Salmon and Steelhead Recovery Efforts in the FCRPS. Completed Projects 2000-2006

Species (ESU / DPS)	Population (Geographic Scale/Area)	Fish Screen Name	Estimated Timing of Action	Fish Screen Type	Funding Status (Existing and/or Expected)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Responsible Entity(ies)	Funding Source(s)
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	East Fork Salmon River Populations	SEF-04	2001	3 Bay, 30" by 12', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	East Fork Salmon River Populations	SEF-10/11	2001	2 Bay, 30" by 10', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	East Fork Salmon River Populations	SEFHC-03	2001	1 Bay, 30" by 12', PW Drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	East Fork Salmon River Populations	SEF-18A	2002	1 Bay, 2' by 10', solar drum, 14 DEG	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	East Fork Salmon River Populations	SEFHCLC-01	2002	1 Bay Modular, PW	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	East Fork Salmon River Populations	SEFBBC-01	2003	1 BAY, 18" by 12', PW DRUM	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	East Fork Salmon River Populations	SEFBBC-02	2003	2 BAY, 18" by 12', PW DRUM	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	East Fork Salmon River Populations	SEF-15	2006	POD - flat plate wipper	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS

Table 17-1a. State of Idaho Screen Program Projects that May Affect Salmon and Steelhead Recovery Efforts in the FCRPS. Completed Projects 2000-2006

Species (ESU / DPS)	Population (Geographic Scale/Area)	Fish Screen Name	Estimated Timing of Action	Fish Screen Type	Funding Status (Existing and/or Expected)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Responsible Entity(ies)	Funding Source(s)
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	East Fork Salmon River Populations	SEF-17	2005	2 Bay, 24" by 10', PW Drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	East Fork Salmon River Populations	SEF-18	2005	1 Bay, 24" by 10', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	L-30	2000	4 Bay, 3' by 12', PW Drums	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	L-43	2000	1 Bay, 24" by 12', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	L-43C	2000	*Bubbler intake for pump	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	L-30A	2001	1 Bay, 24" by 12', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	L-43B	2001	1 Bay, 24" by 12', PW Drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	LHCEF-01	2001	2 Bay, 24" by 8', PW Drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS

Table 17-1a. State of Idaho Screen Program Projects that May Affect Salmon and Steelhead Recovery Efforts in the FCRPS. Completed Projects 2000-2006

Species (ESU / DPS)	Population (Geographic Scale/Area)	Fish Screen Name	Estimated Timing of Action	Fish Screen Type	Funding Status (Existing and/or Expected)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Responsible Entity(ies)	Funding Source(s)
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	L-18Mi	2002	2 Bay, 24" by 12, PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	LSC-02	2002	1 Bay, 24" by 6' Modular, PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	L-13	2003	3 Bay, 30" by 12', PW Drums	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	L-35A	2003	POD solar	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	L-43A	2003	1 Bay, 30" by 12', PW Drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	L-46/46A	2005	3 Bay, 30" by 12', PW Drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	LBC-03	2005	1 Bay, 42" by 12', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	LBC-04	2005	1 Bay, 36" by 10', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS

Table 17-1a. State of Idaho Screen Program Projects that May Affect Salmon and Steelhead Recovery Efforts in the FCRPS. Completed Projects 2000-2006

Species (ESU / DPS)	Population (Geographic Scale/Area)	Fish Screen Name	Estimated Timing of Action	Fish Screen Type	Funding Status (Existing and/or Expected)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Responsible Entity(ies)	Funding Source(s)
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	LBC-05	2005	1 Bay, 24" by 10, PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	LKC-03	2005	POD - Brush drum solar	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	LBC-06	2006	1 Bay, 30" by 12', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	LKC-02	2006	1 Bay, 36" by 12', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	S-04A	2000	Modular, 2.5' by 6', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	S-09	2001	4 Bay, 42" by 14', PW drums	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lemhi River Populations	S-02	2002	6' by 24" modular	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Pahsimeroi River Populations	PBSC-03	2002	3 Bay, 36" by 10', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS

Table 17-1a. State of Idaho Screen Program Projects that May Affect Salmon and Steelhead Recovery Efforts in the FCRPS. Completed Projects 2000-2006

Species (ESU / DPS)	Population (Geographic Scale/Area)	Fish Screen Name	Estimated Timing of Action	Fish Screen Type	Funding Status (Existing and/or Expected)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Responsible Entity(ies)	Funding Source(s)
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Pahsimeroi River Populations	PBSC-05	2002	1 Bay, 18" by 12', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Pahsimeroi River Populations	P-06	2003	2 Bay, 24" by 12', PW drums	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Pahsimeroi River Populations	PBSC-04	2003	1 Bay, 24" by 12', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Pahsimeroi River Populations	PBSC-06	2003	12" by 10' Wiper screen/solar	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Pahsimeroi River Populations	PBSC-07/08	2003	3 Bay. 30" by 12', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Pahsimeroi River Populations	P-12	2004	1 Bay new screen	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Pahsimeroi River Populations	P-01A	2005	12" by 8', POD screen, solar, wiper	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	S-10	2000	4 Bay, 42" by 14', PW Drums V-Scrn	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS

Table 17-1a. State of Idaho Screen Program Projects that May Affect Salmon and Steelhead Recovery Efforts in the FCRPS. Completed Projects 2000-2006

Species (ESU / DPS)	Population (Geographic Scale/Area)	Fish Screen Name	Estimated Timing of Action	Fish Screen Type	Funding Status (Existing and/or Expected)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Responsible Entity(ies)	Funding Source(s)
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	S-25/27/30/32	2000	8 Bay, 72" by 14', PW drums	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	S-26/28/29	2000	8 Bay, 78" by 14', PW drums	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	S-13/14	2001	8 Bay, 48" by 12' PW drums VEE	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	S-17	2001	1 Bay, 30" by 12', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	S-11	2002	4 Bay, 42" by 14', PW drums	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	S-12	2002	3 Bay, 42" by 10', PW drums	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	S-33	2002	1 Bay, 30" by 12', PW Drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	SChaCEC-01	2002	POD installed by irrigator	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS

Table 17-1a. State of Idaho Screen Program Projects that May Affect Salmon and Steelhead Recovery Efforts in the FCRPS. Completed Projects 2000-2006

Species (ESU / DPS)	Population (Geographic Scale/Area)	Fish Screen Name	Estimated Timing of Action	Fish Screen Type	Funding Status (Existing and/or Expected)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Responsible Entity(ies)	Funding Source(s)
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	SChaC-09	2003	1 Bay, modular	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	SChaC-03	2004	1 Bay, 30" by 12', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	SChaC-08	2004	4 Bay, 42" by 14" PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	SChaC-08A	2004	POD	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	SChaC-01	2005	1 Bay, wiper/solar	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	SChaC-02	2005	1 Bay, 24" by 12', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	SChaC-11	2005	1 Bay, 18" by 6', Modular	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	SChaC-13	2005	1 Bay, 18" by 6', Modular	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS

Table 17-1a. State of Idaho Screen Program Projects that May Affect Salmon and Steelhead Recovery Efforts in the FCRPS. Completed Projects 2000-2006

Species (ESU / DPS)	Population (Geographic Scale/Area)	Fish Screen Name	Estimated Timing of Action	Fish Screen Type	Funding Status (Existing and/or Expected)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Responsible Entity(ies)	Funding Source(s)
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	SChaC-04	2006	POD - solar flat plate wiper	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	SMC-04/05	2001	1 Bay modular, 24" by 8', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	SMC-06	2001	1 Bay modular, 24" by 6', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	SMC-07	2001	I Bay POD, 16" by 6', Headgate/Solar	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	SMC-01/03	2002	1 Bay, 30" by 12', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	SSC-01	2006	2 Bay, 24" x 10" PW	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	SSC-02	2004	POD Wiper screen/solar	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	SSC-04	2004	1 Bay, 24" by 6', Modular	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS

Table 17-1a. State of Idaho Screen Program Projects that May Affect Salmon and Steelhead Recovery Efforts in the FCRPS. Completed Projects 2000-2006

Species (ESU / DPS)	Population (Geographic Scale/Area)	Fish Screen Name	Estimated Timing of Action	Fish Screen Type	Funding Status (Existing and/or Expected)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Responsible Entity(ies)	Funding Source(s)
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	SSC-05	2004	1 Bay, 18" by 6', Modular	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	SSC-01	2006		Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River Populations (SRLMA)	STMC-02	2004	1 Bay Solar POD wiper	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River- Valley Creek Populations	SVCEC-02	2001	1 Bay, Modular, 24" by 6', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River- Valley Creek Populations	SVCIC-03	2001	I Bay, Modular, 24"' by 6', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River- Valley Creek Populations	SVCIC-04/05/06	2001	1 Bay, 30" by 12', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Salmon River- Valley Creek Populations	SVCIC-02	2005	1 Bay 6' Modular	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Upper Salmon River Populations	S-41 BD	2002		Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS

Table 17-1a. State of Idaho Screen Program Projects that May Affect Salmon and Steelhead Recovery Efforts in the FCRPS. Completed Projects 2000-2006

Species (ESU / DPS)	Population (Geographic Scale/Area)	Fish Screen Name	Estimated Timing of Action	Fish Screen Type	Funding Status (Existing and/or Expected)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Responsible Entity(ies)	Funding Source(s)
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Upper Salmon River Populations	S-41	2003	1 Bay, 1-' by 24" solar drums	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Upper Salmon River Populations	S4THJC-01	2002	1 Bay, 24" by 12', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Upper Salmon River Populations	S4THJC-02	2002	Modular, 1 Bay, 24" by 10', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Upper Salmon River Populations	S4THJC-03	2002	Modular, 2 Bay, 24" by 8', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Upper Salmon River Populations	SChC-01	2003	1 Bay, Modular	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Upper Salmon River Populations	SChC-02/5	2004	1 Bay, 24" by 12', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Upper Salmon River Populations	SGC-04	2003	1 Bay Modular, 18" by 6'	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Upper Salmon River Populations	SWC-01/02	2000	Modular	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS

Table 17-1a. State of Idaho Screen Program Projects that May Affect Salmon and Steelhead Recovery Efforts in the FCRPS. Completed Projects 2000-2006

Species (ESU / DPS)	Population (Geographic Scale/Area)	Fish Screen Name	Estimated Timing of Action	Fish Screen Type	Funding Status (Existing and/or Expected)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Responsible Entity(ies)	Funding Source(s)
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Upper Salmon River Populations	SWmC-01	2000	Passive perf plate	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lower Salmon River Populations	LSRR-03	2004	1 Bay, 24" by 10', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	Lower Salmon River Populations	LSRRSC-01	2006	Modular, 1 Bay, 24" by 6', PW drum	Existing	Fish Screening	Fish Passage, Entrainment	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS

Table 17-1b. State of Idaho Screen Program Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS: Anticipated Projects 2007-2009

Species(ESU / DPS)	Population (Geographic Scale/Area)	Fish Screen Name	Estimated Timing of Action	Project Type	Funding Status (Existing and/or Expected)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Responsible Entity(ies)	Funding Source (s)
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**East Fork Salmon River Populations**	East Fork Fish Screen Access Bridge	2007 to 2009	Bridge	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**East Fork Salmon River Populations**	SEF-13	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**East Fork Salmon River Populations**	SEF-14	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**East Fork Salmon River Populations**	SEF-16/16A	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Lemhi River Populations**	Big Timber Creek Culvert Project	2007 to 2009	Replace Culvert	Expected	Fish Passage	Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Lemhi River Populations**	Big Timber Creek Screening Project	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Lemhi River Populations**	Carmen Creek Water Conservatio	2007 to 2009	Pipeline	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Lemhi River Populations**	LBTC-02 Screen Project	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS

Table 17-1b. State of Idaho Screen Program Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS: Anticipated Projects 2007-2009

Species(ESU / DPS)	Population (Geographic Scale/Area)	Fish Screen Name	Estimated Timing of Action	Project Type	Funding Status (Existing and/or Expected)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Responsible Entity(ies)	Funding Source (s)
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Lemhi River Populations**	LBTC-02 Water Conservation	2007 to 2009	Pipeline	Expected	Conveyance improvements	Fish Passage, dewatering	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Lemhi River Populations**	LWC-02	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Lemhi River Populations**	LWC-04	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Lemhi River Populations**	LWC-05	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Lemhi River Populations**	SCCFC-01	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Lemhi River Populations**	SCCFC-02	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Lemhi River Populations**	Upper Carmen Creek Project	2007 to 2009	Sprinkler	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Lemhi River Populations**	Wimpey Creek Fish Passage	2007 to 2009	Remove or Install Diversion	Expected	Improve diversions to provide fish passage	Fish passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS

Table 17-1b. State of Idaho Screen Program Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS: Anticipated Projects 2007-2009

Species(ESU / DPS)	Population (Geographic Scale/Area)	Fish Screen Name	Estimated Timing of Action	Project Type	Funding Status (Existing and/or Expected)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Responsible Entity(ies)	Funding Source (s)
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Lemhi River Populations**	Wimpey Creek Fish Screening Project	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Middle Fork Salmon River - Marsh Creek Population**	SMFMCKC-01	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Middle Fork Salmon River - Marsh Creek Population**	SMFMCKC-02	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Pahsimeroi River Populations**	Big Springs Creek Fish Passage	2007 to 2009	Remove or Install Diversion	Expected	Provide fish passage	Fish passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Pahsimeroi River Populations**	Big Springs Creek Screen Access	2007 to 2009	Bridge	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Pahsimeroi River Populations**	P-13 Project	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Pahsimeroi River Populations**	P-9 Elimination Project	2007 to 2009	Pipeline	Expected	Conveyance improvements	Fish Passage, dewatering	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Pahsimeroi River Populations**	PBSC-03A	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS

Table 17-1b. State of Idaho Screen Program Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS: Anticipated Projects 2007-2009

Species(ESU / DPS)	Population (Geographic Scale/Area)	Fish Screen Name	Estimated Timing of Action	Project Type	Funding Status (Existing and/or Expected)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Responsible Entity(ies)	Funding Source (s)
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Pahsimeroi River Populations**	PBSC-09	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Salmon River Populations (SRLMA)**	Bayhorse Project Phase I	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Salmon River Populations (SRLMA)**	Bayhorse Project Phase II	2007 to 2009	Remove or Install Diversion	Expected	Improve diversions to provide fish passage	Fish passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Salmon River Populations (SRLMA)**	Bayhorse Project Phase III	2007 to 2009	Sprinkler	Expected	Conveyance improvements	Fish passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Salmon River Populations (SRLMA)**	Challis Lowline Canal Consolidati	2007 to 2009	Bifurcation Structure & Sprinkler System	Expected	Conveyance improvements	Fish passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Salmon River Populations (SRLMA)**	Cow Creek Screen Project	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Salmon River Populations (SRLMA)**	Iron Creek Screening Project	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Salmon River Populations (SRLMA)**	SBC-03	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS

Table 17-1b. State of Idaho Screen Program Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS: Anticipated Projects 2007-2009

Species(ESU / DPS)	Population (Geographic Scale/Area)	Fish Screen Name	Estimated Timing of Action	Project Type	Funding Status (Existing and/or Expected)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Responsible Entity(ies)	Funding Source (s)
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Salmon River Populations (SRLMA)**	SBCC-01	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Salmon River Populations (SRLMA)**	STC-01 Screen Project	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Salmon River-Panther Creek Populations**	Panther Creek Project Phase I	2007 to 2009	Remove or Install Diversion	Expected	Fish Screening	Fish passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Upper Salmon River Populations**	Fourth of July Creek Screening Project	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Upper Salmon River Populations**	Fourth of July Creek Water Conservatio	2007 to 2009	Pipeline	Expected	Conveyance improvements	Fish Passage, dewatering	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Upper Salmon River Populations**	Freeman Creek Passage Project	2007 to 2009	Remove or Install Diversion	Expected	Improve diversions to provide fish passage	Fish passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Upper Salmon River Populations**	SChC-04	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Upper Salmon River Populations**	SSmC-01	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS

Table 17-1b. State of Idaho Screen Program Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS: Anticipated Projects 2007-2009

Species(ESU / DPS)	Population (Geographic Scale/Area)	Fish Screen Name	Estimated Timing of Action	Project Type	Funding Status (Existing and/or Expected)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Responsible Entity(ies)	Funding Source (s)
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Upper Salmon River Populations**	SVCGC-03	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Upper Salmon River Populations**	SVCGC-04	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS
Snake River Spr/Sum Chinook Salmon, Snake River Summer Steelhead	**Upper Salmon River Populations**	SVCGC-05/6	2007 to 2009	Fish Screen	Expected	Fish Screening	Entrainment, Fish Passage	Increase Survival, Production	IDFG Anadromous Fish Screen Program	BPA, NMFS

Table 17-2a. State of Idaho Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recover Efforts in the FCRPS – East for Salmon River

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Existing and/or Expected)	Responsible Entity(ies)	Funding Source(s)
Snake River spring/summer Chinook salmon	East Fork Spring Chinook salmon	Fish Passage improvement (3 projects)	Fish Passage	Improve conditions for migrating fish	2003-2005	Existing	Custer Soil and Water Conservation District	OSC-PCSRF BPA BOR
		Fish Passage improvement Barrier removal (1 project)	Fish Passage	Remove barriers that prevent or delay fish migration	2003	Existing	Custer Soil and Water Conservation District	BPA
		Riparian Habitat Improvement (6 projects)	Degraded Riparian Habitat (increased temperature and sedimentation)	Decreases sedimentation and stabilizes temperatures by improving riparian habitat	2000-2004	Existing	Custer Soil and Water Conservation District	BPA

Table 17-2b. State of Idaho Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Lemhi River

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Existing and/or Expected)	Responsible Entity(ies)	Funding Source(s)
Snake River spring/summer Chinook salmon	Lemhi Spring Chinook salmon	Riparian Habitat Improvement (12 projects)	Degraded Riparian Habitat (increased temperature and sedimentation)	Decreases sedimentation and stabilizes temperatures by improving riparian habitat to improve rearing /migration survival	2000-2006	Existing	Lemhi Soil and Water Conservation District Idaho Dept of Fish and Game	BPA OSC-PCSRF NRCS
		Big Timber Creek reconnect with the Lemhi River (5 projects)	Fragmented Habitat Fish Passage	Removes fish barriers and provides flow for fish passage in a previously dewatered segment to allow fish to access previously unavailable high quality spawning and rearing habitat	2006-2008	Existing Expected	Idaho Dept of Fish and Game Lemhi Soil and Water Conservation District	OSC-PCSRF BPA
		Upper Lemhi Flow Improvement	Channelized Reach Degraded Stream Habitat	Provides flow in upper Lemhi River to improve spawning and rearing habitat for anadromous fish to increase egg to smolt survival	2008	Expected	Lemhi Soil and Water Conservation District Idaho Dept of Fish and Game	OSC-PCSRF

Table 17-2b. State of Idaho Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Lemhi River

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Existing and/or Expected)	Responsible Entity(ies)	Funding Source(s)
		Fish Passage improvement (8 projects)	Fish passage	Remove barriers that prevent or delay fish migration to increase migration survival	2000-2006	Existing	Lemhi Soil and Water Conservation District	BPA
		Barrier Removal (1 project)	Fish Passage	Removes a barrier to fish migration in Canyon Creek	2001	Existing	Lemhi Soil and Water Conservation District	BPA
		Instream Flow Enhancement (1 project)	Fish Passage Degraded Stream Habitat	Improves flow in the Lower Lemhi River to improve rearing and migration survival	2007	Expected	Lemhi Soil and Water Conservation District	OSC-PCSRF
		Instream Habitat Improvement (3 projects)	Degraded Stream Habitat	improves spawning and rearing conditions by increasing stream channel complexity	2000-2004	Existing	Lemhi Soil and Water Conservation District Idaho Transportation Department	Idaho Transportation Department USFWS-PFW (Partners for Fish and Wildlife) BPA
		Irrigation diversion management (1 project)	Fish passage	improve fish passage by modifying irrigation diversions	2006	Existing	Lemhi Soil and Water Conservation District	BPA

Table 17-2b. State of Idaho Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Lemhi River

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Existing and/or Expected)	Responsible Entity(ies)	Funding Source(s)
		Water Quality improvement (3 projects)	Water Quality	Fencing feed lots to reduce organic inputs and sedimentation to increase spawning and rearing survival	2001	Existing	Lemhi Soil and Water Conservation District	BPA WQPA

Table 17-2c. State of Idaho Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Little Salmon River

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Existing and/or Expected)	Responsible Entity(ies)	Funding Source(s)
Snake River Steelhead	Little Salmon River (Rapid River) 1, 2	Fish screen and diversion improvement	Fish passage and streamflow	Reduce juvenile entrainment	Complete	Existing-done	Idaho SWCD	PCSRF, SCC, Mitchell Act, IDFG in-kind
	Little Salmon River (Squaw Creed) 3, 4	Diversion improvement, culvert replacement, streambed gradient improvement	Fish passage and streamflow	Reduce juvenile entrainment and increase juvenile rearing	Complete	Existing-done	Niggins City and Idaho County	PCSRF, NOAA, IFWF, IDFG and Idaho County in-kind
	Little Salmon River (Race Creek) 5	Convert flood irrigation to sprinkler	Fish passage and streamflow	Reduce juvenile entrainment and increase juvenile rearing	Proposed late 2007?	Expected-Grant application submitted	Idaho SWCD	PCSRF, SCC, IDFG in-kind, SCC FRIMA

Table 17-2d. State of Idaho Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Lolo Creek

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Existing and/or Expected)	Responsible Entity(ies)	Funding Source(s)
Snake River Steelhead	Lolo Creek	Improve animal feeding operation	Sediment, temperature, nutrients	Increase juvenile survival Reduce sedimentation Expand spawning grounds	10-15 years	Existing	Clearwater SWCD	Div II AFO:319, SCC, Landowner

Table 17-2e. State of Idaho Existing or Expected Habitat Projects that may Affect salmon and Steelhead Recovery Efforts in the FCRPS – Lower Clearwater River

Species(ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Existing and/or Expected)	Responsible Entity(ies)	Funding Source(s)
Snake River Steelhead	Lower mainstem Clearwater (Big Canyon Drainage)	Upland/riparian improvement BMP actions, fencing 1,2,3	Sediment, temperature	Reduce sedimentation Increase bank stability	20 to 25 years	Existing	Nez Perce SWCD, Nez Perce Tribe	SCC, BPA
	Lower mainstem Clearwater	Upland BMP actions 4	Nutrients	Reduce sedimentation	5 to 10 years	Existing	Lewis SWCD	WQPA SCC
	Lower mainstem Clearwater (Jim Ford Creek)	Upland/ riparian improvement BMP actions 7	Sediment, nutrients, temperature	Reduce sedimentation Reduce summer water temperature	10 to 15 years	Existing	Clearwater SWCD	WQPA SCC
	Lower mainstem Clearwater (Lapwai Creek)	Upland/riparian improvement BMP actions, fencing 8,9	Sediment, temperature, nutrients	Increase bank stability Reduce sedimentation	10 to 15 years	Existing	Nez Perce SWCD, Nez Perce Tribe	BPA

Table 17-2e. State of Idaho Existing or Expected Habitat Projects that may Affect salmon and Steelhead Recovery Efforts in the FCRPS – Lower Clearwater River

Species(ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Existing and/or Expected)	Responsible Entity(ies)	Funding Source(s)
	Lower mainstem Clearwater (multiple operations in Potlatch River, Lapwai Creek, Jim Ford Creek, Lawyer Creek)	Improve animal feeding operation 10,11,13,14, 20, 21	Sediment, temperature, nutrients	Reduce sedimentation	10 to 15 years	Existing	Latah, Lewis SWCD	Landowner, Div. II, AFO:319, SCC
	Lower mainstem Clearwater (Potlatch River in Corral Creek and Little Potlach Creek)	Riparian planting 18, 19	Sediment, temperature, base streamflow	Reduce summer water temperatures Increase bank stability	10 to 15 years	Existing	Latah SWCD	PCSRF
	Lower mainstem Clearwater (Little Canyon Creel of Big Canyon Creek)	Upland/ riparian planting, grade stabilization 22, 23, 24, 25, 26, 27, 28, 29, 30, 31,32,33,34	Sediment, temperature, streamflow	Reduce summer water temperatures Increase bank stability	10 to 15 years	Existing	Lewis SWCD	BPA

Table 17-2e. State of Idaho Existing or Expected Habitat Projects that may Affect salmon and Steelhead Recovery Efforts in the FCRPS – Lower Clearwater River

Species(ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Existing and/or Expected)	Responsible Entity(ies)	Funding Source(s)
	Lower mainstem Clearwater (Potlatch River	Riparian planting/fencing BMP 8,9,18,19 (07-09 project 17)	Sediment, temperature, streamflow	Increase baseflow Reduce summer water temperatures Increase bank stability	10 to 20 years	Expected/existing	Latah SWCD	BPA

Table 17-2f. State of Idaho Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Pahsimeroi River

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Existing and/or Expected)	Responsible Entity(ies)	Funding Source(s)
Snake River spring/summer Chinook salmon	Pahsimeroi summer Chinook salmon	Fish Passage improvement (5 projects)	Fish Passage	Remove barriers that prevent or delay fish migration	2003-2004	Existing	Custer Soil and Water Conservation District	BPA IDFG
		Instream Flow enhancement (1 project)	Degraded Stream habitat Instream flow	Improves spawning and rearing habitat by enhancing flow	2003	Existing	Custer Soil and Water Conservation District	BPA
		Irrigation diversion management (1 project)	Fish Passage	Improves fish passage and spawning habitat	2000	Existing	Custer Soil and Water Conservation District	IDFG BPA
		Riparian Habitat Improvement (6 projects)	Degraded Riparian Habitat (increased temperature and sedimentation)	Decreases sedimentation and stabilizes temperatures by improving riparian habitat	2003-2005	Existing	Custer Soil and Water Conservation District	BPA OSC-PCSRF
		Water Quality Improvement (2 projects)	Degraded Stream Habitat	Stabilize stream banks and improve riparian habitat to enhance spawning habitat	2005	Existing	Custer Soil and Water Conservation District	BPA

Table 17-2g. State of Idaho Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Lower Mainstem Salmon River

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Existing and/or Expected)	Responsible Entity(ies)	Funding Source(s)
Snake River spring/summer Chinook salmon	SRLMA Chinook salmon	Fish Passage Improvement (6 projects)	Fish Passage	Improve fish passage and enhance instream flow	2003	Existing	Custer Soil and Water Conservation District Lemhi Soil and Water Conservation District	BPA IDFG Screen Program NRCS Salmon River Coalition
		Irrigation Diversion Management (2 projects)	Fish Passage	Improve fish passage using fishways	2001-2002	Existing	Lemhi Soil and Water Conservation District	BPA IDFG Screen Program NRCS
		Riparian Habitat Improvement (11 projects)	Degraded Riparian Habitat (increased temperature and sedimentation)	Decreases sedimentation and stabilizes temperatures by improving riparian habitat	2003	Existing	Lemhi Soil and Water Conservation District Custer Soil and Water Conservation District	BPA NOAA Fisheries USFWS
		Iron Creek Reconnect with the Salmon River	Fish Passage Degraded Instream Habitat Degraded Riparian Habitat (increased temperature and sedimentation)	Removes fish barriers and provides flow for fish passage in a previously dewatered segment to allow fish to access previously unavailable spawning and rearing habitat	2005	Existing	Lemhi Soil and Water Conservation District	BPA

Table 17-2h. State of Idaho Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Upper Mainstem Salmon River

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Existing and/or Expected)	Responsible Entity(ies)	Funding Source(s)
Snake River spring/summer Chinook salmon	SRUMA Chinook salmon	Riparian Habitat Improvement (4 projects)	Degraded Riparian Habitat (increased temperature and sedimentation)	Decreases sedimentation and stabilizes temperatures by improving riparian habitat	2001, 2005	Existing	Custer Soil and Water Conservation District	BPA

Table 17-2i. State of Idaho Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – South Fork Clearwater River

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Existing and/or Expected)	Responsible Entity(ies)	Funding Source(s)
Snake River Steelhead	South Fork Clearwater River (Cottonwood Creek)	Upland/ riparian improvement BMP actions 5, 6	Sediment, temperature, nutrients	Reduce Sedimentation Increase stream baseflow	10 to 15 years	Existing	Idaho SWCD	WQPA SCC
	South Fork Clearwater River (multiple operations in Threemile Creek, Cottonwood Creek)	Improve animal feeding operations 15, 16	Sediment, temperature, nutrients	Reduce Sedimentation	10 to 15 years	Existing	Idaho SWCD	DIV II AFO:319, SCC, Landowner

Table 17-2j. State of Idaho Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Valley Creek

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Existing and/or Expected)	Responsible Entity(ies)	Funding Source(s)
Snake River spring/summer Chinook salmon	Valley Creek Chinook salmon	Riparian Habitat Improvement (1 project)	Degraded Riparian Habitat (increased temperature and sedimentation)	Decreases sedimentation and stabilizes temperatures by improving riparian habitat	2004	Existing	Custer Soil and Water Conservation District	BPA

Table 17-3a. Inventory of Actions on Private Lands - Mountain Snake Province Clearwater Subbasin

Program or Project Name	Description Habitat Actions	Location	Sponsor	Limiting Factors	Population	MPG (ESU)	Start	Done	Species Response
WQPA SCC	Upland BMPs, 3465 ac treated	Big Canyon Cr	Nez Perce SWCD	sediment	Lower Clearwater A-run SH	Snake River SH	2/96	10/06	1
WQPA SCC	Upland BMPs, 10,237 ac treated	Little Canyon (Big Canyon trib.)	Nez Perce SWCD	sediment	Lower Clearwater A-run SH	Snake River SH	2/96	10/06	2
Bonneville	Upland & riparian BMPs: 47 gully plugs; 6500 LF grasswaterways; 25 ac grass seed; 1 mi fence 8 offsite water; 5000LF channel veg; +2yrs unknown BMP installed?	Big Canyon Cr	Nez Perce SWCD	sediment, temp	Lower Clearwater A-run SH	Snake River SH	3/00	10/06	3
Bonneville	80 ac weed control; 6 mi fence; 3 ac planting	Big Canyon Cr	Nez Perce Tribe	sediment, temp	Lower Clearwater A-run SH	Snake River SH	4/03	ongoing	3
WQPA SCC	Upland BMPs, 3832 ac treated	Camas Prairie Lewis Prairie	Lewis SWCD	ground water nitrate	Lower Clearwater A-run SH	Snake River SH	1/04	ongoing	4
WQPA SCC	Upland & riparian BMPs, 6748 ac upland, 11,022 LF riparian	Cottonwood Cr S.Fork	Idaho SWCD	sediment, temp, nutrients	South Fork Clearwater B run SH	Snake River SH	5/01	ongoing	5
WQPA SCC	Upland BMPs, 2827 ac treated	Cottonwood Cr S.Fork	Idaho SWCD	sediment, nutrients	South Fork Clearwater B run SH	Snake River SH	10/03	ongoing	6
WQPA SCC	Upland & riparian BMPs, 1100 ac upland, 42,411 LF riparian, AFO 1074 (# head)	Jim Ford Cr	Clearwater SWCD	sediment, temp, nutrients	Lower Clearwater A-run SH	Snake River SH	3/02	6-Nov	7
Bonneville	Upland & riparian BMPs: 13 gully plugs; 26 ac range seeding; 16 ac critical area planting; 2500LF fence; 4000 riparian veg; 3 offsite water; 15ac tree planting; 1300ac weed control; 300LF biolog installed; 200LF wetland sod installed;	Lapwai Cr	Nez Perce SWCD	sediment, temp, nutrients	Lower Clearwater A-run SH	Snake River SH	3/02	ongoing	8
Bonneville	6 mifence; 140 ac weed treatment; 3 ac plantings	Lapwai Cr	Nez Perce Tribe	sediment, temp, nutrients	Lower Clearwater A-run SH	Snake River SH	3/02	ongoing	9

Table 17-3a. Inventory of Actions on Private Lands - Mountain Snake Province Clearwater Subbasin

Program or Project Name	Description Habitat Actions	Location	Sponsor	Limiting Factors	Population	MPG (ESU)	Start	Done	Species Response
Div II AFO:319 & SCC, landowner owner costshare	Animal Feeding Operations: waste mngm't systems, water facilities; veg planting; fencing;	Potlatch River: Pine & Middle Fk Crs -1 ea; mainstem - 2; Cedar Cr- 4	Latah SWCD	sediment, temperature, nutrients	Lower Clearwater A-run SH	Snake River SH	2003	2006	10
Div II AFO:319 & SCC,landowner owner costshare	Animal Feeding Operations: waste mngm't systems, water facilities; veg planting; fencing;	Lapwai Cr - 3	Nez Perce SWCD	sediment, temperature, nutrients	Lower Clearwater A-run SH	Snake River SH		2006	11
Div II AFO:319 & SCC,landowner owner costshare	Animal Feeding Operations: waste mngm't systems, water facilities; veg planting; fencing;	Lolo Cr - 1	Clearwater SWCD	sediment, temperature, nutrients	Lolo Cr A/B run SH	Snake River SH		2006	12
Div II AFO:319 & SCC,landowner owner costshare	Animal Feeding Operations: waste mngm't systems, water facilities; veg planting; fencing;	Jim Ford Cr	Clearwater SWCD	sediment, temperature, nutrients	Lower Clearwater A-run SH	Snake River SH		2006	13
Div II AFO:319 & SCC,landowner owner costshare	Animal Feeding Operations: waste mngm't systems, water facilities; veg planting; fencing;	Lawyer Cr - 5	Lewis and Idaho SWCDs	sediment, temperature, nutrients	Lower Clearwater A-run SH	Snake River SH		2006	14
Div II AFO:319 & SCC,landowner owner costshare	Animal Feeding Operations: waste mngm't systems, water facilities; veg planting; fencing;	Cottonwood Cr - 1, Rock Cr (tributary) - 3	Idaho SWCD	sediment, temperature, nutrients	South Fork Clearwater B run SH	Snake River SH		2006	15
Div II AFO:319 & SCC,landowner owner costshare	Animal Feeding Operations: waste mngm't systems, water facilities; veg planting; fencing;	South Fork lower: unnamed trib - 1, 3Mile - 1	Idaho SWCD	sediment, temperature, nutrients	South Fork Clearwater B run SH	Snake River SH		2006	16

Table 17-3a. Inventory of Actions on Private Lands - Mountain Snake Province Clearwater Subbasin

Program or Project Name	Description Habitat Actions	Location	Sponsor	Limiting Factors	Population	MPG (ESU)	Start	Done	Species Response
Div II AFO:319 & SCC,landowner owner costshare	Approximately 20 more projects in planning phase anticipate construction w/I 3 years	Clearwater lower, Clearwater South Fork	SWCDs	sediment, temperature, nutrients	Lower Clearwater A-run SH	Snake River SH	2007	2009	NA
Div II AFO:319 & SCC,landowner owner costshare	Several projects in planning	Salmon River lower	Idaho SWCD	sediment, temperature, nutrients		Snake River SH	2007	2009	NA
Bonneville	Post-planning Implementation Program begins 2007. Will include other funding sources	Potlatch River	Latah SWCD	sediment, temperature, base flow	Lower Clearwater A-run SH	Snake River SH	2007	ongoing	17
PCSRF	Riparian plantings 3.2 ac	Potlatch River Corral Cr	Latah SWCD	sediment, temperature, base flow	Lower Clearwater A-run SH	Snake River SH	2005	2006	18
PCSRF	Riparian plantings 2 ac	Potlatch River Little Potlatch Cr-upper	Latah SWCD	sediment, temperature, base flow	Lower Clearwater A-run SH	Snake River SH	2005	2006	19
WQPA SCC	Riparian & AFO	????	Nez Perce SWCD	sediment, temperature, nutrients	Lower Clearwater A-run SH	Snake River SH	4/02	ongoing	N/A
Div II AFO:319 & SCC,landowner owner costshare	Animal Feeding Operations: waste mngm't systems, water facilities; veg planting; fencing;	Potlatch River Spring Valley Cr - 4 sites	Latah SWCD	sediment, temperature, nutrients	Lower Clearwater A-run SH	Snake River SH	2006	2008	20
Div II AFO:319 & SCC,landowner owner costshare	Animal Feeding Operations: waste mngm't systems, water facilities; veg planting; fencing;	Potlatch River 1-Boulder Cr, 1-Big Bear	Latah SWCD	sediment, temperature, nutrients	Lower Clearwater A-run SH	Snake River SH	2006	2008	21
Bonneville	Upland Treatment: 1388 ac direct seeding; 9 sediment basins; 275 ac grass seeding; 19 grade stabilization structures	Little Canyon (Big Canyon trib.)	Lewis SWCD	sediment, temperature flows	Lower Clearwater A-run SH	Snake River SH	2000	2000	22

Table 17-3a. Inventory of Actions on Private Lands - Mountain Snake Province Clearwater Subbasin

Program or Project Name	Description Habitat Actions	Location	Sponsor	Limiting Factors	Population	MPG (ESU)	Start	Done	Species Response
Bonneville	Upland Treatment: 2474 ac direct seeding; 2 sediment basins; 17 grade stabilization	Little Canyon (Big Canyon trib.)	Lewis SWCD	sediment, temperature, flows	Lower Clearwater A-run SH	Snake River SH	2001	2001	23
Bonneville	Upland Treatment: 3559 ac direct seeding; 1sediment basins; 17 ac grass seeding; 13 grade stabilization structures	Little Canyon (Big Canyon trib.)	Lewis SWCD	sediment, temperature, flows	Lower Clearwater A-run SH	Snake River SH	2002	2002	24
Bonneville	Upland Treatment: 3973 ac direct seeding; 6 grade stabilization structures	Little Canyon (Big Canyon trib.)	Lewis SWCD	sediment, temperature, flows	Lower Clearwater A-run SH	Snake River SH	2003	2003	25
Bonneville	Upland Treatment: 4406 ac direct seeding; 3 grade stabilization structures	Little Canyon (Big Canyon trib.)	Lewis SWCD	sediment, temperature, flows	Lower Clearwater A-run SH	Snake River SH	2004	2004	26
Bonneville	Upland Treatment: 6630 ac direct seeding; 2 grade stabilization structures	Little Canyon (Big Canyon trib.)	Lewis SWCD	sediment, temperature, flows	Lower Clearwater A-run SH	Snake River SH	2005	2005	27
Bonneville	Upland Treatment: 3813 ac direct seeding; 9 sediment basins; 275 ac grass seeding; 19 grade stabilization structures	Little Canyon (Big Canyon trib.)	Lewis SWCD	sediment, temperature, flows	Lower Clearwater A-run SH	Snake River SH	2006	2006	28
Bonneville	Riparian Treatment: 2 off-site watering	Little Canyon (Big Canyon trib.)	Lewis SWCD	sediment, temperature, flows	Lower Clearwater A-run SH	Snake River SH	2000	2000	29
Bonneville	Riparian Treatment: 1 off-site watering	Little Canyon (Big Canyon trib.)	Lewis SWCD	sediment, temperature, flows	Lower Clearwater A-run SH	Snake River SH	2001	2001	30
Bonneville	Riparian Treatment: 2 off-site watering	Little Canyon (Big Canyon trib.)	Lewis SWCD	sediment, temperature, flows	Lower Clearwater A-run SH	Snake River SH	2003	2003	31
Bonneville	Riparian Treatment: 2 off-site watering	Little Canyon (Big Canyon trib.)	Lewis SWCD	sediment, temperature, flows	Lower Clearwater A-run SH	Snake River SH	2004	2004	32
Bonneville	Riparian Treatment: 1 off-site watering	Little Canyon (Big Canyon trib.)	Lewis SWCD	sediment, temperature, flows	Lower Clearwater A-run SH	Snake River SH	2005	2005	33

Table 17-3a. Inventory of Actions on Private Lands - Mountain Snake Province Clearwater Subbasin

Program or Project Name	Description Habitat Actions	Location	Sponsor	Limiting Factors	Population	MPG (ESU)	Start	Done	Species Response
Bonneville	Riparian Treatment: 300 trees/shrubs	Little Canyon (Big Canyon trib.)	Lewis SWCD	sediment, temperature, flows	Lower Clearwater A-run SH	Snake River SH	2006	2006	34

Table 17-3b. Inventory of Actions on Private Lands - Mountain Snake Province Salmon Subbasin

Program or Project Name	Description Habitat Actions	Location	Sponsor	Limiting Factors	Population	MPG (ESU)	Start	Done	Species Response
PCSRF & SCC, IDFG in-kind	Diversion improvement, 12 ac upland & 600 LF riparian BMPs: BOR engineering & environ compliance	Little Salmon River:Rapid River	Idaho SWCD	Passage, water conservation	Little Salmon River SH	Snake River	8/05	10/05	1
Mitchell Act, IDFG in-kind	Fish screen, diversion improvement: BOR engineering & environ compliance	Little Salmon: Rapid River - Shingle Cr	Idaho SWCD	Passage, water conservation	Little Salmon River SH	Snake River	10/05	12/05	2
PCSRF, IDFG & Riggins City in-kind	Diversion and water withdrawl removal: BOR engineering & environ compliance	Little Salmon River: Squaw Creek lower	Riggins City	Passage, water conservation	Little Salmon River SH	Snake River	10/05	11/05	3
PCSRF, NOAA, IFWF, IDFG & Idaho County in-kind	Culvert replacement and streambed gradient improvement: BOR engineering & environ compliance	Little Salmon River: Squaw Creek mid	Idaho County	passage	Little Salmon River SH	Snake River	8/07	9/07	4
PCSRF & SCC, IDFG in-kind	Fish screen flood irrigation conversion to sprinler: BOR engineering & environ compliance	Lower Salmon: Race Creek	Idaho SWCD	passage and water conservation	?	Snake River	9/07	10/07	5
Multiple	Fish screen, irrigation improvements, passage projects anticipated in Little/Lower Salmon. Some projects have been identified	Salmon River: Little Salmon, Lower Salmon			Little Salmon River SH	Snake River	2007	2009	NA
SCC	Upland and riparian BMPs: Diversion improvement, 319 ac upland & 1,210 ac riparian, AFO treatment (2,425 head)	Lemhi River	Lemhi SWCD	passage and water conservation	Lemhi River SH, Ch	Snake River	12/00	ongoing	
WQPA SCC	Upland and riparian BMPs: 135 upland ac treated	Pahsimeroi River	Lemhi SWCD	sediment	Pahsimeroi SH, Ch	Snake River	1/05	ongoing	
Div II AFO:319 & SCC, landowner owner costshare	several projects in planning	Salmon River lower	Idaho SWCD	sediment, temperature, nutrients	?	Snake River	2006	2008	NA

Table 17-4a. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Asotin Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1]/	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
Snake River Spring/ Summer Chinook ESU & Snake River Steelhead DPS	Asotin Creek Spring/ Summer Chinook Asotin Creek Steelhead (Asotin Creek portion of WRIA 35 Middle Snake)	Revised GMA Critical Areas Ordinance Adopted	Habitat Protection	Regulations to protect wetlands and fish and wildlife habitat using best available science and giving special consideration to protection/conservation of salmonids.	12/01/08	Exists Expect	Asotin County City of Asotin Garfield County	State General Fund & Local General Funds
		SMA Shoreline Master Program Update	Habitat Protection Habitat Restoration	Shoreline Master Programs are being updated consistent with revised statewide Shoreline Master Program Guidelines (2003) to protect shoreline resources, vegetation, fish and wildlife.	12/01/14	Expect Anticipate	Asotin County City of Asotin Garfield County	State General Fund & Local General Funds
		SMA Permits Issued	Habitat Protection	Substantial development permits and conditional use permits issued with conditions consistent with SMA Master Programs.	Ongoing	Exists	Asotin County City of Asotin Garfield County	Local General Funds
		SMA Permits Approved or Denied	Habitat Protection	Conditional use permits and variance approved with added conditions, 1 variance denied.	Ongoing	Exists	WA Dept. of Ecology	State General Fund
		Habitat Project Grants	Habitat Restoration and Preservation	20 projects with total cost of $2.4 mil. For both Asotin and Tucannon subbasins consistent with recovery plan and independent technical review; 9% of statewide project funding allocated to entire Snake River region.	2000-2006	Exists Expect	WA Salmon Recovery Funding Board and project sponsors	PCSRF and State Salmon Account (54%), sponsors match (46%)
		Water Acquisitions	Habitat Restoration Stream Flow	9.2 annual acre ft. lease for Alpowa Creek; acquisition or leasing of 33,322 acre ft. of water for mainstem Columbia River flow benefits all populations.	FY 04-06 & Ongoing	Exists Expect	WA Dept. of Ecology	State Drought & Building Construction Accounts BPA

Table 17-4a. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Asotin Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1]/	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Watershed Plan Implementation	Water Resource Use Water Quality Habitat Protection and Restoration Stream Flow	Watershed plan approval expected 2007.	Ongoing	Exists Expect	Asotin County Garfield County WA Dept. of Ecology	State Water Quality Account
		NPDES Permits	Water Quality Protection	14 active NPDES permits (4 construction stormwater, 2 industrial stormwater, 4 sand & gravel, 2 municipal, 1 industrial, 1 fish hatchery)	Ongoing	Exists	WA Dept. of Ecology	Permit Fee Acct. State Toxics Acct. EPA CWA Grant State General Fund
		Implementing TMDL and Water Cleanup Plans	Water Quality Protection and Restoration	12 of 116 needed water cleanup plans for WRIA 35 stream segments are underway or completed	Ongoing	Exists Expect Anticipate	WA Dept. of Ecology	State General Fund EPA CWA Grant
		Water Quality Improvement Grants	Water Quality Protection and Restoration	2 projects in Asotin Creek watershed funded since 2000; total project cost of $489,000	Ongoing	Exists Expect	WA Dept. of Ecology	Centennial Fund CWA Section 319
		Forest Lands HCP	Habitat Protection and Restoration	2.1% of entire WRIA 35 covered by Forest & Fish HCP applicable to private forest lands	Ongoing	Exists Expect	WA Dept of Natural Resources & forest land owners	PCSRF State General Fund Forest Landowners
		Hydraulic Project Approvals	Habitat Protection Water Quality Protection	310 HPAs issued for projects in or near state waters in entire WRIA 35 from 2000–2006 consistent with Aquatic Habitat Guidelines	Ongoing	Exists Expect	WA Dept. of Fish and Wildlife	State General Fund

Table 17-4a. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Asotin Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1]/	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Asotin Habitat Enhancement and Restoration Program	Water Quality Excess Sediment Riparian Condition	Direct seeding/planting/terracing projects on several thousand acres of CREP lands and sediment catch basins constructed to reduce erosion and sediment; continuing planting and fencing projects to improve thousands of lineal feet of riparian condition, improving feedlots (2 completed) to improve water quality	2000-2009	Exists Expect	Asotin Cons. District	BPA F&W NRCS CREP Land Owner Cost-share
		Fish Screen Projects	Obstruction Diversion	Reduce salmon mortality caused by water withdrawals and diversions by installing fish screens	2006	Exists	Asotin Cons. District	WA SRFB
		Upland Sediment Reduction	Water Quality Excess Sediment	Control sources of erosion and reduce delivery of sediment to George Creek from upland land uses.	2006	Exists	Asotin Cons. District	WA SRFB
		LWD Replenishment and Riparian Enhancement	Riparian Condition Habitat Quantity Habitat Diversity	Re-establish LWD structure in S. Fork Asotin Creek and plant native trees in riparian area to enhance riparian function and provide future recruitment of large wood to the stream	2006-2008	Exists Expect	WA Dept of Fish and Wildlife	WA SRFB

[1/] The non-Federal actions contained in this table and similar tables for other populations in Columbia River Basin tributaries in Washington are based upon information in regional salmon recovery plans or NPCC Fish and Wildlife subbasin plans and on existing State statutory responsibilities and related programs. Nothing in this table should be implied or construed to create any new legal obligation to implement these actions beyond responsibilities already created by Federal or State laws or contracts that are entered into voluntarily.

Table 17-4b. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Columbia Gorge (Trib) & Little White Salmon Subbasins

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect/ Anticipate)	Responsible Entity(ies)	Funding Source(s)
Lower Columbia Chinook, Lower Columbia Coho, Columbia River Chum ESUs & Lower Columbia Steelhead DPS	Upper Gorge Chinook, Coho, Chum, and Steelhead (portions of WRIA 29 Wind/White Salmon not in Wind Subbasin or Klickitat County)	Revised GMA Critical Areas Ordinance Adopted	Habitat Protection	Regulations to protect wetlands and fish and wildlife habitat using best available science and giving special consideration to protection/conservation of salmonids.	12/01/09	Exists Expect	Skamania County City of Stevenson	State General Fund & Local General Funds
		SMA Shoreline Master Program Update	Habitat Protection Habitat Restoration	Shoreline Master Programs are being updated consistent with revised statewide Shoreline Master Program Guidelines (2003) to protect shoreline resources, vegetation, fish and wildlife.	12/01/12	Expect Anticipate	Skamania County City of Stevenson	State General Fund & Local General Funds
		Habitat Project Grants	Habitat Restoration and Preservation	10 projects with total cost of $3.4 mil. , including 2 acquisitions, consistent with recovery plan and independent technical review; 11% of statewide project funding expected to be available to Mid-Columbia region.	2000-2006	Exists Expect	WA Salmon Recovery Funding Board and project sponsors	PCSRF and State Salmon Account (78%), sponsors match (22%)
		Water Acquisitions	Habitat Restoration Stream Flow	Acquisition or leasing of 33,322 acre ft. of water for mainstem Columbia River flow benefits all populations	FY 04-06 & Ongoing	Exists Expect Anticipate	WA Dept. of Ecology	State Drought & Building Construction Accounts BPA

Table 17-4b. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Columbia Gorge (Trib) & Little White Salmon Subbasins

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect/ Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Watershed Plan Implementation	Water Resource Use Water Quality Habitat Protection and Restoration	Watershed plan adopted 11/06	Ongoing	Exists Expect Anticipate	Skamania County WA Dept. of Ecology	State Water Quality Account
		Instream Flow Rule Adopted	Habitat Restoration Stream Flow	New instream flow rule planned by 2009	Ongoing	Exists	WA Dept. of Ecology	State Water Quality Account State General Fund
		NPDES Permits	Water Quality Protection	9 active NPDES permits (4 construction stormwater, 1 industrial stormwater, 2 sand & gravel, 2 municipal)	Ongoing	Exists	WA Dept. of Ecology	Permit Fee Acct. State Toxics Acct. EPA CWA Grant State General Fund
		Implementing TMDL and Water Cleanup Plans	Water Quality Protection and Restoration	34 of 46 needed water cleanup plans for WRIA 29 stream segments are underway or completed	Ongoing	Exists Expect Anticipate	WA Dept. of Ecology	State General Fund EPA CWA Grant
		Water Quality Improvement Grants	Water Quality Protection and Restoration	6 projects in WRIA 29 funded since 2000 at a project cost of $646,000	Ongoing	Exists Expect	WA Dept. of Ecology	Centennial Fund CWA Section 319 Aquatic Weeds Acct.
		Water Quality Certification	Water Quality Protection	2 individual Section 401 water quality certifications issued	Since 01/04	Exists	WA Dept. of Ecology	State Water Quality Account State General Fund

Table 17-4b. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Columbia Gorge (Trib) & Little White Salmon Subbasins

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect/ Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Forest Lands HCPs	Habitat Protection and Restoration	12.8% of entire WRIA 29 covered by DNR state forest lands HCP, 34.1% of WRIA 29 covered by Forest & Fish HCP applicable to private forest lands	Ongoing	Exists Expect Anticipate	WA Dept of Natural Resources & forest land owners	DNR Forest Development Acct. DNR Resource Mgt. Cost Acct. PCSRF, SGF Forest Land Owners
		Hydraulic Project Approvals	Habitat Protection Water Quality Protection	165 HPAs issued for projects in or near state waters in entire WRIA 29 from 2000–2006 consistent with Aquatic Habitat Guidelines	Ongoing	Exists Expect	WA Dept. of Fish and Wildlife	State General Fund
		Floodplain Protection	Habitat Protection Stream Corridor Structure & Function	Prevent floodplain impacts and protect floodplain function, CMZ processes and off-channel habitat through land use controls and best management practices (see also CAO and SMA actions)	2007-2016	Anticipate	Skamania County WDOE	State General Fund & Local General Funds
		Acquisition of Sensitive Areas	Habitat Protection Water Quality Watershed Processes	Acquire sensitive habitats or purchase conservation easements to protect watershed processes and habitat functions where existing protections are inadequate	Ongoing	Exists Expect Anticipate	LCFRB WDFW USFWS BPA	WA SRFB USFWS BPA

Table 17-4b. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Columbia Gorge (Trib) & Little White Salmon Subbasins

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect/ Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Technical Assistance for Land Owners	Habitat Protection Habitat Restoration	Technical assistance to land owners and land owner participation in conservation programs to protect and restore habitat and watershed processes	Ongoing	Exists Expect Anticipate	UCD, NRCS WDFW, WDNR Skamania County LCFEG	State General Fund WA SRFB NRCS Funds
		Increase Habitat Enhancement Projects	Habitat Restoration Habitat Preservation Water Quality	Increase funding and implementation of voluntary habitat enhancement projects in high priority reaches and subwatersheds	Ongoing	Exists Expect Anticipate	LCFRB, WDFW BPA F&W, NRCS UCD, LCFEG	WA SRFB BPA
		Assess/Correct Passage Barriers	Fish Passage/Access	Assess the impact of fish passage barriers throughout subbasins and restore access to potentially productive spawning and rearing habitats	2007-2016	Exists Expect Anticipate	WDFW, WDNR Skamania County WSDOT	State Capital Funds PCSRF WA SRFB
		On-site Sewage Systems	Water Quality	Assess, upgrade and/or replace on-site sewage systems that may contribute to water quality impairment	Ongoing	Exists Expect Anticipate	Skamania County UCD	Local General Funds (Health District)
		Address Stream Temperature	Water Quality Stream Temperature	Address stream temperature impairment through TMDL plan for specific Little White Salmon River segments	2007-2016	Expect Anticipate	WDOE	State Water Quality Account

[1/] The non-Federal actions contained in this table and similar tables for other populations in Columbia River Basin tributaries in Washington are based upon information in regional salmon recovery plans or NPCC Fish and Wildlife subbasin plans and on existing State statutory responsibilities and related programs. Nothing in this table should be implied or construed to create any new legal obligation to implement these actions beyond responsibilities already created by Federal or State laws or contracts that are entered into voluntarily.

Table 17-4c. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Entiat Subbasin

Species (ESU/ DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
Upper Columbia Chinook ESU & Upper Columbia Steelhead DPS	Entiat Chinook & Entiat Steelhead (Entiat Subbasin & WRIA 46 Entiat, 477 sq. miles)	GMA Comp. Plan Adopted	Habitat Protection	Provides comprehensive framework and policy direction for local land use decisions including shoreline policies and any subarea plans.	05/02/06 11/09/06	Exists	Chelan County City of Entiat	State General Fund & Local General Funds
		GMA Development Regulations Adopted	Habitat Protection	Regulations consistent with Comp. Plan and governing development of land, such as zoning, subdivisions and site plans	11/09/06	Exists	City of Entiat	State General Fund & Local General Funds
		Revised GMA Critical Areas Ordinance Adopted	Habitat Protection	Regulations to protect wetlands and fish and wildlife habitat using best available science and giving special consideration to protection/conservation of salmonids.	11/09/06 12/01/07	Exists Expect	City of Entiat Chelan County	State General Fund & Local General Funds
		SMA Shoreline Master Program Update	Habitat Protection Habitat Restoration	Shoreline Master Programs are being updated consistent with revised statewide Shoreline Master Program Guidelines (2003) to protect shoreline resources, vegetation, fish and wildlife.	12/01/13	Expect Anticipate	Chelan County and City of Entiat	State General Fund & Local General Funds
		SMA Permits Issued	Habitat Protection	13 substantial development permits and 3 conditional use permits issued with conditions consistent with SMA Master Programs	Ongoing	Exists	Chelan County and City of Entiat	Local General Funds
		SMA Permits Approved or Denied	Habitat Protection	1 variance approved with added conditions	Ongoing	Exists	WA Dept. of Ecology (WDOE)	State General Fund (SGF)

Table 17-4c. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Entiat Subbasin

Species (ESU/ DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Habitat Project Grants	Habitat Restoration and Preservation	10 projects with total cost of $3.4 mil. , including 2 acquisitions, consistent with recovery plan and independent technical review; 11% of statewide project funding allocated to entire Upper Columbia region.	2000-2006	Exists Expect	WA Salmon Recovery Funding Board and project sponsors	PCSRF and State Salmon Account (78%), sponsors match (22%)
		Water Acquisitions	Habitat Restoration Stream Flow	Water banking , trust and leasing program with 1-5 enrolled per year for 10 years; acquisition or leasing of 33,322 acre ft. of water for mainstem Columbia River flow benefits all populations	1-10 years FY 04-06 & Ongoing	Exists Expect Anticipate	WDOE, WA Rivers Conservancy WA Water Trust	State Drought & Building Construction Accounts BPA F&W
		Watershed Plan Implementation	Water Resource Use Water Quality Habitat Protection and Restoration Stream Flow	Watershed plan adopted 09/04 and Implementation plan adopted 02/06	Ongoing	Exists Expect Anticipate	Chelan County WDOE Chelan Co. Cons. District	State Water Quality and Building Construction Accts; BPA F&W; WA SRFB; Trib Fund; NFWF
		Instream Flow Rule Adoption and Implementation	Habitat Restoration Stream Flow	New instream flow rule adopted 08/05 provides new flow management program	Ongoing	Exists Expect	WDOE	State Water Quality Account
		NPDES Permits	Water Quality Protection	2 active NPDES permits (1 construction stormwater, 1 industrial)	Ongoing	Exists	WDOE	Permit Fee Acct. State Toxics Acct. EPA CWA Grant State General Fund

Table 17-4c. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Entiat Subbasin

Species (ESU/ DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Implementing TMDL and Water Cleanup Plans	Water Quality Protection and Restoration	TMDL determined not needed for pH; riparian prioritization/restoration strategy under development to address temperature listing under category 4(b)	Ongoing	Exists Expect Anticipate	WDOE	State Water Quality Account
		Forest Lands HCPs	Habitat Protection and Restoration	2.2% of WRIA 46 covered by DNR state forest lands HCP, 6.1% of WRIA 46 covered by Forest & Fish HCP applicable to private forest lands	Ongoing	Exists Expect Anticipate	WA Dept of Natural Resources & forest land owners	DNR Forest Development Acct. DNR Resource Mgt. Cost Acct. PCSRF, SGF Forest Land Owners
		Hydraulic Project Approvals	Habitat Protection Water Quality Protection	39 HPAs issued for projects in or near state waters from 2000–2006 consistent with Aquatic Habitat Guidelines	Ongoing	Exists Expect	WA Dept. of Fish and Wildlife	State General Fund
		Tributary Habitat Conservation – Mid-Columbia PUDs HCPs	Hydro Dam Survival Habitat Restoration Compensation	Habitat improvements will contribute 2% of survival toward 100% “no-net-impact” goal	2003-2053	Exists Expect	Chelan County PUD Douglas County PUD	Dedicated PUD Accounts
		Hatchery Supplementation - Mid-Columbia PUDs HCPs	Hydro Dam Survival Hatchery Compensation	Hatchery supplementation will contribute 7% toward the 100% “no-net-impact” goal	2003-2053	Exists Expect	Chelan County PUD Douglas County PUD	Dedicated PUD Accounts

Table 17-4c. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Entiat Subbasin

Species (ESU/ DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Hydropower Operations - Mid-Columbia PUDs HCPs	Hydro Dam Survival Wells Dam Rock Island Dam Rocky Reach Dam	Achieve 91% adult and juvenile overall project survival; 95% juvenile dam passage survival and 93% juvenile survival throughout projects by implementing spill, juvenile bypass system, and other project improvements.	2003-2053	Exists Expect	Chelan County PUD Douglas County PUD	Dedicated PUD Accounts
		Maintain and Enhance Wetlands	Water Quality Stream Temperature	Wetlands function to moderate stream temperature (winter/low & summer/high)	20 years	Anticipate	NRCS, Chelan Co. Cons. District	NRCS Wetland Reserve Program
		Landowner BMPs	Water Quality Protection	BMPs reduce effects of herbicide and pesticide application, livestock/nutrient effects, and effects of septic systems	2-4 new farm plan/yr for 10 years	Exists Expect Anticipate	NRCS, Chelan Co. Cons. District, WDOE	NRCS EQIP & CRP programs; WA Cons. Com. WQ funds.
		Water Restoration	Low Stream Flows	Consolidate two irrigation ditches and extend efficient irrigation line; improve water diversion and conveyance efficiency; improve on-farm water efficiency and conservation (2-4 systems /yr); increase water metering and reporting (1-3 meters/yr); and convert surface water diversions to wells (2-4/yr)	10 years	Exists Expect Anticipate	NRCS, Chelan Co. Cons. District, WDOE	Fed. Farm Bill; BPA F&W; WDOE Water Resources
		Upgrade Water Screens	Obstructions Passage/Access	Screen and/or upgrade screens on water pump/diversion intakes (1/yr) and repair 2 Stormy Creek culverts creating fish passage problem	10 years & 3-4 years for culverts	Exists Expect	Chelan Co. Cons. District, WDFW	Mitchell Act; USFWS FRIMA; BPA; SRFB; Trib Fund

Table 17-4c. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Entiat Subbasin

Species (ESU/ DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Protect and Restore Riparian areas and Stream Structure	Habitat Diversity Floodplain Function Channel Connectivity Riparian Function	Place up to 65 pool forming structures; up to flood plain and side-channel reconnection projects; up to 40,000 lineal feet of riparian planting; protect larger undisturbed riparian areas through conservation easements, leasing, or transfer of development rights; install 5-10 gravel recruitment structures; install up to 10 LWD structures	10 years for floodplain/ Channel work; 10-25 years for other structure and riparian work	Exists Expect Anticipate	Chelan Co. Cons. District	State Water Quality Acct. USFWS Partners funds, BPA F&W WA SRFB Trib Fund NFWF

[1/] The non-Federal actions contained in this table and similar tables for other populations in Columbia River Basin tributaries in Washington are based upon information in regional salmon recovery plans or NPCC Fish and Wildlife subbasin plans and on existing State statutory responsibilities and related programs. Nothing in this table should be implied or construed to create any new legal obligation to implement these actions beyond responsibilities already created by Federal or State laws or contracts that are entered into voluntarily.

Table 17-4d. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) 1/	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
Mid-Columbia Steelhead DPS	Klickitat River Steelhead (WRIA 30 Klickitat, 1,436 sq. miles)	Revised GMA Critical Areas Ordinance Adopted	Habitat Protection	Regulations to protect wetlands and fish and wildlife habitat using best available science and giving special consideration to protection/conservation of salmonids.	12/01/11	Exists Expect	Klickitat County and City of Goldendale	State General Fund & Local General Funds
		SMA Shoreline Master Program Update	Habitat Protection Habitat Restoration	Shoreline Master Programs are being updated consistent with revised statewide Shoreline Master Program Guidelines (2003) to protect shoreline resources, vegetation, fish and wildlife.	12/01/14	Expect Anticipate	Klickitat County and City of Goldendale	State General Fund & Local General Funds
		SMA Permits Issued	Habitat Protection	7 substantial development permits and 5 conditional use permits issued with conditions consistent with SMA Master Programs	Ongoing	Exists	Klickitat County and Cities of Goldendale, Bingen, White Salmon	Local General Funds
		SMA Permits Approved or Denied	Habitat Protection	1 conditional use permit and 1 variance approved with added conditions	Ongoing	Exists	WA Dept. of Ecology	State General Fund
		Habitat Project Grants	Habitat Restoration and Preservation	13 projects with total cost of $4.7 mil. , including 3 acquisitions, consistent with lead entity habitat strategy and independent technical review; 10% of statewide project funding allocated to entire Mid-Columbia region.	2000-2006	Exists Expect	WA Salmon Recovery Funding Board and project sponsors	PCSRF and State Salmon Account (80%), sponsors match (20%)

Table 17-4d. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Water Acquisitions	Habitat Restoration Stream Flow	Acquisition or leasing of 33,322 acre ft. of water for mainstem Columbia River flow benefits all populations	FY 04-06 & Ongoing	Exists Expect	WA Dept. of Ecology	State Drought & Building Constructio n Accounts BPA
		Watershed Plan Implementation	Water Resource Use Water Quality Habitat Protection and Restoration	Watershed plan adopted 08/06 and Phase 4 implementation grant requested 11/06	Ongoing	Exists Expect	WA Dept. of Ecology Klickitat County Klickitat PUD City of Goldendale Central Klickitat Cons. Dist. (CKCD)	State Water Quality Account
		NPDES Permits	Water Quality Protection	20 active NPDES permits (2 construction stormwater, 1 industrial stormwater, 10 sand & gravel, 4 municipal, 1 industrial, 2 fish hatchery)	Ongoing	Exists	WA Dept. of Ecology	Permit Fee Acct. State Toxics Acct. EPA CWA Grant State General Fund
		Implementing TMDL and Water Cleanup Plans	Water Quality Protection and Restoration	20 of 25 needed water cleanup plans for stream segments are underway or completed	Ongoing	Exists Expect Anticipate	WA Dept. of Ecology	State General Fund EPA CWA Grant

Table 17-4d. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) 1/	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Water Quality Improvement Grants	Water Quality Protection and Restoration	8 projects funded since 2000 at a project cost of $9.0 million	Ongoing	Exists Expect	WA Dept. of Ecology	Centennial Fund CWA Section 319
		Water Quality Certification	Water Quality Protection	1 individual Section 401 water quality certification issued	Since 01/04	Exists	WA Dept. of Ecology (WDOE)	State Water Quality Account State General Fund
		Forest Lands HCPs	Habitat Protection and Restoration	6.2% of WRIA 30 covered by DNR state forest lands HCP, 32.9% of watershed covered by Forest & Fish HCP applicable to private forest lands	Ongoing	Exists Expect	WA Dept of Natural Resources & forest land owners	DNR Forest Development Acct. DNR Resource Mgt. Cost Acct. PCSRF, SGF Forest Land Owners
		Hydraulic Project Approvals	Habitat Protection Water Quality Protection	177 HPAs issued for projects in or near state waters from 2000–2006 consistent with Aquatic Habitat Guidelines	Ongoing	Exists Expect	WA Dept. of Fish and Wildlife (WDFW)	State General Fund

Table 17-4d. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) 1/	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Renovate and Improve Fishways	Fish Passage/ Access	Renovations and improvements at Castile Falls Fishway included conversion to a vertical slot fishway to allow passage over a wider range of flow conditions. Improvements are also planned at Lyle Falls Fishway.	Castile Falls 2003-2005	Exists Anticipate	Yakama Nation	NOAA Mitchell Act Funds BPA PCSRF
		Replace Culverts and Other Barriers	Fish Passage/ Access	Replacing current culverts in subbasin with bottomless arch culverts and bridges for passage of all steelhead life stages. Two other barriers in Logging Camp Creek and Snyder Creek recently corrected.	Ongoing	Expect Anticipate	Klickitat County Yakama Nation WDFW, WA Stat Parks, Mid-Columbia RFEG	PCSRF Mid-C RFEG Tribal Funds BPA
		Habitat Restoration Projects	Habitat Quality Habitat Diversity Riparian Condition Water Quality Floodplain Connectivity Fish Passage/ Access	Various stream and riparian habitat restoration projects in Snyder Creek, lower Klickitat, Little Klickitat River and other locations in Klickitat subbasin	2004-2006 Ongoing	Exists Expect Anticipate	Klickitat Watershed Enhancement Project Yakima/ Klickitat Fisheries Project Underwood Cons. Dist. Mid-Columbia RFEG	PCSRF Mid-C RFEG BPA Tribal Funds Land Trust
		Stream Temperature Projects	Stream Temperature Water Quality	Restoring Bloodgood Springs and converting water use withdrawal from Bloodgood Springs to improve water temperature of Little Klickitat River	2001-2006 Ongoing	Exists Anticipate	City of Goldendale WDOE CK Cons. Dist.	WDOE Water Quality Grants

Table 17-4d. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Bank Stability and Water Quality Projects	Sediment Water Quality Riparian Condition	Restoration projects to address bank stability and water quality in the Little Klickitat River	2000-2006 Ongoing	Exists Expect Anticipate	CK Cons. Dist. WA Cons. Corps Yakama Nation	NRCS EQIP, CREP & CCRP BPA, PCSRF
		Floodplain Management	Habitat Protection Floodplain Function	A floodplain management ordinance regulates all development that may increase flood hazards and requires permits for development within areas with special flood hazards	Ongoing	Exists	Klickitat County	Local General Funds
		Land Use Zoning	Habitat Protection	A county zoning ordinance creates an extensive agriculture land use zone for much of the Klickitat River watershed which generally requires a 20 acre minimum lot size and restricts more intensive land use.	Ongoing	Exists	Klickitat County	Local General Funds

[1/] The non-Federal actions contained in this table and similar tables for other populations in Columbia River Basin tributaries in Washington are based upon information in regional salmon recovery plans or NPCC Fish and Wildlife subbasin plans and on existing State statutory responsibilities and related programs. Nothing in this table should be implied or construed to create any new legal obligation to implement these actions beyond responsibilities already created by Federal or State laws or contracts that are entered into voluntarily.

Table 17-4e. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Methow Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
Upper Columbia Chinook ESU & Upper Columbia Steelhead DPS	Methow River Spring Chinook Methow River Steelhead (WRIA 48 Methow)	Revised GMA Critical Areas Ordinance Adopted	Habitat Protection	Regulations to protect wetlands and fish and wildlife habitat using best available science and giving special consideration to protection/conservation of salmonids.	12/01/11	Exists Expect	Okanogan County Cities of Pateros, Twisp, Winthrop	State General Fund & Local General Funds
		SMA Shoreline Master Program Update	Habitat Protection Habitat Restoration	Shoreline Master Programs are being updated consistent with revised statewide Shoreline Master Program Guidelines (2003) to protect shoreline resources, vegetation, fish and wildlife.	12/01/14	Expect Anticipate	Okanogan County Cities of Pateros, Twisp, Winthrop	State General Fund & Local General Funds
		SMA Permits Issued	Habitat Protection	28 substantial development permits and 2 conditional use permits issued with conditions consistent with SMA Master Programs	Ongoing	Exists	Okanogan County Cities of Pateros, Twisp, Winthrop	Local General Funds
		SMA Permits Approved or Denied	Habitat Protection	2 conditional use permits approved with added conditions	Ongoing	Exists	WA Dept. of Ecology	State General Fund
		Habitat Project Grants	Habitat Restoration and Preservation	25 projects with total cost of \$10.1 mil. , including 8 acquisitions, consistent with recovery plan and independent technical review; 11% of statewide project funding allocated to entire Upper Columbia region.	2000-2006	Exists Expect	WA Salmon Recovery Funding Board and project sponsors	PCSRF and State Salmon Account (73%), sponsors match (27%)

Table 17-4e. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Methow Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Water Acquisitions	Habitat Restoration Stream Flow	977 annual acre ft. purchased or leased; plus 1 irrigation efficiency project; acquisition/leasing of 33,322 acre ft. of water for mainstem Columbia River flow benefits all populations	FY 04-06 & Ongoing	Exists Expect	WA Dept. of Ecology	State Drought & Building Construction Accounts BPA
		Watershed Plan Implementation	Water Resource Use Water Quality Habitat Protection and Restoration	Watershed plan adopted 06/05; Phase 4 implementation anticipated to begin 2007	Ongoing	Exists Expect	Okanogan County WA Dept. of Ecology	State Water Quality Account
		Instream Flow Rule and Regulation	Habitat Restoration Stream Flow	Instream flow rule since 1976 will be revisited when new data available	Ongoing	Exists	WA Dept. of Ecology	State Water Quality Account State General Fund
		NPDES Permits	Water Quality Protection	19 active NPDES permits (1 construction stormwater, 3 sand & gravel, 3 municipal, 1 industrial, 8 fruit packers, 3 fish hatchery)	Ongoing	Exists	WA Dept. of Ecology	Permit Fee Acct. State Toxics Acct. EPA CWA Grant State General Fund
		Implementing TMDL and Water Cleanup Plans	Water Quality Protection and Restoration	9 of 11 needed water cleanup plans for stream segments are underway or completed	Ongoing	Exists Expect Anticipate	WA Dept. of Ecology	State General Fund EPA CWA Grant
		Water Quality Improvement Grants	Water Quality Protection and Restoration	4 projects funded since 2000 at a project cost of $3.27 million	Ongoing	Exists Expect	WA Dept. of Ecology	Centennial Fund CWA Section 319

Table 17-4e. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Methow Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Water Quality Certification	Water Quality Protection	2 individual Section 401 water quality certifications issued	Since 01/04	Exists	WA Dept. of Ecology	State Water Quality Account State General Fund
		Forest Lands HCPs	Habitat Protection and Restoration	0.5% of WRIA 48 covered by DNR state forest lands HCP, 2.5% of WRIA 48 covered by Forest & Fish HCP applicable to private forest lands	Ongoing	Exists Expect	WA Dept of Natural Resources & forest land owners	DNR Forest Development Acct. DNR Resource Mgt. Cost Acct. PCSRF, SGF Forest Land Owners
		Hatchery Improvement to Recover Wild Stocks	Hatchery Impact on Wild Stocks	Pending completion of HSRG review, 12 of 19 recovery plan hatchery improvement actions for steelhead completed (1) or in process, 12 of 16 actions for spring Chinook in process	2005-Present Ongoing	Exists Expect	WA Dept. of Fish and Wildlife, Chelan County PUD, Douglas County PUD	Contracts with Chelan County PUD, Douglas County PUD
		Hydraulic Project Approvals	Habitat Protection Water Quality Protection	169 HPAs issued for projects in or near state waters from 2000–2006 consistent with Aquatic Habitat Guidelines	Ongoing	Exists Expect	WA Dept. of Fish and Wildlife	State General Fund
		Tributary Habitat Conservation – Mid-Columbia PUDs HCPs	Hydro Dam Survival Habitat Restoration Compensation	Habitat improvements will contribute 2% of survival toward 100% "no-net-impact" goal	2003-2053	Exists Expect	Chelan County PUD Douglas County PUD	Dedicated PUD Accounts

Table 17-4e. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Methow Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Hatchery Supplementation - Mid-Columbia PUDs HCPs	Hydro Dam Survival Hatchery Compensation	Hatchery supplementation will contribute 7% toward the 100% "no-net-impact" goal	2003-2053	Exists Expect	Chelan County PUD Douglas County PUD	Dedicated PUD Accounts
		Hydropower Operations - Mid-Columbia PUDs HCPs	Hydro Dam Survival Wells Dam Rock Island Dam Rocky Reach Dam	Achieve 91% adult and juvenile overall project survival; 95% juvenile dam passage survival and 93% juvenile survival throughout projects by implementing spill, juvenile bypass system, and other project improvements.	2003-2053	Exists Expect	Chelan County PUD Douglas County PUD	Dedicated PUD Accounts
		Reestablish Beaver Populations	Water Quantity Habitat Diversity Habitat Quantity	Improve water storage capacity and instream structure and diversity though reestablishing beaver populations across subbasin in 3-6 locations	2009-2016	Anticipate	Pacific Biodiversity Institute USFS, WDFW	WA SRFB BPA Other Grant Funds
		Dike Removal and Side Channel Reconnection	Habitat Diversity Habitat Quality Floodplain Function	Evaluate and implement as feasible and appropriate dike removal along mainstem Methow River	2006-2012	Exists Expect	Methow Salmon Recovery Foundation (MSRF)	Trib Fund WA SRFB
		Riparian Restoration	Habitat Diversity Habitat Quality Riparian Condition	Protect cottonwood forest and replant unused lands in ripatrian areas of Methow River; implement Respect the River Program in tributary creeks and rivers; fence riparian area of Lower Chewuch	Ongoing	Exists Expect	MSRF Methow Conservancy	Trib Fund WA SRFB
		Nutrient Restoration	Depleted Nutrients	Use hatchery carcasses and/or carcass analogs to enhance nutrients available in habitat in Upper Methow and Chewuch River	2009-2012 Ongoing	Exists Expect	WDFW Methow Fly Fishers	Donated Volunteer Time

Table 17-4e. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Methow Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Culvert Replacement	Obstructions Passage/Access	Replace 8 culverts blocking passage at different locations	2006-2012	Exists Expect	WDFW	WDFW WA SRFB
		Bridge Reconstruction	Obstructions Passage/Access	Rebuild three bridges on Highway 20 affecting fish passage	2006-2020	Exists	WSDOT	Fish Enhancement Fund
		Restore Instream Structure	Habitat Diversity Habitat Quality Habitat Quantity	Add LWD complexes and other instream structure to improve habitat quantity, diversity, and quality in tributary creeks	2006-2020	Exists Expect	MSRF	Trib Fund WA SRFB
		Comprehensive Flood Hazard Management Plan (CMZ)	Floodplain Function Habitat Protection and Restoration	Criteria establishing land use regulations within the channel migration zone/100 year floodplain	2003-2009	Exists Expect	Okanogan County and Municipalities	FCAAP Local General Funds

[1/] The non-Federal actions contained in this table and similar tables for other populations in Columbia River Basin tributaries in Washington are based upon information in regional salmon recovery plans or NPCC Fish and Wildlife subbasin plans and on existing State statutory responsibilities and related programs. Nothing in this table should be implied or construed to create any new legal obligation to implement these actions beyond responsibilities already created by Federal or State laws or contracts that are entered into voluntarily.

Table 17-4f. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Yakima Subbasin (Lower Yakima WRIA 37)

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
Mid-Columbia Steelhead DPS	Satus Creek Steelhead Toppenish Creek Steelhead (WRIA 37 Lower Yakima, 2,910 sq. miles)	GMA Comp. Plan Adopted	Habitat Protection	Provides comprehensive framework and policy direction for local land use decisions including shoreline policies and any subarea plans.	7/27/04 12/01/06	Exists	City of Benton City Benton County Cities of Prosser, West Richland Yakima County and Cities of Grandview, Granger, Harrah, Mabton, Moxee, Sunnyside, Toppenish, Union Gap, Wapato, Yakima, Zillah	State General Fund & Local General Funds
		GMA Development Regulations Adopted	Habitat Protection	Regulations consistent with Comp. Plan and governing development of land, such as zoning, subdivisions and site plans	12/01/06	Exists	Benton County Cities of Benton City, Prosser, West Richland Yakima County and Cities of Grandview, Granger, Harrah, Mabton, Moxee, Sunnyside, Toppenish, Union Gap, Wapato, Yakima, Zillah	State General Fund & Local General Funds

Table 17-4f. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Yakima Subbasin (Lower Yakima WRIA 37)

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) 1/	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Revised GMA Critical Areas Ordinance Adopted	Habitat Protection	Regulations to protect wetlands and fish and wildlife habitat using best available science and giving special consideration to protection/conservation of salmonids.	12/01/07 12/01/10	Exists Expect	Benton County Cities of Prosser, West Richland Yakima County Cities of Grandview, Granger, Harrah, Mabton, Moxee, Sunnyside, Toppenish, Union Gap, Yakima, Zillah City of Benton city City of Wapato	State General Fund & Local General Funds
		SMA Shoreline Master Program Update	Habitat Protection	Shoreline Master Programs are being updated consistent with revised statewide Shoreline Master Program Guidelines (2003) to protect shoreline resources, vegetation, fish and wildlife.	12/01/13	Expect Anticipate	Benton County Cities of Benton City, Prosser, West Richland Yakima County Cities of Grandview, Granger, Harrah, Mabton, Moxee, Sunnyside, Toppenish, Union Gap, Wapato, Yakima, Zillah	State General Fund & Local General Funds

Table 17-4f. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Yakima Subbasin (Lower Yakima WRIA 37)

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		SMA Permits Issued	Habitat Protection	24 substantial development permits and 10 conditional use permits issued with conditions consistent with SMA Master Programs	Ongoing	Exists	Benton County Cities of Benton City, Prosser, West Richland Yakima County Cities of Grandview, Granger, Harrah, Mabton, Moxee, Sunnyside, Toppenish, Union Gap, Wapato, Yakima, Zillah	Local General Funds
		SMA Permits Approved or Denied	Habitat Protection	5 conditional use permits and 1 variance approved with added conditions	Ongoing	Exists	WA Dept. of Ecology	State General Fund
		Habitat Project Grants	Habitat Restoration and Preservation	8 projects with total cost of $1.9 mil. , including 1 acquisition, consistent with recovery plan and independent technical review; 10% of statewide project funding allocated to entire Mid-Columbia region.	2000-2006	Exists Expect	WA Salmon Recovery Funding Board and project sponsors	PCSRF and State Salmon Account (42%), sponsors match (58%)
		Water Acquisitions	Habitat Restoration Stream Flow	363 annual acre ft. purchased/leased and 1 irrigation efficiency project; acquisition/leasing of 33,322 acre ft. of water for mainstem Columbia River flow benefits all populations	FY 04-06 & Ongoing	Exists Expect	WA Dept. of Ecology	State Drought & Building Construction Accounts BPA

Table 17-4f. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Yakima Subbasin (Lower Yakima WRIA 37)

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) 1/	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
	Lower Yakima River	Watershed Plan Implementation	Water Resource Use Water Quality Habitat Protection and Restoration	Watershed plan adopted 11/05 and Phase 4 implementation initiated 09/06	Ongoing	Exists Expect	Yakima County Benton County WA Dept. of Ecology	State Water Quality Account
		Instream Target Flow Regulation	Habitat Restoration Stream Flow	Target flows and tribal treaty flow rights enacted by Congress and Federal Court	Ongoing	Exists	US Bureau of Reclamation (BOR)	BOR
		NPDES Permits	Water Quality Protection	174 active NPDES permits (14 construction stormwater, 21 industrial stormwater, 19 sand & gravel, 13 municipal, 42 industrial, 54 fruit packers, 8 animal feedlots, 1 fish hatchery, 2 aquatic perticide)	Ongoing	Exists	WA Dept. of Ecology	Permit Fee Acct. State Toxics Acct. EPA CWA Grant State General Fund
		Implementing TMDL and Water Cleanup Plans	Water Quality Protection and Restoration	14 of 107 needed water cleanup plans for stream segments are underway or completed	Ongoing	Exists Expect Anticipate	WA Dept. of Ecology	State General Fund EPA CWA Grant
		Water Quality Improvement Grants	Water Quality Protection and Restoration	21 projects in WRIA 37 funded since 2000 at a project cost of $7.9 million	Ongoing	Exists Expect	WA Dept. of Ecology	Centennial Fund CWA Section 319 Aquatic Weeds Acct. State Toxics Acct. Local Toxics Acct.

Table 17-4f. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Yakima Subbasin (Lower Yakima WRIA 37)

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
	Satus Creek Steelhead	Water Quality Certification	Water Quality Protection	2 individual Section 401 water quality certifications issued	Since 01/04	Exists	WA Dept. of Ecology (WDOE)	State Water Quality Account State General Fund
		Forest Lands HCPs	Habitat Protection and Restoration	1.5% of WRIA 37 covered by DNR state forest lands HCP, 2.3 % of WRIA 37 covered by Forest & Fish HCP applicable to private forest lands	Ongoing	Exists Expect	WA Dept of Natural Resources & forest land owners	DNR Forest Development Acct. DNR Resource Mgt. Cost Acct. PCSRF, SGF Forest Land Owners
	Toppenish Creek Steelhead	Hydraulic Project Approvals	Habitat Protection Water Quality Protection	276 HPAs issued for projects in or near state waters from 2000–2006 consistent with Aquatic Habitat Guidelines	Ongoing	Exists Expect	WA Dept. of Fish and Wildlife (WDFW)	State General Fund
		Artificial Production & Kelt Reconditioning	Juvenile and Adult Survival/Productivity	Use artificial production techniques, including kelt reconditioning, to increase number of steelhead returning to underutilized habitats	Ongoing	Exists Expect Anticipate	Yakima/Klickitat Fisheries Project Yakama Nation WDFW	BPA WDFW
		Water Diversion Screening	Juvenile Mortality	Reduce entrainment mortality of juveniles and kelts by completing adequate screening of all water diversions on Yakima Basin tributaries and pumps and small diversions on mainstem Yakima River	Ongoing	Exists Expect Anticipate	Yakama Nation County Conservation Districts Irrigation Districts Individual Irrigators	BPA WDFW

Table 17-4f. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Yakima Subbasin (Lower Yakima WRIA 37)

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Easements/Aquisitions	Habitat Protection	Use conservation easements and land acquisitions downstream from Sunnyside Dam to protect key habitat functions	Ongoing	Exists Expect Anticipate	Yakama Nation Tapteal Greenway Yakima Greenway BOR	BPA, WDFW WA SRFB Yakama Nation Private Funds
		Irrigation Efficiency & Delivery Efficiency	Stream Flows	Increase on-farm irrigation efficiency and irrigation water delivery efficiency	Ongoing	Exists Expect Anticipate	WDOE, BOR, USDA County Cons. Dists. Irrigation Districts	BOR USDA Irrigators
		Mainstem and Side-Channel Habitat Restoration	Habitat Quantity Habitat Diversity Floodplain Connectivity	Restore mainstem and side-channel rearing habitats and refugia below Sunnyside Dam and from Naches River to Sunnyside Dam	Ongoing	Exists Expect Anticipate	Yakima County Flood Control Zone District, USACE BOR, Yakama Nation	USACE, BPA WA SRFB Yakima County Flood Control Zone District
		Irrigation Return Flows	Water Quality Sediment	Improve quality of irrigation return flows	Ongoing	Exists Expect Anticipate	WDOE, BIA, USDA Irrigation Districts County Cons. Dists. WSU Extension	USDA Irrigators WDOE
		Instream Flows	Stream Flow Habitat Quality Water Quality	Develop and implement biologically based instream flows below Prosser Dam	2007-2010	Anticipate	BOR WDOE	BOR

Table 17-4f. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Yakima Subbasin (Lower Yakima WRIA 37)

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) 1/	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Irrigation Return Flows	Water Quality Habitat Quality	Reduce and improve irrigation return flows in lower Satus Creek by rerouting North Drain into wetlands and improving Satus East and West Laterals	2007-2013	Anticipate	USACE, USDA BPA, USFWS BIA/Wapato Project Yakama Nation	BPA BIA
		Improved Grazing Management	Riparian Condition Sediment	Improve feral horse management and continue improvement in cattle management to reduce grazing impacts and riparian zone damage	Ongoing	Exists	Yakama Nation BIA	BIA BPA
		Correct Passage Barrier	Fish Passage/Access	Restore fish passage at Highway 97 crossing of Shinando Creek	2007-2013	Anticipate	WSDOT	WSDOT
		Remove Diversion Dam	Fish Passage/Access Habitat Quality	Remove the Satus Diversion Dam to improve fish passage and channel habitat	2007-2010	Anticipate	Yakama Nation	BPA
		Road Closure and/or Improvement	Sediment Habitat Quality	Improve, relocate or close forest roads in the Satus Creek watershed to reduce sediment and peak flows	2007-2013	Anticipate	BIA Yakama Agency Yakama Nation	BIA BPA
		Restore Alluvial Fan and Floodplain	Habitat Connectivity Habitat Quantity	Rehabilitate alluvial fan and downstream floodplain to reconnect and improve habitat and address seepage loss in fan	2007-2015	Expect Anticipate	Yakama Nation BIA	BPA
		Riparian and Floodplain Acquisitions	Riparian Condition Habitat Quality	Continue lease or purchase of riparian areas of Toppenish and Simcoe Creeks and adjacent areas of Yakima River	Ongoing	Exists Expect	Yakama Nation	BPA

Table 17-4f. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Yakima Subbasin (Lower Yakima WRIA 37)

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Road Closure and/or Improvement	Sediment Habitat Quality	Improve, relocate or close forest roads in the Toppenish Creek watershed to reduce sediment and peak flows	2007-2013	Expect Anticipate	BIA Yakama Agency Yakama Nation	BIA BPA
		Replace Undersized Culvert	Fish Passage/Access	Replace undersized crossing culvert in lower Toppenish Creek that is partial blockage or purchase property to correct passage and protect habitat	2010	Anticipate	Yakama Nation	BPA

[1/] The non-Federal actions contained in this table and similar tables for other populations in Columbia River Basin tributaries in Washington are based upon information in regional salmon recovery plans or NPCC Fish and Wildlife subbasin plans and on existing State statutory responsibilities and related programs. Nothing in this table should be implied or construed to create any new legal obligation to implement these actions beyond responsibilities already created by Federal or State laws or contracts that are entered into voluntarily.

Table 17-4g. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Yakima Subbasin (Naches WRIA 38)

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) 1/	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
Mid-Columbia Steelhead DPS	Naches River Steelhead (WRIA 38 Naches, 1,109 sq. miles)	GMA Comp. Plan Adopted	Habitat Protection	Provides comprehensive framework and policy direction for local land use decisions including shoreline policies and any subarea plans.	12/01/06	Exists	Yakima County Cities of Naches, Selah, Tieton	State General Fund & Local General Funds
		GMA Development Regulations Adopted	Habitat Protection	Regulations consistent with Comp. Plan and governing development of land, such as zoning, subdivisions and site plans	12/01/06	Exists	Yakima County Cities of Naches, Selah, Tieton	State General Fund & Local General Funds
		Revised GMA Critical Areas Ordinance Adopted	Habitat Protection	Regulations to protect wetlands and fish and wildlife habitat using best available science and giving special consideration to protection/conservation of salmonids.	12/01/07 12/01/10	Exists Expect	Yakima County Cities of Selah, Tieton City of Naches	State General Fund & Local General Funds
		SMA Shoreline Master Program Update	Habitat Protection Habitat Restoration	Shoreline Master Programs are being updated consistent with revised statewide Shoreline Master Program Guidelines (2003) to protect shoreline resources, vegetation, fish and wildlife.	12/01/13	Expect Anticipate	Yakima County Cities of Naches, Selah, Tieton	State General Fund & Local General Funds
		SMA Permits Issued	Habitat Protection	17 substantial development permits, 2 conditional use permits issued with conditions consistent with SMA Master Programs	Ongoing	Exists	Yakima County Cities of Naches, Selah, Tieton	Local General Funds
		SMA Permits Approved or Denied	Habitat Protection	1 conditional use permit and 4 variances approved with added conditions	Ongoing	Exists	WA Dept. of Ecology	State General Fund

Table 17-4g. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Yakima Subbasin (Naches WRIA 38)

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Habitat Project Grants	Habitat Restoration and Preservation	7 projects with total cost of $4.0 mil. , including 2 acquisitions, consistent with recovery plan and independent technical review; 10% of statewide project funding allocated to entire Mid-Columbia region.	2000-2006	Exists Expect	WA Salmon Recovery Funding Board and project sponsors	PCSRF and State Salmon Account (38%), sponsors match (62%)
		Water Acquisitions	Habitat Restoration Stream Flow	260,000 annual acre ft. purchased or leased; acquisition or leasing of 33,322 acre ft. of water for mainstem Columbia River flow benefits all populations	FY 04-06 & Ongoing	Exists Expect	WA Dept. of Ecology	State Drought & Building Construction Accounts BPA
		Watershed Plan Implementation	Water Resource Use Water Quality Habitat Protection and Restoration	Watershed plan adopted 11/05 and Phase 4 implementation initiated 09/06	Ongoing	Exists Expect	Yakima County WA Dept. of Ecology	State Water Quality Account
		Instream Target Flow Regulation	Habitat Restoration Stream Flow	Target flows and tribal treaty flow rights enacted by Congress and Federal Court	Ongoing	Exists	US Bureau of Reclamation (BOR)	Federal BOR Funds
		NPDES Permits	Water Quality Protection	48 active NPDES permits (7 construction stormwater, 3 industrial stormwater, 5 sand & gravel, 3 municipal, 3 industrial, 26 fruit packers, 1 fish hatchery)	Ongoing	Exists	WA Dept. of Ecology	Permit Fee Acct. State Toxics Acct. EPA CWA Grant State General Fund

Table 17-4g. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Yakima Subbasin (Naches WRIA 38)

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Implementing TMDL and Water Cleanup Plans	Water Quality Protection and Restoration	3 of 39 needed water cleanup plans for stream segments are underway or completed	Ongoing	Exists Expect Anticipate	WA Dept. of Ecology	State General Fund EPA CWA Grant
		Water Quality Improvement Grants	Water Quality Protection and Restoration	5 projects funded since 2000 at a project cost of $1.94 million	Ongoing	Exists Expect	WA Dept. of Ecology	Centennial Fund State Revolving Acct. Aquatic Weeds Acct.
		Forest Lands HCPs	Habitat Protection and Restoration	3.1% of WRIA 38 covered by DNR state forest lands HCP, 2.5% of WRIA 38 covered by other forest owner HCP, 6.9% of WRIA 38 covered by Forest & Fish HCP applicable to private forest lands	Ongoing	Exists Expect	WA Dept of Natural Resources & forest land owners	DNR Forest Development Acct. DNR Resource Mgt. Cost Acct. PCSRF, SGF Forest Land Owners
		Hydraulic Project Approvals	Habitat Protection Water Quality Protection	305 HPAs issued for projects in or near state waters from 2000–2006 consistent with Aquatic Habitat Guidelines	Ongoing	Exists Expect	WA Dept. of Fish and Wildlife (WDFW)	State General Fund
		Artificial Production & Kelt Reconditioning	Juvenile and Adult Survival/Productivity	Use artificial production techniques, including kelt reconditioning, to increase number of steelhead returning to underutilized habitats	Ongoing	Exists Expect Anticipate	Yakima/Klickitat Fisheries Project Yakama Nation WDFW	BPA WDFW

Table 17-4g. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Yakima Subbasin (Naches WRIA 38)

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) 1/	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Water Diversion Screening	Juvenile Mortality	Reduce entrainment mortality of juveniles and kelts by completing adequate screening of all water diversions on Yakima Basin tributaries and pumps and small diversions on mainstem Yakima River	Ongoing	Exists Expect Anticipate	Yakama Nation North Yakima Cons. District Irrigation Districts Individual Irrigators	BPA WDFW WA SRFB
		Improve Water Use Efficiency	Stream Flow	Improve stream flows by improving conveyance and water use efficiency in irrigation systems	2007-2013	Exists Anticipate	Irrigation Districts North Yakima Cons. District, BOR	BOR, BPA, USDA Irrigation Districts WDOE
		Floodplain Restoration	Floodplain Connectivity Riparian Condition Habitat Quality	Restore lower Naches River and lower Cowiche Creek floodplain habitat connectivity by removal of passage barrier/false attraction problems, levee pull-backs, riparian/channel improvement	2016	Anticipate	Lower Naches Partnership Group Yakima Co. Flood Control Zone District City of Yakima Land Owners WDFW	BPA, USACE WA SRFB City of Yakima Yakima Co. Flood Control Zone Dist.
		Reduce Recreation Impacts	Water Quality Habitat Quality	Reduce dispersed impacts of recreation and related facilities on stream habitats	Ongoing	Exists Anticipate	USFS, DNR Mid-Columbia RFEG	USFS Mid-C RFEG
		Provide Fish Passage in Tributaries	Fish Passage/ Access	New bridge and channel reconstruction in Nile Creek; barrier removal in Ahtanum, Cowiche, and Rattlesnake Creeks	2006-2012	Exists Expect Anticipate	Yakima Co. Public Services, North Yakima Cons. Dist. Irrigators	USFS BPA WA SRFB Yakima County

Table 17-4g. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Yakima Subbasin (Naches WRIA 38)

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Improve Tributary Stream Flows	Stream Flows Habitat Quality	Improve irrigation management and/or acquire water rights to improve instream flows in Nile, Rattlesnake, Cowiche and Ahtanum Creeks	2006-2012	Exists Expect Anticipate	North Yakima Cons. Dist., Yakima Co. Public Services Irrigators, WDOE	BPA USDA WDOE
		Restore Riparian Areas	Riparian Condition Habitat Quality	Restore and improve riparian habitat including reaches on Oak, Ahtanum, Cowiche, and Rattlesnake Creeks and the Little Naches River	Ongoing	Exists Expect Anticipate	North Yakima Cons. Dist., Yakama Nation WDFW, DNR USFS, Land Owners	BPA, USFS USDA WA SRFB Mid-C RFEG

[1/] The non-Federal actions contained in this table and similar tables for other populations in Columbia River Basin tributaries in Washington are based upon information in regional salmon recovery plans or NPCC Fish and Wildlife subbasin plans and on existing State statutory responsibilities and related programs. Nothing in this table should be implied or construed to create any new legal obligation to implement these actions beyond responsibilities already created by Federal or State laws or contracts that are entered into voluntarily.

Table 17-4h. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRP – Yakima Subbasin (Upper Yakima WRIA 39)

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
Mid-Columbia Steelhead DPS	Upper Yakima Steelhead (WRIA 39 Upper Yakima, 2,136 sq. miles)	GMA Comp. Plan Adopted	Habitat Protection	Provides comprehensive framework and policy direction for local land use decisions including shoreline policies and any subarea plans.	3/15/04 12/29/05 12/01/06	Exists	Cities of Cle Elum, Kittitas, S. Cle Elum Cities of Ellensburg, Roslyn Kittitas County	State General Fund & Local General Funds
		Revised GMA Critical Areas Ordinance Adopted	Habitat Protection	Regulations to protect wetlands and fish and wildlife habitat using best available science and giving special consideration to protection/conservation of salmonids.	3/14/06 12/01/07 12/01/10	Exists Expect	City of Roslyn Kittitas County Cities of Ellensburg, South Cle Elum Cities of Cle Elum, Kittitas	State General Fund & Local General Funds
		SMA Shoreline Master Program Update	Habitat Protection Habitat Restoration	Shoreline Master Programs are being updated consistent with revised statewide Shoreline Master Program Guidelines (2003) to protect shoreline resources, vegetation, fish and wildlife.	12/01/13	Expect Anticipate	Kittitas County Cities of Cle Elum, Ellensburg, Kittitas, Roslyn, South Cle Elum	State General Fund & Local General Funds
		SMA Permits Issued	Habitat Protection	32 substantial development permits and 1 conditional use permit issued with conditions consistent with SMA Master Programs, 1 variance denied	Ongoing	Exists	Kittitas County Cities of Cle Elum, Ellensburg, Kittitas, Roslyn, South Cle Elum	Local General Funds
		SMA Permits Approved or Denied	Habitat Protection	1 conditional use permit and 12 variances approved with added conditions, 1 variance denied	Ongoing	Exists	WA Dept. of Ecology	State General Fund

Table 17-4h. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRP – Yakima Subbasin (Upper Yakima WRIA 39)

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Habitat Project Grants	Habitat Restoration and Preservation	17 projects with total cost of $5.2 mil. , including 6 acquisitions, consistent with recovery plan and independent technical review; 10% of statewide project funding allocated to entire Mid-Columbia region.	2000-2006	Exists Expect	WA Salmon Recovery Funding Board and project sponsors	PCSRF and State Salmon Account (64%), sponsors match (36%)
		Water Acquisitions	Habitat Restoration Stream Flow	9,901 annual acre ft. purchased or leased; plus 7 irrigation efficiency projects; acquisition or leasing of 33,322 acre ft. of water for mainstem Columbia River flow benefits all populations	FY 04-06 & Ongoing	Exists Expect	WA Dept. of Ecology	State Drought & Building Construction Accounts BPA
		Instream Target Flow Regulation	Habitat Restoration Stream Flow	Managing target flows and tribal treaty flow rights enacted by Congress and Federal Court	Ongoing	Exists	US Bureau of Reclamation (BOR)	Federal BOR Funds
		NPDES Permits	Water Quality Protection	48 active NPDES permits (16 construction stormwater, 4 industrial stormwater, 16 sand & gravel, 4 municipal, 3 industrial, 3 fruit packers, 1 fish hatchery, 1 animal feedlot)	Ongoing	Exists	WA Dept. of Ecology	Permit Fee Acct. State Toxics Acct. EPA CWA Grant State General Fund

Table 17-4h. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRP – Yakima Subbasin (Upper Yakima WRIA 39)

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Implementing TMDL and Water Cleanup Plans	Water Quality Protection and Restoration	67 of 107 needed water cleanup plans for stream segments are underway or completed	Ongoing	Exists Expect Anticipate	WA Dept. of Ecology	State General Fund EPA CWA Grant
		Water Quality Improvement Grants	Water Quality Protection and Restoration	15 projects funded since 2000 at a project cost of $2.59 million	Ongoing	Exists Expect	WA Dept. of Ecology	Centennial Fund CWA Section 319 Local Toxics Acct. Aquatic Weeds Acct.
		Water Quality Certification	Water Quality Protection	2 individual Section 401 water quality certifications issued	Since 01/04	Exists	WA Dept. of Ecology (WDOE)	State Water Quality Account State General Fund
		Forest Lands HCPs	Habitat Protection and Restoration	5.1% of WRIA 39 covered by DNR state forest lands HCP, 5.3% of WRIA 39 covered by other forest owner HCPs, 15.0% of WRIA 39 covered by Forest & Fish HCP applicable to private forest lands	Ongoing	Exists Expect	WA Dept of Natural Resources (DNR) Forest Land Owners	DNR Forest Development Acct. DNR Resource Mgt. Cost Acct. PCSRF, SGF Forest Land Owners

Table 17-4h. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRP – Yakima Subbasin (Upper Yakima WRIA 39)

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Hydraulic Project Approvals	Habitat Protection Water Quality Protection	768 HPAs issued for projects in or near state waters from 2000–2006 consistent with Aquatic Habitat Guidelines	Ongoing	Exists Expect	WA Dept. of Fish and Wildlife	State General Fund
		Artificial Production & Kelt Reconditioning	Juvenile and Adult Survival/ Productivity	Use artificial production techniques, including kelt reconditioning, to increase number of steelhead returning to underutilized habitats	Ongoing	Exists Expect Anticipate	Yakima/Klickitat Fisheries Project Yakama Nation WDFW	BPA WDFW
		Water Diversion Screening	Juvenile Mortality	Reduce entrainment mortality of kelts and juveniles by completing adequate screening of all water diversions on Yakima Basin tributaries and pumps and small diversions on mainstem Yakima R.	Ongoing	Exists Expect Anticipate	Yakima Nation Kittitas Cons. Dist. Irrigation Districts Individual Irrigators	BPA WDFW WA SRFB
		Reduce Channel Confinement	Floodplain Connectivity Habitat Quantity	Reduce confinement of upper Yakima River channel by reconnecting side-channels or ponds and levee pullbacks	2006-2016	Expect Anticipate	WSDOT, Yakama Nation, Yakima Co., Kittitas Co., USACE, Gravel Operators	WSDOT WA SRFB BPA USACE
		Restore Riparian Areas	Riparian Condition Habitat Diversity	Restore tributary riparian areas in lower ends of numerous tributaries in Kittitas Valley	Ongoing	Expect Anticipate	Kittitas Cons. District Kittitas Cons. Trust Yakama Nation	BPA WA SRFB Mid-C FEG USDA

Table 17-4h. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRP – Yakima Subbasin (Upper Yakima WRIA 39)

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Habitat Protection in Development Plans	Habitat Protection Habitat Preservation	Build conservation easements and other habitat protections into development plans for Teanaway River, Ellensburg growth area, Swauk Creek and Big Creek	2006-2012	Anticipate	Kittitas County Kittitas Cons. Trust Cascade Land Conservancy	BPA WA SRFB WWRP Private/ NGO Funds
		Improve Instream Flows	Stream Flows Water Quantity	Improve instream flows in Swauk Creek by improved water management, off-stream storage, water acquisitions	Ongoing	Anticipate	WDOE Kittitas Cons. Trust Yakama Nation BOR Kittitas County	BPA WDOE BOR Land Owners
		Restore Instream Habitat Complexity	Habitat Diversity Habitat Quality	Restore habitat complexity in middle and lower reaches of Swauk and Taneum Creeks and Teanaway and Cle Elun Rivers by LWD and instream structure and bank and channel reshaping	2006-2012	Exists Anticipate	Yakama Nation Kittitas County WDFW, BOR Kittitas Cons. District Kittitas Cons. Trust	BPA WA SRFB
		Acquisitions or Easements in Teanaway	Habitat Protection Habitat Preservation	Acquire land or conservation easements in Teanaway watershed needed to protect high quality habitat from intense development pressure	2007-2017	Exists Anticipate	Cascade Land Conservancy WDFW, BOR, USFS Kittitas Cons. Trust	BPA KVT WA SRFB Land Owners Land Trusts
		Replace Culverts	Fish Passage/ Access	Replace two culverts affecting fish passage in Jack Creek and Indian Creek	2009	Exists Expect	Kittitas Cons. District Kittitas County Kittitas Cons. Trust USFS	USFS BPA WA SRFB

Table 17-4h. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRP – Yakima Subbasin (Upper Yakima WRIA 39)

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Acquire/Restore Floodplain, Channel and Riparian Habitats	Habitat Protection Floodplain Function Riparian Condition Habitat Diversity Habitat Quality	Acquire and restore key floodplain, channel and riparian habitats that have been degraded in high priority Easton and Cle Elum reaches	Ongoing	Exists Expect Anticipate	Yakama Nation Private Land Owner Kittitas Cons. Trust Cascade Land Conservancy	BPA WA SRFB WWRP
		Provide Passage at Barriers	Fish Passage/ Access	Provide passage at barriers to fish passage in seven upper Yakima River tributary streams	2004-2015	Exists Expect	Kittitas Cons. District Irrigation Districts Kittitas Cons. Trust Yakama Nation BOR	BPA BOR Irrigators WA SRFB WDOE
		Separate Irrigation Conveyance from Streams	Water Quality Stream Flows	Separate irrigation conveyance from live stream channels and conserve water for stream flow for Dry, Reecer, and Currier Creeks and Wilson Creek and its tributaries	Ongoing	Exists Anticipate	Kittitas Cons. District Irrigation Districts	BPA BOR Irrigators WA SRFB WDOE

[1/] The non-Federal actions contained in this table and similar tables for other populations in Columbia River Basin tributaries in Washington are based upon information in regional salmon recovery plans or NPCC Fish and Wildlife subbasin plans and on existing State statutory responsibilities and related programs. Nothing in this table should be implied or construed to create any new legal obligation to implement these actions beyond responsibilities already created by Federal or State laws or contracts that are entered into voluntarily.

Table 17-4i. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Okanogan Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) 1/	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
Upper Columbia Steelhead DPS	Okanogan River Steelhead (WRIA 49 Okanogan, 2,101 sq. miles)	Revised GMA Critical Areas Ordinance Adopted	Habitat Protection	Regulations to protect wetlands and fish and wildlife habitat using best available science and giving special consideration to protection/conservation of salmonids.	12/01/08 12/01/11	Exists Expect	Cities of Conconully, Riverside Okanogan County Cities of Omak, Okanogan, Oroville, Tonasket	State General Fund & Local General Funds
		SMA Shoreline Master Program Update	Habitat Protection Habitat Restoration	Shoreline Master Programs are being updated consistent with revised statewide Shoreline Master Program Guidelines (2003) to protect shoreline resources, vegetation, fish and wildlife.	12/01/14	Expect Anticipate	Okanogan County Cities of Omak, Conconully, Oroville, Okanogan, Riverside, Tonasket	State General Fund & Local General Funds
		SMA Permits Issued	Habitat Protection	26 substantial development permits and 5 conditional use permits issued with conditions consistent with SMA Master Programs	Ongoing	Exists	Okanogan County Cities of Omak, Conconully, Oroville, Okanogan, Riverside, Tonasket	Local General Funds
		SMA Permits Approved or Denied	Habitat Protection	4 conditional use permits approved with added conditions	Ongoing	Exists	WA Dept. of Ecology (WDOE)	State General Fund

Table 17-4i. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Okanogan Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Habitat Project Grants	Habitat Restoration and Preservation	6 projects with total cost of $1.0 mil. consistent with recovery plan and independent technical review; 11% of statewide project funding allocated to entire Upper Columbia region.	2000-2006	Exists Expect	WA Salmon Recovery Funding Board (SRFB) and project sponsors	PCSRF and State Salmon Account (75%), sponsors match (25%)
		Water Acquisitions	Habitat Restoration Stream Flow	Acquisition or leasing of 33,322 acre ft. of water for mainstem Columbia River flow benefits all populations	FY 04-06 & Ongoing	Exists Expect	WDOE, Colville Confederated Tribes Fish and Wildlife (CCT F&W)	State Drought & Building Constructio n Accounts, BPA Chelan, Douglas, Grant PUDs
		Watershed Plan	Water Resource Use Water Quality Habitat Protection and Restoration Stream Flow	Watershed plan underway and due in 2009	Ongoing	Exists Expect	Okanogan Cons. District WA Dept. of Ecology	State Water Quality Account
		Instream Flow Regulation	Habitat Restoration Stream Flow	Instream flow rule was adopted in 1976	Ongoing	Exists	WA Dept. of Ecology	State Water Quality Account State General Fund

Table 17-4i. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Okanogan Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) 1/	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		NPDES Permits	Water Quality Protection	37 active NPDES permits (2 construction stormwater, 1 industrial stormwater, 5 sand & gravel, 5 municipal, 3 industrial, 20 fruit packers, 1 fish hatchery)	Ongoing	Exists	WA Dept. of Ecology CCT Environmental Trust	Permit Fee Acct. State Toxics Acct. EPA CWA Grant State General Fund
		Implementing TMDL and Water Cleanup Plans	Water Quality Protection and Restoration	34 of 40 needed water cleanup plans for stream segments are underway or completed	Ongoing	Exists Expect Anticipate	WA Dept. of Ecology CCT Environmental Trust	State General Fund EPA CWA Grant
		Water Quality Improvement Grants	Water Quality Protection and Restoration	7 projects funded since 2000 at a project cost of $2.72 million	Ongoing	Exists Expect	WA Dept. of Ecology CCT Environmental Trust	Centennial Fund CWA Section 319 State Toxics Acct.
		Forest Lands HCP	Habitat Protection and Restoration	20.4 % of WRIA 49 covered by Forest & Fish HCP applicable to private forest lands	Ongoing	Exists Expect	WA Dept of Natural Resources & Forest Land Owners, CCT Environmental Trust	PCSRF State General Fund Forest Land Owners

Table 17-4i. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Okanogan Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Hatchery Improvement to Recover Wild Stocks	Hatchery Impact on Wild Stocks	Pending completion of HSRG review, 8 of 19 recovery plan hatchery improvement actions for steelhead completed (1) or in process	2005 – Present Ongoing	Exists Expect	WA Dept. of Fish and Wildlife (WDFW), Chelan County PUD, Douglas County PUD CCT F&W	Contracts with Chelan County PUD, Douglas County PUD
		Hydraulic Project Approvals	Habitat Protection Water Quality Protection	213 HPAs issued for projects in or near state waters from 2000–2006 consistent with Aquatic Habitat Guidelines	Ongoing	Exists Expect	WDFW CCT Environmental Trust	State General Fund
		Tributary Habitat Conservation – Mid-Columbia PUDs HCPs	Hydro Dam Survival Habitat Restoration Compensation	Habitat improvements will contribute 2% of survival toward 100% “no-net-impact” goal	2003-2053	Exists Expect	Chelan County PUD Douglas County PUD	Dedicated PUD Accounts
		Hatchery Supplementation - Mid-Columbia PUDs HCPs	Hydro Dam Survival Hatchery Compensation	Hatchery supplementation will contribute 7% toward the 100% “no-net-impact” goal	2003-2053	Exists Expect	Chelan County PUD Douglas County PUD	Dedicated PUD Accounts

Table 17-4i. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Okanogan Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Hydropower Operations - Mid-Columbia PUDs HCPs	Hydro Dam Survival Wells Dam Rock Island Dam Rocky Reach Dam	Achieve 91% adult and juvenile overall project survival; 95% juvenile dam passage survival and 93% juvenile survival throughout projects by implementing spill, juvenile bypass system, and other project improvements.	2003-2053	Exists Expect	Chelan County PUD Douglas County PUD	Dedicated PUD Accounts
		Protect Existing Habitat	Habitat Diversity	Protect existing habitat functions through acquiring easements and other programs	2003- Ongoing	Exist Expect Anticipate	CCT F&W, Chelan, Douglas, Grant PUDS	Dedicated PUD Accounts
		Install or Improve Screens	Obstructions	Install or improve screens for irrigation diversions and pump intakes in Lower Okanogan River	2007- Ongoing	Expect Anticipate	CCT F&W WDOE	WDOE
		Culvert Replacement	Obstructions to Fish Passage	Replace culverts affecting passage in Loup Loup and Omak Creeks and other small tributaries (2 or more per year)	2006-2016 Ongoing	Expect Anticipate	CCT F&W, BIA Okanogan County CCT Forestry WSDOT	Chelan, Douglas, Grant PUDs WA SRFB

Table 17-4i. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Okanogan Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Riparian restoration	Habitat Diversity Habitat Quantity Sediment	Improve bank stability and riparian condition by planting native vegetation and livestock management throughout subbasin	2000-2016	Exists Expect Anticipate	CCT F&W Okanogan County Weed Board	Chelan, Douglas, Grant PUDs WA SRFB NRCS
		Floodplain Restoration	Habitat Diversity Habitat Quantity Sediment	Reconnect floodplain in areas of Upper Okanogan	2012-2016	Anticipate	CCT F&W	Chelan, Douglas, Grant PUDs WA SRFB
		Increase Stream Flows	Habitat Diversity Habitat Quantity Instream Flows	Increase stream flows by improving irrigation efficiency and converting surface diversions to ground water wells in Loup Loup, Omak and other small creeks	2006-2016	Expect	CCT F&W Okanogan County WDOE	Chelan, Douglas, Grant PUDs WA SRFB PCSRF
		Establish Stream Flow	Water Quantity Instream Flow	Reconnect lower 4.3 miles of Salmon Creek to Okanogan River by reestablishing flow and channel	2006-2012	Expect	CCT F&W, City of Okanogan, WDOE Okanogan County	Chelan, Douglas, Grant PUDs WA SRFB PCSRF
		LWD Recruitment	Habitat Diversity Habitat Quantity	Establish LWD complexes in lower 2.2 miles of Loup Loup Creek when flows established	2016	Anticipate	CCT F&W Okanogan County WDOE	Chelan, Douglas, Grant PUDs WA SRFB PCSRF

Table 17-4i. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Okanogan Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Reduce Sediments	Sediment	Road maintenance or removal, silt fencing and sediment catch basins in Omak Creek and other small tributaries	2006-2016	Exists Expect Anticipate	CCT F&W, BIA Okanogan County CCT Forestry WSDOT	Okanogan County
		Remove Dams	Obstructions to Fish Passage	Remove concrete/wood dams in Tank Creek	2006-2009	Anticipate	CCT F&W Okanogan County	Chelan, Douglas, Grant PUDs WA SRFB PCSRF
		Comprehensive Flood Hazard Management Plan (CMZ)	Floodplain Function Habitat Protection and Restoration	Criteria establishing land use regulations within the channel migration zone/100 year floodplain	2003-2009	Exists Expect	Okanogan County and Municipalities	FCAAP Local General Funds

[1/] The non-Federal actions contained in this table and similar tables for other populations in Columbia River Basin tributaries in Washington are based upon information in regional salmon recovery plans or NPCC Fish and Wildlife subbasin plans and on existing State statutory responsibilities and related programs. Nothing in this table should be implied or construed to create any new legal obligation to implement these actions beyond responsibilities already created by Federal or State laws or contracts that are entered into voluntarily.

Table 17-4j. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Tucannon Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
Snake River Spring/Summer Chinook ESU & Snake River Steelhead DPS	Tucannon River Spring/Summer Chinook Tucannon River Steelhead (Tucannon River portion of WRIA 35 Middle Snake)	Revised GMA Critical Areas Ordinance Adopted	Habitat Protection	Regulations to protect wetlands and fish and wildlife habitat using best available science and giving special consideration to protection/conservation of salmonids.	12/01/11	Exists Expect	Columbia County City of Starbuck Garfield County City of Pomeroy	State General Fund & Local General Funds
		SMA Shoreline Master Program Update	Habitat Protection Habitat Restoration	Shoreline Master Programs are being updated consistent with revised statewide Shoreline Master Program Guidelines (2003) to protect shoreline resources, vegetation, fish and wildlife.	12/01/14	Expect Anticipate	Columbia County City of Starbuck Garfield County City of Pomeroy	State General Fund & Local General Funds
		SMA Permits Issued	Habitat Protection	Substantial development permits and conditional use permits issued with conditions consistent with SMA Master Programs	Ongoing	Exists	Columbia County City of Starbuck Garfield County City of Pomeroy	Local General Funds
		SMA Permits Reviewed and Approved or Denied	Habitat Protection	Conditional use permits and variance approved with added conditions, 1 variance denied	Ongoing	Exists	WA Dept. of Ecology	State General Fund

Table 17-4j. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Tucannon Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Habitat Project Grants	Habitat Restoration and Preservation	20 projects with total cost of $2.4 mil. for both Asotin and Tucannon subbasins consistent with recovery plan and independent technical review; 9% of statewide project funding allocated to entire Snake River region.	2000-2006	Exists Expect	WA Salmon Recovery Funding Board and project sponsors	PCSRF and State Salmon Account (54%), sponsors match (46%)
		Water Acquisitions	Habitat Restoration Stream Flow	3 completed and 8 future irrigation efficiency projects in Tucannon subbasin (w/o acre ft estimate); plus 2 projects in Tucannon saving 181 annual acre ft.; acquisition/leasing of 33,322 annual acre ft. of water for mainstem Columbia River flow benefits all populations	FY 04-06 & Ongoing	Exists Expect	WA Dept. of Ecology	State Drought & Building Constructi on Accounts BPA
		Watershed Plan Implementation	Water Resource Use Water Quality Habitat Protection and Restoration Stream Flow	Watershed plan approval expected 2007	Ongoing	Exists Expect	Columbia County Garfield County WA Dept. of Ecology	State Water Quality Account

Table 17-4j. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Tucannon Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		NPDES Permits	Water Quality Protection	5 active NPDES permits (1 industrial stormwater, 2 municipal, 2 fish hatchery)	Ongoing	Exists	WA Dept. of Ecology	Permit Fee Acct. State Toxics Acct. EPA CWA Grant State General Fund
		Implementing TMDL and Water Cleanup Plans	Water Quality Protection and Restoration	12 of 116 needed water cleanup plans for WRIA 35 stream segments are underway or completed	Ongoing	Exists Expect Anticipate	WA Dept. of Ecology	State General Fund EPA CWA Grant
		Water Quality Improvement Grants	Water Quality Protection and Restoration	3 projects in Tucannon River watershed funded since 2000 at a project cost of $1.65 million	Ongoing	Exists Expect	WA Dept. of Ecology	Centennial Fund CWA Section 319
		Forest Lands HCP	Habitat Protection and Restoration	2.1% of entire WRIA 35 covered by Forest & Fish HCP applicable to private forest lands	Ongoing	Exists Expect	WA Dept of Natural Resources & forest land owners	PCSRF State General Fund Forest Land Owners

Table 17-4j. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Tucannon Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Hydraulic Project Approvals	Habitat Protection Water Quality Protection	310 HPAs issued for projects in or near state waters in entire WRIA 35 from 2000–2006 consistent with Aquatic Habitat Guidelines	Ongoing	Exists Expect	WDFW	State General Fund
		Habitat Sediment Reduction in Garfield County	Water Quality Riparian Condition Excess Sediment	Reduce sediment from uplands in Garfield County and enhance rip[arian function and water quality through CREP (1,333 acres of no-till seeding, 1500 acres of direct seeding, 10 acres of terrace and sediment basins, .63 miles of fencing, 2 off-site watering, 10 acres native planting	2006	Exists	Pomeroy Soil and Water conservation District	BPA F&W NRCS CREP Land Owner Cost-share
		Water Storage Ponds	Habitat Quality Habitat Quantity Stream Flows	Construct water retention pond on Hartsock Creek to reduce peak stream flows	Start 2007	Expect	Columbia Cons. District WDFW	WA Dept. of Ecology
		Barrier Removal	Fish Access/Passage	Remove fish barrier at Curl Lake to connect isolated habitat and increase access and range for salmon.	2006	Exists	WDFW	WA SRFB
		School Fire Riparian Recovery	Riparian Condition Water Quality Sediment	Restore riparian habitat areas damaged during the School Fire	2005-2006	Exists	WDFW Columbia Cons. District USFS	WA SRFB WDFW USFS, BPA WA Cons. Com.

Table 17-4j. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Tucannon Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Wooten Wildlife Area Riparian Recovery	Riparian Condition Water Quality Sediment	Riparian recovery and LWD replenishment to restore riparian function damaged by School Fire; 15 miles of riparian area restored through CREP and campground modified to reduce impacts; upland seeding to reduce sediment	2006-2008	Exists Expect	WDFW Columbia Cons. District USFS, NRCS	WA SRFB USFS WA Cons. Com. NRCS CREP Columbia Cons. District

[1/] The non-Federal actions contained in this table and similar tables for other populations in Columbia River Basin tributaries in Washington are based upon information in regional salmon recovery plans or NPCC Fish and Wildlife subbasin plans and on existing State statutory responsibilities and related programs. Nothing in this table should be implied or construed to create any new legal obligation to implement these actions beyond responsibilities already created by Federal or State laws or contracts that are entered into voluntarily.

Table 17-4k. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Walla Walla Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) 1/	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
Mid-Columbia Steelhead DPS	Walla Walla River Steelhead Touchet River Steelhead (WRIA 32 Walla Walla, 1,420 sq. miles)	Revised GMA Critical Areas Ordinance Adopted	Habitat Protection	Regulations to protect wetlands and fish and wildlife habitat using best available science and giving special consideration to protection/conservation of salmonids.	12/01/08 12/01/11	Exists Expect	Walla Walla County Cities of Walla Walla, College Place Cities of Prescott, Waitsburg Columbia County City of Dayton	State General Fund & Local General Funds
		SMA Shoreline Master Program Update	Habitat Protection Habitat Restoration	Shoreline Master Programs are being updated consistent with revised statewide Shoreline Master Program Guidelines (2003) to protect shoreline resources, vegetation, fish and wildlife.	12/01/14	Expect Anticipate	Walla Walla County Cities of College Place, Prescott, Waitsburg, Walla Walla Columbia County City of Dayton	State General Fund & Local General Funds
		SMA Permits Issued	Habitat Protection	18 substantial development permits, 3 conditional use permits issued with conditions consistent with SMA Master Programs, 1 variance denied	Ongoing	Exists	Walla Walla and Columbia Counties Cities of College Place, Prescott, Waitsburg, Walla Walla, Dayton	Local General Funds

Table 17-4k. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Walla Walla Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) 1/	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Habitat Project Grants	Habitat Restoration and Preservation	25 projects with total cost of $4.6 mil. , including 4 acquisitions, consistent with recovery plan and independent technical review; 9 % of statewide project funding allocated to entire Snake River region.	2000-2006	Exists Expect	WA Salmon Recovery Funding Board and project sponsors	PCSRF and State Salmon Account (73%), sponsors match (27%)
		Water Acquisitions	Habitat Restoration Stream Flow	1650 annual acre ft. water restored primarily to Walla Walla River and 2 irrigation efficiency projects; acquisition/leasing of 33,322 annual acre ft. of water for mainstem Columbia River flow benefits all populations	FY 04-06 & Ongoing	Exists Expect	WA Dept. of Ecology	State Drought & Building Construction Accounts BPA
		Watershed Plan Implementation	Water Resource Use Water Quality Habitat Protection and Restoration Stream Flow Water Storage	Watershed plan adopted 06/05 and implementation plan adopted 06/06	Ongoing	Exists Expect	Walla Walla County Columbia County WA Dept. of Ecology	State Water Quality Account
		Instream Flow Rule Adopted	Habitat Restoration Stream Flow	Instream flow rule amendments recommended with adoption expected 04/07	Ongoing	Exists	WA Dept. of Ecology	State General Fund State Water Quality Account

Table 17-4k. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Walla Walla Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
	Touchet River Steelhead	NPDES Permits	Water Quality Protection	41 active NPDES permits (Walla Walla - 10 construction stormwater, 7 industrial stormwater, 3 sand & gravel, 4 municipal, 7 industrial, 1 animal feedlot; Touchet – 2 construction stormwater, 3 sand & gravel, 2 municipal, 1 fruit packer, 1 fish hatchery)	Ongoing	Exists	WA Dept. of Ecology	Permit Fee Acct. State Toxics Acct. EPA CWA Grant State General Fund
		Implementing TMDL and Water Cleanup Plans	Water Quality Protection and Restoration	7 of 124 needed water cleanup plans for WRIA 32 stream segments are underway or completed	Ongoing	Exists Expect Anticipate	WA Dept. of Ecology	State General Fund EPA CWA Grant
		Water Quality Improvement Grants	Water Quality Protection and Restoration	2 projects in WRIA 32 funded since 2000 at a project cost of $150,000	Ongoing	Exists Expect	WA Dept. of Ecology (WDOE)	Local Toxics Acct.
		Forest Lands HCP	Habitat Protection and Restoration	7.3% of WRIA 32 covered by Forest & Fish HCP applicable to private forest lands	Ongoing	Exists Expect	WA Dept of Natural Resources & forest land owners	PCSRF, State General Fund Forest Land Owners
		Hydraulic Project Approvals	Habitat Protection Water Quality Protection	841 HPAs issued for projects in or near state waters in WRIA 32 from 2000–2006 consistent with Aquatic Habitat Guidelines	Ongoing	Exists Expect	WA Dept. of Fish and Wildlife	State General Fund

Table 17-4k. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Walla Walla Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) 1/	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
	Walla Walla River Steelhead	Conservation Easements	Habitat Protection Riparian Condition Stream Flow	Secure conservation easement on S. Fork Coppei Crk (44 acres) to protect 2 miles of riparian zone from grazing or development and on N. Fork Coppei Crk (80 acres) to protect spring-fed stream providing flow	2006-2007	Exists Expect	Inland Empire Action Coalition Tri-State Steelheaders Reg. Fish Enhancement Group	WA SRFB
		Culvert Replacements	Fish Passage Barriers Sediment	Replace, install or remove 9 culverts affecting fish passage on S. Fork Coppei Crk (3) and Jim Crk (6).	2005-2007	Exists Expect	Tri-State Steelheaders Walla Walla County RFEG Land Owner	WA SRFB RFEG
		McKinley Habitat Enhancement	Habitat Diversity Habitat Quality	Improve stream morphology and structure, increase instream cover, spawning and resting areas	2006	Exists	Columbia Cons. District	WA SRFB
		LWD and Sediment Reduction	Habitat Diversity Riparian Condition Stream Bank Stability	Stream bank restoration using LWD to restructure eroding bank and provide instream habitat and plant riparian vegetation	2006-2008	Exists	RFEG WDFW USFWS Land Owner	WA SRFB
		Hofer Dam Fish Passage	Fish Passage Barrier Juvenile Mortality	Reconstruct irrigation diversion at Hofer Dam to improve passage and screening and reduce juvenile entrainment mortality	2005-2006	Exists	Walla Walla Cons. District WDFW RFEG	WA SRFB

Table 17-4k. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Walla Walla Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Dayton Acclimation Ponds Improvements	Water Quality Juvenile Mortality	Screen the intake at the Dayton Ponds to reduce mortality and dredge pond to improve effluent water quality	2006-2007	Expect	WDFW LSRCP	WA SRFB BPA WDOE
		Irrigation Efficiency Projects	Water Quantity Water Quality	Implement actions to increase efficiency of irrigation systems, e.g. replacing open ditches with closed piping in East End Ditch, Hearn Ditch, Touchet Valley Golf Course and West End Ditch	2006-2008	Exists Expect	Ditch Board Columbia Cons, Dist. WWWA Columbia County	Walla Walla Watershed Alliance (WWWA) WDOE
		Dayton Juvenile Fishing Pond	Water Quality Juvenile Mortality	Convert pond water source from diversion to screened pump system or well	2007	Expect	Columbia Cons. Dist. City of Dayton WDFW	WA SRFB WWWA
		Steelhead Acclimation Pond Improvements	Fish Passage Barrier Juvenile Mortality	Construct a fish ladder, screens and consolidating diversions	2007	Expect	WDFW	WA SRFB
		Touchet River Fishway	Fish Passage Barrier Water Quality Habitat Quality	Combine three irrigation diversions and utilize and intake dam; build a pool and chute fishway	2006-2007	Expect	WDFW USFWS Columbia Cons. Dist. Local Irrigators	WA SRFB
		Hearn and West End Ditch Consolidation	Juvenile Mortality	Combine water intakes to reduce juvenile entrainment mortality	2006-2007	Expect	WDFW	WA SRFB
		South Fork River Flows	Instream Flow	Reduce over appropriation of water to increase ir maintain flows in South Fork	2006	Exists	CTUIR	WA SRFB

Table 17-4k. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Walla Walla Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Touchet River Habitat consolidation	Fish Passage Barrier Habitat Quantity Habitat Diversity	Connect isolated habitat to increase access to blocked areas and increase the range and distribution of salmon	2006	Expect	WDFW	WA SRFB
		Wolf Fork Habitat Enhancement	Habitat Quantity Habitat Diversity	Construct instream structure and habitat with LWD structures and boulders	2006-2008	Expect	WDFW RFEG Land Owner USFWS	WA SRFB
		Doan Creek Restoration	Stream Flow Habitat Quantity Habitat Diversity Riparian Condition	Excavate a channel with natural alignment and geometry to reestablish Doane Creek with 3 miles of spring branch spawning/rearing habitat; reintroduce flow and riparian vegetation	2005-2008	Exists Expect	Walla Walla Cons. District WDFW RFEG	WA SRFB
		Piping Irrigation Ditches District #2	Stream Flow Water Quality	Replace open irrigation ditches with closed piping to improve irrigation efficiency and stream flow	2007 -2010	Anticipate	Walla Walla Cons. District Ditch Board	WA SRFB
		Mud Creek Restoration	Habitat Quantity Habitat Quality	Reestablish natural stream and habitat characteristics to Mud Creek (5miles)	2005-2008	Exists Expect	Walla Walla Cons. District WDFW Land Owners	WA SRFB
		McEvoy Creek Restoration	Habitat Quality Habitat Diversity Riparian Condition	Restore length of McEvoy Cr. (1.25 miles) historic channel, instream structure, LWD, and riparian vegetation	2006-2008	Expect	WDFW Land Owners RFEG, USFWS	WA SRFB

Table 17-4k. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Walla Walla Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Remove Barriers on Mill Creek	Fish Passage Barrier Juvenile Mortality	Install fish passage at Gose Street Bridge and a screened lift pump system at Stiller Irrigation Diversion to improve adult and juvenile fish passage and reduce juvenile entrainment mortality	2005-2006	Exists	Walla Walla Cons. District WDFW, RFEG CTUIR	WA SRFB
		Burlingame Dam Modification	Stream Flows	Reduce over appropriation of water to increase or maintain flows for salmon	2006	Exists	Gardena Farms Irrigation Dist. 13	WA SRFB
		Hofer Dam Removal	Habitat Quality	Restore natural river function by removing dam structure	2006	Expect	Walla Walla Cons. District	WA SRFB BPA
		Municipal Service Area Water Efficiency	Stream Flow Water Quality	Municipal water conservation program to detect leaks, meter water use, provide efficiency incentives	Ongoing	Exists Expect	City of Walla Walla	WDOE
		Dry Creek Flow Improvement	Stream Flows	Reduce over appropriation of water to increase or maintain flows for salmon	2006	Exists Expect	Walla Walla County	WA SRFB
		Piping Gardena Farms Ditch	Stream Flow	Replace open irrigation ditch with closed piping to improve irrigation efficiency and stream flow	2006-2010	Exists Expect	Gardena Farms Irrigation District 13	WDOE WWWA WA SRFB

Table 17-4k. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Walla Walla Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) 1/	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Install Fish Screens	Juvenile Mortality	Install screens to cut off access to Garrison Creek, Schulke Ditch and other locations as needed through completion of Cooperative Compliance Program (90 screens) to reduce entrainment mortality	2006-2008	Expect	Walla Walla Cons. District Walla Walla Com. College WDFW, WDOE	WA SRFB
		Johnson Riparian Restoration and Conservation Easement	Habitat Diversity Sediment Riparian Condition	Install LWD for stream structure and bank stabilization, plant riparian buffer and protect 5 acres with easement	2006	Exists	Tri-State Steelheaders RFEG	RFEG
		Kooskooskie Dam Removal	Fish Passage Barriers	Improve fish passage by removing passage barrier on upper Mill Creek	2005	Exists	Tri-State Steelheaders (TSS) RFEG	WA SRFB
		Dike Removal	Floodplain Connectivity	Remove a remnant dike on lower Walla Walla River and a dike on WDFW property on McDonald Road	2006-2008	Exists Expect	WDOW, WDFW CTUIR, USACE Walla Walla County	WA SRFB
		Yellowhawk Creek Stormwater Runoff	Water Quality Sediment Water Temperature	Re-route stormwater runof , provide treatment and indirect discharge, replant vegetation in riparian corridor	2006-2008	Exists	WDOE	WDOE National F&W Found. (NFWF)
		Shallow Aquifer Recharge	Water Quality Water Quantity	Continue implementation of shallow aquifer recharge project to improve water conditions in lower Walla Walla River	Ongoing	Exists Expect	WDOE, Walla Walla County, WW Basin Watershed Council, USACE, CTUIR	WDOE WWWA

Table 17-4k. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Walla Walla Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Urban Landscape Demonstration Project	Water Quality Water Quantity	Urban landscape pilot xeriscape planting to conserve water along planted sidewalks	2007	Expect	Kooskooskie Commons	WWWA
		Creek Restoration Projects	Riparian Condition	Restore riparian areas and related functions along Russell, Yellowhawk, Cottonwood , and Caldwell Creeks	2006-2008	Exists Expect	TSS, RFEG, WDFW, Land Owners, NRCS, USFWS	WA SRFB
		On-Farm Irrigation Efficiency	Water Quantity Stream Flow	Improve efficiency (e.g. convert from flood to sprinkler) of farms (8 projects, 10csf of flow)	2006-2008	Exists Expect	Walla Walla Cons. District	WDOE
		Touchet River at Bolles Junction Riparian and Streambank Improvement	Habitat Diversity Sediment Riparian Condition	Improve bank stability, increase in stream habitat and decrease water temperature	2007-2008	Exists	Walla Walla Cons. District	NFWF
		Yellowhawk Urban Riparian Improvement	Sediment Temperature	Improve riparian habitat and reduce discharge of urban landscape pesticides and sediment into Yellowhawk Creek	2007-2008	Exists	Kooskooskie Commons	NFWF

[1/] The non-Federal actions contained in this table and similar tables for other populations in Columbia River Basin tributaries in Washington are based upon information in regional salmon recovery plans or NPCC Fish and Wildlife subbasin plans and on existing State statutory responsibilities and related programs. Nothing in this table should be implied or construed to create any new legal obligation to implement these actions beyond responsibilities already created by Federal or State laws or contracts that are entered into voluntarily.

Table 17-4l. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Washougal and Lower Columbia (Bonneville) Tribs Subbasins

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
Lower Columbia Chinook and Coho, Columbia River Chum ESUs & Lower Columbia Steelhead DPS	Washougal River Chinook, Coho, Chum, Steelhead Lower Gorge Chinook, Coho, Chum, Steelhead (WRIA 28 Salmon/ Washougal except Salmon Creek)	GMA Comp. Plan Adopted	Habitat Protection	Provides comprehensive framework and policy direction for local land use decisions including shoreline policies and any subarea plans.	12/01/04	Exists	Clark County Cities of Camas, Vancouver, Washougal	State General Fund & Local General Funds
		GMA Development Regulations Adopted	Habitat Protection	Regulations consistent with Comp. Plan and governing development of land, such as zoning, subdivisions and site plans	12/01/04	Exists	Clark County Cities of Camas, Vancouver, Washougal	State General Fund & Local General Funds
		Revised GMA Critical Areas Ordinance Adopted	Habitat Protection	Regulations to protect wetlands and fish and wildlife habitat using best available science and giving special consideration to protection/conservation of salmonids.	12/01/04 12/01/09 12/01/06	Exists Expect	Clark County Cities of Camas, Vancouver, Washougal Skamania County City of North Bonneville	State General Fund & Local General Funds

Table 17-4l. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Washougal and Lower Columbia (Bonneville) Tribs Subbasins

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) 1/	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		SMA Shoreline Master Program Update	Habitat Protection Habitat Restoration	Shoreline Master Programs are being updated consistent with revised statewide Shoreline Master Program Guidelines (2003) to protect shoreline resources, vegetation, fish and wildlife.	12/01/11 12/01/12	Expect Anticipate	Clark County Cities of Camas, Vancouver, Washougal Skamania County City of North Bonneville	State General Fund & Local General Funds
		SMA Permits Issued	Habitat Protection	124 substantial development permits, 70 conditional use permits and 1 variance issued with conditions consistent with SMA Master Programs, 1conditional use permit denied	Ongoing	Exists	Clark County Cities of Camas, Vancouver, Washougal	Local General Funds
		SMA Permits Approved or Denied	Habitat Protection	6 conditional use permits and 2 variances approved with conditions on variance permit; 1 conditional use permit denied	Ongoing	Exists	WA Dept. of Ecology	State General Fund

Table 17-4l. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Washougal and Lower Columbia (Bonneville) Tribs Subbasins

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Habitat Project Grants	Habitat Restoration and Preservation	10 projects with total cost of $2.8 mil. , including 3 acquisitions, consistent with recovery plan and independent technical review; 15% of statewide project funding allocated to entire Lower Columbia region.	2000-2006	Exists Expect	WA Salmon Recovery Funding Board and project sponsors	PCSRF and State Salmon Account (70%), sponsors match (30%)
		Water Acquisitions	Habitat Restoration Stream Flow	Acquisition/leasing of 33,322 acre ft. of water for mainstem Columbia River flow benefits all populations	FY 04-06 & Ongoing	Exists Expect Anticipate	WA Dept. of Ecology	State Drought & Building Construction Accounts, BPA
		Watershed Plan Implementation	Water Resource Use Water Quality Habitat Protection and Restoration Stream Flow	Watershed plan adopted 07/06 and will begin Phase 4 implementation by 05/07	Ongoing	Exists Expect Anticipate	Clark County WA Dept. of Ecology	State Water Quality Account
		Instream Flow Rule Adopted	Habitat Restoration Stream Flow	New instream flow rule recommended and underway for adoption in 2008	Ongoing	Exists	WA Dept. of Ecology	State Water Quality Account State General Fund

Table 17-4I. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Washougal and Lower Columbia (Bonneville) Tribs Subbasins

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) 1/	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		NPDES Permits	Water Quality Protection	298 active NPDES permits (189 construction stormwater, 54 industrial stormwater, 18 sand & gravel, 7 municipal, 27 industrial, 3 fish hatchery)	Ongoing	Exists	WA Dept. of Ecology	Permit Fee Acct. State Toxics Acct. EPA CWA Grant State General Fund
		Implementing TMDL and Water Cleanup Plans	Water Quality Protection and Restoration	36 of 106 needed water cleanup plans for stream segments in WRIA 29 are underway or completed	Ongoing	Exists Expect Anticipate	WA Dept. of Ecology	State General Fund EPA CWA Grant
		Water Quality Improvement Grants	Water Quality Protection and Restoration	6 projects funded since 2000 at a project cost of $1.1 million.	Ongoing	Exists Expect	WA Dept. of Ecology	Centennial Fund CWA Section 319 State Toxics Acct
		Water Quality Certification	Water Quality Protection	16 individual Section 401 water quality certifications issued	Since 01/04	Exists	WA Dept. of Ecology (WDOE)	State Water Quality Account State General Fund

Table 17-4I. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Washougal and Lower Columbia (Bonneville) Tribs Subbasins

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Forest Lands HCPs	Habitat Protection and Restoration	16.0% of WRIA 28 covered by DNR state forest lands HCP, 35.2% of WRIA 28 covered by Forest & Fish HCP applicable to private forest lands	Ongoing	Exists Expect Anticipate	WA Dept of Natural Resources & forest land owners	DNR Forest Development Acct. DNR Resource Mgt. Cost Acct. PCSRF, SGF Forest Land Owners
		Hydraulic Project Approvals	Habitat Protection Water Quality Protection	575 HPAs issued for projects in or near state waters in entire WRIA 28 from 2000–2006 consistent with Aquatic Habitat Guidelines	Ongoing	Exists Expect	WA Dept. of Fish and Wildlife (WDFW)	State General Fund
		Floodplain Restoration	Floodplain Function Habitat Quantity Erosion/ Sediment Stream Temperature Channel Stability	Conduct floodplain restoration where feasible along the lower mainstem and in major tributaries with channel confinement to restore floodplain function, habitat diversity and availability	2007-2016	Anticipate	Clark Cons. Dist.(CCD), NRCS Underwood Cons. District (UCD) WDFW, USACE, LCFEG	WA SRFB

Table 17-4I. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Washougal and Lower Columbia (Bonneville) Tribs Subbasins

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Floodplain Protection	Habitat Protection Stream Corridor Structure & Function	Prevent floodplain impacts and protect floodplain function, CMZ processes and off-channel habitat through land use controls and best management practices (see also CAO and SMA actions)	2007-2016	Anticipate	Clark County Cities of Camas & Washougal Skamania County WDOE	State General Fund & Local General Funds
		Acquisition of Sensitive Areas	Habitat Protection Water Quality Watershed Processes	Acquire sensitive habitats or purchase conservation easements to protect watershed processes and habitat functions where existing protections are inadequate	Ongoing	Exists Expect Anticipate	LCFRB WDFW USFWS BPA	WA SRFB USFWS BPA
		Operating Programs ESA Compliance	Habitat Protection Sediment Riparian Condition Water Quality	Review/adjust county program operations (e.g. road, park and weed management) as needed to protect habitat and water quality and ensure compliance with ESA	Ongoing	Exists Expect	Clark County Camas, Washougal Skamania County	Local General Funds (Clark Co. has general fund ESA program)

Table 17-4l. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Washougal and Lower Columbia (Bonneville) Tribs Subbasins

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Technical Assistance for Land Owners	Habitat Protection Habitat Restoration	Increase technical assistance to land owners and land owner participation in conservation programs to protect and restore habitat and watershed processes	Ongoing	Exists Expect Anticipate	CCD, UCD, NRCS WDFW, WDNR Clark County Skamania County	State General Fund WA SRFB NRCS Funds
		Federal Forest Land Management	Water Quality Sediment Stream Flows Habitat Quality Habitat Quality Fish Passage/ Access	Continue to manage federal forest lands according to Northwest Forest Plan and Aquatic Conservation Strategy to increase stream LWD and habitat structure, reduce road related sediment, decrease peak flow volume, improve stream temperature and restore and preserve fish access	Ongoing	Exists Expect Anticipate	USFS	USFS Federal Funds
		Increase Habitat Enhancement Projects	Habitat Restoration Habitat Preservation Water Quality	Increase funding and implementation of voluntary habitat enhancement projects in high priority reaches and subwatersheds	Ongoing	Exists Expect Anticipate	LCFRB, WDFW BPA F&W, NRCS CCD, UCD, LCFEG	WA SRFB BPA

Table 17-4l. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Washougal and Lower Columbia (Bonneville) Tribs Subbasins

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) 1/	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Restore Native Vegetation	Habitat Protection Riparian Condition	Protect and restore native plan communities from effects of invasive weed species and to protect and restore riparian and watershed function	Ongoing	Exists Expect Anticipate	State and Local Weed Control Boards NRCS, CCD, UCD LCFEG	WA SRFB Clark co. Weed Control Board Funds
		On-site Sewage Systems	Water Quality	Assess, upgrade and/or replace on-site sewage systems that may contribute to water quality impairment	Ongoing	Exists Expect Anticipate	Clark County Skamania County CCD, UCD, LCFEG	Local General Funds (Health District)
		Side-Channel Habitat	Habitat Quantity Habitat Diversity	Create and/or restore side-channel and off-channel habitat to increase habitat available for chum spawning and coho overwintering	2007-2016	Anticipate	LCFRB, LCRFEG WDFW, NRCS CCD, UCD	WA SRFB BPA
		Assess/ Correct Passage Barriers	Fish Passage/ Access	Assess the impact of fish passage barriers throughout subbasins and restore access to potentially productive spawning and rearing habitats	2000-2016	Exists Expect Anticipate	WDFW, WDNR Clark County Skamania County WSDOT, LCFEG	WA SRFB Local Public Works Funds

1/ The non-Federal actions contained in this table and similar tables for other populations in Columbia River Basin tributaries in Washington are based upon information in regional salmon recovery plans or NPCC Fish and Wildlife subbasin plans and on existing State statutory responsibilities and related programs. Nothing in this table should be implied or construed to create any new legal obligation to implement these actions beyond responsibilities already created by Federal or State laws or contracts that are entered into voluntarily.

Table 17-4m. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Wenatchee Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
Upper Columbia Chinook ESU & Upper Columbia Steelhead DPS	Wenatchee River Spring Chinook Wenatchee River Steelhead (WRIA 45 Wenatchee, 1,371 sq. miles)	GMA Comp. Plan Adopted	Habitat Protection	Provides comprehensive framework and policy direction for local land use decisions including shoreline policies and any subarea plans.	05/02/06 08/10/04	Exists	Chelan County City of Leavenworth	State General Fund & Local General Funds
		Revised GMA Critical Areas Ordinance Adopted	Habitat Protection	Regulations to protect wetlands and fish and wildlife habitat using best available science and giving special consideration to protection/ conservation of salmonids.	12/01/07 12/01/10	Exists Expect	Chelan County City of Wenatchee Cities of Cashmere, Leavenworth	State General Fund & Local General Funds
		SMA Shoreline Master Program Update	Habitat Protection Habitat Restoration	Shoreline Master Programs are being updated consistent with revised statewide Shoreline Master Program Guidelines (2003) to protect shoreline resources, vegetation, fish and wildlife.	12/01/13	Expect Anticipate	Chelan County Cities of Cashmere, Leavenworth, Wenatchee	State General Fund & Local General Funds

Table 17-4m. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Wenatchee Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		SMA Permits Issued	Habitat Protection	33 substantial development permits, 3 conditional use permits, and 2 variances issued with conditions consistent with SMA Master Programs	Ongoing	Exists	Chelan County Cities of Cashmere, Leavenworth, Wenatchee	Local General Funds
		SMA Permits Approved or Denied	Habitat Protection	1 conditional use permit and 2 variances approved with added conditions	Ongoing	Exists	WA Dept. of Ecology	State General Fund
		Habitat Project Grants	Habitat Restoration and Preservation	13 projects with total cost of $3.5 mil. , including 1 acquisition, consistent with recovery plan and independent technical review; 11% of statewide project funding allocated to entire Upper Columbia region.	2000-2006	Exists Expect	WA Salmon Recovery Funding Board and project sponsors	PCSRF and State Salmon Account (76%), sponsors match (24%)

Table 17-4m. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Wenatchee Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Water Acquisitions	Habitat Restoration Stream Flow	Acquisition or leasing of 33,322 acre ft. of water for mainstem Columbia River flow benefits all populations	FY 04-06 & Ongoing	Exists Expect	WA Dept. of Ecology	State Drought & Building Construction Accounts BPA
		Watershed Plan Implementation	Water Resource Use Water Quality Habitat Protection and Restoration Stream Flow	Watershed plan adopted 06/06 and initiation of Phase 4 implementation expected in 2007	Ongoing	Exists Expect	Chelan County WA Dept. of Ecology	State Water Quality Account Local General Funds
		Instream Flow Rule Adopted	Habitat Restoration Stream Flow	Amended instream flow rule recommended with new water management strategy. Draft amended rule to be filed in 2007	Ongoing	Exists	WA Dept. of Ecology Chelan County	State Water Quality Account State General Fund
		NPDES Permits	Water Quality Protection	66 active NPDES permits (12 construction stormwater, 6 industrial stormwater, 5 sand & gravel, 9 municipal, 7 industrial, 24 fruit packers, 2 fish hatchery, 1 aquatic pesticide)	Ongoing	Exists	WA Dept. of Ecology	Permit Fee Acct. State Toxics Acct. EPA CWA Grant State General Fund

Table 17-4m. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Wenatchee Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Implementing TMDL and Water Cleanup Plans	Water Quality Protection and Restoration	6 of 139 needed water cleanup plans for stream segments are underway or completed	Ongoing	Exists Expect Anticipate	WA Dept. of Ecology	State General Fund EPA CWA Grant
		Water Quality Improvement Grants	Water Quality Protection and Restoration	4 projects funded since 2000 at a project cost of $1.6 million	Ongoing	Exists Expect	WA Dept. of Ecology (WDOE)	Centennial Fund Local Toxics Acct.
		Forest Lands HCPs	Habitat Protection and Restoration	0.7% of WRIA 45 covered by DNR state forest lands HCP, 10.7% of WRIA 45 covered by Forest & Fish HCP applicable to private forest lands	Ongoing	Exists Expect	WA Dept of Natural Resources & forest land owners	DNR Forest Development Acct. DNR Resource Mgt. Cost Acct. PCSRF, SGF Forest Land Owners
		Hatchery Improvement to Recover Wild Stocks	Hatchery Impact on Wild Stocks	Pending completion of HSRG review, 12 of 16 recovery plan hatchery improvement actions for steelhead completed (5) or in process; 13 of 18 actions for spring Chinook completed (6) or in process	2005 – Present Ongoing	Exists Expect	WA Dept. of Fish and Wildlife, Chelan County PUD, Douglas County PUD	Contracts with Chelan County PUD, Douglas County PUD

Table 17-4m. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Wenatchee Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Hydraulic Project Approvals	Habitat Protection Water Quality Protection	169 HPAs issued for projects in or near state waters from 2000–2006 consistent with Aquatic Habitat Guidelines	Ongoing	Exists Expect	WA Dept. of Fish and Wildlife (WDFW)	State General Fund
		Tributary Habitat Conservation – Mid-Columbia PUDs HCPs	Hydro Dam Survival Habitat Restoration Compensation	Habitat improvements will contribute 2% of survival toward 100% "no-net-impact" goal	2003-2053	Exists Expect	Chelan County PUD Douglas County PUD	Dedicated PUD Accounts
		Hatchery Supplementation - Mid-Columbia PUDs HCPs	Hydro Dam Survival Hatchery Compensation	Hatchery supplementation will contribute 7% toward the 100% "no-net-impact" goal	2003-2053	Exists Expect	Chelan County PUD Douglas County PUD	Dedicated PUD Accounts
		Hydropower Operations - Mid-Columbia PUDs HCPs	Hydro Dam Survival Wells Dam Rock Island Dam Rocky Reach Dam	Achieve 91% adult and juvenile overall project survival; 95% juvenile dam passage survival and 93% juvenile survival throughout projects by implementing spill, juvenile bypass system, and other project improvements.	2003-2053	Exists Expect	Chelan County PUD Douglas County PUD	Dedicated PUD Accounts

Table 17-4m. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Wenatchee Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Side-Channel Reconnection	Habitat Diversity Habitat Quantity	Acquire LIDAR data to enhance CMZ information for Lower Wenatchee, Peshastin , Nason, Icicle Creeks and channel reconnection projects in Lower Wenatchee, Lower Peshastin, Mission (RM 4-6), and Chumstick Creeks	LIDAR and at least 1 project 2009	Exists Expect	US Bureau of Reclamation (BOR) Chelan County	BOR WA SRFB Local General Funds
		Install LWD Instream Structure	Habitat Diversity Habitat Quantity	Stockpile LWD and install 3-5 instream structures per year	2006-2016	Exists Expect	Chelan County	WA SRFB BPA, Local General Funds
		Acquire Easements to Protect Floodplain and Riparian Areas	Habitat Diversity Floodplain and Riparian Condition	Acquisition of easements to protect floodplain/riparian habitat as opportunities arise in Lower Wenatchee, Nason Creek, White River, Chiwawa and Icicle Creeks	2006-2016	Exists Expect	Chelan County Chelan/Douglas Land Trust	WA SRFB BPA, Local General Funds

Table 17-4m. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Wenatchee Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Instream Flow Restoration	Water Quantity	Improve farm irrigation efficiency in delivery and use, convert small surface pumps to wells in Lower Wenatchee, Peshastin, Mission and Icicle Creeks	2006-2016	Exists Expect	WA Rivers Conservancy WA Water Trust Chelan County	Federal Farm Bill WA SRFB WDOE, BPA Local General Funds
		Instream Flow Restoration	Water Quantity	Improve intake, pumping system and delivery pipe at Icicle Creek hatchery	2009	Anticipate	USFWS	USFWS BOR
		Riparian Restoration	Habitat Diversity Habitat Quantity Riparian Condition Excess Sediment	Livestock control fencing, invasive weed removal, and restoring native vegetation; including riparian treatment (planting) of 3600-5000 ft. per year.	2006-2016	Exists Expect	Chelan County Chelan Co. Cons. District	WA SRFB BPA Local General Funds
		Restore Fish Passage	Obstructions	Repair and/or replace culverts causing obstruction of fish passage; complete 3 within 1-3 yrs, plus 12-15 more within 1-6 years, plus 45 more within 1-10 yrs.	2006-2016	Exists Expect	Chelan County	WA SRFB BPA Local General Funds

Table 17-4m. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Wenatchee Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Restore Fish Passage	Obstructions	Restore passage at Dam 5 and headgate on Icicle Ck. and at Icicle-Peshastin Dam	Dam 5-2009 I-P 2012	Anticipate	USFWS	USFWS BOR
		Metallic Debris Cleanup	Habitat Quality	Remove autos and other debris from Mission and Chumstick Creeks	2006-2012	Exists Expect	Chelan County	State and Local General Funds
		Screen Water Diversions	Habitat Quality	Complete replacement upgrade of water intake diversion screens in Icicle Creek	2006-2012	Anticipate	USFWS	USFWS BOR
		Add Nutrients to Stream	Depleted Nutrients	Add nutrients using hatchery carcasses or carcass analogs in Chiwawa, Nason Creeks, Little Wenatchee, White Rivers	2009-2012 Ongoing	Exists Expect	WDFW Chelan County	State and Local General Funds
		Restore Fish Passage	Obstructions	Install stream structures to increase thalweg depth in Peshastin Creek	2006-2012	Exists Expect	Chelan Co. Cons. District	WA SRFB BPA Local General Funds
		Stream Bank Restoration	Excess Sediment	Restore stream bank below hatchery in Icicle Creek up to 500 ft. per year	2009-2016	Exists Expect	Chelan County Chelan Co. Cons. District	WA SRFB BPA Local General Funds

Table 17-4m. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Wenatchee Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s)[1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/ Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Side Channel Restoration	Channel Stability	Reconnect and restore side/off channels on Nason Creek; 1 project/yr, total 2-8 miles	2009-2012	Exists Expect	Chelan County Chelan Co. Cons. District	WA SRFB BPA Local General Funds

[1/] The non-Federal actions contained in this table and similar tables for other populations in Columbia River Basin tributaries in Washington are based upon information in regional salmon recovery plans or NPCC Fish and Wildlife subbasin plans and on existing State statutory responsibilities and related programs. Nothing in this table should be implied or construed to create any new legal obligation to implement these actions beyond responsibilities already created by Federal or State laws or contracts that are entered into voluntarily.

Table 17-4n. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Wind Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
Lower Columbia Chinook, Lower Columbia Coho, Columbia River Chum ESUs & Lower Columbia Steelhead DPS	Wind River Steelhead, Chinook, Coho (WRIA 29 Wind/White Salmon portions in Wind River Subbasin)	Revised GMA Critical Areas Ordinance Adopted	Habitat Protection	Regulations to protect wetlands and fish and wildlife habitat using best available science and giving special consideration to protection/conservation of salmonids.	12/01/09	Exists Expect	Skamania County	State General Fund & Local General Funds
		SMA Shoreline Master Program Update	Habitat Protection Habitat Restoration	Shoreline Master Programs are being updated consistent with revised statewide Shoreline Master Program Guidelines (2003) to protect shoreline resources, vegetation, fish and wildlife.	12/01/12	Expect Anticipate	Skamania County	State General Fund & Local General Funds
		SMA Permits Issued	Habitat Protection	20 substantial development permits, 6 conditional use permits and 1 variance permit issued with conditions consistent with SMA Master Programs	Ongoing	Exists	Skamania County City of Stevenson	Local General Funds
		SMA Permits Approved or Denied	Habitat Protection	4 conditional use and 1 variance permit approved with added conditions on variance permit	Ongoing	Exists	WA Dept. of Ecology	State General Fund
		Habitat Project Grants	Habitat Restoration and Preservation	5 projects with total cost of $1.2 mil. consistent with recovery plan and independent technical review; 15% of statewide project funding allocated to entire Lower Columbia region.	2000-2006	Exists Expect	WA Salmon Recovery Funding Board and project sponsors	PCSRF and State Salmon Account (55%), sponsors match (45%)

Table 17-4n. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Wind Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Water Acquisitions	Habitat Restoration Stream Flow	Acquisition/leasing of 33,322 acre ft. of water for mainstem Columbia River flow benefits all populations	FY 04-06 & Ongoing	Exists Expect Anticipate	WA Dept. of Ecology	State Drought & Building Construction Accounts BPA
		Watershed Plan Implementation	Water Resource Use Water Quality Habitat Protection and Restoration	Watershed plan adopted 11/06	Ongoing	Exists Expect Anticipate	Skamania County WA Dept. of Ecology	State Water Quality Account
		Instream Flow Rule Adopted	Habitat Restoration Stream Flow	New instream flow rule planned by 2009	Ongoing	Exists	WA Dept. of Ecology	State Water Quality Account State General Fund
		NPDES Permits	Water Quality Protection	4 active NPDES permits (2 construction stormwater, 2 industrial stormwater)	Ongoing	Exists	WA Dept. of Ecology	Permit Fee Acct. State Toxics Acct. EPA CWA Grant State General Fund
		Implementing TMDL and Water Cleanup Plans	Water Quality Protection and Restoration	34 of 46 needed water cleanup plans for WRIA 29 stream segments are underway or completed	Ongoing	Exists Expect Anticipate	WA Dept. of Ecology	State General Fund EPA CWA Grant

Table 17-4n. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Wind Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Water Quality Improvement Grants	Water Quality Protection and Restoration	6 projects in WRIA 29 funded since 2000 at a project cost of $646,000	Ongoing	Exists Expect	WA Dept. of Ecology (WDOE)	Centennial Fund CWA Section 319 Aquatic Weeds Acct.
		Forest Lands HCPs	Habitat Protection and Restoration	12.8% of entire WRIA 29 covered by DNR state forest lands HCP, 34.1% of WRIA 29 covered by Forest & Fish HCP applicable to private forest lands	Ongoing	Exists Expect Anticipate	WA Dept of Natural Resources (WDNR) & Forest Land Owners	DNR Forest Developmen t Acct. DNR Resource Mgt. Cost Acct. PCSRF, SGF Forest Land Owners
		Hydraulic Project Approvals	Habitat Protection Water Quality Protection	165 HPAs issued for projects in or near state waters in entire WRIA 29 from 2000–2006 consistent with Aquatic Habitat Guidelines	Ongoing	Exists Expect	WA Dept. of Fish and Wildlife (WDFW)	State General Fund
		Federal Forest Land Management	Water Quality Sediment Stream Flows Habitat Quality Habitat Quality Fish Passage/Access	Continue to manage federal forest lands according to Northwest Forest Plan and Aquatic Conservation Strategy to increase stream LWD and habitat structure, reduce road related sediment, decrease peak flow volume, improve stream temperature and restore and preserve fish access	Ongoing	Exists Expect Anticipate	USFS	USFS Federal General Funds & Aquatics Program Funds

Table 17-4n. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Wind Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Floodplain Restoration	Floodplain Function Habitat Quantity Erosion/Sediment Stream Temperature Channel Stability	Conduct floodplain restoration where feasible along the middle/upper mainstem and lower mainstem to restore floodplain function, habitat diversity and availability	2007-2010	Anticipate	Underwood Cons. District(UCD),NRCS WDFW USACE LCFEG	NRCS Funds BPA WA SRFB LCFEG Funds
		Floodplain Protection	Habitat Protection Stream Corridor Structure & Function	Prevent floodplain impacts and protect floodplain function, CMZ processes and off-channel habitat through land use controls and best management practices (see also CAO and SMA actions)	2007-2016	Anticipate	Skamania County WDOE	State General Fund & Local General Funds
		Acquisition of Sensitive Areas	Habitat Protection Water Quality Watershed Processes	Acquire sensitive habitats or purchase conservation easements to protect watershed processes and habitat functions where existing protections are inadequate	Ongoing	Exists Expect Anticipate	LCFRB WDFW USFWS BPA	WA SRFB USFWS BPA
		Technical Assistance for Land Owners	Habitat Protection Habitat Restoration	Increase technical assistance to land owners and land owner participation in conservation programs to protect and restore habitat and watershed processes	Ongoing	Exists Expect Anticipate	UCD, NRCS WDFW, WDNR Skamania County	State General Fund WA SRFB NRCS Funds BPA

Table 17-4n. State of Washington Existing or Expected Habitat Projects that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS – Wind Subbasin

Species (ESU / DPS)	Population (Geographic Scale/Area)	Action(s) Affecting Limiting Factor(s) [1/]	Limiting Factor(s) Affected	Effect(s) on Fish or Critical Habitat	Estimated Timing of Action	Funding Status (Exists/Expect /Anticipate)	Responsible Entity(ies)	Funding Source(s)
		Increase Habitat Enhancement Projects	Habitat Restoration Habitat Preservation Water Quality	Increase funding and implementation of voluntary habitat enhancement projects in high priority reaches and subwatersheds	Ongoing	Exists Expect Anticipate	LCFRB, WDFW BPA F&W, NRCS UCD, LCFEG	WA SRFB BPA
		Hemlock Dam Passage	Fish Passage/Access	Address passage issues at Hemlock Dam to increase survival through Hemlock Dam and Lake Reach	2007-2010	Expect	USFS WDFW	USFS BPA
		Side-Channel Habitat	Habitat Quantity Habitat Diversity	Create and/or restore side-channel and off-channel habitat to increase habitat available for chum spawning and coho overwintering	2007-2016	Anticipate	LCFRB, LCRFEG WDFW, NRCS UCD	WA SRFB BPA
		Restore Native Vegetation	Habitat Protection Riparian Condition	Protect and restore native plan communities from effects of invasive weed species and to protect and restore riparian and watershed function	Ongoing	Exists Expect Anticipate	State and Local Weed Control Boards NRCS, UCD LCFEG	BPA WA SRFB LCFEG
		On-site Sewage Systems	Water Quality	Assess, upgrade and/or replace on-site sewage systems that may contribute to water quality impairment	Onging	Exists Expect Anticipate	Skamania County UCD LCFEG	Local General Funds (Health District)

[1/] The non-Federal actions contained in this table and similar tables for other populations in Columbia River Basin tributaries in Washington are based upon information in regional salmon recovery plans or NPCC Fish and Wildlife subbasin plans and on existing State statutory responsibilities and related programs. Nothing in this table should be implied or construed to create any new legal obligation to implement these actions beyond responsibilities already created by Federal or State laws or contracts that are entered into voluntarily.

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet)								Agency	Program	Description	Timeline	Constraints
			1	2	3	4	5	6	7	8					
All Areas	All Populations	Agricultural chemicals (organophoshates and other insecticides) above state standards impair the growth and survival of coho, spring Chinook, winter steelhead, and summer steelhead fry and summer parr, and fall Chinook fry.	–	–	–	–	–	X	–	–	ODA	Pesticides	The ODA Pesticide Division regulates pesticide applicators, labeling, and regulates misuse.	In place, regulation is ongoing	capacity for outreach
All Areas	All Populations	Agricultural chemicals (organophoshates and other insecticides) above state standards impair the growth and survival of coho, spring Chinook, winter steelhead, and summer steelhead fry and summer parr, and fall Chinook fry.	–	–	–	–	–	X	–	–	ODEQ	Need to identify			
All Areas	All Populations	Agricultural chemicals (organophoshates and other insecticides) above state standards impair the growth and survival of coho, spring Chinook, winter steelhead, and summer steelhead fry and summer parr, and fall Chinook fry.	–	–	–	–	–	X	–	–	ODA	Need to identify			
All Areas	All Populations	Agricultural chemicals (organophoshates and other insecticides) above state standards impair the growth and survival of coho, spring Chinook, winter steelhead, and summer steelhead fry and summer parr, and fall Chinook fry.	–	–	–	–	–	X	–	–	ODA	Agricultural Water Quality Management (SB 1010)	In 1995, the legislature supplemented the Act with ORS 561.191. This statute reinforces ODA's responsibility for and jurisdiction over agricultural practices and water pollution associated with activities on agricultural and rural lands. Administrative rules adopted to guide Program administration are found in OAR Chapter 603, Divisions 90 and 95. Regulatory actions address violations when they arise. Monitoring tools include DEQ ambient monitoring sites, local monitoring programs such as Rogue Valley Council of Government's Bear Creek monitoring and ODA Riparian Conditional Analysis for agricultural lands.	Affected by rate of riparian vegetation development where needed. Development timeline will vary from 5 to 50 years depending on present site condition and site potential.	Landowner cooperation, capacity for outreach, changing land ownerships and new landowners knowledge of agricultural issues, perception that this is only a complaint driven process, technical assistance, adequate monitoring at meaningful scales
All Areas	All Populations	Agricultural chemicals (organophoshates and other insecticides) above state standards impair the growth and survival of coho, spring Chinook, winter steelhead, and summer steelhead fry and summer parr, and fall Chinook fry.	X	X	–	X	X	X	X	X	ODA	Soil and Water Conservation Districts	SWCDs identify and address natural resource concerns within their respective boundaries and work w/ local, state, Federal and private interests to deliver conservation services.	Program is in place, outreach and technical support is ongoing	Stable and adequate levels of resources (Funding)
All Areas	All Populations	Agricultural chemicals (organophoshates and other insecticides) above state standards impair the growth and survival of coho, spring Chinook, winter steelhead, and summer steelhead fry and summer parr, and fall Chinook fry.	X	X	X	X	X	X	–	X	USDA-NRCS	Wildlife Habitat Incentives Program	The Wildlife Habitat Incentives Program (WHIP) is a voluntary program that provides both technical and financial assistance to non-Federal landowners and tribes to create, restore, and enhance fish and wildlife habitats. The Wildlife Habitat Incentives Program is administered by the Natural Resources Conservation Service (NRCS), as established by the 1996 Farm Bill and reauthorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill).	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Agricultural chemicals (organophoshates and other insecticides) above state standards impair the growth and survival of coho, spring Chinook, winter steelhead, and summer steelhead fry and summer parr, and fall Chinook fry.	–	X	X	–	–	X	–	X	USDA-NRCS	Conservation Security Program	The Conservation Security Program (CSP) is a voluntary program that provides financial and technical assistance to promote the conservation and improvement of soil, water, air, energy, plant and animal life, and other conservation purposes on Tribal and private working lands. Working lands include cropland, grassland, prairie land, improved pasture, and range land, as well as forested land that is an incidental part of an agriculture operation. The program provides equitable access to benefits to all producers, regardless of size of operation, crops produced, or geographic location.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Agricultural chemicals (organophoshates and other insecticides) above state standards impair the growth and survival of coho, spring Chinook, winter steelhead, and summer steelhead fry and summer parr, and fall Chinook fry.	X	X	X	X		X	–	–	USDA-NRCS	Wetlands Reserve Program	The Wetlands Reserve Program (WRP) is a voluntary program that provides technical and financial assistance to eligible landowners to restore, enhance, and protect wetlands. Landowners have the option of enrolling eligible lands through permanent easements, 30-year easements, and restoration cost-share agreements. Landowners in Oregon have found that participating in WRP offers an excellent way to retain open space, respect private property rights, benefit fish and wildlife and remove unproductive or inappropriate cropland from cultivation.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Agricultural chemicals (organophoshates and other insecticides) above state standards impair the growth and survival of coho, spring Chinook, winter steelhead, and summer steelhead fry and summer parr, and fall Chinook fry.	–	X	–	–	–	X	–	X	USDA-NRCS	Farm and Ranch Land Protection Program	The Farm and Ranch Land Protection Program (FRPP) is a voluntary program that allows productive farm and ranch lands to remain in agricultural production under private ownership. FRPP assists states, tribes, local governments, or non-profit entities in the purchase of conservation easements or development rights on prime, unique or other productive farmland. The program also provides assistance for farms containing significant historical or archaeological resources.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
All Areas	All Populations	Agricultural chemicals (organophoshates and other insecticides) above state standards impair the growth and survival of coho, spring Chinook, winter steelhead, and summer steelhead fry and summer parr, and fall Chinook fry.	_	X	X	X	X	X	_	X	USDA-NRCS	Environmental Quality Incentives Program	The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program that provides assistance to agricultural producers in a manner that will promote agricultural production and environmental quality as compatible goals and optimize environmental benefits. EQIP is re-authorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill). Through EQIP, farmers may receive financial and technical assistance to implement structural and management conservation practices on agricultural land.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Agricultural chemicals (organophoshates and other insecticides) above state standards impair the growth and survival of coho, spring Chinook, winter steelhead, and summer steelhead fry and summer parr, and fall Chinook fry.	_	X	_	_	_	X	_	X	USDA-NRCS	Grassland Reserve Program	The Grassland Reserve Program (GRP) is a voluntary program offering landowners the opportunity to protect, restore, and enhance grasslands on their property. Section 2401 of the Farm Security and Rural Investment Act of 2002 (Pub. L. 107-171) amended the Food Security Act of 1985 to authorize this program. The Natural Resources Conservation Service, Farm Service Agency and Forest Service are coordinating implementation of GRP, which helps landowners restore and protect grassland, rangeland, pastureland, shrubland and certain other lands and provides assistance for rehabilitating grasslands. The program will conserve vulnerable grasslands from conversion to cropland or other uses and conserve valuable grasslands by helping maintain viable ranching operations.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Fine sediment input from interbasin transfer of glacial water to clearwater streams that impacts the survival of coho, fall Chinook, and steelhead eggs and alevins..	_	_	_	X	_	X	_	_	OWRD	NEED TO IDENTIFY			
All Areas	All Populations	Fine sediment input from interbasin transfer of glacial water to clearwater streams that impacts the survival of coho, fall Chinook, and steelhead eggs and alevins..	_	_	_	_	_	X	_	_	ODEQ	Need to identify			
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	_	X	_	X	_	X	X	X	ODA	Agricultural Water Quality Management (SB 1010)	In 1995, the legislature supplemented the Act with ORS 561.191. This statute reinforces ODA's responsibility for and jurisdiction over agricultural practices and water pollution associated with activities on agricultural and rural lands. Administrative rules adopted to guide Program administration are found in OAR Chapter 603, Divisions 90 and 95. Regulatory actions address violations when they arise. Monitoring tools include DEQ ambient monitoring sites, local monitoring programs such as Rogue Valley Council of Government's Bear Creek monitoring and ODA Riparian Conditional Analysis for agricultural lands.	Affected by rate of riparian vegetation development where needed. Development timeline will vary from 5 to 50 years depending on present site condition and site potential.	Landowner cooperation, capacity for outreach, changing land ownerships and new landowners knowledge of agricultural issues, perception that this is only a complaint driven process, technical assistance, adequate monitoring at meaningful scales
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	_	X	_	X	_	X	X	X	ODA	Weed Control and Invasive Species	The Noxious Weed Control Program provides leadership and technical expertise for weed control programs throughout the state. ODA also tracks invasive exotic plants, insects and animals through a number of detection programs including reporting from citizens and other agencies.	Program is in place, outreach and implementation are ongoing	Adequate technical support, capacity for outreach, perception that this is not doable because it is an ongoing challenge
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	X	X	X	X	X	X	X	_	ODFW	Lands Resources Program	The Wildlife Division Land Resources Program helps guide land-use activities in Oregon that affect fish and wildlife habitats. The program offers tax incentives, grants and technical assistance to private and public landowners, businesses and governments to promote conservation of fish and wildlife habitats, and to ensure environmental protection standards are met. Programs goals promote healthy riparian and wetland corridors - decreasing bank erosion and filtering run-off.	Ongoing	Funding and staff time.
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	X	X	X	X	X	X	X	_	ODFW	Conservation Strategy for Oregon	Previously called the Comprehensive Wildlife Conservation Strategy, the Conservation Strategy for Oregon provides a non-regulatory, statewide approach to species and habitat conservation. It synthesizes existing plans, scientific data, and local knowledge into a broad vision and conceptual framework for long-term conservation of Oregon's native fish, wildlife and habitats. Conservation of instream and upland habitats will promote watershed health.	Internal review by January 2008; varying levels of external review to occur at 5 – and 10 – year intervals.	Voluntary measures – no assurance that it will be implemented
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	X	X	X	X	X	X	X	_	ODFW	Watershed Council Liaison	The ODFW Watershed Council Liaison position provides technical support to watershed councils involved in assessing watershed conditions and conducting restoration projects designed to address watershed needs. Among those projects are actions that specifically address conditions contributing to increased fine sediments in streams.	Not identified.	No staff.
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	X	X	X	X	X	X	X	_	ODFW	Restoration and Enhancement Program	ODFW oversees a comprehensive program to assist in enhancing natural fish production, improve hatchery programs, and provide additional public access to fishing waters. To achieve these goals, the R and E Program provides funding that directly benefits fish by addressing items such as fish passage, habitat restoration, public education, research and monitoring.	Ongoing.	broad legal mandates of the program limit the ability of the program to focus solely on the needs of recovery planning, variable funding due to funding mechanism.
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	X	X	X	X	X	X	X	_	ODFW	Salmon Trout Enhancement Program	The Salmon and Trout Enhancement Program (STEP) recognizes that volunteers play an important role in the restoration of salmon, steelhead and trout. STEP (1) educates the public about Oregon's salmon and trout resources and the habitats they depend on, (2) inventories and monitors fish populations and their habitat, (3) enhances, restores and protects habitat for native stocks of salmon, steelhead, and trout, and (4) produces fish to supplement natural fish production, augment fisheries, or, in the case of the classroom egg incubation program, provide educational opportunities. Habitat monitoring and enhancement function under STEP, could be used to address this limiting factor.	Ongoing.	Funding.

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet)								Agency	Program	Description	Timeline	Constraints
			1	2	3	4	5	6	7	8					
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	X	X	_	X	X	X	X	X	ODA	Soil and Water Conservation Districts	SWCDs identify and address natural resource concerns within their respective boundaries and work w/ local, state, Federal and private interests to deliver conservation services.	Program is in place, outreach and technical support is ongoing	Stable and adequate levels of resources (Funding)
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	_	X	_	X	_	X	_	X	ODEQ	Storm Water Permits	DEQ issues water quality permits to protect surface and ground waters of the state. Stormwater permits are required for and regulate storm water discharges to surface waters from: Construction activities (that disturb greater than 1 acre); industrial activities (subject to Federal permitting requirements determined by SIC codes listed in the Federal regulations); and municipalities (covered under Phase 1 (populations over 100,000) and Phase 2 (populations over 50,000) permitting requirements).	In-place and on-going	Number of staff is always a limitation. Funding is a blend of Federal, state and fee support. Additional funding has recently been provided based on a Blue Ribbon Committee Report which recommended changes to fee structures and additional general funds (DEQ has a preliminary budget request in for additional wastewater and stormwater staff for the 2007 Legislature subject to the Governor's approval).
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	_	_	_	_	_	X	_	_	ODEQ	Water Quality Standards	DEQ develops numeric and narrative water quality standards to protect for the most sensitive beneficial uses of the waters of the state – typically for protection of fish and other aquatic life and human health. As required under the Clean Water Act, these standards are to be reviewed every three years to insure that they are scientifically up-to-date.	In-place and on-going	Number of staff
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	_	_	_	_	_	X	_	_	ODEQ	Water Quality Monitoring	States need comprehensive water quality monitoring and assessment information on environmental conditions and changes over time to help set levels of protection in water quality standards and to identify problem areas that are emerging or that need additional regulatory and non-regulatory actions to support water quality management decisions such as TMDLs, NPDES permits, enforcement, and non-point source management. DEQ's monitoring falls into three broad categories: status and trends; compliance monitoring for standards and permits; and effectiveness monitoring of water quality pollution management programs.	In-place and on-going	Staffing
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	_	_	_	_	_	X	_	_	ODEQ	303(d) Listings	Section 303(d) of the Clean Water Act requires states to identify waters that do not meet water quality standards on a biennial basis.	In-place and on-going	Data availability, accessibility and management
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	_	_	_	_	_	X	_	_	ODEQ	TMDLs	TMDLs are required for waters on the 303(d) list and describe the amount of a pollutant a water body can receive and not violate water quality standards. Loads are allocated among point and nonpoint sources while maintaining a reserve for future growth and a margin of safety.	In-place and on-going	Staffing resources. (DEQ has a preliminary budget request to restore TMDL staffing in for the 2007 legislature subject to the Governor's approval)
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	_	_	_	_	_	X	_	_	ODEQ	401 Dredge & Fill Certifications	Section 401 of the Federal Clean Water Act requires that an applicant for a Federal permit, to conduct an activity that may result in a discharge to waters of the State, must provide the permitting agency with a State water quality certification. A water quality certification is the mechanism by which the State evaluates whether an activity will meet water quality standards. Certifications may be denied, approved or approved with conditions, which if met, will ensure that water quality standards are met.	In-place and on-going	the state review is primarily fee based. Fees need to be periodically adjusted to cover the cost of the program. (DEQ has a preliminary budget request in for the 2007 Legislature subject to the Governor's approval).
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	_	_	_	_	_	X	_	_	ODEQ	Non-Point Source Program	DEQ requires Management Agencies to develop Non Point Source Implementation Plan for sub basins that have TMDLs. Additionally, DEQ works in cooperation with other state, Federal and local agencies to enhance their programs to address elements of non point source pollution and administers grants and loans to implement on-the-ground projects.	In-place and on-going	see other programs listed in this document for constraints.
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	X	X	X	X	_	X	X	X	ODF	Oregon Forest Practices Act	The Oregon Forest Practices Act encourages economically efficient forest management in Oregon and the continuous growing and harvesting of trees and maintenance of forestland on privately owned land consistent with the protection of forest resources through the sound management of soil, air, water, fish and wildlife resources. The forest practices act recognizes that keeping forestland in forestland may be the most effective way to address overall water quality including fine sediment and spawning habitat. With regards to fine sediment, the forest practices act regulates slash treatment, road construction, harvesting, and hauling. Rules vary for each practice, however each is designed to prevent or minimize sediment or debris delivery to waters of the state and meet clean water standards. In addition to regulations for each specific practice, riparian buffers along fish bearing streams add an additional area of filtration between operation activities and waters of the state. A staff of field foresters work with landowners and operators to assist, educate, and enforce the fules. A statewide monitoring program assesses compliance with the rules and rule effectiveness at achieving objectives.	Program is active & ongoing. Recent changes include wet weather hauling rules, road drainage, and management in locations prone to landslides.	Resources and collaboration are always constraining, especially with regards to supporting individual landowners and conducting monitoring work. Before any changes to Oregon's forest practices act are made, ORS 527.714 requires among other things, that resource degradation is likely, the proposed rules address the necessary protection, the proposed solution is the least burdensome while still meeting desired level of protection, and that the benefits outweigh the costs. This "constraint" merely constrains using regulations as an initial solution to problems when other, better solutions exist.
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	X	X	X	X	X	X	X	X	ODF	Private forestry component of the Oregon Plan for Salmon and Watersheds	The Oregon Plan for Salmon and Watersheds coordinates efforts across land uses and landowners to restore clean water and wild salmon. Forest landowners contribute to the Oregon Plan by complying with Oregon's Forest Practices Act and by accomplishing additional projects that contribute to Oregon plan goals. With regards to fine sediments, forest landowners voluntarily rehabilitate legacy roads to reduce the threat of fine sediment. This includes adding water bars, removing culverts, and pulling back perched soils on roads built prior to adoption of the Oregon Forest Practices Act. Oregon Plan measures on private forestland are currently being updated to include recommendations from the work of the forest practices advisory committee and the DEQ sufficiency analysis.	Ongoing.	Resources necessary to implement Oregon Plan voluntary measures must compete with other opportunities. For this reason it is critical that the science behind actions be sound and also be well communicated. Without these two components landowners will be hesitant to contribute their personal resources. As always, more resources would increase education, coordination, projects, and monitoring. The OWEB grant cycle can be a disincentive for some landowners who do road work on an opportunistic basis.
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	_	_	_	_	_	_	_	X	ODLCD	Statewide Comprehensive Land Use Planning	Oregon's statewide comprehensive land use program requires cities and counties to plan for and manage land use in compliance with 19 statewide planning goals. Local land use plans and ordinances must identify and protect natural resources and identify and plan for hazard areas. The statewide land use program provides a framework for local governments to adopt land use plans and ordinances and approve development that are salmon-friendly.	Implementation is on-going. Plans and ordinances are updated according to local needs and as a result of legislation.	Technical and planning assistance to local governments would be highly beneficial in enlisting local planning efforts in salmon recovery.

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	_	_	_	_	_	X	_	_	ODSL	Removal-Fill Program	Oregon´s Removal-Fill Law requires people who plan to remove or fill material in waters of the state to obtain a permit from the Department of State Lands. By offering a streamlined General Authorization for projects with minimal impacts (i.e. bioengineering methods and planting instead of riprap), the permit process encourages applicants to design projects with minimized impacts to water quality. All permits issued by DSL include conditions that require protection of water quality, including turbidity monitoring and sediment and erosion control.	Program is ongoing	The half-time Compliance Monitoring Specialist position is funded for three years and is subject to reauthorization each year of the three year period. The status of the position is uncertain after that time. Additional compliance staff are needed.
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	X	X	X	X	X	X	X	X	OWEB	Grant Program	OWEB's grant program supports voluntary efforts by Oregonians seeking to maintain and restore native fish and healthy watersheds. OWEB funds projects that restore, maintain, and enhance the state's watersheds, supports the capacity of local watershed-based citizen groups to carry out a variety of restoration projects, promotes citizen understanding of watershed needs and restoration ideas, provides technical skills to citizens working to restore urban and rural watersheds, and monitors the effectiveness of investments in watershed restoration. OWEB regular grants are awarded every 6 months for restoration and protection of ecological resources. Grant applications are reviewed by a regional multidisciplinary team to develop recommendations and prioritization of grant applications for OWEB consideration. The review teams evaluate whether the grant applications address limiting factors and the technical soundness of the proposals.	Ongoing	Funding and focus for effort by land use category (forest, urban and agriculture).
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	_	_	_	_	_	_	_	X	OWRD	Lease/Transfer Water Rights Associated with CREP Program	Water rights appurtenant to lands enrolled under the CREP program are not subject to forfeiture for non-use during the enrollment period. OWRD encourages CREP participants to voluntarily lease or temporarily transfer associated water rights instream while enrolled in CREP. Associated water rights leased or transferred instream can be protected instream to benefit minimum flows and listed species.	Ongoing	The program is dependent upon private landowner awareness of the program and voluntary participation levels. Outreach and education is constrained by available resources.
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	_	X	X	X	X	X	_	X	USDA-NRCS	Environmental Quality Incentives Program	The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program that provides assistance to agricultural producers in a manner that will promote agricultural production and environmental quality as compatible goals and optimize environmental benefits. EQIP is re-authorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill). Through EQIP, farmers may receive financial and technical assistance to implement structural and management conservation practices on agricultural land.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	X	X	X	X	X	X	_	X	USDA-NRCS	Wildlife Habitat Incentives Program	The Wildlife Habitat Incentives Program (WHIP) is a voluntary program that provides both technical and financial assistance to non-Federal landowners and tribes to create, restore, and enhance fish and wildlife habitats. The Wildlife Habitat Incentives Program is administered by the Natural Resources Conservation Service (NRCS), as established by the 1996 Farm Bill and reauthorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill).	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	X	X	X	X		X	_	_	USDA-NRCS	Wetlands Reserve Program	The Wetlands Reserve Program (WRP) is a voluntary program that provides technical and financial assistance to eligible landowners to restore, enhance, and protect wetlands. Landowners have the option of enrolling eligible lands through permanent easements, 30-year easements, and restoration cost-share agreements. Landowners in Oregon have found that participating in WRP offers an excellent way to retain open space, respect private property rights, benefit fish and wildlife and remove unproductive or inappropriate cropland from cultivation.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	_	X	_	_	_	X	_	X	USDA-NRCS	Grassland Reserve Program	The Grassland Reserve Program (GRP) is a voluntary program offering landowners the opportunity to protect, restore, and enhance grasslands on their property. Section 2401 of the Farm Security and Rural Investment Act of 2002 (Pub. L. 107-171) amended the Food Security Act of 1985 to authorize this program. The Natural Resources Conservation Service, Farm Service Agency and Forest Service are coordinating implementation of GRP, which helps landowners restore and protect grassland, rangeland, pastureland, shrubland and certain other lands and provides assistance for rehabilitating grasslands. The program will conserve vulnerable grasslands from conversion to cropland or other uses and conserve valuable grasslands by helping maintain viable ranching operations.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	_	X	_	_	_	X	_	X	USDA-NRCS	Farm and Ranch Land Protection Program	The Farm and Ranch Land Protection Program (FRPP) is a voluntary program that allows productive farm and ranch lands to remain in agricultural production under private ownership. FRPP assists states, tribes, local governments, or non-profit entities in the purchase of conservation easements or development rights on prime, unique or other productive farmland. The program also provides assistance for farms containing significant historical or archaeological resources.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	_	X	X	_	_	X	_	X	USDA-NRCS	Conservation Security Program	The Conservation Security Program (CSP) is a voluntary program that provides financial and technical assistance to promote the conservation and improvement of soil, water, air, energy, plant and animal life, and other conservation purposes on Tribal and private working lands. Working lands include cropland, grassland, prairie land, improved pasture, and range land, as well as forested land that is an incidental part of an agriculture operation. The program provides equitable access to benefits to all producers, regardless of size of operation, crops produced, or geographic location.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	X	X	_	_	X	X	X	X	OWEB	CREP Program	OWEB is the state cost share partner for the Conservation Reserve Enhancement Program (CREP) that pays for riparian restoration and provides a 10-15 year conservation rental for maintenance of the plantings. The program has enrolled nearly 2,000 miles of stream since 1999.	Ongoing	Funding

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	X	X	X	X	_	X	X	X	ODF	Fire Program	The Fire Program of the Oregon Department of Forestry provides effective protection from fire for forest resources including water and watersheds, fisheries, wildlife, soil productivity and soil stability. National Fire Plan activities target fuel reduction and stand management that contribute to stands that are more fire resilient and benefit all forest resources. The Fire Program also educates forest landowners and forest homeowners about eh value off fire hazard and risk reduction measures and takes positive action to minimize threats.	Program is active & ongoing.	Federal and private forest 'checker-board' ownership can place private forestlands at risk for uncharacteristic wildfire when either forest is not managed. There is a need for both ODF and ODF&W, and all landowners to play a role in the management of Federal forests located in Oregon. A collaborative relationship between state natural resource agencies and Federal forest management agencies may restore the health, diversity, and resilience of Federal forests by increasing the information shared and by providing a variety of perspectives on site-specific and landscape level determinations. Wildfire-prone areas are identified in a community wildfire protection plans identifying priority areas for hazardous fuel removal from Federal lands.
All Areas	All Populations	Fine sediment inputs from variety of sources that impacts the survival of eggs and alevins.	X	_	X	X	_	X	X	X	ODF	State Forest Program	The State Forest Program implements actions related to roads and timber harvest to minimize the ability of sediment to reach streams. First, roads are built and maintained according to the standards of the Forest Roads Manual. Additionally, roads are surveyed at the watershed scale to identify locations of potential effects to streams. (This is usually conducted through the watershed analysis process.) Based on these surveys, actions are taken to reduce hydrologic connectivity, potential for road failure, and other potential sediment impacts. Timber harvest, likewise, is conducted to minimize sediment contributions to streams. The wide buffers specified by the Forest Management Plan prevent disturbance in the near stream area that might otherwise result in sediment delivery to streams. Finally, ODF conducts monitoring to ensure that actions are applied properly and to evaluate the effectiveness of these actions.	Forests are currently being managed according to the strategies of the Northwest Oregon State Forests Management Plan. Sediment sources, including roads, are being evaluated on a watershed-by-watershed basis through the watershed analysis process. Monitoring is also ongoing. A final report from the Riparian Function and Stream Temperature monitoring project is due in 2011.	Staffing and funding are the major constraints to sediment reduction projects. While new roads are built according to current standards, and road maintenance is ongoing, improvements to existing roads are scheduled as time and funding allows.
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	X	X	X	X	X	X	X	_	ODFW	Lands Resources Program	The Wildlife Division Land Resources Program helps guide land-use activities in Oregon that affect fish and wildlife habitats. The program offers tax incentives, grants and technical assistance to private and public landowners, businesses and governments to promote conservation of fish and wildlife habitats, and to ensure environmental protection standards are met. Programs goals promote healthy riparian and wetland corridors – decreasing bank erosion and filtering run-off.	Ongoing	Funding and staff time.
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	_	X	_	X	_	X	X	X	ODA	Agricultural Water Quality Management (SB 1010)	In 1995, the legislature supplemented the Act with ORS 561.191. This statute reinforces ODA's responsibility for and jurisdiction over agricultural practices and water pollution associated with activities on agricultural and rural lands. Administrative rules adopted to guide Program administration are found in OAR Chapter 603, Divisions 90 and 95. Regulatory actions address violations when they arise. Monitoring tools include DEQ ambient monitoring sites, local monitoring programs such as Rogue Valley Council of Government's Bear Creek monitoring and ODA Riparian Conditional Analysis for agricultural lands.	Affected by rate of riparian vegetation development where needed. Development timeline will vary from 5 to 50 years depending on present site condition and site potential.	Landowner cooperation, capacity for outreach, changing land ownerships and new landowners knowledge of agricultural issues, perception that this is only a complaint driven process, technical assistance, adequate monitoring at meaningful scales
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	X	X	X	X	X	X	X	_	ODFW	Conservation Strategy for Oregon	Previously called the Comprehensive Wildlife Conservation Strategy, the Conservation Strategy for Oregon provides a non-regulatory, statewide approach to species and habitat conservation. It synthesizes existing plans, scientific data, and local knowledge into a broad vision and conceptual framework for long-term conservation of Oregon's native fish, wildlife and habitats. Conservation of instream and upland habitats will promote watershed health.	Internal review by January 2008; varying levels of external review to occur at 5 – and 10 – year intervals.	Voluntary measures – no assurance that it will be implemented.
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	X	X	X	X	X	X	X	_	ODFW	Watershed Council Liaison	The ODFW Watershed Council Liaison position provides technical support to watershed councils involved in assessing watershed conditions and conducting restoration projects designed to address watershed needs. Among those projects are actions that specifically address riparian enhancement.	Not identified.	No staff.
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	X	X	X	X	X	X	X	_	ODFW	Restoration and Enhancement Program	ODFW oversees a comprehensive program to assist in enhancing natural fish production, improve hatchery programs, and provide additional public access to fishing waters. To achieve these goals, the R and E Program provides funding that directly benefits fish by addressing items such as fish passage, habitat restoration, public education, research and monitoring.	Ongoing.	broad legal mandates of the program limit the ability of the program to focus solely on the needs of recovery planning, variable funding due to funding mechanism.
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	X	X	X	X	X	X	X	_	ODFW	Salmon Trout Enhancement Program	The Salmon and Trout Enhancement Program (STEP) recognizes that volunteers play an important role in the restoration of salmon, steelhead and trout. STEP (1) educates the public about Oregon's salmon and trout resources and the habitats they depend on, (2) inventories and monitors fish populations and their habitat, (3) enhances, restores and protects habitat for native stocks of salmon, steelhead, and trout, and (4) produces fish to supplement natural fish production, augment fisheries, or, in the case of the classroom egg incubation program, provide educational opportunities. Habitat monitoring and enhancement function under STEP, could be used to address this limiting factor.	Ongoing.	Funding.
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	X	X	_	X	X	X	X	X	ODA	Soil and Water Conservation Districts	SWCDs identify and address natural resource concerns within their respective boundaries and work w/ local, state, Federal and private interests to deliver conservation services.	Program is in place, outreach and technical support is ongoing	Stable and adequate levels of resources (Funding)

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	_	_	_	_	_	X	_	_	ODEQ	Water Quality Standards	DEQ develops numeric and narrative water quality standards to protect for the most sensitive beneficial uses of the waters of the state – typically for protection of fish and other aquatic life and human health. As required under the Clean Water Act, these standards are to be reviewed every three years to insure that they are scientifically up-to-date.	In-place and on-going	Number of staff
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	_	_	_	_	_	X	_	_	ODEQ	Water Quality Monitoring	States need comprehensive water quality monitoring and assessment information on environmental conditions and changes over time to help set levels of protection in water quality standards and to identify problem areas that are emerging or that need additional regulatory and non-regulatory actions to support water quality management decisions such as TMDLs, NPDES permits, enforcement, and non-point source management. DEQ's monitoring falls into three broad categories: status and trends; compliance monitoring for standards and permits; and effectiveness monitoring of water quality pollution management programs.	In-place and on-going	Staffing
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	_	_	_	_	_	X	_	_	ODEQ	303(d) Listings	Section 303(d) of the Clean Water Act requires states to identify waters that do not meet water quality standards on a biennial basis.	In-place and on-going	Data availability, accessibility and management
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	_	_	_	_	_	X	_	_	ODEQ	TMDLs	TMDLs are required for waters on the 303(d) list and describe the amount of a pollutant a water body can receive and not violate water quality standards. Loads are allocated among point and nonpoint sources while maintaining a reserve for future growth and a margin of safety.	In-place and on-going	Staffing resources. (DEQ has a preliminary budget request to restore TMDL staffing in for the 2007 legislature subject to the Governor's approval)
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	_	_	_	_	_	X	_	_	ODEQ	401 Hydroelectric Recertification	Section 401 of the Federal Clean Water Act requires that an applicant for a Federal permit, to conduct an activity that may result in a discharge to waters of the State, must provide the permitting agency with a State water quality certification. A water quality certification is the mechanism by which the State evaluates whether an activity will meet water quality standards. Certifications may be denied, approved or approved with conditions, which if met, will ensure that water quality standards are met.	In-place and on-going	the state review is primarily fee based. Fees need to be periodically adjusted to cover the cost of the program
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	_	_	_	_	_	X	_	_	ODEQ	Non-Point Source Program	DEQ requires Management Agencies to develop Non Point Source Implementation Plan for sub basins that have TMDLs. Additionally, DEQ works in cooperation with other state, Federal and local agencies to enhance their programs to address elements of non point source pollution and administers grants and loans to implement on-the-ground projects.	In-place and on-going	see other programs listed in this document for constraints.
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	_	_	_	_	_	X	_	_	ODF	Oregon Forest Practices Act	The Oregon Forest Practices Act encourages economically efficient forest management in Oregon and the continuous growing and harvesting of trees and maintenance of forestland on privately owned land consistent with the protection of forest resources through the sound management of soil, air, water, fish and wildlife resources. The purpose of the water protection rules is to protect, maintain and, where appropriate, improve the functions and values of streams, lakes, wetlands, and riparian management areas. These functions and values include water quality, hydrologic functions, the growing and harvesting of trees, and fish and wildlife resources. Temperature is primarily addressed in the water protection rules that include general vegetation retention prescriptions for streams, lakes and wetlands. Requirements for vegetation along fish bearing streams varies by stream size and geographic region, however along all fish bearing streams, trees within 20 feet, vegetation within 10 feet, and trees leaning over the channel are required to be retained. Retention requirements beyond this vary. size and geographic region.	Monitoring of small and medium fish bearing streams is under way. Board of Forestry work plan indicates evaluation of small non-fish bearing streams for temperature in 2008.	Private Forests Program monitoring studies span multiple years of data collection and therefore it takes time for analyses and results to provide feedback to inform policy decisions. Resources and collaboration are needed to implement the necessary monitoring projects. Before any changes to Oregon's forest practices act are made, ORS 527.714 requires among other things, that resource degradation is likely, the proposed rules address the necessary protection, the proposed solution is the least burdensome while still meeting desired level of protection, and that the benefits outweigh the costs. This "constraint" merely constrains using regulations as an initial solution to problems when other, better solutions
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	_	_	_	_	_	X	_	_	ODF	Private forestry component of the Oregon Plan for Salmon and Watersheds	Working together, Oregonians have the opportunity to help restore clean water and wild salmon for the benefit of us all and for future generations. The Oregon Plan for Salmon and Watersheds coordinates these efforts across land uses and landowners. Forest Landowners contribute to the Oregon Plan by complying with Oregon's Forest Practices Act and by accomplishing additional projects that contribute to Oregon Plan goals. With regards to temperature, forest landowners manage riparian areas, leave additional conifers along streams, increase RMAs for non-fish bearing streams, and place leave trees to benefit Oregon Plan objectives. Oregon Plan measures on forestland are currently being updated to include recommendations from the work of the forest practices advisory committee and the DEQ sufficiency analysis.	Ongoing	Funding for research to define the links between riparian areas, stream temperature, and healthy populations of salmonids.
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	X	X	X	X	X	X	X	X	OWEB	Grant Program	OWEB's grant program supports voluntary efforts by Oregonians seeking to maintain and restore native fish and healthy watersheds. OWEB funds projects that restore, maintain, and enhance the state's watersheds, supports the capacity of local watershed-based citizen groups to carry out a variety of restoration projects, promotes citizen understanding of watershed needs and restoration ideas, provides technical skills to citizens working to restore urban and rural watersheds, and monitors the effectiveness of investments in watershed restoration. OWEB regular grants are awarded every 6 months for restoration and protection of ecological resources. Grant applications are reviewed by a regional multidisciplinary team to develop recommendations and prioritization of grant applications for OWEB consideration. The review teams evaluate whether the grant applications address limiting factors and the technical soundness of the proposals.	Ongoing	Funding
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	X	X	_	_	X	X	X	X	OWEB	CREP Program	OWEB is the state cost share partner for the Conservation Reserve Enhancement Program (CREP) that pays for riparian restoration and provides a 10-15 year conservation rental for maintenance of the plantings. The program has enrolled nearly 2,000 miles of stream since 1999.	Ongoing	Funding

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	_	X	X	X	X	X	_	X	USDA-NRCS	Environmental Quality Incentives Program	The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program that provides assistance to agricultural producers in a manner that will promote agricultural production and environmental quality as compatible goals and optimize environmental benefits. EQIP is re-authorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill). Through EQIP, farmers may receive financial and technical assistance to implement structural and management conservation practices on agricultural land.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	X	X	X	X	X	X	_	X	USDA-NRCS	Wildlife Habitat Incentives Program	The Wildlife Habitat Incentives Program (WHIP) is a voluntary program that provides both technical and financial assistance to non-Federal landowners and tribes to create, restore, and enhance fish and wildlife habitats. The Wildlife Habitat Incentives Program is administered by the Natural Resources Conservation Service (NRCS), as established by the 1996 Farm Bill and reauthorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill).	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	X	X	X	X		X	_	_	USDA-NRCS	Wetlands Reserve Program	The Wetlands Reserve Program (WRP) is a voluntary program that provides technical and financial assistance to eligible landowners to restore, enhance, and protect wetlands. Landowners have the option of enrolling eligible lands through permanent easements, 30-year easements, and restoration cost-share agreements. Landowners in Oregon have found that participating in WRP offers an excellent way to retain open space, respect private property rights, benefit fish and wildlife and remove unproductive or inappropriate cropland from cultivation.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	_	X	_	_	_	X	_	X	USDA-NRCS	Grassland Reserve Program	The Grassland Reserve Program (GRP) is a voluntary program offering landowners the opportunity to protect, restore, and enhance grasslands on their property. Section 2401 of the Farm Security and Rural Investment Act of 2002 (Pub. L. 107-171) amended the Food Security Act of 1985 to authorize this program. The Natural Resources Conservation Service, Farm Service Agency and Forest Service are coordinating implementation of GRP, which helps landowners restore and protect grassland, rangeland, pastureland, shrubland and certain other lands and provides assistance for rehabilitating grasslands. The program will conserve vulnerable grasslands from conversion to cropland or other uses and conserve valuable grasslands by helping maintain viable ranching operations.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	_	X	_	_	_	X	_	X	USDA-NRCS	Farm and Ranch Land Protection Program	The Farm and Ranch Land Protection Program (FRPP) is a voluntary program that allows productive farm and ranch lands to remain in agricultural production under private ownership. FRPP assists states, tribes, local governments, or non-profit entities in the purchase of conservation easements or development rights on prime, unique or other productive farmland. The program also provides assistance for farms containing significant historical or archaeological resources.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	_	X	X	_	_	X	_	X	USDA-NRCS	Conservation Security Program	The Conservation Security Program (CSP) is a voluntary program that provides financial and technical assistance to promote the conservation and improvement of soil, water, air, energy, plant and animal life, and other conservation purposes on Tribal and private working lands. Working lands include cropland, grassland, prairie land, improved pasture, and range land, as well as forested land that is an incidental part of an agriculture operation. The program provides equitable access to benefits to all producers, regardless of size of operation, crops produced, or geographic location.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	X	X	X	X	_	X	X	X	ODF	Fire Program	The Fire Program of the Oregon Department of Forestry provides effective protection from fire for forest resources including water and watersheds, fisheries, wildlife, soil productivity and soil stability. National Fire Plan activities target fuel reduction and stand management that contribute to stands that are more fire resilient and benefit all forest resources. The Fire Program also educates forest landowners and forest homeowners about eh value off fire hazard and risk reduction measures and takes positive action to minimize threats.	Program is active & ongoing.	Federal and private forest 'checker-board' ownership can place private forestlands at risk for uncharacteristic wildfire when either forest is not managed. There is a need for both ODF and ODF&W, and all landowners to play a role in the management of Federal forests located in Oregon. A collaborative relationship between state natural resource agencies and Federal forest management agencies may restore the health, diversity, and resilience of Federal forests by increasing the information shared and by providing a variety of perspectives on site-specific and landscape level determinations. Wildfire-prone areas are identified in a community wildfire protection plans identifying priority areas for hazardous fuel removal from Federal lands.
All Areas	All Populations	High water temperatures due to degraded riparian conditions result in increased stress and mortality of juveniles.	_	_	_	_	_	X	_	_	ODF	State Forest Program	The State Forest Program applies management standards for aquatic and riparian areas that include wide riparian buffers on fish bearing streams. These same standards apply to large and medium perennial streams without fish. Small perennial streams without fish also have tree retention requirements. ODF also applies additional risk-reduction strategies in Salmon Anchor Habitats (until 2011).. Finally, monitoring is conducted. ODF evaluates the effectiveness of its riparian strategies through its adaptive management program.	Forests, including riparian management areas, are currently being managed according to the strategies of the Northwest Oregon State Forests Management Plan. Monitoring through the ODF Riparian Function and Stream Temperature monitoring project is ongoing. A final report from the Riparian Function and Stream Temperature monitoring project is due in 2011.	None identified.

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet)								Agency	Program	Description	Timeline	Constraints
			1	2	3	4	5	6	7	8					
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	X	X	X	X	X	X	X	_	ODFW	Lands Resources Program	The Wildlife Division Land Resources Program helps guide land-use activities in Oregon that affect fish and wildlife habitats. The program offers tax incentives, grants and technical assistance to private and public landowners, businesses and governments to promote conservation of fish and wildlife habitats, and to ensure environmental protection standards are met. Programs goals promote healthy riparian and wetland corridors – decreasing bank erosion and filtering run-off.	Ongoing	Funding and staff time.
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	X	X	X	X	X	X	X	_	ODFW	Conservation Strategy for Oregon	Previously called the Comprehensive Wildlife Conservation Strategy, the Conservation Strategy for Oregon provides a non-regulatory, statewide approach to species and habitat conservation. It synthesizes existing plans, scientific data, and local knowledge into a broad vision and conceptual framework for long-term conservation of Oregon's native fish, wildlife and habitats. Conservation of instream and upland habitats will promote watershed health.	Internal review by January 2008; varying levels of external review to occur at 5 – and 10 – year intervals.	Voluntary measures – no assurance that it will be implemented
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	X	X	X	X	X	X	X	_	ODFW	Watershed Council Liaison	The ODFW Watershed Council Liaison position provides technical support to watershed councils involved in assessing watershed conditions and conducting restoration projects designed to address watershed needs. Among those projects are actions that specifically address habitat complexity in streams.	Not identified.	No staff.
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	X	X	X	X	X	X	X	_	ODFW	Restoration and Enhancement Program	ODFW oversees a comprehensive program to assist in enhancing natural fish production, improve hatchery programs, and provide additional public access to fishing waters. To achieve these goals, the R and E Program provides funding that directly benefits fish by addressing items such as fish passage, habitat restoration, public education, research and monitoring.	Ongoing.	broad legal mandates of the program limit the ability of the program to focus solely on the needs of recovery planning, variable funding due to funding mechanism.
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	X	X	X	X	X	X	X	_	ODFW	Salmon Trout Enhancement Program	The Salmon and Trout Enhancement Program (STEP) recognizes that volunteers play an important role in the restoration of salmon, steelhead and trout. STEP (1) educates the public about Oregon's salmon and trout resources and the habitats they depend on, (2) inventories and monitors fish populations and their habitat, (3) enhances, restores and protects habitat for native stocks of salmon, steelhead, and trout, and (4) produces fish to supplement natural fish production, augment fisheries, or, in the case of the classroom egg incubation program, provide educational opportunities. Habitat monitoring and enhancement function under STEP, could be used to address this limiting factor.	Ongoing.	Funding.
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	X	X	_	X	X	X	X	X	ODA	Soil and Water Conservation Districts	SWCDs identify and address natural resource concerns within their respective boundaries and work w/ local, state, Federal and private interests to deliver conservation services.	Program is in place, outreach and technical support is ongoing	Stable and adequate levels of resources (Funding)
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	X	X	_	X	X	X	X	X	ODF	Oregon Forest Practices Act	The Oregon Forest Practices Act encourages economically efficient forest management in Oregon and the continuous growing and harvesting of trees and maintenance of forestland on privately owned land consistent with the protection of forest resources through the sound management of soil, air, water, fish and wildlife resources. The purpose of the water protection rules is to protect, maintain and, where appropriate, improve the functions and values of streams, lakes, wetlands, and riparian management areas. With regards to habitat complexity and off-channel habitat availability, the OFPA regulates slash treatment, reforestation, chemical applications, road construction, harvesting, and hauling. Statutes and administrative rules vary for each practice, however each is designed to protect and maintain the specific vegetation retention requirements along streams. Requirements vary by stream size and geographic region, however along all fish bearing streams, trees within 20 feet, vegetation within 10 feet, and trees leaning over the channel are required to be retained. Retention requirements beyond this vary. Vegetation requirements also vary along non-fish bearing streams by stream size and geographic region.	Ongoing.	Before any changes to Oregon's forest practices act are made, ORS 527.714 requires among other things, that resource degradation is likely, the proposed rules address the necessary protection, the proposed solution is the least burdensome while still meeting desired level of protection, and that the benefits outweigh the costs. This "constraint" merely constrains using regulations as an initial solution to problems when other, better solutions exist. More resources would increase education, assistance, enforcement, and participation in voluntary solutions to providing habitat complexity.
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	X	X	X	_	X	X	X	X	ODF	Private forestry component of the Oregon Plan for Salmon and Watersheds	Working together, Oregonians have the opportunity to help restore clean water and wild salmon for the benefit of us all and for future generations. The Oregon Plan for Salmon and Watersheds coordinates these efforts across land uses and landowners. Forest Landowners contribute to the Oregon Plan by complying with Oregon's Forest Practices Act and by accomplishing additional projects that contribute to Oregon Plan goals. Regarding habitat complexity and off channel habitat availability, forest landowners place wood in streams, manage riparian areas, restore conifers in riparian management areas, and participate in habitat restoration activities. Oregon Plan measures on forestland are currently being updated to include recommendations from the work of the forest practices advisory committee and the DEQ sufficiency analysis.	Ongoing, updated voluntary measures planned for 2007.	Sufficient incentives are necessary to increase the scope of non-regulatory measures to match the needs. More stewardship foresters and habitat biologists are necessary to support the commitment landowners have willingly made. This would strengthen the educational component and complement the technical assistance from ODF, ODF&W, and OSU Extension foresters.
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	X	_	_	_	X	_	_	_	ODLCD	Statewide Comprehensive Land Use Planning	Oregon's statewide comprehensive land use program requires cities and counties to plan for and manage land use in compliance with 19 statewide planning goals. Local land use plans and ordinances must identify and protect natural resources and identify and plan for hazard areas. The statewide land use program provides a framework for local governments to adopt land use plans and ordinances and approve development that are salmon-friendly.	Implementation is on-going. Plans and ordinances are updated according to local needs and as a result of legislation.	Technical and planning assistance to local governments would be highly beneficial in enlisting local planning efforts in salmon recovery.
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	X	_	_	_	X	_	_	_	ODSL	Removal-Fill Program	Oregon´s Removal-Fill Law requires people who plan to remove or fill material in waters of the state to obtain a permit from the Department of State Lands. Proposed permanent impacts to off-channel and side-channel habitat are required to be offset with compensatory mitigation actions such as riparian planting or large wood placement. The Department is in the process of developing a streamlined application process for stream restoration activities including projects that would improve habitat complexity and off-channel habitat availability. The goal is to have a pilot program for this new process up and running in the spring of 2007.	Program is ongoing	The half-time Compliance Monitoring Specialist position is funded for three years and is subject to reauthorization each year of the three year period. The status of the position is uncertain after that time. Additional compliance staff are needed. The fact that DSL does not have jurisdiction over the removal of large wood hinders our ability to protect off-channel and side-channel habitat.

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet)								Agency	Program	Description	Timeline	Constraints
			1	2	3	4	5	6	7	8					
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	X	_	_	_	X	_	_	_	ODSL	Voluntary Restoration Initiative	Under DSL's new Voluntary Restoration Initiative, two Wetland Restoration Specialists are working with landowners and organizations interested in restoring wetlands. The primary objectives are to provide technical assistance on restoration site assessment, permitting and monitoring, facilitate the restoration of historical wetland types with an emphasis on rare and at-risk habitats, and accurately track and report the quality and quantity of voluntary wetland restoration projects currently being implemented throughout the state.	Initiative began in March of 2006 and is scheduled as a three-year program.	The Initiative is funded for three years and is subject to reauthorization each year of the three year period. The status of the program is uncertain after that time.
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	X	X	X	X	X	X	X	X	OWEB	Grant Program	OWEB's grant program supports voluntary efforts by Oregonians seeking to maintain and restore native fish and healthy watersheds. OWEB funds projects that restore, maintain, and enhance the state's watersheds, supports the capacity of local watershed-based citizen groups to carry out a variety of restoration projects, promotes citizen understanding of watershed needs and restoration ideas, provides technical skills to citizens working to restore urban and rural watersheds, and monitors the effectiveness of investments in watershed restoration. OWEB regular grants are awarded every 6 months for restoration and protection of ecological resources. Grant applications are reviewed by a regional multidisciplinary team to develop recommendations and prioritization of grant applications for OWEB consideration. The review teams evaluate whether the grant applications address limiting factors and the technical soundness of the proposals.	Ongoing	Funding
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	X	X	_	_	X	X	X	X	OWEB	CREP Program	OWEB is the state cost share partner for the Conservation Reserve Enhancement Program (CREP) that pays for riparian restoration and provides a 10-15 year conservation rental for maintenance of the plantings. The program has enrolled nearly 2,000 miles of stream since 1999.	Ongoing	Funding
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	_	X	X	X	X	X	_	X	USDA-NRCS	Environmental Quality Incentives Program	The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program that provides assistance to agricultural producers in a manner that will promote agricultural production and environmental quality as compatible goals and optimize environmental benefits. EQIP is re-authorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill). Through EQIP, farmers may receive financial and technical assistance to implement structural and management conservation practices on agricultural land.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	X	X	X	X	X	X	_	X	USDA-NRCS	Wildlife Habitat Incentives Program	The Wildlife Habitat Incentives Program (WHIP) is a voluntary program that provides both technical and financial assistance to non-Federal landowners and tribes to create, restore, and enhance fish and wildlife habitats. The Wildlife Habitat Incentives Program is administered by the Natural Resources Conservation Service (NRCS), as established by the 1996 Farm Bill and reauthorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill).	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	X	X	X	X		X	_	_	USDA-NRCS	Wetlands Reserve Program	The Wetlands Reserve Program (WRP) is a voluntary program that provides technical and financial assistance to eligible landowners to restore, enhance, and protect wetlands. Landowners have the option of enrolling eligible lands through permanent easements, 30-year easements, and restoration cost-share agreements. Landowners in Oregon have found that participating in WRP offers an excellent way to retain open space, respect private property rights, benefit fish and wildlife and remove unproductive or inappropriate cropland from cultivation.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	_	X	_	_	_	X	_	X	USDA-NRCS	Grassland Reserve Program	The Grassland Reserve Program (GRP) is a voluntary program offering landowners the opportunity to protect, restore, and enhance grasslands on their property. Section 2401 of the Farm Security and Rural Investment Act of 2002 (Pub. L. 107-171) amended the Food Security Act of 1985 to authorize this program. The Natural Resources Conservation Service, Farm Service Agency and Forest Service are coordinating implementation of GRP, which helps landowners restore and protect grassland, rangeland, pastureland, shrubland and certain other lands and provides assistance for rehabilitating grasslands. The program will conserve vulnerable grasslands from conversion to cropland or other uses and conserve valuable grasslands by helping maintain viable ranching operations.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	_	X	_	_	_	X	_	X	USDA-NRCS	Farm and Ranch Land Protection Program	The Farm and Ranch Land Protection Program (FRPP) is a voluntary program that allows productive farm and ranch lands to remain in agricultural production under private ownership. FRPP assists states, tribes, local governments, or non-profit entities in the purchase of conservation easements or development rights on prime, unique or other productive farmland. The program also provides assistance for farms containing significant historical or archaeological resources.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	_	X	X	_	_	X	_	X	USDA-NRCS	Conservation Security Program	The Conservation Security Program (CSP) is a voluntary program that provides financial and technical assistance to promote the conservation and improvement of soil, water, air, energy, plant and animal life, and other conservation purposes on Tribal and private working lands. Working lands include cropland, grassland, prairie land, improved pasture, and range land, as well as forested land that is an incidental part of an agriculture operation. The program provides equitable access to benefits to all producers, regardless of size of operation, crops produced, or geographic location.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

			Management Strategies (see "Strategy Description" worksheet)												
Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	X	X	X	X	_	X	X	X	ODF	Fire Program	The Fire Program of the Oregon Department of Forestry provides effective protection from fire for forest resources including water and watersheds, fisheries, wildlife, soil productivity and soil stability. National Fire Plan activities target fuel reduction and stand management that contribute to stands that are more fire resilient and benefit all forest resources. The Fire Program also educates forest landowners and forest homeowners about eh value off fire hazard and risk reduction measures and takes positive action to minimize threats.	Program is active & ongoing.	Federal and private forest 'checker-board' ownership can place private forestlands at risk for uncharacteristic wildfire when either forest is not managed. There is a need for both ODF and ODF&W, and all landowners to play a role in the management of Federal forests located in Oregon. A collaborative relationship between state natural resource agencies and Federal forest management agencies may restore the health, diversity, and resilience of Federal forests by increasing the information shared and by providing a variety of perspectives on site-specific and landscape level determinations. Wildfire-prone areas are identified in a community wildfire protection plans identifying priority areas for hazardous fuel removal from Federal lands.
All Areas	All Populations	Loss of instream habitat complexity and off channel habitat availability juveniles due to past and/or present land management practices.	X	_	_	X	X	_	_	_	ODF	State Forest Program	The State Forest Program applies management standards for aquatic and riparian areas which are designed to increase the development of riparian large wood to restore aquatic habitats. These include a wider riparian management zone than specified under the FPA, with additional tree retention. Where appropriate, the FMP promotes the use of alternative vegetation treatments to accelerate the development of large wood. Active restoration is also applied to improve habitat complexity. Restoration projects include wood placement and re-routing of roads away from streams. Priority areas for restoration are generally identified through the watershed analysis process. Finally, monitoring is conducted. ODFW conducts monitoring to evaluate the effectiveness of restoration projects, while ODF evaluates the effectiveness of its riparian strategies through an adaptive management process.	Forests, including riparian management areas, are currently being managed according to the strategies of the Northwest Oregon State Forests Management Plan. Priority areas for restoration are being identified on a watershed-by-watershed basis through the watershed analysis process. Additionally, consultations with ODFW are conducted with timber sale projects. Monitoring by ODFW and through the ODF Riparian Function and Stream Temperature monitoring project is also ongoing. A final report from the Riparian Function and Stream Temperature monitoring project is due in 2011.	Staffing and funding are the major constraints to habitat restoration projects. Projects are generally conducted opportunistically in connection with timber sales. Additional projects could be conducted with increased staffing and funding.
All Areas	All Populations	Reduced instream flows due to water withdrawals impairs the growth, survival, or movement of juveniles.	X	X	X	X	X	X	X	X	OWEB	Grant Program	OWEB's grant program supports voluntary efforts by Oregonians seeking to maintain and restore native fish and healthy watersheds. OWEB funds projects that restore, maintain, and enhance the state's watersheds, supports the capacity of local watershed-based citizen groups to carry out a variety of restoration projects, promotes citizen understanding of watershed needs and restoration ideas, provides technical skills to citizens working to restore urban and rural watersheds, and monitors the effectiveness of investments in watershed restoration. OWEB regular grants are awarded every 6 months for restoration and protection of ecological resources. Grant applications are reviewed by a regional multidisciplinary team to develop recommendations and prioritization of grant applications for OWEB consideration. The review teams evaluate whether the grant applications address limiting factors and the technical soundness of the proposals.	Ongoing	Funding
All Areas	All Populations	Reduced instream flows due to water withdrawals impairs the growth, survival, or movement of juveniles.	_	_	_	X	_	_	_	_	OWRD	Lease/Transfer Water Rights Associated with CREP Program	Water rights appurtenant to lands enrolled under the CREP program are not subject to forfeiture for non-use during the enrollment period. OWRD encourages CREP participants to voluntarily lease or temporarily transfer associated water rights instream while enrolled in CREP. Associated water rights leased or transferred instream can be protected instream to benefit minimum flows and listed species.	Ongoing	The program is dependent upon private landowner awareness of the program and voluntary participation levels. Outreach and education is constrained by available resources.
All Areas	All Populations	Reduced instream flows due to water withdrawals impairs the growth, survival, or movement of juveniles.	_	_	_	X	_	_	_	_	OWRD	Water Distribution and Regulation	Distribution and regulation of water use for the protection of senior water rights, including instream rights, is a priority for the OWRD. Staff regularly monitors streamflow, particularly on those streams with established instream rights, and work to eliminate illegal use through compliance and enforcement of Oregon water law.	Ongoing	Funding for staff and monitoring capabilities is unstable and declining. The 2007-2009 agency budget requests funding to add monitoring and distribution capacity. The junior status of some instream water rights may limit their flow benefit in some areas. In these instances, voluntary restoration measures are key to achieving recovery goals as they relate to flow.
All Areas	All Populations	Reduced instream flows due to water withdrawals impairs the growth, survival, or movement of juveniles.	_	_	_	X	_	_	_	_	OWRD	Water Use Measurement Strategy	Federal and state agencies, cities, counties, schools, irrigation districts and other special districts are required to report water use on an annual basis. Since 1990, many new permits have required water meters to be installed and annual reports to be submitted to the state. In addition, the Water Resource Commission considered water use measurement in 2000 and adopted a strategy for improving water measurement statewide. The strategy includes a program to inventory and complete field assessments of significant points of diversion and to look for opportunities to increase measurement at those diversions by ensuring compliance and promoting voluntary measurement via cost-share programs. Significant diversions are characterized as those required to measure through a water right condition, or those diversions without a measurement condition that are greater than 5 cfs, or greater than 10% of the lowest monthly 50% exceedance flow as defined in the water availability model, and greater than 0.25 cfs.	Ongoing with partial implementation	Implementation of the water use measurement strategy is constrained by available resources and staff. Restoration of the Water Use Measurement and Reporting position is included with the 2007 budget request.

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
All Areas	All Populations	Reduced instream flows due to water withdrawals impairs the growth, survival, or movement of juveniles.	_	_	_	X	_	_	_	_	OWRD	Fish and Fish Habitat Protection	Surface waters in many areas of the state are fully allocated during critical flow periods for fish. However, there are several aspects of the review process for new water right applications that are protective of fish and fish habitat. All new groundwater permits are evaluated to determine the potential to cause substantial interference with surface flows. Surface water availability is modeled monthly and includes existing instream water rights. Applications to appropriate surface waters are evaluated at the 80% exceedance level. Permits are subject to public interest review standards that include interagency consultation on potential impacts of further appropriation to fish and fish habitat. Permits, if approved, can be conditioned to address impacts identified through the public interest standard and interagency review process.	Ongoing	Funding to support monitoring capabilities is unstable and declining. A policy option package for the 2007-2009 biennium would improve statewide monitoring capabilities.
All Areas	All Populations	Reduced instream flows due to water withdrawals impairs the growth, survival, or movement of juveniles.	_	_	_	X	_	_	_	_	OWRD	Flow Restoration Programs	ODFW and OWRD have identified priority watersheds where flow restoration will produce the most benefit for listed species. OWRD Staff work with water rights holders to restore streamflow through voluntary flow restoration measures. Voluntary measures include instream leases, instream transfers, allocations of water conserved through improved efficiencies, and changes to existing rights including consolidation or transfers of points of diversion. In certain circumstances, reclaimed water from certain municipal, industrial and confined animal feeding operations may provide an effective alternative to new diversions of surface water or ground water.	Ongoing	Programs are constrained by limited funding and resources for outreach and education, lease/transfer follow-up and re-enrollment, and accessibility of lease/transfer data to support monitoring and evaluation of flow restoration efforts and their impacts on listed species.
All Areas	All Populations	Reduced instream flows due to water withdrawals impairs the growth, survival, or movement of juveniles.	_	_	_	X	_	_	_	_	OWRD	Water Supply and Conservation Planning	OWRD Staff work with water rights holders to address water supply through the development of water management and conservation plans. The development of these plans for new and extended municipal rights and through voluntary participation of irrigation districts must identify conservation measures that will be pursued. Municipal plans must also include five year benchmarks for implementation of conservation activities.	Water Management and Conservation Plan programs are in place and ongoing. Development and implementation of the Water Supply and Conservation Initiative is subject to funding during the 2007-2009 biennium.	Water supply and conservation planning is constrained by limited funding and resources for outreach, education, and program development. The 2007-2009 agency budget requests funding for the Water Supply and Conservation Initiative.
All Areas	All Populations	Reduced instream flows due to water withdrawals impairs the growth, survival, or movement of juveniles.	_	_	_	X	_	_	_	_	OWRD	Water Rights Programs	All new water right applications are subject to review through an interagency review and consultation process. Permits, if approved, may be conditioned to address impacts on listed species identified through the consultation process.	Ongoing	Funding to support monitoring capabilities is unstable and declining. A policy option package for the 2007-2009 biennium would improve statewide monitoring capabilities.
All Areas	All Populations	Reduced instream flows due to water withdrawals impairs the growth, survival, or movement of juveniles.	X	X	X	X	X	X	_	X	USDA-NRCS	Wildlife Habitat Incentives Program	The Wildlife Habitat Incentives Program (WHIP) is a voluntary program that provides both technical and financial assistance to non-Federal landowners and tribes to create, restore, and enhance fish and wildlife habitats. The Wildlife Habitat Incentives Program is administered by the Natural Resources Conservation Service (NRCS), as established by the 1996 Farm Bill and reauthorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill).	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Reduced instream flows due to water withdrawals impairs the growth, survival, or movement of juveniles.	_	X	X	_	_	X	_	X	USDA-NRCS	Conservation Security Program	The Conservation Security Program (CSP) is a voluntary program that provides financial and technical assistance to promote the conservation and improvement of soil, water, air, energy, plant and animal life, and other conservation purposes on Tribal and private working lands. Working lands include cropland, grassland, prairie land, improved pasture, and range land, as well as forested land that is an incidental part of an agriculture operation. The program provides equitable access to benefits to all producers, regardless of size of operation, crops produced, or geographic location.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Reduced instream flows due to water withdrawals impairs the growth, survival, or movement of juveniles.	X	X	X	X		X	_	_	USDA-NRCS	Wetlands Reserve Program	The Wetlands Reserve Program (WRP) is a voluntary program that provides technical and financial assistance to eligible landowners to restore, enhance, and protect wetlands. Landowners have the option of enrolling eligible lands through permanent easements, 30-year easements, and restoration cost-share agreements. Landowners in Oregon have found that participating in WRP offers an excellent way to retain open space, respect private property rights, benefit fish and wildlife and remove unproductive or inappropriate cropland from cultivation.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Reduced instream flows due to water withdrawals impairs the growth, survival, or movement of juveniles.	_	X	_	_	_	X	_	X	USDA-NRCS	Farm and Ranch Land Protection Program	The Farm and Ranch Land Protection Program (FRPP) is a voluntary program that allows productive farm and ranch lands to remain in agricultural production under private ownership. FRPP assists states, tribes, local governments, or non-profit entities in the purchase of conservation easements or development rights on prime, unique or other productive farmland. The program also provides assistance for farms containing significant historical or archaeological resources.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Reduced instream flows due to water withdrawals impairs the growth, survival, or movement of juveniles.	_	X	X	X	X	X	_	X	USDA-NRCS	Environmental Quality Incentives Program	The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program that provides assistance to agricultural producers in a manner that will promote agricultural production and environmental quality as compatible goals and optimize environmental benefits. EQIP is re-authorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill). Through EQIP, farmers may receive financial and technical assistance to implement structural and management conservation practices on agricultural land.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.
All Areas	All Populations	Reduced instream flows due to water withdrawals impairs the growth, survival, or movement of juveniles.	_	X	_	_	_	X	_	X	USDA-NRCS	Grassland Reserve Program	The Grassland Reserve Program (GRP) is a voluntary program offering landowners the opportunity to protect, restore, and enhance grasslands on their property. Section 2401 of the Farm Security and Rural Investment Act of 2002 (Pub. L. 107-171) amended the Food Security Act of 1985 to authorize this program. The Natural Resources Conservation Service, Farm Service Agency and Forest Service are coordinating implementation of GRP, which helps landowners restore and protect grassland, rangeland, pastureland, shrubland and certain other lands and provides assistance for rehabilitating grasslands. The program will conserve vulnerable grasslands from conversion to cropland or other uses and conserve valuable grasslands by helping maintain viable ranching operations.	Ongoing	Section 7 ESA and NHPA Consultations, as well as limited numbers of specialized FTE's. Projects are voluntary – there is no assurance that they will be implemented. Limited Technical Assistance (TA) funding limits the amount of outreach NRCS can facilitate. Funding is subject to Farm Bill Appropriations.

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet)								Agency	Program	Description	Timeline	Constraints
			1	2	3	4	5	6	7	8					
All Areas	All Populations	Road crossings and other land use related passage impediments impairs the upstream migration of returning adults.	X	X	X	X	X	X	X	_	ODFW	Salmon Trout Enhancement Program	The Salmon and Trout Enhancement Program (STEP) recognizes that volunteers play an important role in the restoration of salmon, steelhead and trout. STEP (1) educates the public about Oregon's salmon and trout resources and the habitats they depend on, (2) inventories and monitors fish populations and their habitat, (3) enhances, restores and protects habitat for native stocks of salmon, steelhead, and trout, and (4) produces fish to supplement natural fish production, augment fisheries, or, in the case of the classroom egg incubation program, provide educational opportunities. Habitat monitoring and enhancement function under STEP, could be used to address this limiting factor.	Ongoing.	Funding.
All Areas	All Populations	Road crossings and other land use related passage impediments impairs the upstream migration of returning adults.	_	_	X	_	_	_	_	_	ODFW	Fish Passage Program	The owner or operator of an artificial obstruction located in waters in which native migratory fish are currently or were historically present must address fish passage requirements by gaining approval from ODFW prior to certain trigger events. Trigger events include installation, major replacement, a fundamental change in permit status (e.g., new water right, renewed hydroelectric license), or abandonment of the artificial obstruction. In addition, ODFW is working toward identification of the highest priority passage sites, at which passage can be addressed.	ongoing	Staffing to perform regulatory and outreach role
All Areas	All Populations	Road crossings and other land use related passage impediments impairs the upstream migration of returning adults.	_	_	X	_	_	_	_	_	ODFW	Fish Screening and Passage Grant Program	Oregon water users may be eligible for an ODFW cost-share incentive program and state tax credit designed to promote the installation of ODFW approved fish screening or fish passage devices. Fish screens prevent fish from entering water diversions. Fishways provide fish passage to allow migration. ODFW works with owners who apply for funding, as well as actively seeks projects at which to provide fish screening and passage.	On-going	Funding, enrollment
All Areas	All Populations	Road crossings and other land use related passage impediments impairs the upstream migration of returning adults.	X	X	X	X	X	X	X	_	ODFW	Lands Resources Program	The Wildlife Division Land Resources Program helps guide land-use activities in Oregon that affect fish and wildlife habitats. The program offers tax incentives, grants and technical assistance to private and public landowners, businesses and governments to promote conservation of fish and wildlife habitats, and to ensure environmental protection standards are met. Programs goals promote healthy riparian and wetland corridors – decreasing bank erosion and filtering run-off.	Ongoing	Funding and staff time.
All Areas	All Populations	Road crossings and other land use related passage impediments impairs the upstream migration of returning adults.	X	X	X	X	X	X	X	_	ODFW	Conservation Strategy for Oregon	Previously called the Comprehensive Wildlife Conservation Strategy, the Conservation Strategy for Oregon provides a non-regulatory, statewide approach to species and habitat conservation. It synthesizes existing plans, scientific data, and local knowledge into a broad vision and conceptual framework for long-term conservation of Oregon's native fish, wildlife and habitats. Conservation of instream and upland habitats will promote watershed health.	Internal review by January 2008; varying levels of external review to occur at 5 – and 10 – year intervals.	Voluntary measures – no assurance that it will be implemented
All Areas	All Populations	Road crossings and other land use related passage impediments impairs the upstream migration of returning adults.	X	X	X	X	X	X	X	_	ODFW	Watershed Council Liaison	The ODFW Watershed Council Liaison position provides technical support to watershed councils involved in assessing watershed conditions and conducting restoration projects designed to address watershed needs. Among those projects are actions that specifically address fish passage barriers.	Not identified.	No staff.
All Areas	All Populations	Road crossings and other land use related passage impediments impairs the upstream migration of returning adults.	X	X	X	X	X	X	X	_	ODFW	Restoration and Enhancement Program	ODFW oversees a comprehensive program to assist in enhancing natural fish production, improve hatchery programs, and provide additional public access to fishing waters. To achieve these goals, the R and E Program provides funding that directly benefits fish by addressing items such as fish passage, habitat restoration, public education, research and monitoring.	Ongoing.	broad legal mandates of the program limit the ability of the program to focus solely on the needs of recovery planning, variable funding due to funding mechanism.
All Areas	All Populations	Road crossings and other land use related passage impediments impairs the upstream migration of returning adults.	_	_	X	_	_	_	_	_	ODF	Oregon Forest Practices Act	The Oregon Forest Practices Act encourages economically efficient forest management in Oregon and the continuous growing and harvesting of trees and maintenance of forestland on privately owned land consistent with the protection of forest resources through the sound management of soil, air, water, fish and wildlife resources. The forest practices act recognizes that keeping forestland in forestland may be the most effective way to address overall water quality including access to high quality spawning and rearing areas. With regards to road crossings, the Oregon Forest Practices act regulates road construction and maintenance. Road construction must allow the migration of adult and juvenile fish upstream and downstream during conditions when fish movement in that stream normally occurs. For roads constructed after 1994, the forest practices act requires fish passage to be maintained. For all other roads the FPA encourages this standard. For roads constructed prior to 1994, other statutes apply that are outside the jurisdiction of the Department of Forestry.	Implementation of FPA best management practices is ongoing.	Resources necessary to implement FPFO Indicator monitoring for roads is needed to evaluate success of fish passage efforts on Oregon's public and private forests. Resources to conduct Private Forests Program compliance & effectiveness monitoring are needed.
All Areas	All Populations	Road crossings and other land use related passage impediments impairs the upstream migration of returning adults.	_	_	X	_	_	_	_	_	ODF	Private forestry component of the Oregon Plan for Salmon and Watersheds	Working together, Oregonians have the opportunity to help restore clean water and wild salmon for the benefit of us all and for future generations. The Oregon Plan for Salmon and Watersheds coordinates these efforts across land uses and landowners. Forest Landowners contribute to the Oregon Plan by complying with Oregon's Forest Practices Act and by accomplishing additional projects that contribute to Oregon Plan goals. Regarding fish passage, forest landowners close or rehabilitate legacy roads and update functioning roads to meet current standards,□ Oregon Plan measures on forestland are currently being updated to include recommendations from the work of the forest practices advisory committee and the DEQ sufficiency analysis.	Work on roads built prior to the FPA will be ongoing. A timeline for the needed FPFO monitoring has not yet been determined.	Resources necessary to implement FPFO Indicator monitoring for roads is needed to evaluate the voluntary efforts of Oregon's public and private forest landowners to maintain and improve forest road conditions. For some landowners, the OWEB grant cycle is a disincentive when road work is done on an opportunistic basis. Communication and assistance for landowners to implement their 'legacy' road & stream crossing projects.
All Areas	All Populations	Road crossings and other land use related passage impediments impairs the upstream migration of returning adults.	_	_	X	_	_	_	_	_	ODLCD	Statewide Comprehensive Land Use Planning	Oregon's statewide comprehensive land use program requires cities and counties to plan for and manage land use in compliance with 19 statewide planning goals. Local land use plans and ordinances must identify and protect natural resources and identify and plan for hazard areas. The statewide land use program provides a framework for local governments to adopt land use plans and ordinances and approve development that are salmon-friendly.	Implementation is on-going. Plans and ordinances are updated according to local needs and as a result of legislation.	Technical and planning assistance to local governments would be highly beneficial in enlisting local planning efforts in salmon recovery.

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
All Areas	All Populations	Road crossings and other land use related passage impediments impairs the upstream migration of returning adults.	_	_	X	_	_	_	_	_	ODSL	Removal-Fill Program	Oregon´s Removal-Fill Law requires people who plan to remove or fill material in waters of the state to obtain a permit from the Department of State Lands. The Department is in the process of developing a streamlined application process for stream restoration activities including projects that would improve access to high quality spawning and rearing areas. The goal is to have a pilot program for this new process up and running in the spring of 2007.	Program is ongoing	The half-time Compliance Monitoring Specialist position is funded for three years and is subject to reauthorization each year of the three year period. The status of the position is uncertain after that time. Additional compliance staff are needed.
All Areas	All Populations	Road crossings and other land use related passage impediments impairs the upstream migration of returning adults.	X	X	X	X	X	X	X	X	OWEB	Grant Program	OWEB's grant program supports voluntary efforts by Oregonians seeking to maintain and restore native fish and healthy watersheds. OWEB funds projects that restore, maintain, and enhance the state's watersheds, supports the capacity of local watershed-based citizen groups to carry out a variety of restoration projects, promotes citizen understanding of watershed needs and restoration ideas, provides technical skills to citizens working to restore urban and rural watersheds, and monitors the effectiveness of investments in watershed restoration. OWEB regular grants are awarded every 6 months for restoration and protection of ecological resources. Grant applications are reviewed by a regional multidisciplinary team to develop recommendations and prioritization of grant applications for OWEB consideration. The review teams evaluate whether the grant applications address limiting factors and the technical soundness of the proposals.	Ongoing	Funding
All Areas	All Populations	Road crossings and other land use related passage impediments impairs the upstream migration of returning adults.	X	X	X	X	_	X	X	X	ODF	Fire Program	The Fire Program of the Oregon Department of Forestry provides effective protection from fire for forest resources including water and watersheds, fisheries, wildlife, soil productivity and soil stability. National Fire Plan activities target fuel reduction and stand management that contribute to stands that are more fire resilient and benefit all forest resources. The Fire Program also educates forest landowners and forest homeowners about eh value off fire hazard and risk reduction measures and takes positive action to minimize threats.	Program is active & ongoing.	Federal and private forest 'checker-board' ownership can place private forestlands at risk for uncharacteristic wildfire when either forest is not managed. There is a need for both ODF and ODF&W, and all landowners to play a role in the management of Federal forests located in Oregon. A collaborative relationship between state natural resource agencies and Federal forest management agencies may restore the health, diversity, and resilience of Federal forests by increasing the information shared and by providing a variety of perspectives on site-specific and landscape level determinations. Wildfire-prone areas are identified in a community wildfire protection plans identifying priority areas for hazardous fuel removal from Federal lands.
All Areas	All Populations	Road crossings and other land use related passage impediments impairs the upstream migration of returning adults.	_	_	X	_	_	_	_	_	ODF	State Forest Program	The State Forest Program implements actions related to roads to minimize effects upon fish passage. First, roads are built and maintained according to the standards of the Forest Roads Manual. Additionally, stream crossings are surveyed at the watershed scale to identify locations of potential effects to fish passage. (This is usually conducted through the watershed analysis process.) Based on these surveys, actions are taken to improve fish passage, where necessary. Finally, ODF conducts monitoring to ensure that actions are applied properly and to evaluate the effectiveness of these actions	Implementation of practices in the roads manual is ongoing.	New road construction and reconstruction projects are completed to current fish passage standards. Limited funding exists for passage improvement projects not associated with timber harvest. Highest priority projects are completed first, with lower priority projects being completed as funds become available. Some districts work closely with watershed councils to attain funding for non-timber related passage improvement projects.
Lower Columbia	Big Creek	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	X	X	X	X	X	X	X	_	ODFW	North Coast Watershed Council Liaison	The ODFW Watershed Council Liaison position provides technical support to watershed councils involved in assessing watershed conditions and conducting restoration projects designed to address watershed needs. Among those projects are actions that specifically address conditions contributing to increased fine sediments in streams.	This position is funded biennially.	Limited staff time available to provide technical support
Lower Columbia	Big Creek	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region.	Ongoing	Staffing to meet demands for restoration projects and technical assistance, funds to implement projects.
Lower Columbia	Big Creek	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and Federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat.	Ongoing.	Funding.
Lower Columbia	Big Creek	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	X	X	_	_	X	X	_	X	Clatsop County SWCD	Conservation Planning Program	Clatsop SWCD works with landowners and agricultural producers to craft Conservation Plans. The plans follow a strict model established by the Natural Resource Conservation Service. The plans are a tool to assist landowners in reaching a level of natural resource sustainability - soil, water, air, plants, and animals (both wild and domestic). Riparian areas and upland wildlife habitat are an integral part of the program. Improvements in soil conservation on agricultural lands help reduce input of fine sediment into local waterways.	Ongoing	Funding, landowner participation
Lower Columbia	Big Creek	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	_	_	_	_	_	_	_	x	ODF	Astoria District Area Operations Plan	Annual Operations Plans (AOP) for the Astoria District describes operations, activities and projects designed to achieve the goals, strategies, and objectives of ODF's plans and policies. Land surveying and a variety of forest road and transportation system management activities are planned in the AOP's. Primary objectives include providing forest access and meeting the goals, objectives and standards contained in the Forest Roads Manual (2000). The Forest Road Manual (2000) identifies prescriptive measures for vacating road and preventing sediment laden run-off from entering streams.	Developed annually to meet specific objectives.	

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Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
Lower Columbia	Big Creek	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	_	_	_	_		X	_	X	Clatsop County	Maintence BMP's	The Clatsop County Road Department has adopted the Oregon Department of Transportation Routine Road Maintenance Water Quality and Habitat Guide Best Management Practices as revised in 2004. The guide governs the manner in which Clatsop County maintenance crews proceed on a wide variety of routine maintenance activities including surface and shoulder work, ditch, bridge, culvert maintenance, emergency maintenance, mowing, brush control and other vegetation management for all of the county. These BMP's help reduce the introduction of fine sediment into streams.	Ongoing	None
Lower Columbia	Big Creek	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	_	_	_	_		X	_	X	Clatsop County	Herbicide and Integrated Vegetation Management Plan	The Clatsop County Road Department has recently developed an Herbicide and Integrated Vegetation Management Plan. The plan calls for additional setbacks around riparian areas and use of aquatic herbicide products only. Protection of riparian corridors will improve sediment filtration and reduce contribution of fine sediment to streams.	Ongoing	Road Infrastructure was not originally developed to avoid riparian corridors
Lower Columbia	Big Creek	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins	_	_	_	_	_	X	X	X	Clatsop County	Erosion Control Development Standards	Clatsop County Erosion Control and Development Standards manage development activities including clearing, grading, excavation, and filling of land that can lead to soil erosion and the sedimentation of watercourses, wetlands, riparian areas, public and private roadways.	Ongoing	Funding
Lower Columbia	Big Creek	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	X	X	_	_	X	X	X	X	Clatsop County	Riparian Protection Standards	Clatsop County Riparian Protection Standards protects riparian vegetation on lands not subject to the Forest Practices Act.	Ongoing	Funding
Lower Columbia	Big Creek	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	X	X	X	_	X	X	X	_	CREST	Watershed Council Support	CREST, among other functions, provides technical and administrative support to watershed councils. Support includes assistance with completiion of watershed assessments, identifying and correcting limiting factors to salmon production, developing action plans, and assistance with implementation of habitat restoration projects. CREST restoration projects help reduce input of fine sediments into streams; help increase stream complexity through addition of large wood and riparian projects that increase LWD recruitment potential; help increase stream-side shading; and include identifying and improving passage for chum salmon and other species.	Ongoing	Program performance dependedant in part upon active participation by watershed councils. Staff time for watershed council support is split among several watershed councils.
Lower Columbia	Big Creek	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	X	X	_	_	X	X	X	_	CREST	Technical Support for Municipalities and Ports	CREST provides technical support to member jurisdictions (cities, ports, and counties in the lower Columbia River)- While most of the emphasis is on assessing impacts to the estuary, CREST staff also reviews permit applications and development proposals to determine consistency with local comprehensive plans and applicable laws and ordinances throughout the basin. Technical guidance provided by CREST supports riparian protection and restoration, promotes streambank stabilization, and reduces fine sediment input into streams; and supports riparian protection and restoration, promotes stream-side shading.	Ongoing	Staff time for technical assistance.
Lower Columbia	Big Creek	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	X	X	_	_	X	X	X	_	CREST	Big Creek Restoration Plan (In Preparation)	CREST, along with the Nicolai-Wickiup Watershed Council, is in the process of developing a comprehensive restoration plan for the Big Creek subbasin. The plan will explicity identify limiting factors in Big Creek and specify prescriptive restoration measures.	Summer 2007 draft completed.	Funding for implementation
Lower Columbia	Big Creek	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	_	_	_	_	_	_	_	_	Hampton Affiliates				
Lower Columbia	Big Creek	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	_	_	_	_	_	_	_	_	Nicolai-Wickiup Watershed Council	Watershed Action Plan	The Nicolai-Wickiup Watershed Council, along with other Lower Columbia River Watershed Councils, has developed a joint action plan (May 2003) that begins to address this threat; although few specific projects were identified.		
Lower Columbia	Big Creek	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	_	_	X	_	_	X	_	_	Weyerhaeuser Company	Road Inventory Project	Inventoried all roads through Weyerhaueser ownership to determine problem areas. Developed plans for road repair maintenance that, among other objectives, helps reduce fine sediment input into streams.	1997-1999	None
Lower Columbia	Big Creek	Hatchery weirs and water diversion structures at Big Creek and Gnat Creek hatcheries impair passage to spawning habitat above hatcheries.	_	_	_	_	_	_	_	_	ODFW	Big Creek Hatchery	Big Creek Hatchery operates a weir at the hatchery that completely blocks upstream migration of coho, chinook, chum, and winter steelhead. A water diversion dam above the hatchery also blocks passage.	None currently identified.	Need funding for personnel to operate trap. Need funding for trap improvements, and screen upgrades. Need funding for upstream habitat assessment and characterization. Pathogens in hatchery water supply is major concern. May need water treatment system if disease becomes a problem.
Lower Columbia	Big Creek	Hatchery weirs and water diversion structures at Big Creek and Gnat Creek hatcheries impair passage to spawning habitat above hatcheries.	_	_	_	_	_	_	_	_	ODFW	Gnat Creek Hatchery	Gnat Creek Hatchery does not operate a weir and adult trap as they do not collect broodstock at this facility. There are however, two barriers associated with the hatchery (ODFW, 2002). The first is a steep rock falls that was blasted into bedrock 100 yards below the water intake to prevent adult salmon from passing above the water intake during high flow events. The second barrier is a concrete dam at the water diversion structurethat is passable to adult salmon only during high water events. There is currently a ladder/bypass structure incorporated into the the intake that could be modified for use to sort and selectively remove hatchery fish.	None currently identified.	Need funding for passage improvements and personnel to operate trap. Need funding for screen upgrades.

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet)								Agency	Program	Description	Timeline	Constraints
			1	2	3	4	5	6	7	8					
Lower Columbia	Big Creek	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr and steelhead fry and summer parr.	X	X	X	X	X	X	X	_	ODFW	North Coast Watershed Council Liaison	The ODFW Watershed Council Liaison position provides technical support to watershed councils involved in assessing watershed conditions and conducting restoration projects designed to address watershed needs. Among those projects are actions that specifically address conditions contributing to increased fine sediments in streams.	This position is funded biennially.	Limited staff time available to provide technical support
Lower Columbia	Big Creek	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr and steelhead fry and summer parr.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region.	Ongoing	staffing to meet demands for restoration projects and technical assistance, funds to implement projects.
Lower Columbia	Big Creek	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr and steelhead fry and summer parr.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and Federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat.	Ongoing.	Funding.
Lower Columbia	Big Creek	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr and steelhead fry and summer parr.	X	X	_	_	X	X	X	X	Clatsop County	Riparian Protection Standards	Clatsop County Riparian Protection Standards protects riparian vegetation on lands not subject to the Forest Practices Act.	Ongoing	Funding
Lower Columbia	Big Creek	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr and steelhead fry and summer parr.	X	X	X	_	X	X	X	_	CREST	Watershed Council Support	CREST, among other functions, provides technical and administrative support to watershed councils. Support includes assistance with completiion of watershed assessments, identifying and correcting limiting factors to salmon production, developing action plans, and assistance with implementation of habitat restoration projects. CREST restoration projects help reduce input of fine sediments into streams; help increase stream complexity through addition of large wood and riparian projects that increase LWD recruitment potential; help increase stream-side shading; and include identifying and improving passage for chum salmon and other species.	Ongoing	Program performance dependedant in part upon active participation by watershed councils. Staff time for watershed council support is split among several watershed councils.
Lower Columbia	Big Creek	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr and steelhead fry and summer parr.	X	X	_	_	X	X	X	_	CREST	Technical Support for Municipalities and Ports	CREST provides technical support to member jurisdictions (cities, ports, and counties in the lower Columbia River)- While most of the emphasis is on assessing impacts to the estuary, CREST staff also reviews permit applications and development proposals to determine consistency with local comprehensive plans and applicable laws and ordinances throughout the basin. Technical guidance provided by CREST supports riparian protection and restoration, promotes streambank stabilization, and reduces fine sediment input into streams; and supports riparian protection and restoration, promotes stream-side shading.	Ongoing	Staff time for technical assistance.
Lower Columbia	Big Creek	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr and steelhead fry and summer parr.	_	_	_	_	_	_	_	_	Nicolai-Wickiup Watershed Council	Watershed Action Plan	The Nicolai-Wickiup Watershed Council, along with other Lower Columbia River Watershed Councils, has developed a joint action plan (May 2003) that begins to address this threat; although few specific projects were identified.		
Lower Columbia	Big Creek	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr and steelhead fry and summer parr.	_	X	_	_	X	X	_	X	ODF	Northwest Oregon Area Forest Management Plan	The Forest Management Plan has standards that meet or exceed the FPA.	Ongoing	Staffing and funding
Lower Columbia	Big Creek	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr and steelhead fry and summer parr.	X	X	_	_	X	X	X	X	Clatsop County SWCD	Habitat Restoration Program	Clatsop Soil and Water Conservation District assists landowners in identifying instream restoration opportunites on their property. Bank stabilization projects promote soil conservation while adding instream complexity in the form of large woody debris. Riparian restoration using native plant species promote future stream-side shading.	Ongoing	Funding, landowner participation
Lower Columbia	Big Creek	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr and steelhead fry and summer parr.	_	X	_	X	_	X	_	_	Weyerhaeuser Company	Voluntary Wildlife Tree Retention and Riparian Buffers	Weyerhaeuser provides additional tree retention on many coho core area streams above what is required in the Oregon Forest Practices Act. Among other functions, increased tree retention helps promote streamside shading.	1996 to present	None
Lower Columbia	Big Creek	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr and steelhead fry and summer parr.	_	X	_	_	_	_	_	_	Clatsop County SWCD	Noxious Weed Control Program	Clatsop SWCD is the lead county agency for noxious weed control. Much effort has been placed on knotweed eradication funded by non-profit, state, and private entities. Two herbicide applicators currently work full-time from May through October. They operate under state licenses. Clatsop SWCD works under an umbrella organization called the North Coast Weed Management Area Committee made up of representatives of watershed councils; state, county and Federal agencies; and private stakeholders. Eradication of noxious and invasive weeds in riparian areas promotes re-etablishment of native, shade producing species.	Ongoing	Funding, landowner participation

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
Lower Columbia	Big Creek	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr and steelhead fry and summer parr.	_	X	_	_	X	X	_	_	Clatsop County	Native Plant Program	Clatsop County maintains native plant sites along their right-of-way that allow restoration groups to transplant native seedlings to an area that benefits streams and riparian areas.	Ongoing	None
Lower Columbia	Big Creek	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	X	X	X	X	X	X	X	_	ODFW	North Coast Watershed Council Liaison	The ODFW Watershed Council Liaison position provides technical support to watershed councils involved in assessing watershed conditions and conducting restoration projects designed to address watershed needs. Among those projects are actions that specifically address conditions contributing to increased fine sediments in streams.	This position is funded biennially.	Limited staff time available to provide technical support
Lower Columbia	Big Creek	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region.	Ongoing	Staffing to meet demands for restoration projects and technical assistance, funds to implement projects.
Lower Columbia	Big Creek	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and Federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat.	Ongoing.	Funding.
Lower Columbia	Big Creek	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	X	X	_	_	X	X	X	X	Clatsop County	Riparian Protection Standards	Clatsop County Riparian Protection Standards protects riparian vegetation on lands not subject to the Forest Practices Act.	Ongoing	Funding
Lower Columbia	Big Creek	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	X	X	X	_	X	X	X	_	CREST	Watershed Council Support	CREST, among other functions, provides technical and administrative support to watershed councils. Support includes assistance with completion of watershed assessments, identifying and correcting limiting factors to salmon production, developing action plans, and assistance with implementation of habitat restoration projects. CREST restoration projects help reduce input of fine sediments into streams; help increase stream complexity through addition of large wood and riparian projects that increase LWD recruitment potential; help increase stream-side shading; and include identifying and improving passage for chum salmon and other species.	Ongoing	Program performance dependedant in part upon active participation by watershed councils. Staff time for watershed council support is split among several watershed councils.
Lower Columbia	Big Creek	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	X	X	_	_	X	X	X	_	CREST	Big Creek Restoration Plan (In Preparation)	CREST, along with the Nicolai-Wickiup Watershed Council, is in the process of developing a comprehensive restoration plan for the Big Creek subbasin. The plan will explicity identify limiting factors in Big Creek and specify prescriptive restoration measures.	Summer 2007 draft completed.	Funding for implementation
Lower Columbia	Big Creek	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	_	_	_	_	_	_	_	_	Nicolai-Wickiup Watershed Council	Watershed Action Plan	The Nicolai-Wickiup Watershed Council, along with other Lower Columbia River Watershed Councils, has developed a joint action plan (May 2003) that begins to address this threat; although few specific projects were identified.		
Lower Columbia	Big Creek	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	_	X	_	_	X	X	_	X	ODF	Northwest Oregon Area Forest Management Plan	The Forest Management Plan has standards that meet or exceed the FPA.	Ongoing	Staffing, funding & permitting process for in-stream work
Lower Columbia	Big Creek	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	_	_	_	_	X	_	_	_	ODF	Habitat Restoration Biologists for Clatsop/Tillamook State Forests	ODF provides funding for an ODFW position to implement restoration and enhancement projects on ODF lands in the Clatsop and Tillamook forests. Among these activities are instream enhancement projects that contribute to habitat complexity.	Subject to biennial approval	None identified

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

			Management Strategies (see "Strategy Description" worksheet)												
Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
Lower Columbia	Big Creek	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	X	X	_	_	X	X	X	X	Clatsop County SWCD	Habitat Restoration Program	Clatsop Soil and Water Conservation District assists landowners in identifying instream restoration opportunites on their property. Bank stabilization projects promote soil conservation while adding instream complexity in the form of large woody debris. Riparian restoration using native plant species promote future LWD recruitment potentiial.	Ongoing	Funding, landowner participation
Lower Columbia	Big Creek	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	_	_	_	_	X	_	_	_	Weyerhaeuser Company	Instream Habitat Restoration Projects	Weyerhaeuser works with Oregon Department of Fish and Wildlife and local watershed councils to implement instream restoration projects on their land. These projects primarily introduce large woody debris to small, low gradient stream reaches to create habitat complexity.	1995 to present	Funding and contractor availability
Lower Columbia	Big Creek	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	_	X	_	X	_	X	_	_	Weyerhaeuser Company	Voluntary Wildlife Tree Retention and Riparian Buffers	Weyerhaeuser provides additional tree retention on many coho core area streams above what is required in the Oregon Forest Practices Act. Among other functions, increased tree retention helps provide for future LWD recruitment.	1996 to present	None
Lower Columbia	Big Creek	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	X	X	X	X	X	X	X	_	ODFW	North Coast Watershed Council Liaison	The ODFW Watershed Council Liaison position provides technical support to watershed councils involved in assessing watershed conditions and conducting restoration projects designed to address watershed needs. Among those projects are actions that specifically address conditions contributing to increased fine sediments in streams.	This position is funded biennially.	Limited staff time available to provide technical support
Lower Columbia	Big Creek	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region.	Ongoing	S+P169taffing to meet demands for restoration projects and technical assistance, funds to implement projects.
Lower Columbia	Big Creek	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and Federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat.	Ongoing.	Funding.
Lower Columbia	Big Creek	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	X	X	X	_	X	X	X	_	CREST	Watershed Council Support	CREST, among other functions, provides technical and administrative support to watershed councils. Support includes assistance with completiion of watershed assessments, identifying and correcting limiting factors to salmon production, developing action plans, and assistance with implementation of habitat restoration projects. CREST restoration projects help reduce input of fine sediments into streams; help increase stream complexity through addition of large wood and riparian projects that increase LWD recruitment potential; help increase stream-side shading; and include identifying and improving passage for chum salmon and other species.	Ongoing	Program performance dependedant in part upon active participation by watershed councils. Staff time for watershed council support is split among several watershed councils.
Lower Columbia	Big Creek	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	_	_	X	_	_	X	_	_	Weyerhaeuser Company	Road Inventory Project	Inventoried all roads through Weyerhaeuser ownership to determine problem areas. Developed plans for road repair maintenance that, among other objectives, helped identify potential fish passage barriers.	1997-1999 for inventory; passage improvements are ongoing	None
Lower Columbia	Clackamas	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, spring Chinook, chum, and steelhead eggs and alevins.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region.	Ongoing	Staffing to meet demands for restoration projects and technical assistance, funds to implement projects.
Lower Columbia	Clackamas	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, spring Chinook, chum, and steelhead eggs and alevins.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and Federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat.	Ongoing.	Funding.
Lower Columbia	Clackamas	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, spring Chinook, chum, and steelhead eggs and alevins.	X	X	X	X	X	X	X	X	Clackamas River Basin Council (CRBC)	Watershed Restoration Program	The Clackamas River Basin Council works with private landowners in the Clackamas Watershed to implement Oregon Plan measures directing the restoration and enhancement of Oregon 's salmonid habitats in the region.	Ongoing	Funding
Lower Columbia	Clackamas	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, spring Chinook, chum, and steelhead eggs and alevins.	X	X	X	X	X	X	X	X	Johnson Creek Watershed Council	Watershed Restoration Program	The Johnson Creek Watershed Council works with private landowners in the Johnson Creek to implement Oregon Plan measures directing the restoration and enhancement of Oregon 's salmonid habitats in the region.	Ongoing	Funding

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet)								Agency	Program	Description	Timeline	Constraints
			1	2	3	4	5	6	7	8					
Lower Columbia	Clackamas	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, spring Chinook, chum, and steelhead eggs and alevins.	X	X	X	X	X	X	X	X	Clackamas County	Conservation Programs	The Clackamas SWCD promotes and implements voluntary natural resource conservation projects with landowners by providing leadership, education, outreach, and improved access to State and Federal cost share assistance in both urban and rural communities.	Established in 1958, ongoing.	Funding
Lower Columbia	Clackamas	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, spring Chinook, chum, and steelhead eggs and alevins.	_	_	X	_	_	_	X	_	Clackamas County	Road Department			
Lower Columbia	Clackamas	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, spring Chinook, chum, and steelhead eggs and alevins.	_	X	_	_	X	X	_	_	Clackamas County	Riparian Protection Standards			
Lower Columbia	Clackamas	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, spring Chinook, chum, and steelhead eggs and alevins.	_	_	_	X	_	X	_	X	City of Portland	Sustainable Stormwater Management Program (SSMP)	Provides outreach, financial and technical assistance, and education for new and redeveloping properties that incorporate innovative stormwater techniques; performance evaluation of stormwater management facilities.	Ongoing	Funding.
Lower Columbia	Clackamas	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, spring Chinook, chum, and steelhead eggs and alevins.	_	_	_	_	_	X	X	X	City of Portland	Erosion Control	Identify proactive practices that can be taken to prevent erosion, releases of sediment and other pollutants generated at a site of ground disturbance.	Ongoing	Staffing for enforcement
Lower Columbia	Clackamas	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, spring Chinook, chum, and steelhead eggs and alevins.	_	X	_	_	X	X	_	X	City of Portland	Revegetation Program	Revegetation Program restores native vegetation in riparian, wetland and upland habitats to provide habitat, protect water quality and protect infrastructure.	Ongoing	An inventory of all City owned properties is needed.
Lower Columbia	Clackamas	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, spring Chinook, chum, and steelhead eggs and alevins.	_	_	_	X	_	X	_	_	City of Portland	Maintenance Engineering and Stormwater Operations and Maintenance	Maintenance Engineering and Stormwater O&M protects and improves surface water and groundwater quality to protect public health and safety and support native fish and wildlife populations and biological communities.	Ongoing with immediate effectiveness	Additional funding could potentially influence the type of project selected and the number of projects implemented
Lower Columbia	Clackamas	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, spring Chinook summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region.	Ongoing	Staffing to meet demands for restoration projects and technical assistance, funds to implement projects.
Lower Columbia	Clackamas	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, spring Chinook summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and Federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat.	Ongoing.	Funding.
Lower Columbia	Clackamas	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, spring Chinook summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	X	X	X	X	X	X	X	X	Clackamas River Basin Council (CRBC)	Watershed Restoration Program	The Clackamas River Basin Council works with private landowners in the Clackamas Watershed to implement Oregon Plan measures directing the restoration and enhancement of Oregon 's salmonid habitats in the region.	Ongoing	Funding

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet)								Agency	Program	Description	Timeline	Constraints
			1	2	3	4	5	6	7	8					
Lower Columbia	Clackamas	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, spring Chinook summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	X	X	X	X	X	X	X	X	Johnson Creek Watershed Council	Watershed Restoration Program	The Johnson Creek Watershed Council works with private landowners in the Johnson Creek to implement Oregon Plan measures directing the restoration and enhancement of Oregon 's salmonid habitats in the region.	Ongoing	Funding
Lower Columbia	Clackamas	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, spring Chinook summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	X	X	X	X	X	X	X	X	Clackamas County	Conservation Programs	The Clackamas SWCD promotes and implements voluntary natural resource conservation projects with landowners by providing leadership, education, outreach, and improved access to State and Federal cost share assistance in both urban and rural communities.	Established in 1958, ongoing.	Funding
Lower Columbia	Clackamas	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, spring Chinook summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	_	X	_	_	X	X	_	_	Clackamas County	Riparian Protection Standards			
Lower Columbia	Clackamas	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, spring Chinook summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	X	X	X	X	X	X	X	_	City of Portland	Habitat Restoration (PWMP & WRDA projects)	Projects designed to restore fish and wildlife habitat, improve water quality, restore normative flows and improve flood management.	Varies with project. Some, such as culvert replacements, show immediate benefits, as demonstrated through monitoring at Miller Creek. Larger habitat restoration projects take years to mature.	Funding
Lower Columbia	Clackamas	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, spring Chinook summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	_	X	_	_	X	X	_	X	City of Portland	Revegetation Program	Revegetation Program restores native vegetation in riparian, wetland and upland habitats to provide habitat, protect water quality and protect infrastructure.	Ongoing	An inventory of all City owned properties is needed.
Lower Columbia	Clackamas	Inadequate high quality spawning gravel for fall and spring Chinook salmon due to impaired gravel recruitment below hydroprojects.	X	_	_	_	X	_	_	_	PGE	Hydro/Fishery Program	PGE action(s) identified in Settlement Agreement for new license, FERC Project # 2195. Settlement Agreement pending FERC approval. Settlement Agreement calls for a volume of 8,000 yd3 to be introduced downstream of River Mill Dam annually, maximum introduction 20,000 yd3 annually.		Settlement Agreement awaiting FERC approval
Lower Columbia	Clackamas	Increased water temperature downstream of hydro projects impairs growth and/or survival of fall Chinook eggs; winter steelhead, spring Chinook, and coho summer parr; returning adult coho and spring Chinook; and spawning fall Chinook.	_	_	_	_	_	X	_	_	PGE	Hydro/Fishery Program			
Lower Columbia	Clackamas	Loss instream habitat complexity for fall Chinook fry and spring Chinook fry, summer and winter parr due to hydro dams.	X	_	_	_	X	_	_	_	PGE	Clackamas River Hydroelectric Project Mitigation Fund and Enhancement Fund	Fund projects designed to benefit anadromous fish populations in Clackamas River Basin to restore habitat lost/modified through inundation by reservoirs. Funds to be used according to Settlement Agreement for land acquisition or lease of riparian, wetlands, and associated uplands, instream habitat, riparian corridor, and wetland enhancement and improvement, water quality improvements, water conservation, conservation easements, fish passage facilities and fish passage bariiers improvements, and water rights acquisition, or lease.		Settlement Agreement not yet approved by FERC.
Lower Columbia	Clackamas	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, spring Chinook fry and winter parr, and steelhead winter parr due to past and/or present land management practices.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region.	Ongoing	staffing to meet demands for restoration projects and technical assistance, funds to implement projects.

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet)								Agency	Program	Description	Timeline	Constraints
			1	2	3	4	5	6	7	8					
Lower Columbia	Clackamas	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, spring Chinook fry and winter parr, and steelhead winter parr due to past and/or present land management practices.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and Federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat.	Ongoing.	Funding.
Lower Columbia	Clackamas	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, spring Chinook fry and winter parr, and steelhead winter parr due to past and/or present land management practices.	X	X	X	X	X	X	X	X	Clackamas River Basin Council (CRBC)	Watershed Restoration Program	The Clackamas River Basin Council works with private landowners in the Clackamas Watershed to implement Oregon Plan measures directing the restoration and enhancement of Oregon 's salmonid habitats in the region.	Ongoing	Funding
Lower Columbia	Clackamas	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, spring Chinook fry and winter parr, and steelhead winter parr due to past and/or present land management practices.	X	X	X	X	X	X	X	X	Johnson Creek Watershed Council	Watershed Restoration Program	The Johnson Creek Watershed Council works with private landowners in the Johnson Creek to implement Oregon Plan measures directing the restoration and enhancement of Oregon 's salmonid habitats in the region.	Ongoing	Funding
Lower Columbia	Clackamas	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, spring Chinook fry and winter parr, and steelhead winter parr due to past and/or present land management practices.	X	X	X	X	X	X	X	X	Clackamas County	Conservation Programs	The Clackamas SWCD promotes and implements voluntary natural resource conservation projects with landowners by providing leadership, education, outreach, and improved access to State and Federal cost share assistance in both urban and rural communities.	Established in 1958, ongoing.	Funding
Lower Columbia	Clackamas	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, spring Chinook fry and winter parr, and steelhead winter parr due to past and/or present land management practices.	–	X	–	–	X	X	–	–	Clackamas County	Riparian Protection Standards			
Lower Columbia	Clackamas	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, spring Chinook fry and winter parr, and steelhead winter parr due to past and/or present land management practices.	X	X	X	X	X	X	X	–	City of Portland	Habitat Restoration (PWMP & WRDA projects)	Projects designed to restore fish and wildlife habitat, improve water quality, restore normative flows and improve flood management.	Varies with project. Some, such as culvert replacements, show immediate benefits, as demonstrated through monitoring at Miller Creek. Larger habitat restoration projects take years to mature.	Funding
Lower Columbia	Clackamas	Mortality of downstream migrating spring Chinook, steelhead, and coho smolts at hydropower operations.	–	–	X	–	–	–	–	–	PGE	Hydro/Fishery Program	PGE actions identified in Settlement Agreement for new license, FERC Project # 2195. Settlement Agreement pending FERC approval. PGE actions identified within Settlement Agreement based on meeting juvenile fish survival standards (i.e. modify and improve North Fork juvenile bypass pipeline, retrofit North Fork Screen to criteria, construct surface collectors at River Mill and North Fork Dams, modify Project generation/operations, guidance curtains.		Settlement Agreement awaiting FERC approval
Lower Columbia	Clackamas	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region.	Ongoing	staffing to meet demands for restoration projects and technical assistance, funds to implement projects.
Lower Columbia	Clackamas	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and Federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat.	Ongoing.	Funding.
Lower Columbia	Clackamas	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	X	X	X	X	X	X	X	X	Clackamas River Basin Council (CRBC)	Watershed Restoration Program	The Clackamas River Basin Council works with private landowners in the Clackamas Watershed to implement Oregon Plan measures directing the restoration and enhancement of Oregon 's salmonid habitats in the region.	Ongoing	Funding

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
Lower Columbia	Clackamas	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	X	X	X	X	X	X	X	X	Johnson Creek Watershed Council	Watershed Restoration Program	The Johnson Creek Watershed Council works with private landowners in the Johnson Creek to implement Oregon Plan measures directing the restoration and enhancement of Oregon 's salmonid habitats in the region.	Ongoing	Funding
Lower Columbia	Clackamas	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	X	X	X	X	X	X	X	_	City of Portland	Habitat Restoration (PWMP & WRDA projects)	Projects designed to restore fish and wildlife habitat, improve water quality, restore normative flows and improve flood management.	Varies with project. Some, such as culvert replacements, show immediate benefits, as demonstrated through monitoring at Miller Creek. Larger habitat restoration projects take years to mature.	Funding
Lower Columbia	Clackamas	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	_	_	X	_	_	_	_	_	Clackamas County	Fish Passage Program	The Clackamas County Fish Passage Program aids in the implementation of its Capitol Improvement Program and Road Maintenance Program, specifically as these programs relate to salmon recovery efforts and the protection of fish and wildlife species and their habitats. The program creates a liason position between ODFW and Clackamas County that assists with development of project design and scope in order to provide maximum protection and benefits to fish and wildlife.	Position is currently funded through 2008 and is expected to be renewed for a minimum of two years beyond 2008.	Limited funding specific for fish passage projects limits the ability of County program staff to implement the highest priority projects.
Lower Columbia	Clatskanie	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region.	Ongoing	staffing to meet demands for restoration projects and technical assistance, funds to implement projects.
Lower Columbia	Clatskanie	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and Federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat.	Ongoing.	Funding.
Lower Columbia	Clatskanie	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	_	_	_	_	_	_	_	_	Columbia County SWCD				
Lower Columbia	Clatskanie	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	_	_	_	_	_	_	_	_	Columbia County	Columbia County Road Department	Columbia County owns and maintains many miles of roads, from rural unimproved backroads to high use improved highways. The County Road Department currently maintains existing roads and stream crossings under the ODOT Blue Book (Routine Road Maintenance Water Quality and Habitat Guide), a programmatic guide and approach to minimize impacts to fish and wildlife across the landscape by administering applicable BMPs during routine road maintenance activities. The guide was developed through a multi-resource agency effort. When implemented appropriately, actions can greatly reduce sediment inputs to streams both at the project site and regionally as well. Poor funding through the Gas Tax currently precludes appropriate staffing levels and purchase of materials to adequately maintain the county highway infrastructure, resulting in poorly maintained roads and increased inputs of road toxins and fine sediments into streams. The county also works closely with the SBWC to target fish passage issues and implement certain habitat restoration projects along the stream/highway interface.	Ongoing and into the future	Funding source does not provide the County with adequate dollars to maintain the highway infrastructure.
Lower Columbia	Clatskanie	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	_	_	_	_	_	_	_	_	Columbia County	Columbia County Planning Department: Riparian Protection Standards			
Lower Columbia	Clatskanie	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	_	_	_	_	_	_	_	_	Lower Columbia River Estuary Partnership				
Lower Columbia	Clatskanie	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	_	_	_	_	_	_	_	_	ODFW	Lower Columbia River Ecosystem Restoration General Investigation Study (GIS)	The Lower Columbia River Ecosystem Restoration General Investigation Study (GIS) is a Federally funded program getting underway to provide funding towards designated projects that will benefit fish within the lower Columbia River and tributaries. Projects need to be identified through a collaborative process with watershed councils and other groups and funding will be provided based on review. All projects that will benefit fish and the ecological elements of their habitats are eligible for consideration including those that reduce fine sediment inputs into streams.	A few years out	Untested process
Lower Columbia	Clatskanie	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	_	_	_	_	_	_	_	_	Lower Columbia River Watershed Council				
Lower Columbia	Clatskanie	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	X	X	X	X	X	X	X	X	ODF	Northwest Oregon Area Forest Management Plan	The Forest Management Plan has standards the meet or exceeds the FPA requirements.	Ongoing	Staffing and funding

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
Lower Columbia	Clatskanie	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region.	Ongoing	staffing to meet demands for restoration projects and technical assistance, funds to implement projects.
Lower Columbia	Clatskanie	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and Federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat.	Ongoing.	Funding.
Lower Columbia	Clatskanie	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	_	_	_	_	_	_	_	_	ODFW	Lower Columbia River Ecosystem Restoration General Investigation Study (GIS)	The Lower Columbia River Ecosystem Restoration General Investigation Study (GIS) is a Federally funded program getting underway to provide funding towards designated projects that will benefit fish within the lower Columbia River and tributaries. Projects need to be identified through a collaborative process with watershed councils and other groups and funding will be provided based on review. All projects that will benefit fish and the ecological elements of their habitats are eligible for consideration including those that reduce fine sediment inputs into streams.	A few years out	Untested process
Lower Columbia	Clatskanie	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	_	_	_	_	_	_	_	_	Columbia County	Columbia County Road Department	Columbia County owns and maintains many miles of roads, from rural unimproved backroads to high use improved highways. The County Road Department currently maintains existing roads and stream crossings under the ODOT Blue Book (Routine Road Maintenance Water Quality and Habitat Guide), a programmatic guide and approach to minimize impacts to fish and wildlife across the landscape by administering applicable BMPs during routine road maintenance activities. The guide was developed through a multi-resource agency effort. When implemented appropriately, actions can greatly reduce sediment inputs to streams both at the project site and regionally as well. Poor funding through the Gas Tax currently precludes appropriate staffing levels and purchase of materials to adequately maintain the county highway infrastructure, resulting in poorly maintained roads and increased inputs of road toxins and fine sediments into streams. The county also works closely with the SBWC to target fish passage issues and implement certain habitat restoration projects along the stream/highway interface.	Ongoing and into the future	Funding source does not provide the County with adequate dollars to maintain the highway infrastructure.
Lower Columbia	Clatskanie	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	_	_	_	_	_	_	_	_	Columbia County SWCD				
Lower Columbia	Clatskanie	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	_	_	_	_	_	_	_	_	Lower Columbia River Estuary Partnership				
Lower Columbia	Clatskanie	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	_	_	_	_	_	_	_	_	Lower Columbia River Watershed Council				
Lower Columbia	Clatskanie	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region.	Ongoing	staffing to meet demands for restoration projects and technical assistance, funds to implement projects.
Lower Columbia	Clatskanie	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and Federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat.	Ongoing.	Funding.
Lower Columbia	Clatskanie	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	_	_	_	_	_	_	_	_	Columbia County SWCD				

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
Lower Columbia	Clatskanie	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	_	_	_	_	_	_	_	_	ODF	Northwest Oregon Area Forest Management Plan	The Forest Management Plan has standards that meet or exceed the FPA. [Is this one plan or do each of the state forests have their own plan?? Probably should expand on this description]	Ongoing	Staffing, funding & permitting process for in-stream work
Lower Columbia	Clatskanie	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	_	_	_	_	_	_	_	_	Lower Columbia River Estuary Partnership				
Lower Columbia	Clatskanie	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	_	_	_	_	_	_	_	_	Lower Columbia River Watershed Council				
Lower Columbia	Clatskanie	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	_	_	_	_	_	_	_	_	ODFW	Lower Columbia River Ecosystem Restoration General Investigation Study (GIS)	The Lower Columbia River Ecosystem Restoration General Investigation Study (GIS) is a Federally funded program getting underway to provide funding towards designated projects that will benefit fish within the lower Columbia River and tributaries. Projects need to be identified through a collaborative process with watershed councils and other groups and funding will be provided based on review. All projects that will benefit fish and the ecological elements of their habitats are eligible for consideration including those that reduce fine sediment inputs into streams.	A few years out	Untested process
Lower Columbia	Clatskanie	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region.	Ongoing	staffing to meet demands for restoration projects and technical assistance, funds to implement projects.
Lower Columbia	Clatskanie	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and Federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat.	Ongoing.	Funding.
Lower Columbia	Clatskanie	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	_	_	_	_	_	_	_	_	ODFW	Lower Columbia River Ecosystem Restoration General Investigation Study (GIS)	The Lower Columbia River Ecosystem Restoration General Investigation Study (GIS) is a Federally funded program getting underway to provide funding towards designated projects that will benefit fish within the lower Columbia River and tributaries. Projects need to be identified through a collaborative process with watershed councils and other groups and funding will be provided based on review. All projects that will benefit fish and the ecological elements of their habitats are eligible for consideration including those that reduce fine sediment inputs into streams.	A few years out	Untested process
Lower Columbia	Clatskanie	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	_	_	_	_	_	_	_	_	Columbia County	Columbia County Road Department	Columbia County owns and maintains many miles of roads, from rural unimproved backroads to high use improved highways. The County Road Department currently maintains existing roads and stream crossings under the ODOT Blue Book (Routine Road Maintenance Water Quality and Habitat Guide), a programmatic guide and approach to minimize impacts to fish and wildlife across the landscape by administering applicable BMPs during routine road maintenance activities. The guide was developed through a multi-resource agency effort. When implemented appropriately, actions can greatly reduce sediment inputs to streams both at the project site and regionally as well. Poor funding through the Gas Tax currently precludes appropriate staffing levels and purchase of materials to adequately maintain the county highway infrastructure, resulting in poorly maintained roads and increased inputs of road toxins and fine sediments into streams. The county also works closely with the SBWC to target fish passage issues and implement certain habitat restoration projects along the stream/highway interface.	Ongoing and into the future	Funding source does not provide the County with adequate dollars to maintain the highway infrastructure.
Lower Columbia	Hood	Agricultural chemicals (organophoshates and other insecticides) above state standards impair the growth and survival of coho, spring Chinook, winter steelhead, and summer steelhead fry and summer parr, and fall Chinook fry.	_	_	_	_	_	_	_	_	DEQ/CTWSRO/ BPA	NPDES/BMP's	Some DEQ monitoring is currently occurring, funded by CTWSRO and BPA. 2. Legal or statutory guidance DEQ OAR's,NPDES		
Lower Columbia	Hood	Agricultural chemicals (organophoshates and other insecticides) above state standards impair the growth and survival of coho, spring Chinook, winter steelhead, and summer steelhead fry and summer parr, and fall Chinook fry.	_	_	_	_	_	_	_	_	Hood River Valley Growers	BMP's	Hood River Valley Growers have taken an active role in volunteering to implement BMP's to reduce pesticide contamination.		Funding is needed to implement the program and develop new techniques in applying chemicals.

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
Lower Columbia	Hood	Agricultural chemicals (organophoshates and other insecticides) above state standards impair the growth and survival of coho, spring Chinook, winter steelhead, and summer steelhead fry and summer parr, and fall Chinook fry.	–	–	–	–	–	–	–	–	Hood River SWCD	Various	SWCD supplies information, and assistance to area orchardist on methods to reduce pesticide contamination.		
Lower Columbia	Hood	Agricultural chemicals (organophoshates and other insecticides) above state standards impair the growth and survival of coho, spring Chinook, winter steelhead, and summer steelhead fry and summer parr, and fall Chinook fry.	–	–	–	–	–	–	–	–	OSU Extension	Outreach	OSU provides outreach educational materials area orchardist.		
Lower Columbia	Hood	Fine sediment input from interbasin transfer of glacial water to clearwater streams that impacts the survival of coho, fall Chinook, and steelhead eggs and alevins..	–	–	–	–	–	–	–	–	EFID	Central Canal Piping Project	Canal piping project that will alleviate interbasin transfer of glacial water into clear water streams.	Immediate	Funding for entire project has not been ensured.
Lower Columbia	Hood	Fine sediment input from interbasin transfer of glacial water to clearwater streams that impacts the survival of coho, fall Chinook, and steelhead eggs and alevins..	–	–	–	–	–	–	–	–	MFID	Fisheries Management Plan	Program to eliminate the interbasin transfer of glacial water into clear water stream.		
Lower Columbia	Hood	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, and steelhead eggs and alevins.	–	–	–	–	–	–	–	–	Hood River SWCD	Various	Various voluntary programs and public outreach efforts designed to improve agricultural practices.	Immediate implementation effectiveness will take significant time to determine effectiveness.	Adequate funding to projects as they arise is needed.
Lower Columbia	Hood	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, and steelhead eggs and alevins.	–	–	–	–	–	–	–	–	Hood River Watershed Council	Various	Voluntary program that works with private and public landowner for watershed restoration.		Adequate funding to projects as they arise is needed.
Lower Columbia	Hood	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, and steelhead eggs and alevins.	–	–	–	–	–	–	–	–	CTWSRO/BPA	HRPP Habitat Project	HRPP habitat program funds a variety of projects designed to reduce sediment inputs (i.e. East Fork piping project, riparian fencing).		Limited funding is dictated by council.
Lower Columbia	Hood	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, and steelhead eggs and alevins.	–	–	–	–	–	–	–	–	Hood River County	County Forest Road Maintenance	Various road maintenance activities designed to reduce fine sediment input to streams.		
Lower Columbia	Hood	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, and steelhead eggs and alevins.	–	–	–	–	–	–	–	–	Longview Fibre	Forest Road Maintenance	Various road maintenance activities designed to reduce fine sediment input to streams.		
Lower Columbia	Hood	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, and steelhead eggs and alevins.	–	–	–	–	–	–	–	–	Mt. Hood Meadows Ski Resort/USFS	Sediment reduction plan/SUP	Plan to reduce sand from roads and parking lots from entering streams, and control erosion on disturbed areas.		
Lower Columbia	Hood	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	–	–	–	–	–	–	–	–	EFID	Central Canal Piping Project	Piping project is design to return conserved water instream at the EFID diversion site. Temperatures below diversion currently do not meet state standards.		Likely the amount of water returned will not be enough to make stream comply with standards.
Lower Columbia	Hood	Loss of instream habitat complexity and off channel habitat availability for coho winter parr, fall Chinook fry, spring Chinook fry, summer parr and winter parr, and steelhead winter parr due to past and/or present land management practices.	–	–	–	–	–	–	–	–	Hood River County	County planning and zoning requirements	Funding level is not static and appears to be decreasing.		

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
Lower Columbia	Hood	Loss of instream habitat complexity and off channel habitat availability for coho winter parr, fall Chinook fry, spring Chinook fry, summer parr and winter parr, and steelhead winter parr due to past and/or present land management practices.	–	–	–	–	–	–	–	–	Hood River Watershed Council	Various	Citizen group that has been influential in coordinating, developing, and implementing restoration projects.		
Lower Columbia	Hood	Loss of instream habitat complexity and off channel habitat availability for coho winter parr, fall Chinook fry, spring Chinook fry, summer parr and winter parr, and steelhead winter parr due to past and/or present land management practices.	–	–	–	–	–	–	–	–	Hood River County SWCD	Various	The district has taken on a wide variety of habitat restoration and protection projects. Projects are voluntary with landowners.		Funding is often problematic, but can leverage funds Federal and state funds.
Lower Columbia	Hood	Loss of instream habitat complexity and off channel habitat availability for coho winter parr, fall Chinook fry, spring Chinook fry, summer parr and winter parr, and steelhead winter parr due to past and/or present land management practices.	–	–	–	–	–	–	–	–	CTWSRO/BPA	HRPP Habitat Restoration	Habitat restoration project funded by BPA. Project has funded riparian fencing projects, along with large wood projects.		Funding from BPA diminishing
Lower Columbia	Hood	Loss of instream habitat complexity and off channel habitat availability for coho winter parr, fall Chinook fry, spring Chinook fry, summer parr and winter parr, and steelhead winter parr due to past and/or present land management practices.	–	–	–	–	–	–	–	–	Hood River County SWCD/Hood River Watershed Group	Networking, education	Provides a educational and networking forum for the community on issues effecting quality and quantity of habitat.		
Lower Columbia	Hood	Loss of instream habitat complexity and off channel habitat availability for coho winter parr, fall Chinook fry, spring Chinook fry, summer parr and winter parr, and steelhead winter parr due to past and/or present land management practices.	–	–	–	–	–	–	–	–	Longview Fibre	Various	Company has voluntarily implemented many fish habitat restoration projects in the Hood River Basin,		
Lower Columbia	Hood	Passage of returning adult coho, fall Chinook, spring Chinook, winter steelhead and summer steelhead at Powerdale Dam is delayed by certain dam operational practices.	–	–	X	–	–	–	–	–	PacifiCorps	Settlement Agreement, FERC License			Significant modifications would be needed to existing structure
Lower Columbia	Hood	Passage of returning adult coho, winter steelhead and summer steelhead at is blocked by Laurance Lake Dam.	–	–	X	–	–	–	–	–	MF Irrigation District/USFS Hood River District	FID Fisheries Management Plan, USFS Special Use Permit	Fisheries Management Plan currently being developed that will address fish passage at Laurance Lake Dam.	Unknown	Dam is over 100 feet high, funding and appropriate techniques will be issues.
Lower Columbia	Hood	Passage of returning adult coho, winter steelhead and summer steelhead at is blocked by Laurance Lake Dam.	–	–	X	–	–	–	–	–	ODFW	Fish screening and passage program			
Lower Columbia	Hood	Reduced instream flows due to irrigation or domestic withdrawals impairs the growth and survival of coho fry and summer parr, fall Chinook fry, spring Chinook fry and summer, winter steelhead fry and summer parr, and winter steelhead fry and summer parr.	–	–	–	–	–	–	–	–	Farmers Irrigation District	Various	Irrigation district has a variety of programs related to irrigation efficiency that are designed to conserve water and return a portion of savings instream. Piping of open canals that have conserved water has returned instream.		Funding actions is a concern

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
Lower Columbia	Hood	Reduced instream flows due to irrigation or domestic withdrawals impairs the growth and survival of coho fry and summer parr, fall Chinook fry, spring Chinook fry and summer, winter steelhead fry and summer parr, and winter steelhead fry and summer parr.	–	–	–	–	–	–	–	–	Middle Fork Irrigation District	Various	Irrigation district has a variety of programs related to irrigation efficiency that are designed to conserve water and return a portion of savings instream. Piping of open canals that have conserved water has returned instream.		Funding actions is a concern
Lower Columbia	Hood	Reduced instream flows due to irrigation or domestic withdrawals impairs the growth and survival of coho fry and summer parr, fall Chinook fry, spring Chinook fry and summer, winter steelhead fry and summer parr, and winter steelhead fry and summer parr.	–	–	–	–	–	–	–	–	Hood River SWCD	Landowner assistance program for irrigation efficiency	Both outreach and assistance programs designed to increase efficiency of for agricultural and residential irrigation.		
Lower Columbia	Hood	Reduced instream flows due to irrigation or domestic withdrawals impairs the growth and survival of coho fry and summer parr, fall Chinook fry, spring Chinook fry and summer, winter steelhead fry and summer parr, and winter steelhead fry and summer parr.	–	–	–	–	–	–	–	–	Hood River Watershed Council	Watershed Restoration program	Voluntary program that works with private and public landowner for watershed restoration.		
Lower Columbia	Hood	Reduced instream flows due to irrigation or domestic withdrawals impairs the growth and survival of coho fry and summer parr, fall Chinook fry, spring Chinook fry and summer, winter steelhead fry and summer parr, and winter steelhead fry and summer parr.	–	–	–	–	–	–	–	–	City of Hood River	Domestic water supply	City of Hood River diverts water from tributaries of the West Fork. City programs to conserve water benefit instream flows.		
Lower Columbia	Hood	Reduced instream flows due to irrigation or domestic withdrawals impairs the growth and survival of coho fry and summer parr, fall Chinook fry, spring Chinook fry and summer, winter steelhead fry and summer parr, and winter steelhead fry and summer parr.	–	–	–	–	–	–	–	–	Hood R SWCD/Hood R Watershed Group/OSU Extension	Water Conservation Education	Work with all area ater users to promote conservation efforts. Provide educational and networking forum for community to discuss water conservation.		
Lower Columbia	Hood	Reduced instream flows due to irrigation or domestic withdrawals impairs the growth and survival of coho fry and summer parr, fall Chinook fry, spring Chinook fry and summer, winter steelhead fry and summer parr, and winter steelhead fry and summer parr.	–	–	–	–	–	–	–	–	Hood River SWCD	Irrigation Efficiency Programs	Small grant programs to increase irrigation efficiency		
Lower Columbia	Hood	Reduced instream habitat quality/quantity for summer and winter steelhead fry, summer parr, and winter parr due to inundation from Bonneville Dam.	X	–	–	–	X	–	–	–	BPA,COE, Federal Actions Agencies/NOAA	FCRPS BIOP			
Lower Columbia	Lower Gorge	Degraded habitat quality and disconnected habitats resulting from development and ongoing maintenance and construction activities on Interstate 84, Historic Highway 30, and the Union Pacific rail-line.	X	X	–	–	X	–	X	–	Union Pacific Railroad	Unknown	The Railroad parallels the Columbia River and crosses all tributary streams in the Lower Gorge reach. However, the Railroad is a commercially and economically driven entity that does not come to the table to discuss resource issues in any state coordinated project planning venue.	not identified but sooner the better.	Staff time to pursue a working relationship with the Railroad companies.

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet)								Agency	Program	Description	Timeline	Constraints
			1	2	3	4	5	6	7	8					
Lower Columbia	Lower Gorge	Degraded habitat quality and disconnected habitats resulting from development and ongoing maintenance and construction activities on Interstate 84, Historic Highway 30, and the Union Pacific rail-line.	X	X	_	_	X	_	X	_	FHWA/ODOT	Oregon Transportation Investment Act III (OTIA III), ODOT Interstate 84 Strategy	The Oregon Department of Transportation has initiated the "I-84 Strategy" which is aimed primarily at enhancing and preserving the structural/architectural elements of the I-84 corridor, but also provides direction to improve resource integrity, including fish, wildlife and their habitats. Columbia Gorge road projects on I-84 and Highway 30, including bridge replacements and culvert conversions will address fish passage and habitat enhancements to offset construction impacts. In addition, several bridges on I-84 are slated for replacement under the Oregon Transportation Investment Act III (OTIA III). In addition, through the OTIA III Program, ODOT has initiated construction of a Mitigation Conservation Bank in the Youngs and Latourel Creek basin within Rooster Rock State Park that will enhance salmonid spawning and rearing habitat.	Began in 2003 and now ongoing	Cost and staffing can reduce the appropriate amount of time one can afford to review a project and identify good mitigation projects.
Lower Columbia	Lower Gorge	Degraded habitat quality and disconnected habitats resulting from development and ongoing maintenance and construction activities on Interstate 84, Historic Highway 30, and the Union Pacific rail-line.	X	X	_	_	X	_	X	_	Columbia River Gorge National Scenic Area & USFS	Columbia River Gorge National Scenic Area Management Act	The Columbia River Gorge National Scenic Area is guided by the National Scenic Area Act which established a partnership between the USDA Forest Service, a bi-state regional planning body (the Columbia River Gorge Commission) that engages Washington and Oregon, and six counties with land in the Scenic Area. This includes all Priority Location streams. All new development and land uses in the National Scenic Area must be reviewed to comply with ordinances in The Management Plan as directed by the Act. This includes various types of development and highway projects including I-84 and Historic Highway 30 also managed by ODOT and Multnomah County. All permit applications that may affect fish and/or wildlife are also reviewed by ODFW to ensure impacts are minimized and restoration actions are addressed. Permit conditions are often far stricter then those issued in typical County or DSL type permits. With appropriate oversight and review some projects will improve fish and wildlife habitat function in the corridor, particularly where bridges or culverts intersect fish bearing creeks. ODOT has also initiated development of a Mitigation Conservation Bank along Young and Latourel creeks near Rooster Rock State Park that will enhance spawning and rearing habitat for migratory salmonids. In addition, Multnomah County also applies strict management practices on projects to minimize effects to streams and other habitats. ODOT and the many resource and regulatory agencies have collaborated on ways to improve fish passage (Multnomah and Wahkeena Creek culvert and Oneonta bridge crossing), improve habitat complexity (Young and Latourel creeks) and enhanced disbursement of gravels unnaturally aggraded in Multnomah Creek.	Ongoing	Cost and staff time to engage during project development and implementation.
Lower Columbia	Lower Gorge	Degraded habitat quality and disconnected habitats resulting from development and ongoing maintenance and construction activities on Interstate 84, Historic Highway 30, and the Union Pacific rail-line.	X	X	_	_	X	_	X	_	Oregon State Parks	Oregon State Parks	The Oregon State Parks owns and manages the Rooster Rock State Park which embraces the lower reaches of Latourel and Young Creek, important coho and steelhead streams. In 2005, the State Parks entered into a multi-agency agreement (MOA) with ODOT to allow the design and development of a Mitigation Conservation Bank that will enhance and restore salmonid spawning and rearing habitat in these streams, and improve wetland function. Habitat complexity will also be enhanced through large wood placement and riparian plantings. Fish passage was improved at one culvert in Youngs Creek in 2005.	Began in 2005 and will be completed in the next few years	Performance as yet unrealized
Lower Columbia	Lower Gorge	Degraded habitat quality and disconnected habitats resulting from development and ongoing maintenance and construction activities on Interstate 84, Historic Highway 30, and the Union Pacific rail-line.	X	X	_	_	X	_	X	_	ODFW	Lower Columbia River Ecosystem Restoration General Investigation Study (GIS)	The Lower Columbia River Ecosystem Restoration General Investigation Study (GIS) is a Federally funded program getting underway to provide funding towards designated projects that will benefit fish within the lower Columbia River and tributaries. Projects need to be identified through a collaborative process with watershed councils and other groups and funding will be provided based on review. All projects that will benefit fish and the ecological elements of their habitats are eligible for consideration including those that improve habitat quality and quantity.	A few years out.	Untested process
Lower Columbia	Sandy	Altered streamflows due to water storage dams impairs the growth, survival, and movement of steelhead fry and summer parr.	_	_	_	X	_	_	_	_	Portland Water Bureau				
Lower Columbia	Sandy	Direct mortality to fall, late fall, and spring Chinook fry from hydropower production at Marmot and Little Sandy Dams.	_	_	X	_	_	_	_	_	PGE, Settlement Working Group, ODFW, NOOA, USFW	Hydro/Fishery Programs	Marmot and Little Sandy Dam Decommissioning in 07 and 08.	Decommissioning scheduled for 2007 and 2008 according to Settlement Agreement	Settlement Agreement Specifications
Lower Columbia	Sandy	Fine sediment inputs from variety of sources that impact the survival of coho, chum, fall Chinook, late fall Chinook, spring chinook, and steelhead eggs and alevins.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region.	Ongoing	Staffing to meet demands for restoration projects and technical assistance, funds to implement projects.
Lower Columbia	Sandy	Fine sediment inputs from variety of sources that impact the survival of coho, chum, fall Chinook, late fall Chinook, spring chinook, and steelhead eggs and alevins.	X	X	X	_	X	X	X	_	East Multnomah SWCD	Conservation Programs	The East Multnomah SWCD promotes and implements voluntary natural resource conservation projects with landowners by providing leadership, education, outreach, and improved access to State and Federal cost share assistance in both urban and rural communities.	Established in 1958, ongoing.	
Lower Columbia	Sandy	Fine sediment inputs from variety of sources that impact the survival of coho, chum, fall Chinook, late fall Chinook, spring chinook, and steelhead eggs and alevins.	_	_	_	_	_	_	_	_	Clackamas County SWCD	Conservation Programs	The Clackamas SWCD promotes and implements voluntary natural resource conservation projects with landowners by providing leadership, education, outreach, and improved access to State and Federal cost share assistance in both urban and rural communities.	Established in 1958, ongoing.	

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
Lower Columbia	Sandy	Fine sediment inputs from variety of sources that impact the survival of coho, chum, fall Chinook, late fall Chinook, spring chinook, and steelhead eggs and alevins.	_	_	_	_	_	X	_	X	Multnomah County	Road Program			
Lower Columbia	Sandy	Fine sediment inputs from variety of sources that impact the survival of coho, chum, fall Chinook, late fall Chinook, spring chinook, and steelhead eggs and alevins.	_	_	_	_	_	X	_	X	Clackamas County	Road Program			
Lower Columbia	Sandy	Fine sediment inputs from variety of sources that impact the survival of coho, chum, fall Chinook, late fall Chinook, spring chinook, and steelhead eggs and alevins.	X	X	_	_	X	X	X	X	Multnomah County	Planning Department: Riparian Protection Standards			
Lower Columbia	Sandy	Fine sediment inputs from variety of sources that impact the survival of coho, chum, fall Chinook, late fall Chinook, spring chinook, and steelhead eggs and alevins.	X	X	_	_	X	X	X	X	Clackamas County	Planning Department: Riparian Protection Standards			
Lower Columbia	Sandy	Fine sediment inputs from variety of sources that impact the survival of coho, chum, fall Chinook, late fall Chinook, spring chinook, and steelhead eggs and alevins.	_	_	_	_	_	_	_	_		Lower Columbia River Estuary Partnership (LCREP)			
Lower Columbia	Sandy	Fine sediment inputs from variety of sources that impact the survival of coho, chum, fall Chinook, late fall Chinook, spring chinook, and steelhead eggs and alevins.	X	X	X	_	X	X	X	_	Sandy Basin Watershed Council (SBWC)	Watershed Restoration Program	The Sandy Basin Watershed Council works with private landowners in the Clackamas Watershed to implement Oregon Plan measures directing the restoration and enhancement of Oregon 's salmonid habitats in the region.	Ongoing	Funding
Lower Columbia	Sandy	Fine sediment inputs from variety of sources that impact the survival of coho, chum, fall Chinook, late fall Chinook, spring chinook, and steelhead eggs and alevins.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and Federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat.	Ongoing.	Funding.
Lower Columbia	Sandy	Hatchery weir at Cedar Creek hatchery impairs passage for coho and steelhead returning adults.	_	_	_	_	_	_	_	_	ODFW	North Willamette Watershed District (NWWD) Fish Management	The North Willamette Watershed District (NWWD) Fish Management program conducts monitoring and assessment of fisheries resources to maintain all species at optimum levels by determining fish species distribution, abundance, and harvest levels. The District provides recommendations to land management and other regulatory agencies to protect and enhance fish habitats. District staff also responds to information requests from landowners, consultants, and State/Federal/local agencies.	Ongoing	Limited staff and funding reduces the ability for effective management of the numerous fish and fish habitat issues in the District.
Lower Columbia	Sandy	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region.	Ongoing	Staffing to meet demands for restoration projects and technical assistance, funds to implement projects.
Lower Columbia	Sandy	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr.	X	X	X	_	X	X	X	_	East Multnomah SWCD	Conservation Programs	The East Multnomah SWCD promotes and implements voluntary natural resource conservation projects with landowners by providing leadership, education, outreach, and improved access to State and Federal cost share assistance in both urban and rural communities.	Established in 1958, ongoing.	
Lower Columbia	Sandy	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr.	_	_	_	_	_	_	_	_	Clackamas County SWCD	Conservation Programs	The Clackamas SWCD promotes and implements voluntary natural resource conservation projects with landowners by providing leadership, education, outreach, and improved access to State and Federal cost share assistance in both urban and rural communities.	Established in 1958, ongoing.	
Lower Columbia	Sandy	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr.	X	X	X	_	X	X	X	_	Sandy Basin Watershed Council (SBWC)	Watershed Restoration Program	The Sandy Basin Watershed Council works with private landowners in the Clackamas Watershed to implement Oregon Plan measures directing the restoration and enhancement of Oregon 's salmonid habitats in the region.	Ongoing	Funding
Lower Columbia	Sandy	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and Federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat.	Ongoing.	Funding.

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet)								Agency	Program	Description	Timeline	Constraints
			1	2	3	4	5	6	7	8					
Lower Columbia	Sandy	Impaired gravel recruitment impairs the spawning success of fall, late fall, and spring chinook, and steelhead spawners.	_	_	_	_	_	_	_	_	Portland Water Bureau				
Lower Columbia	Sandy	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, late fall Chinook fry, spring Chinook fry and winter parr, and steelhead winter parr due to past and/or present land management.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region.	Ongoing	Staffing to meet demands for restoration projects and technical assistance, funds to implement projects.
Lower Columbia	Sandy	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, late fall Chinook fry, spring Chinook fry and winter parr, and steelhead winter parr due to past and/or present land management.	X	X	X	_	X	X	X	_	East Multnomah SWCD	Conservation Programs	The East Multnomah SWCD promotes and implements voluntary natural resource conservation projects with landowners by providing leadership, education, outreach, and improved access to State and Federal cost share assistance in both urban and rural communities.	Established in 1958, ongoing.	
Lower Columbia	Sandy	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, late fall Chinook fry, spring Chinook fry and winter parr, and steelhead winter parr due to past and/or present land management.	_	_	_	_	_	_	_	_	Clackamas County SWCD	Conservation Programs	The Clackamas SWCD promotes and implements voluntary natural resource conservation projects with landowners by providing leadership, education, outreach, and improved access to State and Federal cost share assistance in both urban and rural communities.	Established in 1958, ongoing.	
Lower Columbia	Sandy	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, late fall Chinook fry, spring Chinook fry and winter parr, and steelhead winter parr due to past and/or present land management.	_	_	_	_	_	_	_	_		Lower Columbia River Estuary Partnership (LCREP)			
Lower Columbia	Sandy	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, late fall Chinook fry, spring Chinook fry and winter parr, and steelhead winter parr due to past and/or present land management.	X	X	X	_	X	X	X	_	Sandy Basin Watershed Council (SBWC)	Watershed Restoration Program	The Sandy Basin Watershed Council works with private landowners in the Clackamas Watershed to implement Oregon Plan measures directing the restoration and enhancement of Oregon 's salmonid habitats in the region.	Ongoing	Funding
Lower Columbia	Sandy	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, late fall Chinook fry, spring Chinook fry and winter parr, and steelhead winter parr due to past and/or present land management.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and Federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat.	Ongoing.	Funding.
Lower Columbia	Sandy	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region.	Ongoing	Staffing to meet demands for restoration projects and technical assistance, funds to implement projects.
Lower Columbia	Sandy	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	_	_	_	_	_	X	_	X	Multnomah County	Road Program			
Lower Columbia	Sandy	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	_	_	_	_	_	X	_	X	Clackamas County	Road Program			
Lower Columbia	Sandy	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	_	_	_	_	_	X	_	X	ODOT	Roads Program			

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet)								Agency	Program	Description	Timeline	Constraints
			1	2	3	4	5	6	7	8					
Lower Columbia	Sandy	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and Federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat.	Ongoing.	Funding.
Lower Columbia	Sandy	Water storage dams impair the upstream migration of returing adult spring Chinook and steelhead.	_	_	X	_	_	_	_	_	Portland Water Bureau				
Lower Columbia	Scappoose	Fine sediment inputs from variety of sources that impact the survival of coho, chum, fall Chinook, and steelhead eggs and alevins.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and Federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat.	Ongoing.	Funding.
Lower Columbia	Scappoose	Fine sediment inputs from variety of sources that impact the survival of coho, chum, fall Chinook, and steelhead eggs and alevins.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region.	Ongoing	Funding
Lower Columbia	Scappoose	Fine sediment inputs from variety of sources that impact the survival of coho, chum, fall Chinook, and steelhead eggs and alevins.	_	_	_	_	_	_	_	_	Columbia County SWCD				
Lower Columbia	Scappoose	Fine sediment inputs from variety of sources that impact the survival of coho, chum, fall Chinook, and steelhead eggs and alevins.	_	_	X	_	_	X	X	X	Columbia County	Road Department	Columbia County owns and maintains many miles of roads, from rural unimproved backroads to high use improved highways. The County Road Department currently maintains existing roads and stream crossings under the ODOT Blue Book (Routine Road Maintenance Water Quality and Habitat Guide), a programmatic guide and approach to minimize impacts to fish and wildlife across the landscape by administering applicable BMPs during routine road maintenance activities. The guide was developed through a multi-resource agency effort. When implemented appropriately, actions can greatly reduce sediment inputs to streams both at the project site and regionally as well. Poor funding through the Gas Tax currently precludes appropriate staffing levels and purchase of materials to adequately maintain the county highway infrastructure, resulting in poorly maintained roads and increased inputs of road toxins and fine sediments into streams. The county also works closely with the SBWC to target fish passage issues and implement certain habitat restoration projects along the stream/highway interface.	Ongoing	Funding source does not provide the County with adequate dollars to maintain the highway infrastructure.
Lower Columbia	Scappoose	Fine sediment inputs from variety of sources that impact the survival of coho, chum, fall Chinook, and steelhead eggs and alevins.	X	X	_	_	X	X	X	X	Columbia County	Planning Department: Riparian Protection Standards			
Lower Columbia	Scappoose	Fine sediment inputs from variety of sources that impact the survival of coho, chum, fall Chinook, and steelhead eggs and alevins.	_	_	_	_	_	_	_	_	Lower Columbia River Estuary Partnership (LCREP)				
Lower Columbia	Scappoose	Fine sediment inputs from variety of sources that impact the survival of coho, chum, fall Chinook, and steelhead eggs and alevins.	_	X	_	_	X	X	X	X	Scappoose Bay Watershed Council (SBWC)	Annual Native Tree and Shrub Distribution	Provide native trees and shrubs to private property owners with riparian and/or wetland habitat. Work with landowners to address erosion concerns.	Trees are provided annually to property owners throughout the watershed.	Sediment input is also coming from industrial timber sites. This is an area for ODF management and outside the scope of what the watershed council is able to address. NRCS and the SWCD are partners for agricultural land concerns. These partners face significant funding restrictions.
Lower Columbia	Scappoose	Fine sediment inputs from variety of sources that impact the survival of coho, chum, fall Chinook, and steelhead eggs and alevins.	X	X	X	X	X	X	X	X	Scappoose Bay Watershed Council (SBWC)	Scappoose Bay Action Plan	The SBWC is active in the Scappoose basin and designs and implements projects that may target reducing fine sediment input through riparian plantings, bank stabilization projects, and by educating land owners who live along tributary streams in the basin.	Soon	Agency priorities/demands and funding for additional agency staff to assist with watershed council project design and implementation efforts.
Lower Columbia	Scappoose	Fine sediment inputs from variety of sources that impact the survival of coho, chum, fall Chinook, and steelhead eggs and alevins.	X	X	X	_	X	X	X	_	ODFW	Lower Columbia River Ecosystem Restoration General Investigation Study (GIS)	The Lower Columbia River Ecosystem Restoration General Investigation Study (GIS) is a Federally funded program getting underway to provide funding towards designated projects that will benefit fish within the lower Columbia River and tributaries. Projects need to be identified through a collaborative process with watershed councils and other groups and funding will be provided based on review. All projects that will benefit fish and the ecological elements of their habitats are eligible for consideration.	A few years out.	Untested process
Lower Columbia	Scappoose	Fine sediment inputs from variety of sources that impact the survival of coho, chum, fall Chinook, and steelhead eggs and alevins.	X	X	_	_	X	X	X	X	City of Scappoose	Scappoose Municipal Code (Sensitive Lands- Fish and Riparian Corridor Overlay)	The City of Scappoose requires 50 foot riparian buffers on streams within Scappoose which bounds a significant area in the lower reaches of South Fork Scappoose Creek. Policy promotes landowner stewardship of the stream, improved bank stability, reduction of fine sediment inputs, and overall improves the temperature regime in the lower basin. Policy may also act as guidance for other land owners in the upper basin.	Ongoing	Limited access to properties and infringement of property rights compromise full implementation of the Municipal Code.

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
Lower Columbia	Scappoose	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr and steelhead fry and summer parr.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and Federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat.	Ongoing.	Funding.
Lower Columbia	Scappoose	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr and steelhead fry and summer parr.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region.	Ongoing	Funding
Lower Columbia	Scappoose	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr and steelhead fry and summer parr.	_	_	_	_	_	_	_	_	Columbia County SWCD				
Lower Columbia	Scappoose	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr and steelhead fry and summer parr.	_	_	_	_	_	_	_	_	Lower Columbia River Estuary Partnership (LCREP)				
Lower Columbia	Scappoose	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr and steelhead fry and summer parr.	X	X	X	_	X	X	X	_	ODFW	Lower Columbia River Ecosystem Restoration General Investigation Study (GIS)	The Lower Columbia River Ecosystem Restoration General Investigation Study (GIS) is a Federally funded program getting underway to provide funding towards designated projects that will benefit fish within the lower Columbia River and tributaries. Projects need to be identified through a collaborative process with watershed councils and other groups and funding will be provided based on review. All projects that will benefit fish and the ecological elements of their habitats are eligible for consideration.	A few years out.	Untested process
Lower Columbia	Scappoose	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr and steelhead fry and summer parr.	X	X	_	_	X	X	X	X	City of Scappoose	Scappoose Municipal Code (Sensitive Lands-Fish and Riparian Corridor Overlay)	The City of Scappoose requires 50 foot riparian buffers on streams within Scappoose which bounds a significant area in the lower reaches of South Fork Scappoose Creek. Policy promotes landowner stewardship of the stream and maintenance of riparian buffers that increase shading and ultimately improves the thermal regime in the creek. Policy also acts as guidance for other landowners in the upper basin.	Ongoing	Limited access to properties and infringement of property rights compromise full implementation of the Municipal Code
Lower Columbia	Scappoose	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr and steelhead fry and summer parr.	_	X	_	_	_	X	_	X	Scappoose Bay Watershed Council (SBWC)		Riparian planting along the mainstem of major creeks in the watershed.	Not currently identified.	Although resources are available to conduct temperature monitoring, staff and volunteer time is limited.
Lower Columbia	Scappoose	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, and steelhead winter parr due to past and/or present land management.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and Federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat.	Ongoing.	Funding.
Lower Columbia	Scappoose	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, and steelhead winter parr due to past and/or present land management.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region.	Ongoing	Funding
Lower Columbia	Scappoose	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, and steelhead winter parr due to past and/or present land management.	_	_	_	_	_	_	_	_	Columbia County SWCD				
Lower Columbia	Scappoose	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, and steelhead winter parr due to past and/or present land management.	_	_	_	_	_	_	_	_	Lower Columbia River Estuary Partnership (LCREP)				

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
Lower Columbia	Scappoose	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, and steelhead winter parr due to past and/or present land management.	X	X	X	_	X	X	X	_	ODFW	Lower Columbia River Ecosystem Restoration General Investigation Study (GIS)	The Lower Columbia River Ecosystem Restoration General Investigation Study (GIS) is a Federally funded program getting underway to provide funding towards designated projects that will benefit fish within the lower Columbia River and tributaries. Projects need to be identified through a collaborative process with watershed councils and other groups and funding will be provided based on review. All projects that will benefit fish and the ecological elements of their habitats are eligible for consideration.	A few years out.	Untested process
Lower Columbia	Scappoose	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, and steelhead winter parr due to past and/or present land management.	X	X	_	_	X	X	X	X	City of Scappoose	Scappoose Municipal Code (Sensitive Lands-Fish and Riparian Corridor Overlay)	The City of Scappoose requires 50 foot riparian buffers on streams within Scappoose which bounds a significant area in the lower reaches of South Fork Scappoose Creek. Policy promotes landowner stewardship of the stream and maintenance of riparian buffers that, in the long-term, may contribute to instream habitat complexity and ecological function of the floodplain. Policy may also act as guidance for other landowners in the upper basin.	Ongoing	Limited access to properties and infringement of property rights compromise full implementation of the Municipal Code
Lower Columbia	Scappoose	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, and steelhead winter parr due to past and/or present land management.	_	_	_	_	X	_	_	_	Scappoose Bay Watershed Council (SBWC)	Large Woody Debris Placement Projects	Large woody debris and gravel placement projects in salmonid refugia habitats in the watershed.	Ongoing	Funding is limited for comprehensive analysis.
Lower Columbia	Scappoose	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, fall Chinook fry, and steelhead winter parr due to past and/or present land management.	X	_	_	_	X	_	_	_	Scappoose Bay Watershed Council (SBWC)	Scappoose Greenway Development	Improve channel conditions and reconnect the floodplain in the lower portions of Scappoose Creek. Important corridor for salmonids heading to spawning and rearing habitat, and restoring floodplain connectivity in the lower watershed will enhance ecological processes and expand refugia habitats.	Not currently identified	Ability to contract for technical expertise
Lower Columbia	Scappoose	Road crossings and other land use related passage impediments impairs the upstream migration of returning adult chum.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and Federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat.	Ongoing.	Funding.
Lower Columbia	Scappoose	Road crossings and other land use related passage impediments impairs the upstream migration of returning adult chum.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region.	Ongoing	Funding
Lower Columbia	Scappoose	Road crossings and other land use related passage impediments impairs the upstream migration of returning adult chum.	_	_	X	_	_	X	X	X	Columbia County	Road Department	Columbia County owns and maintains many miles of roads, from rural unimproved backroads to high use improved highways. The County Road Department currently maintains existing roads and stream crossings under the ODOT Blue Book (Routine Road Maintenance Water Quality and Habitat Guide), a programmatic guide and approach to minimize impacts to fish and wildlife across the landscape by administering applicable BMPs during routine road maintenance activities. The guide was developed through a multi-resource agency effort. When implemented appropriately, actions can greatly reduce sediment inputs to streams both at the project site and regionally as well. Poor funding through the Gas Tax currently precludes appropriate staffing levels and purchase of materials to adequately maintain the county highway infrastructure, resulting in poorly maintained roads and increased inputs of road toxins and fine sediments into streams. The county also works closely with the SBWC to target fish passage issues and implement certain habitat restoration projects along the stream/highway interface.	Ongoing	Funding source does not provide the County with adequate dollars to maintain the highway infrastructure.
Lower Columbia	Scappoose	Road crossings and other land use related passage impediments impairs the upstream migration of returning adult chum.	X	X	X	_	X	X	X	_	ODFW	Lower Columbia River Ecosystem Restoration General Investigation Study (GIS)	The Lower Columbia River Ecosystem Restoration General Investigation Study (GIS) is a Federally funded program getting underway to provide funding towards designated projects that will benefit fish within the lower Columbia River and tributaries. Projects need to be identified through a collaborative process with watershed councils and other groups and funding will be provided based on review. All projects that will benefit fish and the ecological elements of their habitats are eligible for consideration.	A few years out.	Untested process
Lower Columbia	Scappoose	Road crossings and other land use related passage impediments impairs the upstream migration of returning adult chum.	_	_	X	_	_	_	_	_	ODOT	Roads Program			
Lower Columbia	Scappoose	Road crossings and other land use related passage impediments impairs the upstream migration of returning adult chum.	_	_	X	_	_	_	_	_	Scappoose Bay Watershed Council (SBWC)	Fish Passage Program	Systematic removal of high priority fish barriers in the watershed based on a assessment completed in 2001.	Since 2001	Funding for design and implementation is always a limitation to the amount of work that can get done.
Lower Columbia	Upper Gorge	Hatchery weirs block passage of returning adult steelhead at Eagle Creek and Herman Creek.	_	_	_	_	_	_	_	_	ODFW	Cascade Fish Hatchery	Hatchery program designed to mitigate for lost natural production associated with Columbia River Hydro	Immediate	Passage may increase disease at hatchery.
Lower Columbia	Upper Gorge	Hatchery weirs block passage of returning adult steelhead at Eagle Creek and Herman Creek.	_	_	_	_	_	_	_	_	ODFW	Oxbow Fish Hatchery	Hatchery program designed to mitigate for lost natural production associated with Columbia River Hydro	Immediate	None

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
Lower Columbia	Upper Gorge	Reduced instream habitat quality/quantity due to inundation from Bonneville Dam for all steelhead life stages, and eggs, alevins, fry, and spawners of fall Chinook and chum.	X	_	_	_	X	_	_	_	Federal Actions Agencies/NOAA	FCRPS BIOP			
Lower Columbia	Upper Gorge	Simplified habitat in both Hwy and railroad lands for all steelhead life stages, chum eggs, alevins, fry, returning adults, and spawners, and fall Chinook returning adults and spawners.	X	X	_	_	X	_	_	_	Union Pacific Railroad	Unknown	The Railroad parallels the Columbia River and crosses all tributary streams in the Lower Gorge reach. However, the Railroad is a commercially and economically driven entity that does not come to the table to discuss resource issues in any state coordinated project planning venue.	not identified but sooner the better.	Staff time to pursue a working relationship with the Railroad companies.
Lower Columbia	Upper Gorge	Simplified habitat in both Hwy and railroad lands for all steelhead life stages, chum eggs, alevins, fry, returning adults, and spawners, and fall Chinook returning adults and spawners.	X	X	_	_	X	_	_	_	Columbia River Gorge National Scenic Area & USFS	Columbia River Gorge National Scenic Area Management Act	The Columbia River Gorge National Scenic Area is guided by the National Scenic Area Act which established a partnership between the USFDA Forest Service, a bi-state regional planning body (the Columbia River Gorge Commission) that engages Washington and Oregon, and six counties with land in the Scenic Area. This includes all Priority Location streams. All new development and land uses in the National Scenic Area must be reviewed to comply with ordinances in The Management Plan as directed by the Act. This includes various types of development and highway projects including I-84 and Historic Highway 30 also managed by ODOT and Multnomah County. All permit applications that may affect fish and/or wildlife are also reviewed by ODFW to ensure impacts are minimized and restoration actions are addressed. Permit conditions are often far stricter then those issued in typical County or DSL type permits. With appropriate oversight and review some projects will improve fish and wildlife habitat function in the corridor, particularly where bridges or culverts intersect fish bearing creeks.	Ongoing	Cost and staff time to engage during project development and implementation.
Lower Columbia	Youngs Bay	Dewatering of portions of Lewis and Clark River due to City of Warrenton water withdrawals impairs the growth and survival of winter steelhead fry and summer parr.	_	_	X	X	_	X	_	_	Lower Columbia River Estuary Partnership	Comprehensive Conservation and Management Plan	The Lower Columbia River Estuary Comprehensive Conservation and Management Plan (LCREP 1999) identifies 43 actions that focus on preventing further habitat loss, restoring habitats, providing education and coordination among governments, and improving water quality. Twelve actions address habitat loss and modification and the impacts of land use activities. Fifteen actions call for increased education and improved consistency and coordination among government agencies with responsibility for the lower river and estuary. The sixteen actions that address conventional and toxic pollutants involve the regulatory authority of a variety of local, state, and Federal agencies. Some actions reflect existing activities, some call for increased activity. The Estuary Partnership's primary role will be to monitor the progress of the responsible entities to ensure the actions are implemented and the goals are met.	Ongoing	Unclear
Lower Columbia	Youngs Bay	Dewatering of portions of Lewis and Clark River due to City of Warrenton water withdrawals impairs the growth and survival of winter steelhead fry and summer parr.	_	_	X	X	_	_	_	_	City of Warrenton	Municipal Water Program	The City of Warrenton has developed a water conservation and restriction protocol for predicted periods of water supply shortages. It is unclear if this has been adopted as ordinance or to what extent the protocols have been implemented in the past. Over the last 8 years the City has shifted from using a flate rate fee structure to installing meters and charging based on quantity used. This has resulted in peak use reduction of approximately 50%. Despite efficiencies gained in recent years water usage is approaching the maximum capacity of the water supply system.	Ongoing	Location and funding for development of alternative water storage areas. Funding and staff time to refine water conservation plan. May not be sufficient public or political interest in implementing water conservation strategies or incentives.
Lower Columbia	Youngs Bay	Dewatering of portions of Lewis and Clark River due to City of Warrenton water withdrawals impairs the movement of winter steelhead fry and summer parr.	_	_	X	X	_	X	_	_	Lower Columbia River Estuary Partnership	Comprehensive Conservation and Management Plan	The Lower Columbia River Estuary Comprehensive Conservation and Management Plan (LCREP 1999) identifies 43 actions that focus on preventing further habitat loss, restoring habitats, providing education and coordination among governments, and improving water quality. Twelve actions address habitat loss and modification and the impacts of land use activities. Fifteen actions call for increased education and improved consistency and coordination among government agencies with responsibility for the lower river and estuary. The sixteen actions that address conventional and toxic pollutants involve the regulatory authority of a variety of local, state, and federal agencies. Some actions reflect existing activities, some call for increased activity. The Estuary Partnership's primary role will be to monitor the progress of the responsible entities to ensure the actions are implemented and the goals are met.	Ongoing	Unclear
Lower Columbia	Youngs Bay	Dewatering of portions of Lewis and Clark River due to City of Warrenton water withdrawals impairs the movement of winter steelhead fry and summer parr.	_	_	X	X	_	_	_	_	City of Warrenton	Municipal Water Program	The City of Warrenton has developed a water conservation and restriction protocol for predicted periods of water supply shortages. It is unclear if this has been adopted as ordinance or to what extent the protocols have been implemented in the past. Over the last 8 years the City has shifted from using a flate rate fee structure to installing meters and charging based on quantity used. This has resulted in peak use reduction of approximately 50%. Despite efficiencies gained in recent years water usage is approaching the maximum capacity of the water supply system.	Ongoing	Location and funding for development of alternative water storage areas. Funding and staff time to refine water conservation plan. May not be sufficient public or political interest in implementing water conservation strategies or incentives.
Lower Columbia	Youngs Bay	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	_	_	_	_	_	X	_	_	Weyerhaeuser Company	Road Inventory Project	Weyerhaeuser Company has an ongoing voluntary program to survey and inventory forest roads, identify problem areas, and plan repairs as needed to prevent road failures and maintain stream water quality. Weyerhaeuser has decommissioned many roads where water quality was a concern. Weyerhaeuser has Oregon Plan targets for completion of road related repairs, replacements, or removals by approximately 2012. To complete this goal, they schedule about 30 Type F crossings per year to be addressed.	Ongoing	None
Lower Columbia	Youngs Bay	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	_	X	_	X	_	X	_	_	Weyerhaeuser Company	Voluntary Wildlife Tree Retention and Riparian Buffers	Weyerhaeuser's program is to follow the Oregom Plan measures ODF 3.2, 3.3, 3.4, and 3.6 in relation to leaving extra trees, basal area, or snags. Along core salmon streams, they follow these measures. That usually involves leaving 75% of any excess basal area in RMA's that could be harvested according to the FPA. Usually that also entails placing wildlife trees in specific locations, like streams, unstable slopes, small wetlands, etc.		

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Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
Lower Columbia	Youngs Bay	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	_	X	_	_	X	_	_	_	Lower Columbia River Estuary Partnership	Comprehensive Conservation and Management Plan	The Lower Columbia River Estuary Comprehensive Conservation and Management Plan (LCREP 1999) identifies 43 actions that focus on preventing further habitat loss, restoring habitats, providing education and coordination among governments, and improving water quality. Twelve actions address habitat loss and modification and the impacts of land use activities. Fifteen actions call for increased education and improved consistency and coordination among government agencies with responsibility for the lower river and estuary. The sixteen actions that address conventional and toxic pollutants involve the regulatory authority of a variety of local, state, and federal agencies. Some actions reflect existing activities, some call for increased activity. The Estuary Partnership's primary role will be to monitor the progress of the responsible entities to ensure the actions are implemented and the goals are met.	Ongoing	Unclear
Lower Columbia	Youngs Bay	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region. This includes projects to increase instream habitat complexity by adding large wood or boulders, enhancing riparian areas by protection or planting, and correcting fish passage problems.	Ongoing	Staffing to meet demands for restoration projects and technical assistance, funds to implement projects.
Lower Columbia	Youngs Bay	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat. This position directly identifies actions to minimize, mitigate, or eliminate negative impacts to water quality including riparian degradation.	Ongoing.	Funding.
Lower Columbia	Youngs Bay	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	X	X	X	X	X	X	X	X	ODF	Northwest Oregon State Forests Management Plan	The Northwest Oregon State Forests Management Plan (FMP) includes riparian and aquatic strategies that address the range of desired conditions along the stream network. The goal of management along fish-bearing streams and larger non-fish-bearing streams is to grow and retain vegetation so that, over time, riparian and aquatic habitat conditions become similar to those associated with mature forest stands. Along small non-fish-bearing streams, the goal of riparian vegeation management is to grow and retain vegetation sufficient to support imporant functions and processes within the various streams, and to contribute to achieving properly functioning conditions in downstream fish-bearing waters. The FMP specifies wider riparian management areas and greater tree retention than specified under the Forest Practices Act (FPA). This is intended to provide ample shade for streams and to facilitate the eventual development of large-diameter trees near streams. This also provides for filtration of sediment from upslope sources. Additionally, the FMP provides strategies to minimize human-caused sediment delivery from steep slopes and road-related sources.	Ongoing	Staffing and funding
Lower Columbia	Youngs Bay	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	X	X	_	_	X	X	_	X	Clatsop County SWCD	Conservation Planning Program	Clatsop SWCD works with landowners and agricultural producers to craft Conservation Plans. The plans follow a strict model established by the Natural Resource Conservation Service. The plans are a tool to assist landowners in reaching a level of natural resource sustainability - soil, water, air, plants, and animals (both wild and domestic). Riparian areas and upland wildlife habitat are an integral part of the program. Improvements in soil conservation on agricultural lands help reduce input of fine sediment into local waterways.	Ongoing	Funding, landowner participation
Lower Columbia	Youngs Bay	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	_	X	_	_	X	X	_	_	Clatsop County	Native Plant Program	Clatsop County Public Works Department maintains native plant sites along their right-of-ways that allow restoration groups (watershed councils, SWCD's, etc.) to transplant native seedlings to locations that benefit streams and riparian areas. Native plants from this program are used in riparian restoration projects that promote banks stability, streamside shading, and large wood recruitment potential.	Ongoing	None
Lower Columbia	Youngs Bay	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	X	X	_	_	_	X	_	X	Clatsop County	Clatsop County Land and Water Development Use Ordinance and Standards	Clatsop County has developed land and water development ordinance and standards to protect water quality, fish and wildlife habitat, and ecosystem function. Standards include protection of riparian vegetation, Columbia River estuary shoreland and aquatic use, and erosion erosion control. Riparian protection standards (S4.500) apply to lakes, reservoirs, and river segments, as well as associated emergent wetlands. Standards generally require that development occur at least 50-feet outside of these areas and that riparian vegetation within these areas be maintained.	Ongoing	Funding
Lower Columbia	Youngs Bay	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	X	X	X	_	X	X	_	_	Columbia River Estuary Studies Task Force (CREST)	CREST Watershed Council Support	CREST staff provides direct technical and administrative support to the Nicolai-Wickiup Watershed Council, Young's Bay Watershed Council, Skipanon Watershed Council, and the Ecola Creek Watershed Council. Activities include assistance with completing watershed assessments and action plans, identifying factors limiting salmon production, and undertaking restoration projects throughout the watersheds.	Ongoing	Position is supported largely through grant funds. Future funding is uncertain.
Lower Columbia	Youngs Bay	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	X	X	X	X	X	X	X	X	Young's Bay Watershed Council	Watershed Council Activities	Watershed Council members are focused on the declines in salmon and trout, water quality, water quantity and environmental monitoring. Limited population information is known about salmon and trout in the Young's Bay Watershed. Historically, fall chinook, coho, steelhead, sea run cutthroat and chum found their way into the rivers to spawn. Today, most populations are in decline, with chum no longer in the basin. A water quality monitoring program was established by the watershed coucil recently to gather baseline information throughout the year about the parameters: Dissolved Oxygen, pH, flow, turbidity, conductivity / salinity and temperature. Six temperature sites are located around the basin, primarily on the Lewis and Clark River. All water quality parameters are monitored at three of these sites. This data will be incorporated into the Young's Bay Watershed Assessment (Bischoff et al 2000b) and will be used to inform and educate local residents on the connections between land use and water quality. The City of Warrenton, located in the adjacent watershed, is one of the fastest growing communities in Oregon and has municipal water rights to the Young's Bay Basin (specifically	Ongoing	Funding

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Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
													the Lewis and Clark River). Concerns surrounding this water right and the current and future draws from the River are of great concern to the council. The watershed council continues to implement fish passage and habitat restoration projects in the Young's Bay watershed. The council recently sponsored an assessment of coho winter habitat in the watershed that included a prioritized list for restoration opportunities (Boswell 2005). The council has also developed an action plan to begin to focus restoration efforts on key watershed issues (Skipanon, Young's Bay, Nicolai-Wickiup Watersheds Action Plan 2003).		
Lower Columbia	Youngs Bay	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	X	X	X	X	X	X	X	X	Skipanon Watershed Council	Watershed Council Activities	Watershed Council Members are focused on salmon, water quality and quality of life concerns. Specific concerns regarding impacts to water quality are: flow modification, temperature, nutrients and aquatic weeds. The waters of interest include both the surface waters of stream systems / wetlands as well as the many lakes within the watershed. There is also concern about protecting the Clatsop Plains aquifer. The City of Warrenton, located within the watershed is one of the fastest growing communities in Oregon. Concerns surrounding commercial and residential development within the flood plain include the filling of wetlands and the subsequent losses of wetland functions. Especially of interest are the wetland functions: fish and wildlife habitat, water quality, hydrologic control, and aesthetic quality. The Oregon Department of Environmental Quality has 303D listed the Skipanon River (dissolved oxygen) and Cullaby Lake (aquatic weeds) in the 1998 state listings. Waterbodies with possible problems on DEQ's 1998 "Need More Data" list include Cullaby Lake (nutrients), Skipanon River (flow modification, nutrients, algae or weeds and temperature) and Smith Lake (nutrients). DEQ has noted, as well as preliminary watershed assessment work reveals ~ a limited data set relative to baseline water quality parameters for the Skipanon River. Skipanon River Watershed Council, Smith Lake Neighborhood Association members and Cullaby Lake residents are gathering baseline ambient water quality information about the surface waters of the Skipanon River, Smith Lake and Cullaby Lake. The data collected will be used by Skipanon River Watershed Council members, state agency staff and Smith Lake Neighborhood Association members to characterize current water quality conditions, identify specific water quality problem areas, and begin enhancement and restoration projects. The data will also be incorporated into the Skipanon Watershed Assessment (Bischoff et al. 2000a). The Watershed Council and Neighborhood Association will also use the data to educate and inform local residents on the connections between land use and water quality. The council has also developed an action plan to begin to focus restoration efforts on key watershed issues (Skipanon, Young's Bay, Nicolai-Wickiup Watersheds Action Plan 2003)	Ongoing	Funding
Lower Columbia	Youngs Bay	Fine sediment inputs from variety of sources that impacts the survival of coho, fall Chinook, chum, and steelhead eggs and alevins.	X	X	X	X	X	X	X	_	ODFW	North Coast Watershed Council Liaison	The ODFW Watershed Council Liaison position provides technical support to watershed councils involved in assessing watershed conditions and conducting restoration projects designed to address watershed needs. Among those projects are actions that specifically address conditions contributing to increased fine sediments in streams. The North Coast Watershed Council Liaison position, located in Tillamook, provides technical support to the Young's Bay Watershed Council and Skipanon Watershed Council, as well as six other watershed councils located in the North Coast basin.	This position is funded biennially.	Limited staff time available to provide technical support
Lower Columbia	Youngs Bay	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	X	X	X	X	X	X	X	X	Skipanon Watershed Council	Watershed Council Activities	Watershed Council Members are focused on salmon, water quality and quality of life concerns. Specific concerns regarding impacts to water quality are: flow modification, temperature, nutrients and aquatic weeds. The waters of interest include both the surface waters of stream systems / wetlands as well as the many lakes within the watershed. There is also concern about protecting the Clatsop Plains aquifer. The City of Warrenton, located within the watershed is one of the fastest growing communities in Oregon. Concerns surrounding commercial and residential development within the flood plain include the filling of wetlands and the subsequent losses of wetland functions. Especially of interest are the wetland functions: fish and wildlife habitat, water quality, hydrologic control, and aesthetic quality. The Oregon Department of Environmental Quality has 303D listed the Skipanon River (dissolved oxygen) and Cullaby Lake (aquatic weeds) in the 1998 state listings. Waterbodies with possible problems on DEQ's 1998 "Need More Data" list include Cullaby Lake (nutrients), Skipanon River (flow modification, nutrients, algae or weeds and temperature) and Smith Lake (nutrients). DEQ has noted, as well as preliminary watershed assessment work reveals ~ a limited data set relative to baseline water quality parameters for the Skipanon River. Skipanon River Watershed Council, Smith Lake Neighborhood Association members and Cullaby Lake residents are gathering baseline ambient water quality information about the surface waters of the Skipanon River, Smith Lake and Cullaby Lake. The data collected will be used by Skipanon River Watershed Council members, state agency staff and Smith Lake Neighborhood Association members to characterize current water quality conditions, identify specific water quality problem areas, and begin enhancement and restoration projects. The data will also be incorporated into the Skipanon Watershed Assessment (Bischoff et al. 2000a). The Watershed Council and Neighborhood Association will also use the data to educate and inform local residents on the connections between land use and water quality. The council has also developed an action plan to begin to focus restoration efforts on key watershed issues (Skipanon, Young's Bay, Nicolai-Wickiup Watersheds Action Plan 2003).	Ongoing	Funding
Lower Columbia	Youngs Bay	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	_	X	_	X	_	X	_	_	Weyerhaeuser Company	Voluntary Wildlife Tree Retention and Riparian Buffers	Weyerhaeuser's program is to follow the Oregom Plan measures ODF 3.2, 3.3, 3.4, and 3.6 in relation to leaving extra trees, basal area, or snags. Along core salmon streams, they follow these measures. That usually involves leaving 75% of any excess basal area in RMA's that could be harvested according to the FPA. Usually that also entails placing wildlife trees in specific locations, like streams, unstable slopes, small wetlands, etc.		

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet) 1	2	3	4	5	6	7	8	Agency	Program	Description	Timeline	Constraints
Lower Columbia	Youngs Bay	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	_	X	_	_	_	X	_	_	Lower Columbia River Estuary Partnership	Comprehensive Conservation and Management Plan	The Lower Columbia River Estuary Comprehensive Conservation and Management Plan (LCREP 1999) identifies 43 actions that focus on preventing further habitat loss, restoring habitats, providing education and coordination among governments, and improving water quality. Twelve actions address habitat loss and modification and the impacts of land use activities. Fifteen actions call for increased education and improved consistency and coordination among government agencies with responsibility for the lower river and estuary. The sixteen actions that address conventional and toxic pollutants involve the regulatory authority of a variety of local, state, and federal agencies. Some actions reflect existing activities, some call for increased activity. The Estuary Partnership's primary role will be to monitor the progress of the responsible entities to ensure the actions are implemented and the goals are met.	Ongoing	Unclear
Lower Columbia	Youngs Bay	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	_	X	_	_	X	X	_	_	Clatsop County	Native Plant Program	Clatsop County Public Works Department maintains native plant sites along their right-of-ways that allow restoration groups (waershed councils, SWCD's, etc.) to transplant native seedlings to locations that benefit streams and riparian areas. Native plants from this program are used in riparian restoration projects that promote banks stability, streamside shading, and large wood recruitment potential.	Ongoing	None
Lower Columbia	Youngs Bay	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	X	X	_	_	_	X	_	X	Clatsop County	Clatsop County Land and Water Development Use Ordinance and Standards	Clatsop County has developed land and water development ordinance and standards to protect water quality, fish and wildlife habitat, and ecosystem function. Standards include protection of riparian vegetation, Columbia River estuary shoreland and aquatic use, and erosion erosion control. Riparian protection standards (S4.500) apply to lakes, reservoirs, and river segments, as well as associated emergent wetlands. Standards generally require that development occur at least 50-feet outside of these areas and that riparian vegetation within these areas be maintained.	Ongoing	Funding
Lower Columbia	Youngs Bay	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region. This includes projects to increase instream habitat complexity by adding large wood or boulders, enhancing riparian areas by protection or planting, and correcting fish passage problems.	Ongoing	Staffing to meet demands for restoration projects and technical assistance, funds to implement projects.
Lower Columbia	Youngs Bay	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat. This position directly identifies actions to minimize, mitigate, or eliminate negative impacts to water quality including riparian degradation.	Ongoing.	Funding.
Lower Columbia	Youngs Bay	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	X	X	X	X	X	X	X	_	ODFW	North Coast Watershed Council Liaison	The ODFW Watershed Council Liaison position provides technical support to watershed councils involved in assessing watershed conditions and conducting restoration projects designed to address watershed needs. Among those projects are actions that specifically address riparian enhancement. The North Coast Watershed Council Liaison position, located in Tillamook, provides technical support to the Young's Bay Watershed Council and Skipanon Watershed Council, as well as six other watershed councils located in the North Coast basin.	This position is funded biennially.	Limited staff time available to provide technical support
Lower Columbia	Youngs Bay	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	X	X	X	X	X	X	X	X	ODF	Northwest Oregon State Forests Management Plan	The Northwest Oregon State Forests Management Plan (FMP) includes riparian and aquatic strategies that address the range of desired conditions along the stream network. The goal of management along fish-bearing streams and larger non-fish-bearing streams is to grow and retain vegetation so that, over time, riparian and aquatic habitat conditions become similar to those associated with mature forest stands. Along small non-fish-bearing streams, the goal of riparian vegeation management is to grow and retain vegetation sufficient to support imporant functions and processes within the various streams, and to contribute to achieving properly functioning conditions in downstream fish-bearing waters. The FMP specifies wider riparian management areas and greater tree retention than specified under the Forest Practices Act (FPA). This is intended to provide ample shade for streams and to facilitate the eventual development of large-diameter trees near streams. This also provides for filtration of sediment from upslope sources. Additionally, the FMP provides strategies to minimize human-caused sediment delivery from steep slopes and road-related sources.	Ongoing	Staffing and funding
Lower Columbia	Youngs Bay	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	_	X	_	_	_	_	_	_	Clatsop County SWCD	Noxious Weed Control Program	Clatsop SWCD is the lead county agency for noxious weed control. Much effort has been placed on knotweed eradication funded by non-profit, state, and private entities. Two herbicide applicators currently work full-time from May through October. They operate under state licenses. Clatsop SWCD works under an umbrella organization called the North Coast Weed Management Area Committee made up of representatives of watershed councils; state, county and federal agencies; and private stakeholders. Eradication of noxious and invasive weeds in riparian areas promotes re-etablishment of native, shade producing species.	Ongoing	Funding, landowner participation
Lower Columbia	Youngs Bay	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	X	X	X	_	X	X	_	_	Columbia River Estuary Studies Task Force (CREST)	CREST Watershed Council Support	CREST staff provides direct technical and administrative support to the Nicolai-Wickiup Watershed Council, Young's Bay Watershed Council, Skipanon Watershed Council, and the Ecola Creek Watershed Council. Activities include assistance with completing watershed assessments and action plans, identifying factors limiting salmon production, and undertaking restoration projects throughout the watersheds.	Ongoing	Position is supported largely through grant funds. Future funding is uncertain.

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet)								Agency	Program	Description	Timeline	Constraints
			1	2	3	4	5	6	7	8					
Lower Columbia	Youngs Bay	High water temperatures due to degraded riparian conditions result in increased stress and mortality of coho summer parr, steelhead fry and summer parr, and potentially fall chinook eggs.	X	X	X	X	X	X	X	X	Young's Bay Watershed Council	Watershed Council Activities	Watershed Council members are focused on the declines in salmon and trout, water quality, water quantity and environmental monitoring. Limited population information is known about salmon and trout in the Young's Bay Watershed. Historically, fall chinook, coho, steelhead, sea run cutthroat and chum found their way into the rivers to spawn. Today, most populations are in decline, with chum no longer in the basin. A water quality monitoring program was established by the watershed coucil recently to gather baseline information throughout the year about the parameters: Dissolved Oxygen, pH, flow, turbidity, conductivity / salinity and temperature. Six temperature sites are located around the basin, primarily on the Lewis and Clark River. All water quality parameters are monitored at three of these sites. This data will be incorporated into the Young's Bay Watershed Assessment (Bischoff et al 2000b) and will be used to inform and educate local residents on the connections between land use and water quality. The City of Warrenton, located in the adjacent watershed, is one of the fastest growing communities in Oregon and has municipal water rights to the Young's Bay Basin (specifically the Lewis and Clark River). Concerns surrounding this water right and the current and future draws from the River are of great concern to the council. The watershed council continues to implement fish passage and habitat restoration projects in the Young's Bay watershed. The council recently sponsored an assessment of coho winter habitat in the watershed that included a prioritized list for restoration opportunities (Boswell 2005). The council has also developed an action plan to begin to focus restoration efforts on key watershed issues (Skipanon, Young's Bay, Nicolai-Wickiup Watersheds Action Plan 2003).	Ongoing	Funding
Lower Columbia	Youngs Bay	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	X	X	X	X	X	X	X	X	Skipanon Watershed Council	Watershed Council Activities	Watershed Council Members are focused on salmon, water quality and quality of life concerns. Specific concerns regarding impacts to water quality are: flow modification, temperature, nutrients and aquatic weeds. The waters of interest include both the surface waters of stream systems / wetlands as well as the many lakes within the watershed. There is also concern about protecting the Clatsop Plains aquifer. The City of Warrenton, located within the watershed is one of the fastest growing communities in Oregon. Concerns surrounding commercial and residential development within the flood plain include the filling of wetlands and the subsequent losses of wetland functions. Especially of interest are the wetland functions: fish and wildlife habitat, water quality, hydrologic control, and aesthetic quality. The Oregon Department of Environmental Quality has 303D listed the Skipanon River (dissolved oxygen) and Cullaby Lake (aquatic weeds) in the 1998 state listings. Waterbodies with possible problems on DEQ's 1998 "Need More Data" list include Cullaby Lake (nutrients), Skipanon River (flow modification, nutrients, algae or weeds and temperature) and Smith Lake (nutrients). DEQ has noted, as well as preliminary watershed assessment work reveals ~ a limited data set relative to baseline water quality parameters for the Skipanon River. Skipanon River Watershed Council, Smith Lake Neighborhood Association members and Cullaby Lake residents are gathering baseline ambient water quality information about the surface waters of the Skipanon River, Smith Lake and Cullaby Lake. The data collected will be used by Skipanon River Watershed Council members, state agency staff and Smith Lake Neighborhood Association members to characterize current water quality conditions, identify specific water quality problem areas, and begin enhancement and restoration projects. The data will also be incorporated into the Skipanon Watershed Assessment (Bischoff et al. 2000a). The Watershed Council and Neighborhood Association will also use the data to educate and inform local residents on the connections between land use and water quality. The council has also developed an action plan to begin to focus restoration efforts on key watershed issues (Skipanon, Young's Bay, Nicolai-Wickiup Watersheds Action Plan 2003)	Ongoing	Funding
Lower Columbia	Youngs Bay	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	X	_	_	_	X	_	_	_	Weyerhaeuser Company	In-Stream Enhancement Projects	Since 1995, Weyerhaeuser Company has been actively engaged in conducting instream habitat enhancement projects on their lands in Clatsop and Columbia counties. This program, conducted in partnership with local watershed councils, ODFW and others, enhances instream and floodplain habitat complexity primarily through addition of large woody debris within the range of coho salmon. Weyerhaeuser is a committed partner to the Oregon Plan for Salmon and Watersheds and conducts several instream projects per year in conjunction with active harvest units under the Oregon Plan's voluntary measure ODF 3.5. WeyCo plans to start surveying core salmon streams for density of key LWD and total LWD adjacent to planned harvest areas. If they determine that a core stream is lacking LWD and their aquatic biologist recommends log placement, then the number of projects implemented each year will likely increase.	Ongoing	Funding
Lower Columbia	Youngs Bay	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	_	X	_	X	_	X	_	_	Weyerhaeuser Company	Voluntary Wildlife Tree Retention and Riparian Buffers	Weyerhaeuser's program is to follow the Oregom Plan measures ODF 3.2, 3.3, 3.4, and 3.6 in relation to leaving extra trees, basal area, or snags. Along core salmon streams, they follow these measures. That usually involves leaving 75% of any excess basal area in RMA's that could be harvested according to the FPA. Usually that also entails placing wildlife trees in specific locations, like streams, unstable slopes, small wetlands, etc.		

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet)								Agency	Program	Description	Timeline	Constraints
			1	2	3	4	5	6	7	8					
Lower Columbia	Youngs Bay	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	X	X	_	_	X	_	_	_	Lower Columbia River Estuary Partnership	Comprehensive Conservation and Management Plan	The Lower Columbia River Estuary Comprehensive Conservation and Management Plan (LCREP 1999) identifies 43 actions that focus on preventing further habitat loss, restoring habitats, providing education and coordination among governments, and improving water quality. Twelve actions address habitat loss and modification and the impacts of land use activities. Fifteen actions call for increased education and improved consistency and coordination among government agencies with responsibility for the lower river and estuary. The sixteen actions that address conventional and toxic pollutants involve the regulatory authority of a variety of local, state, and federal agencies. Some actions reflect existing activities, some call for increased activity. The Estuary Partnership's primary role will be to monitor the progress of the responsible entities to ensure the actions are implemented and the goals are met.	Ongoing	Unclear
Lower Columbia	Youngs Bay	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	X	X	_	_	_	X	_	X	Clatsop County	Clatsop County Land and Water Development Use Ordinance and Standards	Clatsop County has developed land and water development ordinance and standards to protect water quality, fish and wildlife habitat, and ecosystem function. Standards include protection of riparian vegetation, Columbia River estuary shoreland and aquatic use, and erosion erosion control. Riparian protection standards (S4.500) apply to lakes, reservoirs, and river segments, as well as associated emergent wetlands. Standards generally require that development occur at least 50-feet outside of these areas and that riparian vegetation within these areas be maintained.	Ongoing	Funding
Lower Columbia	Youngs Bay	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region. This includes projects to increase instream habitat complexity by adding large wood or boulders, enhancing riparian areas by protection or planting, and correcting fish passage problems.	Ongoing	staffing to meet demands for restoration projects and technical assistance, funds to implement projects.
Lower Columbia	Youngs Bay	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat. This position directly identifies actions to minimize, mitigate, or eliminate negative impacts to habitat simplification.	Ongoing.	Funding.
Lower Columbia	Youngs Bay	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	_	X	_	_	X	X	_	_	Clatsop County	Native Plant Program	Clatsop County Public Works Department maintains native plant sites along their right-of-ways that allow restoration groups (wtaershed councils, SWCD's, etc.) to transplant native seedlings to locations that benefit streams and riparian areas. Native plants from this program are used in riparian restoration projects that promote banks stability, streamside shading, and large wood recruitment potential.	Ongoing	None
Lower Columbia	Youngs Bay	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	X	X	X	X	X	X	X	_	ODFW	North Coast Watershed Council Liaison	The ODFW Watershed Council Liaison position provides technical support to watershed councils involved in assessing watershed conditions and conducting restoration projects designed to address watershed needs. Among those projects are actions that specifically address habitat complexity in streams. The North Coast Watershed Council Liaison position, located in Tillamook, provides technical support to the Young's Bay Watershed Council and Skipanon Watershed Council, as well as six other watershed councils located in the North Coast basin.	This position is funded biennially.	Limited staff time available to provide technical support
Lower Columbia	Youngs Bay	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	X	X	X	_	X	X	X	X	ODF	Northwest Oregon State Forests Management Plan	The Northwest Oregon State Forests Management Plan (FMP) includes riparian and aquatic strategies that address the range of desired conditions along the stream network. The goal of management along fish-bearing streams and larger non-fish-bearing streams is to grow and retain vegetation so that, over time, riparian and aquatic habitat conditions become similar to those associated with mature forest stands. Along small non-fish-bearing streams, the goal of riparian vegeation management is to grow and retain vegetation sufficient to support imporant functions and processes within the various streams, and to contribute to achieving properly functioning conditions in downstream fish-bearing waters. The FMP specifies wider riparian management areas and greater tree retention than specified under the Forest Practices Act (FPA). This is intended to provide ample shade for streams and to facilitate the eventual development of large-diameter trees near streams. This also provides for filtration of sediment from upslope sources. Additionally, the FMP provides strategies to minimize human-caused sediment delivery from steep slopes and road-related sources.	Ongoing	Staffing, funding & permitting process for in-stream work
Lower Columbia	Youngs Bay	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	_	_	_	_	_	_	_	_	ODFW	Habitat Restoration Biologists for Clatsop/Tillamook State Forests	Oregon Department of Fish and Wildlife provides funding for an ODFW position to implement restoration and enhancement projects on ODF lands in the Clatsop and Tillamook state forests. Among these activities are fish passage improvements and instream enhancement projects that contribute to habitat complexity.	Subject to biennial approval	None identified
Lower Columbia	Youngs Bay	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	X	X	_	_	X	X	X	X	Clatsop County SWCD	Habitat Restoration Program	Clatsop Soil and Water Conservation District assists landowners in identifying instream restoration opportunites on their property. Bank stabilization projects promote soil conservation while adding instream complexity in the form of large woody debris. Riparian restoration using native plant species promote future LWD recruitment potentiial.	Ongoing	Funding, landowner participation

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Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet)								Agency	Program	Description	Timeline	Constraints
			1	2	3	4	5	6	7	8					
Lower Columbia	Youngs Bay	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	X	X	X	_	X	X	_	_	Columbia River Estuary Studies Task Force (CREST)	CREST Watershed Council Support	CREST staff provides direct technical and administrative support to the Nicolai-Wickiup Watershed Council, Young's Bay Watershed Council, Skipanon Watershed Council, and the Ecola Creek Watershed Council. Activities include assistance with completing watershed assessments and action plans, identifying factors limiting salmon production, and undertaking restoration projects throughout the watersheds.	Ongoing	Position is supported largely through grant funds. Future funding is uncertain.
Lower Columbia	Youngs Bay	Loss of instream habitat complexity and off channel habitat availability for coho fry and winter parr, chum fry, fall Chinook fry, and steelhead winter parr due to past and/or present land management practices.	X	X	X	X	X	X	X	X	Young's Bay Watershed Council	Watershed Council Activities	Watershed Council members are focused on the declines in salmon and trout, water quality, water quantity and environmental monitoring. Limited population information is known about salmon and trout in the Young's Bay Watershed. Historically, fall chinook, coho, steelhead, sea run cuthroat and chum found their way into the rivers to spawn. Today, most populations are in decline, with chum no longer in the basin. A water quality monitoring program was established by the watershed couicil recently to gather baseline information throughout the year about the parameters: Dissolved Oxygen, pH, flow, turbidity, conductivity / salinity and temperature. Six temperature sites are located around the basin, primarily on the Lewis and Clark River. All water quality parameters are monitored at three of these sites. This data will be incorporated into the Young's Bay Watershed Assessment (Bischoff et al 2000b) and will be used to inform and educate local residents on the connections between land use and water quality. The City of Warrenton, located in the adjacent watershed, is one of the fastest growing communities in Oregon and has municipal water rights to the Young's Bay Basin (specifically the Lewis and Clark River). Concerns surrounding this water right and the current and future draws from the River are of great concern to the council. The watershed council continues to implement fish passage and habitat restoration projects in the Young's Bay watershed. The council recently sponsored an assessment of coho winter habitat in the watershed that included a prioritized list for restoration opportunities (Boswell 2005). The council has also developed an action plan to begin to focus restoration efforts on key watershed issues (Skipanon, Young's Bay, Nicolai-Wickiup Watersheds Action Plan 2003).	Ongoing	Funding
Lower Columbia	Youngs Bay	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	X	X	X	X	X	X	X	X	Young's Bay Watershed Council	Watershed Council Activities	Watershed Council members are focused on the declines in salmon and trout, water quality, water quantity and environmental monitoring. Limited population information is known about salmon and trout in the Young's Bay Watershed. Historically, fall chinook, coho, steelhead, sea run cuthroat and chum found their way into the rivers to spawn. Today, most populations are in decline, with chum no longer in the basin. A water quality monitoring program was established by the watershed couicil recently to gather baseline information throughout the year about the parameters: Dissolved Oxygen, pH, flow, turbidity, conductivity / salinity and temperature. Six temperature sites are located around the basin, primarily on the Lewis and Clark River. All water quality parameters are monitored at three of these sites. This data will be incorporated into the Young's Bay Watershed Assessment (Bischoff et al 2000b) and will be used to inform and educate local residents on the connections between land use and water quality. The City of Warrenton, located in the adjacent watershed, is one of the fastest growing communities in Oregon and has municipal water rights to the Young's Bay Basin (specifically the Lewis and Clark River). Concerns surrounding this water right and the current and future draws from the River are of great concern to the council. The watershed council continues to implement fish passage and habitat restoration projects in the Young's Bay watershed. The council recently sponsored an assessment of coho winter habitat in the watershed that included a prioritized list for restoration opportunities (Boswell 2005). The council has also developed an action plan to begin to focus restoration efforts on key watershed issues (Skipanon, Young's Bay, Nicolai-Wickiup Watersheds Action Plan 2003).	Ongoing	Funding
Lower Columbia	Youngs Bay	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	X	X	X	X	X	X	X	X	Skipanon Watershed Council	Watershed Council Activities	Watershed Council Members are focused on salmon, water quality and quality of life concerns. Specific concerns regarding impacts to water quality are: flow modification, temperature, nutrients and aquatic weeds. The waters of interest include both the surface waters of stream systems / wetlands as well as the many lakes within the watershed. There is also concern about protecting the Clatsop Plains aquifer. The City of Warrenton, located within the watershed is one of the fastest growing communities in Oregon. Concerns surrounding commercial and residential development within the flood plain include the filling of wetlands and the subsequent losses of wetland functions. Especially of interest are the wetland functions: fish and wildlife habitat, water quality, hydrologic control, and aesthetic quality. The Oregon Department of Environmental Quality has 303D listed the Skipanon River (dissolved oxygen) and Cullaby Lake (aquatic weeds) in the 1998 state listings. Waterbodies with possible problems on DEQ's 1998 "Need More Data" list include Cullaby Lake (nutrients), Skipanon River (flow modification, nutrients, algae or weeds and temperature) and Smith Lake (nutrients). DEQ has noted, as well as preliminary watershed assessment work reveals ~ a limited data set relative to baseline water quality parameters for the Skipanon River. Skipanon River Watershed Council, Smith Lake Neighborhood Association members and Cullaby Lake residents are gathering baseline ambient water quality information about the surface waters of the Skipanon River, Smith Lake and Cullaby Lake. The data collected will be used by Skipanon River Watershed Council members, state agency staff and Smith Lake Neighborhood Association members to characterize current water quality conditions, identify specific water quality problem areas, and begin enhancement and restoration projects. The data will also be incorporated into the Skipanon Watershed Assessment (Bischoff et al. 2000a). The Watershed Council and Neighborhood Association will also use the data to educate and inform local residents on the connections between land use and water quality. The council has also developed an action plan to begin to focus restoration efforts on key watershed issues (Skipanon, Young's Bay, Nicolai-Wickiup Watersheds Action Plan 2003).	Ongoing	Funding

Table 17-5. State and Federal Habitat Programs that may Affect Salmon and Steelhead Recovery Efforts in the FCRPS

Recovery_Area	Population	Limiting Factor/Effect on Fish or Habitat	Management Strategies (see "Strategy Description" worksheet)								Agency	Program	Description	Timeline	Constraints
			1	2	3	4	5	6	7	8					
Lower Columbia	Youngs Bay	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	_	_	X	_	_	X	_	_	Weyerhaeuser Company	Culvert Replacement and Fish Passage Improvement Program	Weyerhaeuser Company has been actively engaged in replacing culverts and bridges on their lands to prevent road failures and improve fish passage. Weyerhaeuser is a committed partner to the Oregon Plan for Salmon and Watersheds. On the average, they have addresses about 30 Type F stream crossing barriers each year since about 1999. The rate should be similar at least through 2012. Our goal is to complete the prioritized areas by 2012.	Ongoing	Funding
Lower Columbia	Youngs Bay	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	X	X	X	_	X	X	_	_	Columbia River Estuary Studies Task Force (CREST)	CREST Watershed Council Support	CREST staff provides direct technical and administrative support to the Nicolai-Wickiup Watershed Council, Young's Bay Watershed Council, Skipanon Watershed Council, and the Ecola Creek Watershed Council. Activities include assistance with completing watershed assessments and action plans, identifying factors limiting salmon production, and undertaking restoration projects throughout the watersheds.	Ongoing	Position is supported largely through grant funds. Future funding is uncertain.
Lower Columbia	Youngs Bay	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	X	X	X	X	X	X	X	_	ODFW	Western Oregon Stream Restoration Program	The Western Oregon Stream Restoration Program provides direct technical support to Watershed Councils and private landowners in western Oregon to implement Oregon Plan measures directing the restoration and enhancement of Oregon's salmonid habitats in the region. This includes projects to increase instream habitat complexity by adding large wood or boulders, enhancing riparian areas by protection or planting, and correcting fish passage problems.	Ongoing	Staffing to meet demands for restoration projects and technical assistance, funds to implement projects.
Lower Columbia	Youngs Bay	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	X	X	X	X	X	X	X	_	ODFW	Habitat Protection Biologist	This position functions as a technical consultant to: (1) other state and federal agencies that issue permits or permission for activities that may affect fish and wildlife, or their habitat; (2) local governments that regulate land use; and (3) landowners and other individuals who seek guidance for actions to maintain, protect, enhance, or restore habitat. This position directly identifies actions to minimize, mitigate, or eliminate negative impacts to habitat simplification and artificial obstructions in streams.	Ongoing.	Funding.
Lower Columbia	Youngs Bay	Road crossings and other land use related passage impediments impairs the upstream migration of returing adult chum.	X	X	X	X	X	X	X	_	ODFW	North Coast Watershed Council Liaison	The ODFW Watershed Council Liaison position provides technical support to watershed councils involved in assessing watershed conditions and conducting restoration projects designed to address watershed needs. Among those projects are actions that specifically address fish passage barriers. The North Coast Watershed Council Liaison position, located in Tillamook, provides technical support to the Young's Bay Watershed Council and Skipanon Watershed Council, as well as six other watershed councils located in the North Coast basin.	This position is funded biennially.	Limited staff time available to provide technical support

Table 17-6a. Habitat Management Strategies and Actions for Recovery of Deschutes River Eastside Steelhead Population

The Deschutes River Eastside population includes the Deschutes River from its mouth to Trout Creek and all of the tributaries flowing in from the east side, including Willow Creek above Pelton Dam. The population contains five major spawning areas: Buck Hollow, Bakeoven, Ward/Antelope/Cold, Lower Trout, and Upper Trout; and two minor spawning areas: Macks Canyon and Jones Canyon.

Primary limiting factors: riparian condition, low flow, temperature, habitat diversity, and lack of fish passage.

Primary threats: grazing, roads, residences, and agriculture practices that simplify habitat; irrigation withdrawals; soil tilling, timber harvest, dams and roads.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Protect the highest quality habitats through acquisition or conservation easements.	1-Bakeoven Cr. (mouth to Deep Cr) 1-Buck Hollow Cr (mouth to Macken Canyon) 1-Trout Cr. (Little Trout Cr. to headwaters) 2-Trout Cr. (Degner Cyn to Little Trout Cr.) 2-Deschutes R. (Harris Cr. to Buck Hollow Cr.) 2-Ward Cr. (mouth to Pole Cr.) 2-Deep Cr. (mouth to Cottonwood Cr)	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing	Overgrazing, channelization, stream bank armoring, agricultural practices, fire suppression,	Abundance, productivity	All	Protecting functioning floodplains and channels that are in balance with their ability to transport water and sediment is identified as one of the highest priorities in the Subbasin Plan. Wild and scenic protection for Deschutes in place.
Protect and conserve rare and unique functioning habitats	1-MiSA's (Seasonal tributaries) 2-Trout Cr. (mouth to Willowdale)	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing	All	Abundance, productivity	All	Seasonal spawning tributaries provide habitat for unique life history trait that utilize seasonal habitats with age 0 migration into Deschutes.
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	1-all MaSA	All factors	All	Abundance, productivity	All	
Develop new and manage existing habitat Cooperative Agreements	Trout Cr. (mouth to headwaters)	Degraded floodplain, channel structure, riparian areas	All	Abundance, productivity	All	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Protect the highest quality habitats through acquisition or conservation easements.	CTWSRO, PGE, DRC, DBLT, NGOs, ODFW, SWCD, USDA FSA	Ongoing	High dispersal downstream	Immediate	Variable	High
Protect and conserve rare and unique functioning habitats	Land trusts, CTWSRO, ODFW, SWCD, NGOs, USFS, PGE,	Ongoing		Immediate	Immediate	High
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	SWCD, USFS, private landowners, ODA, NRCS, CTWSRO, watershed councils, BLM, counties		All MaSAs	Long term	5-15 years	High
Adopt and manage Cooperative Agreements	ODFW	Ongoing	High dispersal downstream	Agreements are for 10-15 years	Immediate	High, although not in perpetuity

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
USFS and BLM	Wilderness Areas, Wilderness Study Areas, Wild and Scenic River corridors, Special Management designations PacFish/Infish	Federally owned lands.	Uncertain	
ODFW/BPA	Trout Creek Fish Habitat Restoration Project	Private lands in the Trout Creek Subbasin	No	Yes, additional lands can be enrolled into the program. Conservation agreements are for only 10-15 years length.
USDA FSA/SWCDs	CREP/CRP	Private agricultural lands throughout MaSA	No	Additional lands can be enrolled, and programs are not permanent in duration.
CTWSRO	Integrated Resources Mgmt Plan	Reservation lands	Yes	Yes, adaptive 10-year management plans
CTWSRO	Watershed Maintenance/ Riparian Fence Program	Reservation lands	No	Yes, continue to expand riparian fence network and maintenance of those fence lines
ODA/SWCDs	Agricultural Water Quality Management Plan	Private agricultural lands throughout MaSA		See Oregon State Agencie's programmatic review.
Local Government	County Planning and Zoning	Private lands throughout MaSA	Uncertain	
PGE	Pelton Habitat Mitigation Fund	MaSA	Uncertain	Newly implemented program, results not yet available.
NGOs (Deschutes Basin Land Trust, Nature Conservancy, Deschutes River Conservancy, Oregon Water Trust etc.)	Lease or purchase of land or instream water rights	Private lands throughout MaSA	No	Limited opportunities arise, but programs can be expanded when opportunities become available.
Watershed Councils	Various Watershed Councils	MaSA	No	Programs can be expanded to included additional interested parties in watershed restoration and protection.

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

Existing forest plans include special management designations for riparian habitat conservation areas (RHCA's). The forest plans and BLM plans have been amended by PACFISH and INFISH, both of which require 300-foot buffers on any fish bearing stream for tree removal, as well as specific guidelines for livestock grazing and riparian vegetation use. Compliance with the 300-foot buffer for timber harvest operations has been very good; however the interpretation of the grazing guidelines has been inconsistent between National Forests.

Farm Service Agency (FSA) programs that protect riparian areas and upland watersheds include the Conservation Reserve Program (CRP) and the Conservation Reserve Enhancement Program (CREP). The CRP program pays landowners not to farm highly erodible soils and the CREP program pays landowners for setting riparian corridors aside from grazing and farming. The long term effectiveness of both programs is limited by the relatively short duration of the contracts which ranges from 10 to 15 years.

ODA's Agricultural Water Quality Management Plan is designed to prevent and control water pollution from agricultural activities and soil erosion on non-Federal and non-Tribal Trust or Reservation lands. ODA relies on voluntary measures to protect water quality, but also enforces pollution and streamside vegetation requirements.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain unimpaired passage and connectivity.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Replace or remove barriers blocking passage including dams, road culverts, irrigation structures, infiltration galleries	1-Bakeoven (road crossing at Stag Canyon) 1-Mud Springs Cr. (at RR culvert in section 15, above Gateway) 1-Hay Creek (new channel near mouth) 2-Antelope Cr. (mouth to headwaters) 2-Trout Cr. (mouth to Clover)	Impaired fish passage	Dams, culverts, instream structures	Abundance, spatial structure, productivity	Primarily adults and 0+juveniles	Adult passage is the first priority, juvenile passage is secondary. Cumulative effects of anthropogenic factors, increase temperatures and reduce streamflow impair juvenile passage on Trout Creek downstream from Forest boundary.
Maintain irrigation diversions and screens	1-Where diversions exist throughout MaSA	Impaired fish passage	Irrigation diversions	Abundance, spatial structure, productivity	Primarily juveniles, but also adults at facilities with ladders.	All known diversion are maintained and generally meet screening criteria.
Provide screening at 100% of irrigation diversions	1-unscreened diversions (all known diversions screened, need comprehensive survey to identify additional needs)	Impaired fish passage	Irrigation diversions	Abundance, spatial structure, productivity	Juveniles	All known legal diversions screened. Additional surveys are needed in Trout Creek subbasin to identify additional diversions.

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Remove/replace barriers blocking passage including dams, road culverts and irrigation structures	CTWSRO, USFS, BLM, SWCDs, watershed councils, NRCS	Ongoing	Access between upstream and downstream habitats	Immediate	Immediate	High
Maintain irrigation diversions and screens	ODFW	Ongoing	Diversions basinwide	Based on funding	Immediate	High
Provide screening at 100% of irrigation diversions	ODFW Fish Passage and Screening	Ongoing	Access between upstream and downstream habitats	Immediate as need is identified	Immediate	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
ODFW	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	Yes, project has made significant improvement in overall fish habitat, needs to be expanded to other properties in basin. Recent large scale stream rehabilitation projects conducted on properties on Trout Creek have been successful at removing berms, restoring stream function, and creating additional habitat.
Jefferson SWCD	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	Yes, this companion project to the ODFW Habitat Project has made significant improvement is overall fish habitat, needs to be expanded to other properties in basin. Project has assisted in several infiltration gallery projects and other passage issues.
ODFW	Fish Passage/Screening	MaSA	No	The program completes a minimum of one project per year, but is dependent upon landowner cooperation and limited funding.
PGE/CTWSRO	Pelton Fish Passage Plan		No	Program not implemented. 50-year time frame.
CTWSRO/ODFW	Salmon and Steelhead Reintroduction Plan		No	Yes, adaptive plan over life of FERC license
ODOT	Culvert replacement or retrofit			See Oregon State Agencie's programmatic review.
CTWSRO	IRMP	Reservation Lands	Yes	Yes, adaptive management plan
CTWSRO, USFS, and BLM	Culvert replacement		No	Yes
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				

Strategy 3. Restore floodplain connectivity and function and maintain unimpaired connectivity and function.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Reconnect floodplains to channels	1-Trout Cr. (Little Trout Cr. To Clover Creek) 1-Trout Cr. (sections from mouth to Antelope Creek) 1-Antelope Cr. (mouth to headwaters) 1-Hay Cr. (mouth to headwaters) 2-Bakeoven Cr. (mouth to headwaters) 2-Buck Hollow Cr (mouth to headwaters)	Degraded floodplain, degraded riparian area, channel structure	Removal of interaction between river and floodplain, grazing, agricultural use, loss of beaver dams	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	Floodplains and channels that are in balance are essential for proper stream function. Bakeoven and Buck Hollow Creeks effected primarily from livestock grazing.
Reconnect side channels and off-channel habitats to stream channels	1-Trout Cr. (Little Trout Cr. To Clover Creek) 1-Trout Cr. (sections from mouth to Antelope Creek) 1-Antelope Cr. (mouth to headwaters) 1-Hay Cr. (mouth to headwaters) 2-Bakeoven Cr. (mouth to headwaters) 2-Buck Hollow Cr (mouth to headwaters)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	Off channel habitat important juvenile rearing habitat. Bakeoven and Buck Hollow Creeks effected primarily from livestock grazing.
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	1-Throughout MaSA	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat	Abundance, productivity	All	As riparian areas recovery beaver recolonization occurs naturally.

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Reconnect floodplain habitats	CTWSRO, ODFW, watershed council, BLM, SWCDs, USFS, PGE, counties	Ongoing	High dispersal downstream from site	Long term	5-15 years	High
Reconnect side channels and off-channel habitats to stream channels	CTWSRO, ODFW, watershed council, SWCD, USFS, BLM, PGE	Ongoing	High dispersal downstream from site	Long term	5-15 years	High
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	CTWSRO, ODFW, USFS, BLM	Ongoing	Basinwide	Long term	Within 5 years	Mod., high

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, no, uncertain)	Needs Expansion
Sherman and Wasco SWCD, Landowners, Oregon State agencies.	Bakeoven and Buck Hollow Watershed Restoration Projects	Bakeoven and Buck Hollow Creek	Uncertain	Project is underway in Bakeoven watershed and is planned over a 10-year period. Project is transitioning to effectiveness monitoring.
NRCS,SWCD, USDA FSA, Private Landowners	CREP/CRP	Private lands throughout MaSA	No	An effective program that could be expanded to more landowners.
BLM Prineville District	Various range and upland restoration projects.	BLM lands throughout MaSA	Uncertain	
ODFW	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	Yes, project has made significant improvement is overall fish habitat, needs to be expanded to other properties in basin.
Jefferson SWCD	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	Yes, this companion project to the ODFW Habitat Project has made significant improvement is overall fish habitat, needs to be expanded to other properties in basin.
PGE/CTWSRO	Relicensing of Pelton/Round Butte Complex	Throughout MaSA	No	Habitat restoration and protection projects to mitigate effects of hydro projects. Additional opportunities exist.
CTWSRO	Various projects	Reservation lands	No	Yes, improving riparian conditions, grazing remains problematic in some areas.
BLM, Oregon State Parks, CTWSRO	Wild and Scenic Rivers	Deschutes from mouth to Trout Creek		See Oregon State Agencie's programmatic review.
ODA/SWCD	Ag WQ Management Program	Private lands		See Oregon State Agencie's programmatic review.
USFS	Stream Restoration Program (PacFish/Infish)	Forest Lands	Uncertain	Effectiveness of program unproven.

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

The Deschutes subbasin plan (NPCC 2004) inventory notes that Buck Hollow "runs clean", intermittent tributaries have become perennial, 95% of riparian areas are in riparian pasture management or exclusion, and upland range conditions are vastly improved. Opportunities may exist to increase summer flows, reduce temperature, and decrease sedimentation through water development (Lower Deschutes River Management Plan). CRP in uplands and riparian protection have and will provide short term benefits, but instream physical habitat improvements may not accrue until the longer term. The upper third of Buck Hollow remains a restoration priority. The future status of habitat benefits accruing from CRP enrollments could be unknown, since economic decisions by the landowners and government entities involved will influence the area under agreements. None of the Buck Hollow watershed is in a "protected" status.

Planning and implementation of restoration and protection measures for Bakeoven Creek are similar to the Buck Hollow project, but began more recently. A draft watershed assessment has been completed and includes an action plan with a 10-year time frame (Clark and Lamson 2005). Many benefits to steelhead have accrued through changes in upland and riparian management plans since the 1987 Farm Bill. While watershed function continues to improve, habitat complexity will increase. However some riparian areas are still unbuffered through fences or grazing management plans. Where riparian buffers do exist, habitat complexity will develop over the longer term if buffers are maintained. Some benefits from trees will be slow to accrue because their size is relatively small, and only when larger age classes are present, will the biological and physical results of large wood recruitment be realized.

Strategy 4. Restore degraded channel structure and complexity and maintain unimpaired structure and complexity.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Restore natural channel form, includes berm and levee removal	1-Trout Cr. (Little Trout Cr. To Clover Creek) 1-Trout Cr. (sections from mouth to Antelope Creek) 1-Antelope Cr. (mouth to headwaters) 1-Hay Cr. (mouth to headwaters) 2-Bakeoven Cr. (mouth to headwaters) 2-Buck Hollow Cr. (mouth to headwaters)	Degraded channel structure and complexity, floodplain, degraded riparian area, altered hydrology, degraded water quality, sediment routing	Grazing, agricultural practices, channelization, berms, roads, railroad bank armoring, floodplain, loss of beaver dams	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	Channelization, berm construction, and bank armoring, following floods has isolated the stream from the floodplain in many areas. Large wood and other instream habitat complexity is lacking in the Buck Hollow watershed.
Increase role and abundance of wood and large organic debris in streambeds	1-Trout Creek (Mouth to Board Hollow Cr) 1-Antelope Cr.(mouth to headwaters)	Degraded channel structure and complexity, floodplain, degraded riparian area , altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	Large woody debris in Deschutes River mainstem consists mostly from white alder trees downstream of hydro projects, currently little or no recruitment from upstream sources. Most problematic upstream of Warm Springs River.
Increase instream habitat through manual placement of structures		Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	Large wood removal	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	Considered an active form of restoration while habitat conditions are restored through more passive efforts
Stabilize streambanks with passive restoration processes	1-Trout Cr. (Little Trout Cr. To Clover Creek) 1-Trout Cr. (sections from mouth to Antelope Creek) 1-Antelope Cr. (mouth to headwaters) 1-Hay Cr. (mouth to headwaters) 2-Bakeoven Cr. (mouth to headwaters) 2-Buck Hollow Cr. (mouth to headwaters)	Degraded channel structure and complexity, floodplain connectivity, degraded riparian areas, sediment routing, flows	Stream channelization, berming, bank armoring, overgrazing in riparian areas	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Restore natural channel form, includes berm and levee removal	CTWSRO, ODFW, SWCD, USFS, BLM, watershed councils	Ongoing	High dispersal downstream	Long term	0-15 years	High
Increase role and abundance of wood and large organic debris in streambeds	ODFW, USFS, PGE, CTWSRO, watershed councils	Ongoing		Long term	Immediate	High
Increase instream habitat through manual placement of structures	ODFW, USFS, CTWSRO, BLM	Ongoing	Limited application throughout MaSA	Long term	Immediate	High
Stabilize streambanks	CTWSRO, ODFW, SWCD, watershed councils, USFS, BLM, ODA	Ongoing	High dispersal downstream	Long term	5-15 years	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
Sherman and Wasco SWCD, Landowners, Oregon State agencies, BPA	Bakeoven and Buck Hollow Watershed Restoration Projects	Bakeoven and Buck Hollow Creeks	No	Effective project, but could be developed onto more private lands.
NRCS,SWCD, USDA FSA, Private Landowners	CREP/CRP	Riparian and upland areas MaSA	No	An effective program for both upland and riparian protection, but could be expanded to additional private lands.
BLM Prineville District	Various range and upland restoration projects.	BLM lands	No	Effective programs that can be implemented on additional lands.
ODFW	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	Yes, project has made significant improvement is overall fish habitat, needs to be expanded to other properties in basin.
Jefferson SWCD	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	Yes, this companion project to the ODFW Habitat Project has made significant improvement is overall fish habitat, needs to be expanded to other properties in basin.
PGE/CTWSRO	Relicensing of Pelton/Round Butte Complex	Throughout MaSA	No	Habitat restoration and protection projects to mitigate effects of hydro projects. Additional opportunities exist.
CTWSRO	Various projects	Reservation lands	No	Yes, improving riparian conditions, grazing remains problematic in some areas.
BLM, Oregon State Parks, CTWSRO	Wild and Scenic Rivers	Deschutes from mouth to Trout Creek		See Oregon State Agencie's programmatic review.
ODA/SWCD	Ag WQ Management Program	Throughout MaSA		See Oregon State Agencie's programmatic review.
USFS	Stream Restoration Program (PacFish/Infish)	Forest Lands	No	Yes, Could be expanded to more streams in Trout Creek Subbasin.

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

CRP in uplands and riparian protection have and will provide short term benefits, but instream physical habitat improvements may not accrue until the longer term. The upper third of Buck Hollow remains a restoration priority. The future status of habitat benefits accruing from CRP enrollments could be unknown, since economic decisions by the landowners and government entities involved will influence the area under agreements.

Planning and implementation of restoration and protection measures for Bakeoven Creek are similar to the Buck Hollow project, but began more recently. A draft watershed assessment has been completed and includes an action plan with a 10-year time frame (Clark and Lamson 2005). Many benefits to steelhead have accrued through changes in upland and riparian management plans since the 1987 Farm Bill. While watershed function continues to improve, habitat complexity will increase.

Recent large scale stream rehabilitation projects in the Trout Creek watershed have been successful at removing berms, restoring stream function, and creating additional habitat. Several landowners with sensitive key spawning and rearing habitats in the Upper Trout Creek may be willing to participate in conservation efforts.

Strategy 5. Restore riparian condition and LWD recruitment and maintain unimpaired conditions.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Restore natural riparian communities	1-Trout Cr. (Little Trout Cr. To Clover Creek) 1-Trout Cr. (sections from mouth to Antelope Creek) 1-Antelope Cr. (mouth to headwaters) 1-Hay Cr. (mouth to headwaters) 2-Bakeoven Cr. (mouth to headwaters) 2-Buck Hollow Cr. (mouth to headwaters) 2-Deschutes R. (Harris Cr. to Buck Hollow Cr.) 2-Deschutes R. (Eagle Cr. to Shitike Cr.)	Bank degradation, degraded riparian communities, LWD recruitment, temperatures, flow, sediment routing	Livestock grazing, agricultural conversion, roads, bank armoring, residential development, loss of beaver dams	Abundance, productivity	All	Riparian areas in the Bakeoven, Buck Hollow and Trout Cr MaSAs have been reduced or damaged by grazing. Riparian canopy cover is relatively low. Streambank erosion and loss of riparian vegetation has led to wide shallow channels and width-to-depth ratios are greater than desirable throughout the watershed. Existing riparian vegetation contributes little to LWD. Loss of riparian function has led to increased sedimentation. Along Deschutes River, railroad armored banks limit riparian growth, campgrounds and heavy recreational use trample streamside vegetation, landowners have cleared vegetation around residences to improve river views and access
Develop grazing strategies that promote riparian recovery	Limited opportunities may exist throughout the MaSA	Bank degradation, degraded riparian communities, flow, sediment routing	Overgrazing	Abundance, productivity	All	
Eradicate invasive plant species from riparian areas	Where opportunities exist throughout the MaSA	Degraded riparian communities	Conversion of natural riparian vegetative communities	Abundance, productivity	All	
Install/maintain fencing to exclude livestock from riparian areas	1-Trout Cr. (Little Trout Cr. To Clover Creek) 1-Trout Cr. (sections from mouth to Antelope Creek) 1-Antelope Cr. (mouth to headwaters) 1-Hay Cr. (mouth to headwaters) 2-Bakeoven Cr. (mouth to headwaters) 2-Buck Hollow Cr. (mouth to headwaters) 2-Deschutes R. (Harris Cr. to Buck Hollow Cr.) 2-Deschutes R. (Eagle Cr. to Shitike Cr.)	Bank degradation, degraded riparian communities, flow, sediment routing	Overgrazing	Abundance, productivity	All	Cattle grazing along the mainstem Deschutes River., damages riparian vegetation and causes increases in erosion.
Install off-stream livestock watering	Limited opportunities may exist throughout the MaSA	Degraded riparian communities, sediment routing	Overgrazing	Abundance, productivity	All	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Restore natural riparian communities	CTWSRO, USFS, SWCDs, ODFW, watershed councils, BLM, OWEB	ongoing	High dispersal downstream	Long term	5-15 years	High
Develop grazing strategies that promote riparian recovery	CTWSRO, USFS, ODA, SWCDs	ongoing	High dispersal downstream	Long term	5-15 years	High
Eradicate invasive plant species from riparian areas	CTWSRO, USFS, ODA, SWCDs, watershed councils	ongoing		Immediate	5-15 years	
Install/maintain fencing to exclude livestock from riparian areas	SWCDs, NRCS, CTWSRO, USFS, ODA, SWCDs, ODFW	ongoing	High dispersal downstream	Immediate	Riparian restoration (0-20 years); increased streamflow, stabilized hydrograph (0-10 yrs)	High
Install off-stream livestock watering	ODFW, CTWSRO, USFS, ODA, SWCD	Expansion of existing effort	Private lands	Ongoing	Riparian restoration (0-5 years)	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
CTWSRO	Watershed Maintenance	Reservation	No	Yes, needs to be expanded and continued
CTWSRO	IRMP	Reservation	No	Yes, adaptive management plan
BLM, Oregon State Parks, CTWSRO	Wild and Scenic Rivers	Deschutes from mouth to Trout Creek		See Oregon State Agencie's programmatic review.
ODFW	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	Yes, project has made significant improvement is overall fish habitat, needs to be expanded to other properties in basin.
Jefferson SWCD	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	Yes, this companion project to the ODFW Habitat Project has made significant improvement is overall fish habitat, needs to be expanded to other properties in basin.
USFS	Stream Restoration Program (PacFish/Infish)	Forest Lands	No	Yes, Could be expanded to more streams in Trout Creek Subbasin.
NRCS,SWCD, USDA FSA, Private Landowners	CREP	Throughout MaSA	No	An effective program for both riparian protection and restoration, but could be expanded to additional private lands.
ODA	Agricultural Water Quality Management Plan	Throughout MaSA		See Oregon State Agencie's programmatic review.
Watershed Councils/OWEB	Various restoration projects	Throughout MaSA	No	Effective program for developing restoration/protection projects and supplying outreach information on resource management. Participation could be expanded.

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

Bakeoven Project is beginning and is planned over a 10-year period. Some riparian areas are still unbuffered through fences or grazing management plans. Habitat complexity will develop over the longer term if existing buffers are maintained. Some benefits from trees will be slow because the trees are small. Only when larger age classes exist will biological and physical results of large wood recruitment be realized.

Recent large scale stream rehabilitation projects in the Trout Creek watershed have been successful at removing berms, restoring stream function, and creating additional habitat. Several landowners with sensitive key spawning and rearing habitats in the Upper Trout Creek may be willing to participate in conservation efforts. Riparian improvements have improved water quality, but additional protection is needed throughout the basin. Public land managers have implemented PACFISH and INFISH standards for protection and restoration of USFS and BLM lands.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Implement agricultural water conservation measures	1-Trout Cr. (mouth to Clover Cr.) 1-Antelope Cr. (mouth to headwaters) 2-Hay Cr. (mouth to headwaters)	Altered hydrology, low flows, high temperatures	Water withdrawals, land conversion on uplands, road network	Abundance, productivity	Primarily fry and summer parr	Consumptive use of flows in Trout Creek exceeds the natural stream flow. Streamflow below Amity Creek average < 1cfs during the summer (WPN 2002). Flows in Trout Cr. Below diversions in the Ashwood and Willowdale areas frequently become intermittent from mid-summer to late fall. Trout Cr. From Hay Creek to Little Trout Creek is listed as priority in EDT.
Improve irrigation conveyance and efficiency	1-Trout Cr. Forest boundary downstream	low flows, high temperatures	Water withdrawals, loss during conveyance	Abundance, productivity	Primarily fry and summer parr	Conversion of flood to sprinkler irrigation, irrigation efficiency improvement, and piping would increase flows.
Lease or purchase water rights and convert to instream	1-Trout Cr. Subbasin (where available) 2-Buck Hollow Creek	low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily fry and summer parr	One surface water right exists (0.57 cfs) in a lower reach of Buck Hollow.
Monitor/regulate water withdrawals	1-Trout Cr. MaSA	low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily fry and summer parr	Most water withdrawals are not monitored for compliance.
Water retention structures	1-Uplands in Bakeoven and Buck Hollow Creeks	Altered hydrology, low flows	Degradation on uplands	Abundance, productivity	Primarily fry and summer parr	
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	All MaSAs	Altered hydrology, low flows, high temperatures, impaired natural functions and processes on uplands, floodplains, riparian areas	Degradation and conversion of uplands, floodplains, riparian areas	Abundance, productivity	Primarily fry and summer parr	Flow fluctuations are now larger than they were historically. High flows have scoured out channels reducing habitat diversity. Reduction of native upland vegetation has reduced its ability to retain and slowly release runoff. Lack of water in the lower reaches and Bakeoven and Deep creeks impedes upstream and downstream fish passage.

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Implement agricultural water conservation measures	SWCD, CTWSRO, landowners	Expands existing program, new projects	Croplands, MaSAs	Based on funding	Immediate increase in Streamflow; habitat diversity, floodplain connection (0-5 yrs)	High
Improve irrigation conveyance and efficiency	SWCD, USFS, OWRD, CTWSRO, OWEB, landowners	Expands existing program, proposes new projects	High dispersal downstream	Ongoing	Increased stream flow (0-5 years)	High
Lease or purchase water rights and convert to instream	ODWR, Oregon Water Trust, PGE, DRC, others	ongoing	Point of diversion to mouth of Deschutes	Long term	Immediate increase in instream flow	High
Monitor/regulate water withdrawals	ODWR	ongoing	Point of diversion to mouth of Deschutes	Long term		High
Water retention structures	SWCDs	ongoing	Uplands	Intermediate	0-10 years	Moderate
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	SWCD, USFS, OWRD, OWEB, ODFW, CTWSRO, landowners	ongoing	Basinwide	Intermediate	Up to 15 years	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
Sherman and Wasco SWCD, Property Owners, CTWSRO, and Oregon State agencies	Bakeoven Watershed Project	Bakeoven Creek	No	Effective programs that will take time before results are available. Program could be expanded to additional landowners.
Buck Hollow Watershed Project	Buck Hollow Watershed Project	Buck Hollow Creek	No	Effective programs that will take time before results are available. Program could be expanded to additional landowners.
ODFW	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	Yes, project has made significant improvement is overall fish habitat, needs to be expanded to other properties in basin. Recent large scale stream rehabilitation projects conducted on properties on Trout Creek have been successful at removing berms, restoring stream function, and creating additional habitat.
Jefferson SWCD	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	Yes, this companion project to the ODFW Habitat Project has made significant improvement is overall fish habitat, needs to be expanded to other properties in basin. Project has assisted in several infiltration gallery projects and other passage issues.
BLM	Various projects related to agriculture and rangeland improvements in uplands.	BLM lands	No	Effective programs that could be expanded to additional lands.
NRCS,SWCD, FSA, Private Landowners	CRP, CREP	Riparian and upland areas MaSA	No	An effective program for both upland and riparian protection, but could be expanded to additional private lands.
Sherman and Wasco SWCD, OWRD, Private, NMFS	Lease instream water rights.			See Oregon State Agencie's programmatic review.
Oregon Water Trust	Lease water rights and return instream.			Yes, program works well, could be expanded with more willing landowners. Need assurance that instream leases remain instream.
Jefferson SWCD, NRCS	Various irrigation efficiency improvements, CRP, CREP.			Yes
ODA/SWCD	Ag WQ Management Program			See Oregon State Agencie's programmatic review.

*Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
The Deschutes subbasin plan's (NPCC 2004) inventory notes that Buck Hollow "runs clean", intermittent tributaries have become perennial, 95% of riparian areas are in riparian pasture management or exclusion, and upland range conditions are vastly improved. Opportunities may exist to increase summer flows, reduce temperature, and decrease sedimentation through water development (Lower Deschutes River Management Plan). CRP in uplands and riparian protection have and will provide short term benefits, but instream physical habitat improvements may not accrue until the longer term. The upper third of Buck Hollow remains a restoration priority. The future status of habitat benefits accruing from CRP enrollments could be unknown, since economic decisions by the landowners and government entities involved will influence the area under agreements. None of the Buck Hollow watershed is in a "protected" status. In 2001, 1 to 1.5 cfs from a headwater well in Buck Hollow Cr. Was used to supplement flow to protect fish from the drought (BPA #200105400).

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Manage irrigation return flow to reduce extreme stream temperatures	1-Trout Cr. (mouth to Clover Creek) 1-Antelope Cr. (mouth to headwaters) 2-Hay Cr. (mouth to headwaters)	Altered stream temperatures, degraded water quality	Water withdrawals	Abundance, productivity	Fry dispersal and rearing	Reaches of Buck Hollow, Bakeoven and Trout Creeks are included on the 303(d) list for exceeding temperature and sediment limits. Temperatures in the systems typically exceed criteria for salmonid rearing during summer months. Several reaches are also listed because of sediment concerns.
Minimize unnatural factors that lead to fluctuations in dissolved oxygen levels	1-Trout Cr. (mouth to sagebrush)	Depleted oxygen		Abundance, productivity	Fry dispersal and rearing	Warm temperatures, and potential pollutants reduce the dissolved oxygen capacity of the water.
Implement Agricultural Water Quality Management Plan	Agricultural lands throughout MaSA	Degraded upland processes, altered hydrology, water quality, altered sediment routing	Land conversion and agricultural practices	Abundance, productivity	Fry dispersal and rearing	
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	Entire MaSA	Degraded upland processes, floodplains, riparian areas, altered hydrology, altered sediment routing	Degradation and conversion of uplands, floodplains, riparian areas	Abundance, productivity	Spawning, incubation, fry dispersal, rearing, over-wintering	
Continue TMDL monitoring	MaSAs and MiSAs	Degraded water quality, sediment routing	Land use practices, water withdrawals, pesticides, fertilizers, herbicides	Abundance, productivity	All	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Manage irrigation return flow to reduce extreme stream temperatures	SWCDs	Ongoing	High dispersal downstream	Less than 5 years	Immediate	high
Minimize unnatural factors that lead to fluctuations in dissolved oxygen levels		ongoing				
Implement Agricultural Water Quality Management Plan	ODA, SWCD		Basinwide	Ongoing	variable	High
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	SWCD	ongoing	Basinwide, high dispersal downstream	Intermediate	Up to 15 years	High
Continue TMDL monitoring	USFS, ODFW, SWCD, ODEQ	ongoing	Basinwide	Ongoing	Immediate	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
Oregon Water Trust, NGO's	Lease or purchase instream water rights.	Trout Creek MaSA	No	Program has been effective, difficult to obtain senior water rights and keep water instream. Program could be expanded.
ODFW	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	Yes, project has made significant improvement is overall fish habitat, needs to be expanded to other properties in basin. Recent large scale stream rehabilitation projects conducted on properties on Trout Creek have been successful at removing berms, restoring stream function, and creating additional habitat.
Wasco SWCD, Property Owners, CTWSRO, and Oregon State agencies, BPA	Bakeoven/Buck Hollow Watershed Project	Bakeoven and Buck Hollow Cr.	No	Effective programs that will take time before results are available. Program could be expanded to additional landowners.
BLM	Various projects related to agriculture and rangeland improvements in uplands.	BLM lands	No	Effective programs that could be expanded to additional lands.
Jefferson SWCD	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	Yes, this companion project to the ODFW Habitat Project has made significant improvement is overall fish habitat, needs to be expanded to other properties in basin. Project has assisted in several infiltration gallery projects and other passage issues.
FSA, NRCS,SWCD, Private Landowners	CRP, CREP	Riparian and upland areas MaSA	No	An effective program for both upland and riparian protection, but could be expanded to additional private lands.
ODA/SWCD	Ag WQ Management Program			See Oregon State Agencie's programmatic review.
USFS	Stream Restoration Program (PacFish/Infish)		Uncertain	Yes
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				
Many benefits to steelhead have accrued through changes in upland and riparian management plans since the 1987 Farm Bill. Opportunities may exist to increase summer flows, reduce temperature, and decrease sedimentation through water development (Lower Deschutes River Management Plan). CRP in uplands and riparian protection have and will provide short term benefits, but instream physical habitat improvements may not accrue until the longer term. The upper third of Bakeoven and Buck Hollow creeks remain restoration priorities. The future status of habitat benefits accruing from CRP and CREP enrollments could be unknown, since economic decisions by the landowners and government entities involved will influence the area under agreements. No areas within the Bakeoven or Buck Hollow watersheds are in a "protected" status.				

Strategy 8. Restore degraded upland processes to minimize unnatural rates of erosion and runoff, and maintain unimpaired natural upland processes.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Achieve 95% conversion to no till farming	1-Buck Hollow Cr. Uplands 1-Bakeoven Cr. Uplands	Altered hydrology, sediment routing	Upland land use practices, loss of water storage capacity	Abundance, productivity	All	
Convert to perennial crops/vegetation (CRP)	1-Buck Hollow Cr. Uplands 1-Bakeoven Cr. Uplands	Altered hydrology, sediment routing	Upland land use practices, loss of water storage capacity	Abundance, productivity	All	
Remove junipers	1-Trout Creek uplands 2-Bakeoven Cr. Uplands 2-Buck Hollow Cr. Uplands	Altered hydrology	loss of water storage capacity	Abundance, productivity	All	
Restore native upland plants and remove noxious weeds	1-Buck Hollow Cr MaSAs 1-Bakeoven Cr. MaSAs 2-Trout Cr. MaSAs	Altered hydrology, sediment routing	Upland land use practices, loss of water storage capacity	Abundance, productivity	All	
Upgrade or remove problem forest roads	1-Trout Cr. Private Forest Lands 2-Trout Cr. USFS Forest Lands	Altered hydrology, sediment routing	Road network	Abundance, productivity	All	
Promote reforestation and fuels management	1-Trout Cr. Private Forest Lands 2-Trout Cr. USFS Forest Lands	Altered hydrology, sediment	Conversion of Vegetative communities	Abundance, productivity	All	
Employ BMPs to minimize unnatural rates of erosion	Entire MaSA and MiSA	Altered hydrology, sediment routing, water quality	Upland land use practices, erosion, loss of water storage capacity	Abundance, productivity	All	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Achieve 95% conversion to no till farming	SWCD	Existing program	Croplands, MaSAs	Ongoing	Reduce runoff, sediment supply, immediate increase in base flow	High
Convert to perennial crops/vegetation (CPR)	NRCS, SWCDs	ongoing	Croplands	Immediate	0-10 years	High
Remove junipers	SWCDs, NRCS	ongoing	uplands	Immediate	0-20 years	High
Restore native upland plants	USFS, BLM, NRCS, SWCDs, watershed councils, CTWSRO, BIA	ongoing	High dispersal downstream	Juniper control can be quick, other actions such as control of invasive plants may take 20 years or more	0-20 years	High
Upgrade or remove problem forest roads	CTWSRO, USFS, ODOT, ODF	ongoing	High dispersal downstream	Long term	Immediate for sediment, other parameters 5-15 yrs	High
Utilize appropriate fire suppression techniques	CTWSRO, USFS, watershed councils, SWCDs, counties	ongoing	forestlands	Long term	0-10 yrs	High
Employ BMPs to minimize unnatural rates of erosion	SWCD, USFS, ODA, ODF, BLM, CTWSRO, watershed councils, NRCS, private landowners	ongoing	High dispersal downstream	Intermediate	5-15 years	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
NRCS,SWCD, Private Landowners	CRP, CREP, Environmental Quality Incentive Program (EQUIP)	Private upland and riparian lands	No	An effective program for both upland and riparian protection, but could be expanded to additional private lands. Continued implementation of program dependent on funding.
SWCDs	Voluntary Watershed Restoration	Private agricultural lands	No	Dependent on funding, and landowner interest.
BLM	Various projects related to agriculture and rangeland improvements in uplands.	BLM lands	No	Effective programs that could be expanded to additional lands.
CTWSRO	IRMP	Reservation Lands	Yes	Yes, adaptive management plan.
USFS	Stream Restoration Program (PacFish/Infish)	USFS forest lands	Uncertain	Effectiveness of program unproven.
ODF	Forest Practice Act	Private forest lands		See Oregon State Agencie's programmatic review.
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				
Many benefits to steelhead have accrued through changes in upland and riparian management. Farm Services Agency (FSA) programs that protect riparian areas and upland watersheds include the Conservation Reserve Program (CRP) and the Conservation Reserve Enhancement Program (CREP). The CRP program pays landowners not to farm highly erodible soils and the CREP program pays landowners for setting riparian corridors aside from grazing and farming. The long term effectiveness of both programs is limited by the relatively short duration of the contracts which ranges from 10 to 15 years.				

Table 17-6b. Habitat Strategies and Actions for Recovery of Fifteenmile Creek Steelhead Population

The Fifteenmile Creek population covers the entire Fifteenmile Subbasin and other smaller subbasins, including the Fifteenmile, Rock, Mosier, Chenoweth, Mill, and Threemile watersheds. The population contains three major spawning areas, which are located in the Fifteenmile Creek watershed: the Upper Fifteenmile MaSA, Eightmile MaSA and Fivemile MaSA.

Primary limiting factors: low flows, high water temperatures, sedimentation, channel confinement, and reduced habitat quality.

Primary threats: roads, residential development, agricultural practices and forest uses.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Protect the highest quality habitats through acquisition or conservation measures	1-Fifteenmile Cr. (Hwy 197 upstream to FS boundary) 1-Eightmile Cr. (Hwy 197 upstream to FS boundary) 1-Ramsey Cr. (mouth to FS boundary) 2-Fivemile Creek from Hwy 197 upstream to headwaters.	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing	All	All	All	Protecting high quality habitats is the most cost effective way to ensure fish have good quality habitat. It is much less expensive over the long term to protect high quality habitat than it is to degrade the habitat and then try to restore it. Protection of existing high quality habitat areas is a broad strategy capable of contributing to meeting all of biological habitat objectives. Land acquisitions, easements, and cooperative agreements may facilitate the implementation of active restoration projects.
Protect and conserve rare and unique functioning habitats	Considering the unique winter life history form present for the MaSA, and no other winter fish in ESU, they are all likely unique. Entire MaSA 1-South Fork Mill Cr. (Water treatment to falls)	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing	All	All	All	Protecting high quality habitats is the most cost effective way to ensure fish have good quality habitat. It is much less expensive over the long term to protect high quality habitat than it is to degrade the habitat and then try to restore it. South Fk. Mill Creek from water treatment plant to falls is in pristine condition. Only area in entire population that remains pristine.
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes	1- Fifteenmile Creek MaSA and MiSA	All factors	All	All	All	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Protect the highest quality habitats through acquisition or conservation measures.	CTWSRO, ODFW, SWCD, USDA FSA, land trusts, NGOs	Ongoing	All MaSAs and MiSAs in Fifteenmile Population.	Existing conservation agreements are complete. Full implementation of conservation measures will take 5-15 years or more	Immediate	High
Protect and conserve rare and unique functioning habitats	Land trusts, CTWSRO, ODFW, SWCD, NGOs, USFS	Ongoing	All MaSAs and MiSAs in Fifteenmile Population.	Immediate	Immediate	High
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	SWCD, USFS, private landowners, ODA, CTWSRO	Ongoing	All MaSAs and MiSAs in Fifteenmile Population.	Long term	5-15 years	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
USFS	Fifteenmile River Keeper, Northwest Forest Plan	USFS lands on Fifteenmile, Ramsey, Eightmile, Fivemile, Mill Creeks.	No	Positive results where the program has been implemented, but it could be expand to more forest lands in the population, and become more available off forest lands.
ODFW	Fifteenmile Creek Fish Habitat Restoration Project	Private lands throughout Fifteenmile MaSA.	No	Positive results where the program has been implemented, but funding and landowner cooperation limits the amount of available projects. In addition, limited legal guarantees that landowners remain in program.
Wasco County SWCD/USDA FSA	CREP, CRP	Private riparian areas and qualified uplands throughout MaSA and MiSA	No	Both programs are effective at protecting riparian areas and uplands, however additional lands need to enrolled. CRP program is near capacity for Wasco county. Some landowners reluctant to enter the federal programs.
Oregon Water Trust or other entity	Lease or purchase instream water rights	Fifteenmile,Eightmile, Fivemile MaSA	No	Program has been effective at obtaining water rights, but continually to maintain water instream to the mouth of the river is difficult. Many landowners reluctant to enter into program. Yes, important to secure water rights to guarantee instream flow.
Wasco County SWCD	No-till Conversion	Uplands throughout population	No	An effective program at reducing erosion, but needs to be expanded to additional properties.
OWEB	Watershed Councils	Fifteenmile and The Dalles watershed council		See Oregon State Agency's programmatic review.
ODA	Agricultural Water Quality Management Plan	Fifteenmile population unit		See Oregon State Agency's programmatic review.
CTWSRO	Watershed Restoration	Tribal lands on Fifteenmile Creek (Rm ?? to ??)	No	Various programs designed to improve riparian, stream, and upland conditions along tribal lands. Additional restoration and protection efforts are needed.
ODF	Oregon Forest Practice Act	Private and state forestlands in Fifteenmile, Eightmile, Ramsey , and Fivemile creeks		See Oregon State Agency's programmatic review.
Local Government	City and County Planning and Zoning	Private lands throughout the entire population unit	Yes	Compliance with zoning requirements is high

*Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
Many programs already in place in the subbasin are designed to restore physical habitat. These programs have proven effective, but it will take years to return the stream to a more natural condition. Existing forest plans include special management designations for riparian reserves. The forest plans and BLM plans have been amended by the Northwest Forest Plan which requires riparian reserve boundaries of two site potential tree heights on both sides of any fish bearing stream and contains very restrictive standards and guidelines to ensure protection of aquatic and riparian resources. Compliance with riparian reserve standards and guidelines for a variety of land use activities including timber harvest operations, cattle grazing, and others has been very good. Farm Service Agency (FSA) programs that protect riparian areas and upland watersheds include the Conservation Reserve Program (CRP) and the Conservation Reserve Enhancement Program (CREP). The CRP program pays landowners not to farm highly erodible soils and the CREP program pays landowners for setting riparian corridors aside from grazing and farming. The long term effectiveness of both programs is limited by the relatively short duration of the contracts which ranges from 10 to 15 years. ODA's Agricultural Water Quality Management Plan is designed to prevent and control water pollution from agricultural activities and soil erosion on non-Federal and non-Tribal Trust or Reservation lands. ODA relies on voluntary measures to protect water quality, but also enforces pollution and streamside vegetation requirements.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain unimpaired passage and connectivity.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Replace barriers blocking passage including dams, road culverts and irrigation structures	1-Barriers that limit adult access: Ramsey Creek (culvert FS 4450 Rd), Ramsey Creek (Olsen Irrigation Division RM 3.5), Fifteenmile Tenold Diversion (RM 2.0) 2-Barriers that limit juvenile access: Fifteenmile same as adults Eightmile Cr. FS 4430 Rd Threemile Cr: (Hwys. I-84 & 197) Chenowith Creek Bridge at Hwy. 30 Fixed Long, Douglas, Standard Hollows Mays Canyon	Impaired fish passage	Dams, culverts, instream structures	Spatial structure, productivity	Primarily adults and 0+juveniles	Spatial structure of the Fifteenmile winter steelhead population has been modified and restricted by culvert barriers and hostile environmental conditions in the middle and lower elevations (NPCC 2004).
Provide screening at 100% of irrigation diversions	1-Additonal survey seeded in MiSA to identify unscreened diversions 2-All known diversions are screened in the Fifteenmile MaSA.	Impaired fish passage	Irrigation diversions	Spatial structure, productivity	Primarily adults and 0+juveniles	Known diversions are screened to criteria.
Replace screens that do not meet criteria	1-MiSA unknown and need survey 2- Fifteenmile all known screens meet criteria.	Impaired fish passage	Irrigation diversions	Spatial structure, productivity	Primarily adults and 0+juveniles	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Replace barriers blocking passage including dams, road culverts and irrigation structures	USFS, SWCD, ODFW	Ongoing	At Barriers	Ongoing	Immediate	High
Provide screening at 100% of irrigation diversions	ODFW, BPA, NOAA Fish	Ongoing	At point of diversion	All legal diversions screened in Fifteenmile. Need further survey work in MiSA to determine number of screens.	Immediate	High
Replace screens that do not meet criteria	ODFW, BPA, NOAA Fish	Ongoing	At point of diversion	Legal diversion meets criteria. Need further survey work in MiSA to determine number of screens.	Immediate	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
ODFW	Fish Passage/Screening	Unscreened or poorly screened diversions throughout MaSAs	No	Continued funding of program is uncertain.
ODOT	Culvert replacement or retrofit	Threemile Cr: culvert at Hwy. I-84 and Hwy. 197; Chenowith Creek Bridge at Hwy. 30.		See Oregon State Agency's programmatic review.
USFS	Culvert replacement	USFS lands	No	Funding and priority of programs is uncertain.
Wasco County Road Department	Culvert replacement	North Fk Mill Creek (RM 6.0)	No	Funding and priority of programs is uncertain.
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				

Strategy 3. Restore floodplain connectivity and function and maintain unimpaired connectivity and function.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Reconnect floodplains to channels	1-Fifteenmile Cr. (Mouth to FS boundary) 1-Ramsey Cr. (Mouth to new FS boundary) 1-Eightmile Cr. (Hwy 197 to FS boundary) 1-Fivemile Cr. (Mouth to FS boundary) 2-Dry Cr.(Mouth to headwaters) 2-Mill Cr.(Mouth to North Fork) 2-North Fk. Mill Cr. (mouth to FS boundary)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity, spatial structure	Primarily fry, summer parr, winter parr	Floodplains and channels that are in balance are essential for proper stream function.
Reconnect side channels and off-channel habitats to stream channels	1-Fifteenmile Cr. (Mouth to FS boundary) 1-Ramsey Cr. (Mouth to new FS boundary) 1-Eightmile Cr. (Hwy 197 to FS boundary) 1-Fivemile Cr. (Mouth to FS boundary) 2-Dry Cr.(Mouth to headwaters) 2-Mill Cr.(Mouth to North Fork) 2-North Fk. Mill Cr. (mouth to FS boundary)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity, spatial structure	Primarily fry, summer parr, winter parr	Side channels provide habitat for spawning and rearing and refugia from high flows.
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes	Population wide.	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat	Abundance, productivity, spatial structure	Primarily fry, summer parr, winter parr	Beaver have started to recolonize many areas in the watershed.

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Reconnect floodplain habitats	ODFW, watershed council, SWCD, USFS	Ongoing	Improved connectivity with channel will be localized; improved water table will increase stream flow and lower water temperatures downstream.	Long term	5-15 years	Moderate
Reconnect side channels and off-channel habitats to stream channels	ODFW, watershed council, SWCD, USFS	Ongoing	Improved connectivity with channel will be localized; improved water table will increase stream flow and lower water temperatures downstream.	Long term	5-15 years	Moderate
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes	Beavers	Ongoing		Long Term	5-15 years	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
USFS	Fifteenmile River Keeper, Northwest Forest Plan	USFS lands on Fifteenmile, Ramsey, Eightmile, Fivemile, Mill Creeks.	No	Positive results where the program has been implemented, but it could be expand to more forest lands in the population, and become more available off forest lands.
ODFW	Fifteenmile Creek Habitat Restoration Project	Private lands in MaSAs from forest service boundary downstream to mouth.	No	Additional projects may be available. Funding may be an issue.
ODF	Oregon Forest Practices Act	Private and state forestlands in Fifteenmile, Eightmile, Ramsey , and Fivemile Creek		See Oregon State Agency's programmatic review.
Wasco SWCD	Watershed restoration	All MaSAs from forest service boundary downstream	No	Yes, conservation protection and outreach measures needed on private lands
ODA	Agricultural Water Quality Management Plan	Fifteenmile population unit		See Oregon State Agency's programmatic review.
CTWSRO	Watershed restoration	Reservation Lands	No	Various programs designed to improve riparian, stream, and upland conditions along tribal lands. Additional restoration and protection efforts are needed.
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				
ODA's Agricultural Water Quality Management Plan is designed to prevent and control water pollution from agricultural activities and soil erosion on non-Federal and non-Tribal Trust or Reservation lands. ODA relies on voluntary measures to protect water quality, but also enforces pollution and streamside vegetation requirements.				

Strategy 4. Restore degraded channel structure and complexity and maintain unimpaired structure and complexity.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural channel form	1-Fifteenmile Cr. (Mouth to FS boundary) 1-Ramsey Cr. (Mouth to new FS boundary) 1-Eightmile Cr. (Hwy 197 to FS boundary) 1-Fivemile Cr. (Mouth to FS boundary) 2-Dry Cr.(Mouth to headwaters) 2-Mill Cr.(Mouth to North Fork) 2-North Fk. Mill Cr. (mouth to FS boundary)	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature, flows	Stream channelization, berming, bank armoring, large wood removal, beaver removal, overgrazing in riparian areas	Abundance, productivity	Primarily egg, alevins, fry, summer parr, winter parr	Fifteenmile has been extensively channelized and straightened and has subsequently downcut. Historical aerial photos indicate that the stream is shorter and steeper now than before the 1970s (NPCC 2004).
Increase role and abundance of wood and large organic debris in streambeds	1- Fifteenmile Cr.(Mouth to City of Dufur intake) 1-Eightmile Cr. (Hwy 197 to Walston Grade (RM19.0)) 1-Fivemile Cr. (Mouth to FS boundary) 2-Dry Cr.(Mouth to headwaters)	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	Large wood removal	Abundance, productivity	Primarily egg, alevins, fry, summer parr, winter parr	Many legacy effects of past land use practices continue to affect channel form and instream habitat. Current practices have less effect.
Increase instream habitat through manual placement of structures	1-Fifteenmile Cr. (Mouth to FS boundary) 1-Ramsey Cr. (Mouth to new FS boundary) 1-Eightmile Cr. (Hwy 197 to FS boundary) 1-Fivemile Cr. (Mouth to FS boundary) 2-Dry Cr.(Mouth to headwaters) 2-Mill Cr.(Mouth to North Fork) 2-North Fk. Mill Cr. (mouth to FS boundary)	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	Large wood removal	Abundance, productivity	Primarily egg, alevins, fry, summer parr, winter parr	Considered an active form of restoration while habitat conditions are restored through more passive efforts. Limited opportunities exist in reaches identified.
Stabilize streambanks	Limited areas throughout MaSA and MiSA	Degraded channel structure and complexity, habitat diversity, sediment routing, flows	Stream channelization, berming, bank armoring, overgrazing in riparian areas	Abundance, productivity	Primarily egg, alevins, fry, summer parr, winter parr	Most actively eroding banks have been protected.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural channel form	ODFW, SWCD, USFS, BPA, OWEB, CTWSRO	Expansion of existing efforts		Ongoing	Increased habitat diversity (0-10 years)	High
Increase role and abundance of wood and large organic debris in streambeds	ODFW, USFS	Expansion of existing efforts		Ongoing	Increased habitat diversity (0-10 years)	High
Increase instream habitat through manual placement of structures	ODFW, USFS	Expansion of existing efforts		Ongoing	Increased habitat diversity (0-10 years)	High
Stabilize streambanks	ODFW, SWCD, USFS	Expansion of existing efforts		Ongoing	Increased habitat diversity (0-10 years)	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
USFS	Fifteenmile River Keeper, Northwest Forest Plan	USFS lands	No	Yes, considerable restoration work has occurred but program could be expanded
ODFW	Fifteenmile Creek Habitat Restoration Project	Private lands in MaSAs from forest service boundary downstream to mouth.	No	Additional projects may be available. Funding may be an issue.
ODF	Oregon Forest Practices Act	Private and state forestlands in Fifteenmile, Eightmile, Ramsey , and Fivemile creeks		See Oregon State Agency's programmatic review.
Wasco SWCD	Watershed restoration	Private agricultural lands	No	Additional opportunities exist for both projects and outreach.
ODA	Ag. Water quality management program	Private agricultural lands		See Oregon State Agency's programmatic review.
CTWSRO	Watershed restoration	Reservation lands	No	Various programs designed to improve riparian, stream, and upland conditions along tribal lands. Additional restoration and protection efforts are needed.
OWEB	Watershed Councils	Private lands population wide		See Oregon State Agency's programmatic review.
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				
ODA's Agricultural Water Quality Program is designed to prevent and control water pollution from agricultural activities and soil erosion on non-Federal and non-Tribal Trust or Reservation lands. ODA relies on voluntary measures to protect water quality, but also enforces pollution and streamside vegetation requirements.				

Strategy 5. Restore riparian condition and LWD recruitment and maintain unimpaired conditions.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Restore natural riparian communities	1-Eightmile Cr (RM 7 upstream RM 17 mostly complete, some opportunities exist) 1-Fivemile Cr. Hwy 197 to RM 5, RM 7 upstream to FS boundary) 2-Fifteenmile Cr. (Mostly fenced or protected from livestock in recovering condition.) 2-Mill Cr. (mouth to forks)	Bank degradation, degraded riparian communities, LWD recruitment, temperatures, flow, sediment routing	Livestock grazing, agricultural conversion, roads, urban development, loss of beaver dams	Abundance, productivity	All	Riparian areas have been altered throughout the subbasin. Many areas are recovering through newly implemented conservation practices. Approximately 126 miles of stream are currently protected through some form of riparian buffer. Primary methods of riparian enhancement include riparian corridor fences to exclude livestock while controlling weeds, changes in grazing management that promote riparian recovery, and planting of native shrubs.
Develop grazing strategies that promote riparian recovery	1-Eightmile RM 8.5	Bank degradation, degraded riparian communities, flow, sediment routing	Livestock grazing	Abundance, productivity	All	Area of heavy grazing by horses.
Eradicate invasive plant species from riparian areas	1-Fifteenmile Cr. (Mouth to FS boundary) 1-Dry Cr.(Mouth to headwaters) 1-Ramsey Cr. (Mouth to FS boundary) 1-Eightmile Cr (Mouth to FS boundary) 1-Fivemile Cr. (Mouth to FS boundary)	Degraded riparian communities	Conversion of natural riparian vegetative communities	Abundance, productivity	All	Riparian lease agreements with ODFW and CREP programs require control of noxious weeds.
Install fencing to exclude livestock from riparian areas	1-Eightmile Cr (RM 7 upstream RM 17 mostly complete, some opportunities exist) 1-Fivemile Cr. Hwy 197 to RM 5, RM 7 upstream to FS boundary) 2-Fifteenmile Cr. (Mostly fenced or protected from livestock in recovering condition.) 2-Mill Cr. (mouth to forks)	Bank degradation, degraded riparian communities, flow, sediment routing	Livestock grazing	Abundance, productivity	All	A considerable amount of riparian fencing has be completed in the population unit, however, some opportunities remain. Long term maintenance of riparian fence is needed.
Install off-stream livestock watering	1-Fifteenmile Cr. (4 sites in Dufur Valley, multiple sites mouth to Hwy 197) 1-Eightmile Cr. Multiple sites needed 1-Fivemile Cr. Multiple sites needed 2-Ramsey Cr. Multiple sites needed 2-Dry Cr. Some sites available	Degraded riparian communities, sediment routing	Livestock grazing	Abundance, productivity	All	Off-stream watering sites reduce livestock impacts on stream banks. Many solar and other innovative techniques are currently being deployed.
Plant riparian vegetation where appropriate		Bank degradation, degraded riparian communities, LWD recruitment, temperatures, flow, sediment routing	Livestock grazing, agricultural conversion, roads, urban development	Abundance, productivity	All	Natural vegetation restoration generally occurs without planting, some planting occurs along with fencing projects and CREP projects.

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Restore natural riparian communities	ODFW,SWCD, NRCS, FSA, ODF	Expansion of existing efforts		Ongoing	Riparian restoration (10-20 years)	High
Develop grazing strategies that promote riparian recovery	ODA, SWCD, NRCS	Unknown		Ongoing	Riparian restoration (10-20 years)	Moderate
Eradicate invasive plant species from riparian areas	ODFW, SWCD, Wasco County	Expansion of existing effort		Ongoing	immediate	High
Install fencing to exclude livestock from riparian areas	ODFW, SWCD, CTWSRO, NRCS, FSA	Expansion of existing effort		Ongoing	Riparian restoration (0-5 years)	High
Install off-stream livestock watering	ODFW, SWCD, NRCS, FSA	Expansion of existing effort		Ongoing	Riparian restoration (0-5 years)	High
Plant riparian vegetation where appropriate	ODFW, SWCD, FSA			Ongoing	Riparian restoration (0-10 years)	Moderate

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
Wasco SWCD	Watershed restoration	Private agricultural lands	No	Additional opportunities exist for both projects and outreach.
USDA FSA, SWCD, NRCS	CREP	Qualified private riparian areas throughout MaSA and MiSA	No	Effective at protecting riparian areas, however additional lands need to enrolled. Some landowners reluctant to enter the federal programs.
Wasco SWCD	Various	Private agricultural lands	No	Additional opportunities exist for both projects and outreach.
ODFW	Fifteenmile Creek Fish Habitat Restoration Project	Private lands throughout Fifteenmile MaSA.	No	Positive results where the program has been implemented, but funding and landowner cooperation limits the amount of available projects. In addition, limited legal guarantees that landowners remain in program.
USFS	Fifteenmile River Keeper, PacFish/InFish	USFS lands on Fifteenmile, Ramsey, Eightmile, Fivemile, Mill Creeks.	No	Positive results where the program has been implemented, but it could be expand to more forest lands in the population, and become more available off forest lands.
ODA	Agricultural Water Quality Management Plan	Private agricultural lands		See Oregon State Agency's programmatic review.
CTWSRO	Watershed restoration	Reservation lands	No	Various programs designed to improve riparian, stream, and upland conditions along tribal lands. Additional restoration and protection efforts are needed.
ODF	Oregon Forest Practice Act	Private and state forestlands in Fifteenmile, Eightmile, Ramsey , and Fivemile Creek		See Oregon State Agency's programmatic review.
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				
Constant maintenance of the fence lines must be conducted to keep livestock out and protect the riparian vegetation. Construction of more off channel watering sites or water gaps would help to address part of the issue.				

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Implement agricultural water conservation measures	1-Fifteenmile Cr. (Mouth to FS boundary) 1-Ramsey Cr. (Mouth to new FS boundary) 1-Eightmile Cr. (Hwy 197 to FS boundary) 1-Fivemile Cr. (Mouth to FS boundary)	Altered hydrology, low flows, high temperatures	water withdrawals, land conversion on uplands, road network	Abundance, productivity	Primarily fry and summer parr	EDT results indicate that high and low flows reduce steelhead populations in every reach (NPCC 2004).
Improve irrigation conveyance and efficiency	1-Fifteenmile Cr. (Mouth to FS boundary) 1-Ramsey Cr. (Mouth to new FS boundary) 1-Eightmile Cr. (Hwy 197 to FS boundary) 1-Fivemile Cr. (Mouth to FS boundary)	Low flows, high temperatures	Water withdrawals, loss during conveyance	Abundance, productivity	Primarily fry and summer parr	Considerable water savings may be possible by utilizing new technology irrigation.
Finish piping Orchard Ridge and Wolf Run diversions	1- Fifteenmile Cr (Orchard Ridge) 1- Eightmile Cr (Wolf Run)	Impaired flows	Irrigation diversions	Spatial structure, productivity	primarily adults and 0+juveniles	Open ditches lose considerable water through evaporation and leakage.
Implement urban conservation measures	1-Mill Creek (City of The Dalles) 2-Fifteenmile Cr. (City of Dufur)	low flows, high temperatures	Water withdrawals	Abundance, productivity	All	Much of the flow of Mill Creek is utilized for domestic drinking water.
Lease or purchase water rights and convert to instream	Population wide.	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily fry and summer parr	Program has been effective when rights have become available. Senior rights generally not available. Many landowners reluctant to sell water rights.
Monitor/regulate water withdrawals	Population wide	low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily fry and summer parr	Annual fluctuations in flow levels are intensified by irrigation withdrawals

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Implement agricultural water conservation measures	SWCD	Expands existing program, proposes new projects	Point of diversion downstream	Ongoing	Immediate increase in streamflow	High
Improve irrigation conveyance and efficiency	SWCD, USFS, OWRD, OWEB landowners	Expands existing program, proposes new projects	Agricultural lands throughout subbasin	Ongoing	Increased stream flow (0-5 years)	High
Finish piping Orchard Ridge and Wolf Run diversions	SWCD	Expansion of existing project	Upper Fifteenmile and Eightmile	Unknown	Immediate increase in instream flow	High
Implement urban conservation measures	SWCD, City of The Dalles	Expands existing program, proposes new projects	Mill Cr. MaSA	Ongoing	Immediate increase in instream flow	High
Lease or purchase water rights and convert to instream	ODWR, Oregon Water Trust, others	Ongoing	Population-wide	Unknown	Immediate increase in instream flow	High
Monitor/regulate water withdrawals	ODWR	Ongoing				High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
USFS	Fifteenmile River Keeper, PacFish/InFish	USFS lands on Fifteenmile, Ramsey, Eightmile, Fivemile, Mill creeks	No	Positive results where the program has been implemented, but it could be expand to more forest lands in the population, and become more available off forest lands.
ODFW	Fifteenmile Creek Fish Habitat Restoration Project	Private lands throughout Fifteenmile MaSA	No	Positive results where the program has been implemented, but funding and landowner cooperation limits the amount of available projects. In addition, limited legal guarantees that landowners remain in program.
Oregon Water Resources Department	Stream Flow Monitoring and Regulation	Population wide		See Oregon State Agency's programmatic review.
Oregon Water Trust or other entity	Lease or purchase instream water rights	Fifteenmile, Eightmile, Fivemile MaSA	No	Program has been effective at obtaining water rights, but continually to maintain water instream to the mouth of the river is difficult. Many landowners reluctant to enter into program. Yes, important to secure water rights to guarantee instream flow
USFS, Wasco Co. SWCD, NRCS, OWEB	Irrigation conveyance efficiency	Population wide	No	Piping open ditches and other efficiency projects will decrease irrigation demand on streams. Program could be expanded to many additional irrigators.
Wasco Co. SWCD	No-till conversion, watershed restoration	Uplands population wide	No	Program has proven effective at reducing erosion, but additional lands could be erolled.
Wasco County SWCD/USDA FSA	CREP, CRP	Private riparian areas and qualified uplands throughout MaSA and MiSA	No	Both programs are effective at protecting riparian areas and uplands, however additional lands need to enrolled. CRP program is near capacity for Wasco county. Some landowners reluctant to enter the federal programs.
CTWSRO	Watershed Restoration	Tribal lands	No	Various programs designed to improve riparian, stream, and upland conditions along tribal lands. Additional restoration and protection efforts are needed.
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				
Peak flows are mitigated via upland vegetation, channel and riparian complexity, and closure of excess roads, particularly those with insufficient drainage. Highly successful program now address upland and riparian conditions. Programs addressing channel complexity and road closure have, to date, only addressed a small portion of the watershed. Low summer flows are affected by the same factors that affect peak flows, but are more directly affected irrigation withdrawals from the stream and associated aquifers. Programs have addressed irrigation efficiency on some but not all farms. They have addressed conveyance efficiency on the Wolf Run Ditch, but not the Orchard Ridge Ditch. Few if any efficiency programs have resulted in instream water rights.				

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Manage irrigation return flow to reduce extreme stream temperatures	1-Fifteenmile(Underhill return diversion)	Altered stream temperatures, degraded water quality	Water withdrawals	Abundance, productivity	Fry dispersal and rearing	Excessive summer temperatures have been identified as a major limiting factor for Fifteenmile Creek. Temperatures often approach or exceed lethal levels for salmonids in some of the subbasin.
Minimize unnatural factors that lead to fluctuations in dissolved oxygen levels	1-Fifteenmile Cr. (Mouth to FS boundary) 1-Ramsey Cr. (Mouth to new FS boundary) 1-Eightmile Cr. (Hwy 197 to FS boundary) 1-Fivemile Cr. (Mouth to FS boundary) 2-Dry Cr.(Mouth to headwaters) 2-Mill Cr.(Mouth to North Fork) 2-North Fk. Mill Cr. (mouth to FS boundary)	Depleted oxygen		Abundance, productivity	Fry dispersal and rearing	Warm temperatures reduce the dissolved oxygen capacity of the water.
Reduce chemical pollution inputs	1-Fifteenmile Cr. (Mouth to FS boundary) 1-Ramsey Cr. (Mouth to new FS boundary) 1-Eightmile Cr. (Mouth to FS boundary) 1-Fivemile Cr. (Mouth to FS boundary) 2-Dry Cr.(Mouth to headwaters) 2-Mill Cr.(Mouth to North Fork)	Chemical pollution	Pesticides, fertilizers, herbicides, vehicle hydrocarbons, etc.	Abundance, productivity		Amounts of chemical pollution reaching streams are unknown and need to be determined. Widespread use of chemicals is common in agricultural practices near streams. Reduced streamflow may accentuate pollution.
Implement Agricultural Water Quality Management Plan	1-Fifteenmile Cr. (Mouth to FS boundary) 1-Ramsey Cr. (Mouth to new FS boundary) 1-Eightmile Cr. (Hwy 197 to FS boundary) 1-Fivemile Cr. (Mouth to FS boundary) 2-Dry Cr.(Mouth to headwaters)	Degraded upland processes, altered hydrology, water quality, altered sediment routing	Land conversion and agricultural practices	Abundance, productivity	Fry dispersal and rearing	Recent conservation measures have greatly reduced sediment inputs; however, sedimentation remains elevated beyond historic conditions. Fifteenmile and Ramsey creeks are on the 303(d) list for sedimentation and EDT modeling identified sedimentation as a key factor limiting steelhead production.
Continue TMDL monitoring	Population wide	Degraded water quality, sediment routing	Land use practices, water withdrawals, pesticides, fertilizers, herbicides	Abundance, productivity	All	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Manage irrigation return flow to reduce extreme stream temperatures	ODEQ, OWR, SWCD	Ongoing	Basinwide	Ongoing	0-5 years	High
Minimize unnatural factors that lead to fluctuations in dissolved oxygen levels	ODEQ, SWCD, FSA, NRCS, ODFW	Ongoing		Ongoing	0-5 years	Moderate
Reduce chemical pollution inputs	ODEQ, WyEast RC&D, others	Ongoing		Ongoing	0-5 years	Moderate
Implement Agricultural Water Quality Management Plan	ODA, SWCD	Ongoing	Basinwide	Ongoing	Variable	High
Continue TMDL monitoring	USFS, ODFW, SWCD, ODEQ	Ongoing	Basinwide	Ongoing	Immediate	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
Wasco Co. SWCD, OWEB, Irrigators	Irrigation conveyance efficiency	Population wide	No	Piping open ditches and other efficiency projects will decrease irrigation demand on streams. Program could be expanded to many additional irrigators.
ODEQ	TMDL Development	Population wide		See Oregon State Agency's programmatic review.
ODEQ, Wasco Co. SWCD, ODFW, USFS	Temperature TMDL Implementation Monitoring	Fifteenmile Creek	No	Continuation of existing level of monitoring efforts, could be expanded. Funding may not be sufficient.
ODEQ, ODA, Wasco SWCD, USFS	Sedimentation Monitoring (TMDL Development and Implementation)	Fifteenmile Creek		See Oregon State Agency's programmatic review.
ODEQ, WyEast RC&D, others?	Toxics monitoring (program doesn't actually exist yet….)	Population wide		See Oregon State Agency's programmatic review.
ODA	Agricultural Water Quality Management Plan	Private agricultural lands		See Oregon State Agency's programmatic review.
WyEast RC&D	IFPnet	Fifteenmile and Mill Creek	No	Program needs expansion to assist agriculture with reducing chemical demand.
Wasco Co. SWCD	No-till conversion, watershed restoration	Uplands population wide	No	Program has proven effective at reducing erosion, but additional lands could be enrolled.
Wasco County SWCD/USDA FSA	CREP, CRP	Private riparian areas and qualified uplands throughout MaSA and MiSA	No	Both programs are effective at protecting riparian areas and uplands, however additional lands need to enrolled. CRP program is near capacity for Wasco county. Some landowners reluctant to enter the federal programs.
CTWSRO	Watershed Restoration	Reservation lands	No	Various programs designed to improve riparian, stream, and upland conditions along tribal lands. Additional restoration and protection efforts are needed.
ODF	Oregon Forest Practice Act	Private and state forestlands in Fifteenmile, Eightmile, Ramsey, and Fivemile creeks		See Oregon State Agency's programmatic review.
ODFW	Fifteenmile Creek Fish Habitat Restoration Project	Private lands throughout Fifteenmile MaSA.	No	Positive results where the program has been implemented, but funding and landowner cooperation limits the amount of available projects. In addition, limited legal guarantees that landowners remain in program.
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				

Strategy 8. Restore degraded upland processes to minimize unnatural rates of erosion and runoff, and maintain unimpaired natural upland processes.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Achieve 95% conversion to no till farming	Fifteenmile Creek Subbasin uplands	Altered hydrology, sediment routing	Upland land use practices, loss of water storage capacity	Abundance, productivity	All	Over half of the agricultural land in the watershed has been converted to direct seed/no till, leaving 50,000-60,000 acres that could be converted (NPCC 2004).
Convert to perennial crops/vegetation		Altered hydrology, sediment routing	Upland land use practices, loss of water storage capacity	Abundance, productivity	All	
Develop Integrated Fruit Production (IFPnet) plans	Orchard lands throughout subbasin	Water quality, hydrology, sediment	pollution	Abundance, productivity	All	
Upgrade or remove problem forest roads	Forest lands	Altered hydrology, sediment routing	Road network	Abundance, productivity	All	
Promote fuel management	Private and federal forest lands	Altered hydrology, sediment	Conversion of Vegetative communities	Abundance, productivity	All	
Initiate demonstration projects	Basinwide	Altered hydrology, sediment routing	Upland land use practices	Abundance, productivity	All	
Employ BMPs to minimize unnatural rates of erosion	Population wide	Altered hydrology, sediment routing, water quality	Upland land use practices, erosion, loss of water storage capacity	Abundance, productivity	All	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Achieve 95% conversion to no till farming	SWCD	Existing program	Croplands, MaSAs	Ongoing (completed by 2012)	Reduce runoff, sediment supply, immediate increase in base flow	High
Convert to perennial crops/vegetation	SWCD	Develop new program	Uplands	Ongoing	Reduce runoff, sediment supply immediately	High
Develop Integrated Fruit Production (IFPnet) plans	WyEast RC&D	Existing effort	Orchard lands through subbasin	Ongoing	Reduce chemical pollution immediately	High
Upgrade or remove problem forest roads	USFS, ODF, private forestland owners	Expansion of existing project	USFS lands	Long term	Variable depending on individual treatment (5-20 yrs)	Moderate
Promote fuel management	USFS, ODF, private forestland owners	Expansion of existing project	USFS lands	Long term	Variable depending on individual treatment (5-20 yrs)	Moderate
Initiate demonstration projects	SWCD, ODA, OSU extension	Ongoing	Basinwide	Ongoing	Variable lag time depending on action taken	Unknown
Employ BMPs to minimize unnatural rates of erosion	SWCD, USFS, ODA, CTWSRO, private landowners	Ongoing	High dispersal downstream	Intermediate	Up to 15 years	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, no, uncertain)	Needs Expansion
Wasco County SWCD/USDA FSA	CREP, CRP	Private riparian areas and qualified uplands throughout MaSA and MiSA	No	Both programs are effective at protecting riparian areas and uplands, however additional lands need to enrolled. CRP program is near capacity for Wasco county. Some landowners reluctant to enter the federal programs.
Wasco Co. SWCD	No-till conversion, watershed restoration	Uplands population wide	No	Program has proven effective at reducing erosion, but additional lands could be erolled.
ODF	Oregon Forest Practice Act	Private and state forestlands in Fifteenmile, Eightmile, Ramsey , and Fivemile Creek		See Oregon State Agency's programmatic review.
USFS	Fifteenmile River Keeper, PacFish/InFish	USFS lands on Fifteenmile, Ramsey, Eightmile, Fivemile, Mill Creeks.	No	Positive results where the program has been implemented, but it could be expand to more forest lands in the population, and become more available off forest lands.
ODA	Agricultural Water Quality Management Plan	Private agricultural lands		See Oregon State Agency's programmatic review.
OSU extension	Various	Private agricultural lands	No	Provide education and outreach information. Program could be expanded to be more effective.
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				

Table 17-6c. Habitat Management Strategies and Actions for Middle Fork John Day River Steelhead Population

Primary limiting factors: degraded channel structure and complexity (habitat quantity and diversity), degraded floodplain function and connectivity, altered sediment routing, altered hydrology, and water temperature.

Primary threats: riparian disturbance, stream channelization and relocation, grazing, timber harvest, road building, passage barriers, irrigation withdrawals, mining, and dredging.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Protect high quality habitats through acquisition or conservation easements	Upper reaches of Big, Big Boulder, and Granite Boulder crs that originate in the Vinegar Hill-Indian Rock Scenic Area (1); Other areas with high potential for protection once they are restored include the Middle Fork mainstem from Ragged Cr to the upper end of Phipps Meadow (2), and streams that drain the north side of Dixie Butte -- Davis (2), Butte (2), Placer Gulch (2), and Greenhorn (2) crs.	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing	Many threats including livestock overgrazing of riparian area, channelization, stream bank armoring, agricultural practices (fertilizers, herbicides, sediments, changes in plant communities), water withdrawals, loss of beaver dams	Productivity, abundance	All	Protecting base stream flows from further appropriations is a very important function of protecting existing high quality habitats. Protection of high quality habitats is the most cost effective way of ensuring fish have good quality habitat. Land acquisitions, easements, and cooperative agreements may also facilitate the implementation of active restoration projects.
Adopt and manage Cooperative Agreements	Middle Fork between Placer Gulch and Caribou Cr (1); through Phipps Meadow (1), from Ragged to Tincup Cr (1), from Paradise Canyon to below Lick Cr.(2), Granite Cr (2)	Same as above	Same as above	Production, abundance	All	
Special management designations in forest and BLM plans	Riparian Habitat Conservation Areas identified in existing Forest Plans	Same as above	Same as above	Production, abundance	All	
Designate additional wilderness and wild and scenic status	Public lands identified in the Forest Plan Revision process	Same as above	Same as above	Production, abundance	All	
Protect and conserve rare and unique functioning habitats	Phipps Meadow (1)	Same as above	Same as above	Productivity, abundance	All	It is much less expensive over the long term to protect high quality habitat than it is to degrade the habitat and then try to restore it.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Protect access to key habitats	None identified at this time, although ODFW periodically reviews proposals that could block passage into spawning and rearing habitat.	Passage barriers, altered hydrology, channel structure	High water temperatures, low flow, channelization	Productivity, Abundance, distribution		Thoroughly review projects that may block fish passage. Current ODFW policy is to grant exemptions from fish passage requirements only if mitigation meets or exceeds the loss of habitat. Exemptions must be approved by the Fish and Wildlife Commission
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	All MaSAs and MiSAs	All	Same as in first cell above	Productivity, abundance	All	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Protect the highest quality habitats through acquisition or conservation easements	CTUIR, TNC, RMEF, John Day Basin Trust, SWCDs	Ongoing	Water quality improvement have high dispersal downstream, stream corridor and function improvements would be confined to the specific site	Existing conservation agreements are complete. Full implementation of conservation measures will take 5-15 years or more	5-15 years with passive restoration approaches	High, based on previous cooperative agreements
Protect and conserve rare and unique functioning habitats	Land trusts, CTWSRO, ODFW, SWCD, NGOs, USFS	Ongoing	Same as above	Existing conservation agreements are complete. Full implementation of conservation measures will take 5-15 years or more	5-15 years with passive restoration approaches	High, based on previous cooperative agreements
Adopt and manage Cooperative Agreements	ODFW, SWCDs, FSA	Ongoing	Same as above	Agreements are for 10 to 15 years	Immediate	High, although not in perpetuity
Special management designations in forest and BLM plans	USFS, BLM	Ongoing as identified	Same as above	Subject to Forest Plan Revision timeframe for designation	Immediate	High, although subject to change from Forest Plan or mgmt plan revision
Designate additional wilderness and wild and scenic status	Public lands identified in the Forest Plan Revision process	Same as above	Same as above	Intermediate, depending on socio-political acceptance	5-15 years	High if designated
Protect access to key habitats	ODFW, USFS, BLM, Watershed Councils, SWCD's	Ongoing	Same as above	Immediate	Immediate	High
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	NRCS, SWCDs, USFS, ODFW, DOF, BLM, ODOT, CTWSRO, ODA, FSA, private landowners	Ongoing	All MaSAs and MiSAs	Long term	5-15 years	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
USFS and BLM	Wilderness Areas, Wilderness Study Areas, Wild and Scenic River corridors, Special Management designations, PACFISH and INFISH		Yes, areas designated PACFISH and INFISH standards are good , but implementation is inconsistent between forests	Yes
ODFW	Cooperative Agreements		No	Yes, the agreements are for only 10-15 years
FSA	CREP		No	Yes, the agreements are for only 10 or 15 years
NGOs	Lease or purchase of lands or instream water rights		Yes	Yes, important to secure critical habitat and/or water rights
ODA	Agricultural Water Quality Management Plan			See Oregon State Agency's programmatic review.
CTWSRO	Watershed Restoration			Yes
ODF	Oregon Forest Practice Act			See Oregon State Agency's programmatic review.
Local Government	City and County Planning and Zoning			Yes

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

The John Day River has 248.6 miles designated as Federal Wild and Scenic River and 317 miles designated as State Wild and Scenic. State designated reaches include the Middle Fork John Day River from its mouth to Crawford Cr Bridge (RM 71). The Indian Rock Vinegar Hill Scenic Area in the Malheur and Umatilla National Forests is managed primarily for its scenic values, which offers good protection for watershed and fish habitat parameters.

Existing forest plans include special management designations for riparian habitat conservation areas (RHCA's). The forest plans and BLM plans have been amended by PACFISH and INFISH, both of which require 300-foot buffers on any fish bearing stream for tree removal, as well as specific guidelines for livestock grazing and riparian vegetation use. Compliance with the 300-foot buffer for timber harvest operations has been very good, however the interpretation and implementation of the grazing guidelines has been inconsistent between National Forests. Forest practices rules for private and state owned forest lands have guidelines for protection of riparian function, however they are less restrictive than those on federal lands. Adding additional wilderness areas and wild and scenic river segments will require designation by Congress. Designating additional RMA's or adding to the current restrictions within RHCA's will be revisited during the Forest Plan Revision process that is currently underway.

Cooperative and conservation agreements on private land are tools for protecting high quality habitats. ODFW has used cooperative agreements over the last 21 years to protect riparian corridors that have been fenced to exclude livestock grazing. Unfortunately those agreements are for only 15 years and there have not been funds or personnel needed to extend them for longer time periods. Over 120 miles of stream throughout the basin have been protected under this program. Additional opportunities will be limited by availability of funds and by willingness of landowners to sign conservation easements and/or agreements.

Conservation agreements and acquisitions by conservation organizations are another recently used tool that can protect high quality habitat. The Middle Fork John Day River has five parcels with conservation easements or conservation organizations as the owners. A perpetual riparian conservation agreement restricting development and grazing is currently in place on a 310 acre private parcel in the Middle Fork near river mile 40. Another conservation property is the Nature Conservancy Dunstan Preserve (approx. 1,200 acres) near RM 50. It is managed primarily for fish benefits. The Oxbow Conservation Area (1,022 acres) and the Forrest Conservation Area (approx 867 acres) both owned by the Confederated Tribes of the Warm Springs Reservation of Oregon are managed as mitigation for the loss of fish and wildlife habitat associated with hydroelectric development on the Columbia River. Another privately owned parcel has a perpetual water lease agreement to prevent water withdrawals after July 20, which will result in approximately 10 cfs being left in the stream, primarily for the benefit of salmon and steelhead.

NRCS programs that protect riparian areas and upland watersheds include the Conservation Reserve Program (CRP) and the Conservation Reserve Enhancement Program (CREP). The CRP program pays landowners not to farm highly erodible soils and the CREP program pays landowners for setting riparian corridors aside from grazing and farming. The long term effectiveness of both programs is limited by the relatively short duration of the contracts which ranges from 10 to 15 years.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain unimpaired passage and connectivity.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Remove or minimize use of push up dams	Long Cr and tributaries (1)	Impaired fish passage	Push up dams	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	Annual maintenance and construction of push up dams contributes to onsite and downstream channel stability, loss of pools and other structure, and increased sediment loads.
Remove or replace barriers blocking passage such as dams, road culverts and irrigation structures	Irrigation or water storage related issues: Long Cr and tributaries (1) Culverts: Camp (2), Long (1), Vinegar (2), Butte (1), Crawford (2), Granite Boulder (1), and Little Boulder (1) crs	Impaired fish passage	Dams, culverts, instream structures	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	Push up irrigation dams, concrete diversions, in-channel stock ponds, and road culverts are located throughout the entire basin. Passage problems at culverts are widespread throughout all subbasins.
Construct ladders over existing permanent concrete or earth fill dams	None identified	Impaired fish passage	Dams	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	A comprehensive survey of all barriers has not been completed, BOR has completed an aerial survey, but has not field verified the potential barriers identified in the aerial survey.
Replace screens that do not meet criteria	Beaver (2), Big, Butte (2), Granite Boulder (2), Long (1), MF John Day (1)	Impaired fish passage	Irrigation diversions	Abundance, productivity, spatial structure	Emergent fry	All known diversions in the Middle Fork are currently screened. Most screens within the Middle Fork population boundaries have been replaced to address new criteria to reduce entrainment of emergent fry and bull trout.

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Remove or minimize use of push up dams	SWCD	Ongoing	Provide access to upstream habitat	Ongoing, but all push up dams not expected to be corrected for at least 15 years. A comprehensive survey has not been completed.	Immediate	High, if comply with fish passage design criteria
Remove or replace barriers blocking passage – dams, road culverts and irrigation structures	USFS, BLM, watershed councils, SWCDs, ODOT	Ongoing	Access to upstream habitat	Ongoing, replacing all culverts blocking fish passage expected to take 20 years. (see appendix --)	Immediate	High, if comply with fish passage design criteria
Construct ladders over existing permanent concrete or earth fill dams	ODFW, SWCDs	Ongoing	Provide access to upstream habitat	Ongoing, providing passage at all diversion and pond barriers will take many years.	Immediate	High if comply with fish passage design criteria
Replace screens that do not meet criteria	ODFW	Ongoing	At point of diversion	Approximately 14 diversions need to be replaced, should take – years	Immediate	High if comply with fish passage design criteria

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
Soil and Water Conservation Districts	Irrigation dam improvements, culvert replacement or retrofits		Yes in some areas, no in others	The Grant Soil and Water District is constrained by the construction window of opportunity. Other counties could expand the program but are constrained by funding and personnel
ODFW	Fish Passage/Screening		No	The program completes a minimum of one project per year, but is dependent upon landowner cooperation and limited funding
USFS and BLM	Culvert replacement		No	Yes
Watershed Councils	Road Crossing Passage improvements, passage improvements		No	Yes
ODOT	Culvert replacement or retrofit			See Oregon State Agency's programmatic review.
BOR	John Day Basin Program		Yes	No
CTWSRO	John Day Basin Program		No	Yes, the tribe contracts with Soil and Water Districts to assist with consultation, permits, and monitoring

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

Most of the mainstem passage problems have been addressed, but there are many tributaries where adult passage is blocked and more areas where juvenile passage problems occur. Irrigation dams, stock ponds, and road culverts are the primary causes of passage issues. Soil and Water Districts are correcting passage at irrigation diversions and improperly installed culverts, but are constrained by funding and by personnel needed for construction oversight. An inventory of road crossings on state and county roads in 1999 indicated 14 culverts on state owned roads and 4 culverts on county owned roads did not meet fish passage criteria within the Middle Fork population boundary. Appendix A presents an inventory of culverts with known passage problems on state or county owned roads. Some culverts have been replaced with structures that do meet the fish passage criteria, but much work remains. Watershed councils and ODOT, who are the principal entities working on culverts are constrained primarily by funding. An inventory of road crossings on federal lands indicates juvenile passage problems are pervasive, particularly on National Forests, with approximately 300 culverts not meeting passage criteria on just the Malheur National Forest. The US Forest Service and BLM are constrained primarily by funding and the personnel needed for NEPA analysis. At the current rate of culvert replacements, it will take over 50 years to correct all passage problems on National Forests. Another constraint is that existing state laws do not require passage improvements at existing barriers unless there is a major change in the structure, such as reconstruction or significant modifications, so landowner cooperation is critical for improving passage throughout the basin.

US Bureau of Reclamation is required in the Columbia River Biological Opinion to identify and assist with passage improvement design and flow restoration.

Currently, the ODFW Fish Passage and Screening program replaces about 20 irrigation diversion screens per year. With over 120 diversions in the John Day Subbasin that either do not meet current screening criteria or are unscreened, it would take at least 6 years to replace them all. Of the 120 diversions, 75 have screens that do not meet NOAA screening criteria. Currently, highest priority is given to diversions that are unscreened with lower priority given to diversions that have screens, but do not meet the criteria. The program is constrained primarily by funding and personnel. Current law does not require water users to screen diversions less than 30 cubic feet per second and virtually all diversions in the John Day are less than 30 cfs, so landowner cooperation is essential to success of the program.

Strategy 3. Restore floodplain connectivity and function and maintain unimpaired connectivity and function.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Reconnect floodplains to channels	Upper mainstem Middle Fork from Big Cr upstream to Idaho Cr (1), Lower Vinegar (2), Vincent (2), and Long (1) crs	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity	Primarily, fry and 0+	
Reconnect side channels and off-channel habitats to stream channels	Upper mainstem Middle Fork from Big Cr upstream to Idaho Cr (1), Lower Vinegar (2), Vincent (2), and Long (1) crs	Degraded floodplain, altered hydrology	Removal of side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity, spatial structure	Primarily, fry and 0+	There has been a loss of off-channel and side-channel habitats that once provided habitat for spawning and rearing, and refugia from high flows.
Restore wet meadows	Long Cr (2), Phipps Meadow (1), Middle Fork between Ragged Cr and Phipps Meadow (1), Flood Meadow (2), Keeney Meadow (2), Camp Cr (1) Coxie Meadow (2)	Degraded floodplain, altered hydrology	Removal of wetlands	Abundance, productivity	Primarily, fry and 0+	
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	Upper mainstem Middle Fork from Big Cr upstream to Idaho Cr (2), Lower Vinegar (2), Vincent (2), and Long crs (1), Camp Cr (1), Placer Gulch (1), Davis Cr (1), Indian Cr (2)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat	Abundance, productivity, spatial structure	Primarily, fry and 0+	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Reconnect floodplain to channel	ODFW, watershed council, SWCD, USFS, BLM	Ongoing	For the treated stream reach	Short term, once identified	Physical response will be immediate, biological response may take 5-10 years	High
Reconnect side channels and off-channel habitats to stream channels	ODFW, watershed council, SWCD, USFS, BLM, CTUIR	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Long term, because of widespread need	5-15 years, depending upon frequency and duration of channel altering flows	Moderate, depending upon how extensive the project is and frequency and duration of channel altering flows
Restore wet meadows	TNC, USFS, CTWSRO	Ongoing and planned	Benefits of improved channel morphology localized, improved water table and resulting increased stream flow and lower water temperatures have high dispersal downstream	Intermediate	5-15 years	Moderate
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	ODFW, CTWSRO, USFS, BLM	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Long term, due to acceptance by landowners and widespread need	Within 5 years once the dams are built	Moderate-high, dependent upon acceptance by landowners

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
ODFW	BPA Habitat Program		No	Yes, if specific needs cannot be addressed by passive restoration techniques
USFS, BLM	Stream enhancement program		Yes in some areas, no in others	Possibly
Watershed Councils	Watershed restoration		Dependent upon need and funding	Only if specific needs cannot be addressed by passive restoration techniques
Soil and Water Conservation Districts	Watershed restoration		Dependent upon need and funding	Only if specific needs cannot be addressed by passive restoration techniques
Nature Conservancy and other NGOs	Restoration projects		Yes	Yes
CTUIR	Watershed restoration			Yes
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				
Instream activities have not been identified as a high priority by the recovery planning team or the subbasin plan team except when identified as a need for specific sites. The planning team prefers that more passive approaches, such as riparian and upland improvements be emphasized. Typically, instream activities would include placement of rootwads, whole trees, or boulder clusters to improved habitat complexity and habitat diversity where those parameters are deficient and not expected to improve with passive restoration.				

Strategy 4. Restore degraded channel structure and complexity and maintain unimpaired structure and complexity.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Restore natural channel form	Upper mainstem Middle Fork from Big Cr upstream to Idaho Cr (1), Lower Vinegar (2), Vincent (2), and Long (2) crs Channel reconfiguration work needed: mouth of Granite Boulder Cr to Ragged Cr (1), between Big Boulder Cr and Camp Cr (1), between Elk Cr and Bear Cr (2), and near the mouth of Mosquito Cr (1); Rush Cr (2)	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature, flows	Stream channelization, bank armoring, large wood removal, beaver removal, removal of riparian vegetation, livestock overgrazing in riparian areas	Abundance, productivity	Primarily, fry and 0+	Passive restoration techniques, such as riparian fencing, are the preferred method for improving channel structure and stability. More active restoration techniques may be appropriate in these reaches. Historic dredge mining in several reaches of the mainstem Middle Fork between Caribou Cr and Mosquito Cr has simplified the stream channel. The North Fork Watershed Council is working with a landowner to restore channel sinuosity on Rush Cr.
Place stable wood and other large organic debris in streambeds	Upper mainstem Middle Fork from Big Cr upstream to Idaho Cr (1), Lower Vinegar (2), Vincent (2), and Long (2) crs; Big Boulder Cr (1), Rush Cr (2)	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	Large wood removal channelization	Abundance, productivity	Primarily, fry and 0+	More active restoration techniques, such as rootwad placement or channel reconfiguration, may be appropriate in these reaches.
Stabilize streambanks	Upper mainstem Middle Fork from Big Cr upstream to Idaho Cr (1),Lower Vinegar (2), Vincent (2), and Long (2) crs	Degraded channel structure and complexity, habitat diversity, sediment routing, flows	Stream channelization, berming, bank armoring, overgrazing in riparian areas	Abundance, productivity	Primarily eggs, fry and 0+	Some bank erosion is inevitable and beneficial. However, where erosion is actively taking place due to unnatural processes, stabilization may be needed to reduce fine sediments

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Restore natural channel form	ODFW, SWCDs, USFS, BLM, watershed councils	Ongoing and planned	For the treated stream reach	Short term, once identified	Physical response will be immediate, biological response may take 5-10 years	High
Place stable wood and other large organic debris in streambeds	ODFW, USFS, watershed councils, BLM, SWCDs	As needed	For the immediate stream reach	Once identified, short term	Immediate	High
Stabilize streambanks	ODFW, USFS, watershed councils, BLM, SWCDs	Ongoing	For the treated stream reach, physical benefits dispersed downstream	Passive stabilization techniques are referred and take longer to implement	With passive restoration the response may take 15 years	Medium to high, depending upon the extent of the treatments

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, no, uncertain)	Needs Expansion
ODFW	BPA Habitat Program		No	Yes, if specific needs cannot be addressed by passive restoration techniques
USFS, BLM	Stream enhancement program		Yes in some areas, no in others	Possibly
Watershed Councils	Watershed restoration		Dependent upon need and funding	Only if specific needs cannot be addressed by passive restoration techniques
Soil and Water Conservation Districts	Watershed restoration		Dependent upon need and funding	Only if specific needs cannot be addressed by passive restoration techniques
CTWSRO	Watershed restoration			
NGOs	Watershed restoration			
*Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Instream activities have not been identified as a high priority by the recovery planning team or the subbasin plan team except when identified as a need for specific sites. The planning team prefers that more passive approaches, such as riparian and upland improvements be emphasized. Typically, instream activities that would improve floodplain function and channel migration processes would include placement of rootwads, whole trees, or boulder clusters to improved habitat complexity and habitat diversity where those parameters are deficient and not expected to improve with passive restoration. Another structural activity would be to construct boulder or log weirs to raise the water table, but only where a passive approach has not worked.				

Strategy 5. Restore riparian condition and LWD recruitment and maintain unimpaired conditions.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural riparian vegetative communities	Mainstem Middle Fork John Day between Crawford and Bridge crs (1), between Horse and Camp crs (1), below Highway 395 (2); and Long (1), Slide (2), Eightmile (2), Sixmile (2), Twelvemile (2), Granite (2), Camp (!), and Crawford (2) crs	Degraded riparian area, channel structure and complexity, floodplain degradation, altered hydrology, sediment, water quality	Overgrazing of riparian area, channelization, stream bank armoring, tree harvest in riparian areas, changes in plant communities (including invasive plants), loss of beaver dams	Abundance, productivity	Primarily fry and 0+	Primary methods of riparian enhancement include riparian corridor fences to exclude livestock, changes in grazing management that promote riparian recovery, and planting of native shrubs.
Develop grazing strategies that promote riparian recovery	Mainstem Middle Fork John Day between Crawford and Bridge crs (1), between Horse and Camp crs (1), below Highway 395 (2); and Long (1), Slide (2), Eightmile (2), Sixmile (2), Twelvemile (2), Granite (2), Camp (!), and Crawford (2) crs	Same as above	Livestock overgrazing of riparian area	Abundance, productivity	Primarily fry and 0+	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Restore natural riparian vegetative communities	ODFW, Watershed Councils, SWCDs, USFS, BLM, CTUIR	Ongoing	Riparian function will be limited to specific reach; water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years, (see above)	High, based upon experience with existing grazing management and riparian recovery projects
Develop grazing strategies that promote riparian recovery	NRCS, AFS, USFS, BLM, SWCDs, ODFW, Watershed Councils, CTUIR	Ongoing	Riparian function will be limited to specific reach; water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years, depending upon grazing plan adopted. Riparian corridor fencing and removal of riparian grazing has the fastest recovery rate.	High, based upon experience with existing grazing management and riparian recovery projects

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
ODFW	BPA Habitat Program		No	Yes
SWCD's	Upland improvements, riparian improvements		Yes in some areas, no in others	Yes
Watershed Councils	Upland improvements, riparian improvements		No	Yes
USFS and BLM	Upland improvements, riparian improvements		No	Yes
NRCS	Upland improvements, riparian improvements		Yes	No
ODA	Agricultural Water Quality Management Plans (AgWQM)			See Oregon State Agencie's programmatic review.
CTUIR	Watershed restoration			Yes
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				
In the last 20+ years ODFW, Watershed Councils, NRCS and Soil and Water Districts have implemented hundreds of miles of riparian improvements on private lands, primarily through construction of riparian corridor fences that exclude livestock grazing and development of off channel watering devices. Public land managers have implemented PACFISH and INFISH standards for protection and restoration of USFS and BLM lands. Even though hundreds of miles of riparian improvements have been completed there are nearly 2,800 miles of stream occupied by steelhead within the John Day River Basin and hundreds more miles of tributaries to these streams If only 10% of the stream reaches are degraded (which is probably low), it will take over 35 years to treat them if agencies proceed at the current rate. Overgrazing of riparian areas by livestock continues, however it is not as widespread as historically. Interest by private landowners and public land managers in riparian improvement remains high. Other projects that have been well accepted and will improve riparian condition are restoring historic cover types by removing juniper, reintroducing fire, enrollment into CREP, and control of invasive/noxious plants. Primary constraints on implementing additional projects for more riparian improvements are funding and personnel needed for planning, promotion, education of landowners, and implementation.				

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Implement agricultural water conservation measures	Long Cr and its tributaries (1); Mainstem Middle Fork, Coyote Cr. To Camp Cr. (2)	Altered hydrology, low flows, high temperatures	Water withdrawals, land conversion on uplands, road network	Abundance, productivity	Fry and 0+	Most other sections of the Middle Fork with consumptive water rights are now under conservation agreements.
Improve irrigation conveyance and efficiency	Long Cr and its tributaries (1); Mainstem Middle Fork, Coyote Cr. To Camp Cr. (2)	Low flows, high temperatures	Water withdrawals, loss during conveyance	Abundance, productivity	Fry and 0+	
Increase pool habitat (beaver ponds)	Long Cr and its tributaries (1), Camp (1), Crawford (1), Deerhorn (2), Davis (2), Placer Gulch (2), Granite (1), Rush (2), Twelvemile (2), Slide (1), Sixmile(2), Squaw (1), Idaho (1), Lick (2), Mainstem Middle Fork, Coyote Cr. To Camp Cr. (2)	Altered hydrology, low flows, high temperatures	Loss of wet meadows			
Floodplain aquifer recharge	Granite Boulder Cr (1)	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Fry and 0+	Pilot project with CTWSRO.
Lease or acquire water rights and convert to instream	Long Cr and its tributaries (2); Mainstem Middle Fork, Coyote Cr. To Camp Cr. (1)	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Fry and 0+	
Monitor/regulate water withdrawals	All MaSAs	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Fry and 0+	annual fluctuations in flow levels are intensified by irrigation withdrawals

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Implement agricultural water conservation measures	SWCD, watershed councils, NRCS	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and dependent upon landowner willingness to participate and availability of projects	Immediate	High, if the saved water is protected from being appropriated to a downstream user
Improve irrigation conveyance and efficiency	SWCD, OWEB, watershed councils, NRCS, landowners	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and dependent upon landowner willingness to participate and availability of projects	Immediate	High, if the saved water is protected from being appropriated to a downstream user
Increase pool habitat (beaver ponds)	SWCD, ODFW, CTWSRO, USFS	Ongoing	High dispersal downstream	Unknown	Immediate increase in instream flow	High
Floodplain aquifer recharge	CTWSRO, SWCDs	Planned, some ongoing	Potentially high dispersal from recharge project site downstream for many miles	Long term, although opportunities for pilot projects is dependent upon willing landowner	Immediate	High, if the additional water is protected from being appropriated to a downstream user

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Lease or acquire water rights and convert to instream	ODWR, Oregon Water Trust, others	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and highly dependent upon landowner willingness to lease.	Immediate	High, if the leased water is protected from being appropriated to a downstream user
Monitor/regulate water withdrawals	ODWR	Ongoing	Point of diversion downstream to mouth of John Day River	Long term, dependent upon ODWR enforcing the requirement to measure water usage	Immediate	High if water use reporting and requirement for measuring devices is enforced

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
ODFW	BPA Habitat Program, riparian improvements		No	Yes
OWRD	Stream Flow Monitoring and Regulation			See Oregon State Agencie's programmatic review.
Oregon Water Trust and BOR	Leasing and Purchase of Water Rights		No	Yes
Soil and Water Conservation Districts	Improve irrigation efficiency, upland improvements, riparian improvements		Yes in some areas, no in others	Yes
Watershed Councils	Upland improvements, riparian improvements		No	Yes
NRCS	Upland improvements, riparian improvements		No	Yes

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

Riparian improvements alone have been documented to improve base stream flows as well as a variety of other habitat parameters. Primary constraints on more riparian improvements are personnel and funding. Many landowners have converted from flood to sprinkler or gated pipe irrigation, which makes more efficient use of the water and grows more palatable forage but there has not been an effective mechanism to protect saved water from being used by another irrigator downstream. Water measuring devices are just beginning to be required on irrigation withdrawals and while progress is being made there is considerable resistance from irrigators. Extensive work by Watershed Councils and NRCS has concentrated on preventing erosion of valuable topsoil by terracing wheat fields, building small sediment retention basins, enrollment of highly erodible soils into the CRP program, and using no-till planting techniques, all of which increases precipitation infiltration rates and reduces the rate of runoff. Flow are also improving through restoration of historic cover types by removing juniper, reintroducing fire, enrollment into CRP, and control of invasive/noxious plants. Primary constraints on implementing additional projects are funding, instream water rights that are junior to most irrigation rights, and water laws that sometimes conflict with conservation practices.

The Oregon Water Trust has made good progress at restoring flows in the Middle Fork with a total of over 20 cfs of water being converted to instream flow and water leases for another approximately 11 cfs on various streams throughout the basin.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Increase riparian shading	Mainstem: between Crawford and Caribou crs (1), between Tincup and Ragged crs (1), between Balance and Camp crs (1), below Highway 395 (2); Long Cr and tributaries (1); Indian Cr (2), Twelvemile (2), Sixmile (2) and Slide (2) crs	High water temperatures	Degraded riparian forests	Abundance, productivity	Fry, and 0+	Elevated water temperatures are the result of reduced riparian vegetation and loss of floodplain function (wet meadow storage). Elevated water temperature is a pervasive water quality problem for the Middle Fork John Day River population, with 21 stream reaches listed as water quality limited. Additional reaches would probably be listed is water temperature data was available.
Manage return flow to reduce extreme stream temperatures	Mainstem: between Highway 7 and Caribou Cr (1), and between Horse and Camp crs (2); Long Cr (1)	High water temperatures	Water withdrawals	Abundance, productivity	Fry, and 0+	
Reduce chemical pollution and nutrient inputs	None identified at this time	Chemical pollution	Pesticides, fertilizers, herbicides, vehicle hydrocarbons, etc.	Abundance, productivity	Fry, and 0+	Using more efficient irrigation methods should result in fewer nutrients from pastures reaching the John Day River. Although the Middle Fork has been extensively impacted by historic mining activity, there are no known contamination issues.
Apply BMPs to animal feeding operations	Granite Cr (1)	Degraded water quality	Animal feed operations	Abundance, productivity	Fry, and 0+	
Continue TMDL monitoring	For sediment: Mainstem Middle Fork above Camp Cr (2), Long Cr and tributaries (1), Butte Cr (2), Indian Cr (2), and Slide Cr (2). For temperature: Mainstem: between Highway 7 and Caribou Cr (1), below Camp Cr (2); Long Cr (1); Indian Cr (2)	Degraded water quality, sediment routing	Land use practices, water withdrawals, pesticides, fertilizers, herbicides	Abundance, productivity	Eggs, fry, juveniles, adults	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Increase riparian shading	ODFW, Watershed Councils, SWCDs, USFS, BLM, CTUIR	Ongoing	water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years	High
Manage return flow to reduce extreme stream temperatures	SWCDs, watershed councils	Ongoing	Water quality improvement would have high dispersal downstream	Less than 5 years, once the project has been identified	Immediate	High, reduced temperatures has been well documented
Reduce chemical pollution and nutrient inputs	ODEQ, others	Ongoing		Ongoing	Reduce chemical pollution immediately	High
Apply BMPs to animal feeding operations	ODA	Ongoing	Water quality improvement would have high dispersal downstream	Some treatments could be done immediately. There are few animal feeding operations within the basin, only one of which has been identified as a problem	5-15 years	High, once a treatment has been agreed upon
Continue TMDL monitoring	USFS, ODFW, SWCD, ODEQ	Ongoing	Basinwide	Ongoing	Immediate	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, no, uncertain)	Needs Expansion
FSA	CREP, CRP		No	Yes
ODEQ	Mine Waste Program			See Oregon State Agencie's programmatic review.
ODA	Confined animal feeding operations (CAFO), AgWQM			See Oregon State Agencie's programmatic review.
ODEQ, ODA, SWCD, USFS	Sedimentation Monitoring (TMDL Development and Implementation)			See Oregon State Agencie's programmatic review.
*Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Low stream flows during the hottest part of the year exacerbate the already warm water temperatures. Opportunities for increasing stream flow through leasing of water rights, which often results in cooler water over a longer stream reach, are being pursued by Oregon Water Trust and US Bureau of Reclamation. Constraints for future projects include acceptance by landowners and a secure, long term funding source. Reducing water temperatures through the use of improved riparian vegetation and more efficient methods of irrigation may take several years to provide measurable results. Many projects that improve water quality by reducing irrigation return water have been completed.				

Strategy 8. Restore degraded upland processes to minimize unnatural rates of erosion and runoff, and maintain unimpaired natural upland processes.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore native upland plant communities	MaSAs; Middle Fork and north side tributaries below Highway 395 (1), Long Cr (1), Slide Cr (2)	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices, loss of water storage capacity	Abundance, productivity	Fry, and 0+	Upland improvements such as restoring native plant communities and controlling invasive weed species will improve precipitation infiltration rates and ultimately improve watershed health, including the hydrograph.
Upgrade or remove problem forest roads	Forest lands	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Road network	Abundance, productivity	Fry, and 0+	
Initiate demonstration projects	None identified	Same as above	Upland land use practices	Abundance, productivity	Fry, and 0+	
Manage vegetation, including juniper removal	MaSAs; Middle Fork and north side tributaries below Highway 395 (1), Long Cr (1), Slide Cr (2)	Altered hydrology, sediment routing	Invasive plants	Abundance, productivity	Fry, and 0+	
Employ BMPs to forest practices, livestock grazing, road management and agricultural practices	MaSAs; Middle Fork and north side tributaries below Highway 395 (1), Long Cr (1), Slide Cr (2)	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices	Abundance, productivity	Fry, and 0+	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Restore native upland plant communities	SWCD, USFS, BLM	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Long term	5-15 years	Moderate, depending upon which treatments are used to restore native plant communities, and whether appropriate short term restrictions on grazing are adopted
Upgrade or remove problem forest roads	USFS, BLM, DOF, ODOT	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, many forest roads have legacy issues with regard to sediment transport and routing of runoff. Decommissioning may take many years	5-15 years	Moderate, although funding on public lands and landowner cooperation on private lands will determine rate of treatment
Initiate demonstration projects	ODFW, NOAA Fisheries, USFWS, USFS, BLM, CTWSRO, Watershed Councils, SWCD's	Ongoing	Entire basin	Long term	Variable lag time	unknown, depends upon action taken as a result of being more informed
Manage vegetation, including juniper removal	USFS, BLM, NRCS, SWCD's, Watershed Councils	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Juniper control can be done quickly, other strategies such as control of invasive plants may take more than 20 years	5-30 years	Moderate
Employ BMPs to forest practices, livestock grazing, road management and agricultural practices	SWCD, VSFS, ODA, CTWSRO, private landowners	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, dependent on implementation of Agricultural Water Quality Management Plans	0-20,years, depending upon treatments applied	Moderate, dependent upon voluntary landowner participation

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
NRCS/Farm Service Agency	CRP		No	Yes
SWCDs	Juniper control		No	Yes
ODFW	Green Forage		No	Very small program
USFS	Forest Plan		No, due to limited funding	Yes
ODA	Agricultural Water Quality Management Plan			See Oregon State Agency's programmatic review.
CTUIR	Watershed Restoration			Yes

*Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
NRCS, SWCD and ODFW programs are relatively small, with the CRP program the largest and best funded. All the programs are limited by funding and, to a lesser extent, acceptance by landowners. CRP has been in existence for 20 years and has been one of the better farm subsidy programs for watershed restoration. Juniper control programs have focused on areas where extensive juniper encroachment has occurred. Juniper control can be completed using several different methods, including controlled burns, cutting with chainsaws, or by removing with bulldozers or trackhoes. Although controlled burns are probably the most effective at controlling the spread of juniper, they are the most difficult to implement because of the threat of the fire getting out of control and costs. Another drawback to controlled burns is that livestock grazing should be excluded from burned areas for at least two growing seasons after the burn to ensure full recovery of desirable perennial grasses. There are opportunities to expand the juniper control program but the lack of a pasture to put livestock into for two years after burning has limited its acceptance. The ODFW Green Forage program provides a wildlife seed mixture of native grasses and desirable forage to landowners who have recently completed juniper clearing projects, logging projects or other ground disturbing activities. The primary purposes are to provide additional forage for deer and elk and to reduce deer and elk damage; however it also has benefits to watershed health by providing grasses that provide perennial ground cover.

Table 17-6d. Habitat Management Strategies and Actions for Recovery of North Fork John Day River Steelhead Population

Primary limiting factors: Degraded channel structure and complexity (habitat quantity, diversity and channel stability), altered sediment routing, water temperature, altered hydrology, degraded floodplain function and connectivity.

Primary threats: riparian disturbance, stream channelization and relocation, grazing, timber harvest, road building, irrigation withdrawals, mining, and dredging.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Protect high quality habitats through acquisition or conservation easements	Tributaries of the North Fork John Day River within the NF John Day Wilderness (1); North Fork John Day River, from Big Cr upstream to headwaters (1); Granite Cr (2); South Fork Desolation Cr (1); upper Clear Cr (1); upper Hidaway Cr. (2)	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing,	Many threats including livestock overgrazing of riparian area, mining, channelization, stream bank armoring, agricultural practices (fertilizers, herbicides, sediments, changes in plant communities), water withdrawals, loss of beaver dams	Productivity, abundance	All	Protection of high quality habitats is the most cost effective way of ensuring fish have good quality habitat. It is much less expensive over the long term to protect high quality habitat than it is to degrade the habitat and then try to restore it. Land acquisitions, easements, and cooperative agreements may facilitate the implementation of active restoration projects.
Adopt and manage Cooperative Agreements	Cottonwood (1); Deer (1), and Rudio crs (2); North Fork John Day River, below Wall Cr (2)	Same as above	Same as above	Productivity, abundance	All	
Special management designations in forest and BLM plans	Recently acquired BLM parcels on the North Fork John Day River, between Monument and Camas Cr (1); areas identified in existing Forest Plans (2)	Same as above	Livestock overgrazing of riparian area, changes in plant communities	Production, abundance	All	
Designate additional wilderness and wild and scenic status	Those areas identified in the Umatilla National Forest Plan Revision and in the BLM Management Plan currently being developed (2)	Same as above	Livestock overgrazing of riparian area, changes in plant communities	Production, abundance	All	
Protect access to key habitats	The lower reaches of Hideaway (1), Cable (1), Desolation (1), Owens (2), Camas (2), Meadowbrook (2), Rudio (2), and Cottonwood (!1) crs.	Passage barriers, altered hydrology, channel structure		Productivity, abundance, distribution		Current law requires ODFW review of any new or substantially modified structure with regard to fish passage. Potential still exists for access to be blocked by warm water temperatures, flow alterations or channel structure to be severely modified by higher than natural flows.
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	All MaSAs and MiSAs	All	Same as above	Productivity, abundance	All	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Protect the highest quality habitats through acquisition or conservation easements	CTUIR, TNC, RMEF, John Day Basin Trust, SWCDs	Ongoing	Water quality improvement have high dispersal downstream, stream corridor and function improvements would be confined to the specific site	Existing conservation agreements are complete. Full implementation of conservation measures will take 5-15 years or more	5-15 years with passive restoration approaches	High, based on previous cooperative agreements
Adopt and manage Cooperative Agreements	ODFW, SWCDs, FSA	Ongoing	Same as above	Agreements are for 10-15 years	Immediate	High, although not in perpetuity
Special management designations in forest and BLM plans	USFS, BLM	Ongoing as identified	Same as above	Many complete, potentially subject to change in Forest Plan revisions	Immediate	High, although subject to change from Forest Plan or management plan revision
Designate additional wilderness and wild and scenic status	UDFS, BLM Oregon State Parks	Ongoing as identified	Water quality and flow improvements would have high dispersal downstream, stream corridor and function improvements confined to the specific site	Unknown	5-15 years	Unknown, subject to availability of areas that meet criteria
Protect access to key habitats	SWCD's, Watershed Councils, BLM, USFS	Ongoing	Immediate area only	Long term	5-15 years	Unknown
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	NRCS, SWCDs, USFS, ODFW, DOF, BLM, ODOT, CTWSRO, ODA, FSA, private landowners	Ongoing	All MaSAs and MiSAs	Long term	5-15 years	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
USFS and BLM	Wilderness Areas, Wilderness Study Areas, Wild and Scenic River corridors, Special Management designations, PACFISH and INFISH		Yes, for areas designated PACFISH and INFISH standards are good ,but implementation is inconsistent between forests	Yes
ODFW	Cooperative Agreements		No	Yes, the agreements are for only 10-15 years
FSA	CREP		No	Yes, the agreements are for only 10-15 years
NGOs	Lease or purchase of lands or instream water rights		Yes	Yes, important to secure critical habitat and/or water rights
ODA	Agricultural Water Quality Management Plan			See Oregon State Agency's programmatic review.
CTWSRO	Watershed Restoration			Yes
ODF	Oregon Forest Practice Act			See Oregon State Agency's programmatic review.
Local Government	City and County Planning and Zoning			Yes

*Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
The John Day River has 248.6 miles designated as Federal Wild and Scenic River and 317 miles designated as State Wild and Scenic, including the North Fork John Day River from Camas Cr (RM 57) to the headwaters (RM 112). State designated reaches include the North Fork John Day from near Monument (RM 20) to the North Fork wilderness boundary (RM 76.5). A wild and scenic designation requires development to be consistent with protecting the Outstandingly Remarkable Values (ORV's) for which the river was designated, requires review of any activity that may affect ORV's within the ¼ mile river corridor, and protects the free flowing condition of the river. Designation as W&S essentially precludes construction of any major dam. A Management Plan was adopted by BLM and Oregon State Parks Department in 2001 for the designated rivers segments. Implementation of all the actions identified in the plan will likely take many years, however grazing management plans for most of the allotments within corridor are complete. Wilderness designation essentially prevents any development and offers the greatest opportunity for protection of high quality habitat. Wilderness areas within the boundaries of the North Fork population include the North Fork John Day Wilderness (85,000 acres). The primary rationale for designating the North Fork Wilderness was for protection of anadromous fish habitat. Existing forest plans include special management designations for riparian habitat conservation areas (RHCA's). The forest plans and BLM plans have been amended by PACFISH and INFISH, both of which require 300 foot buffers on any fish bearing stream for tree removal, as well as specific guidelines for livestock grazing and riparian vegetation use. Compliance with the 300 foot buffer for timber harvest operations has been very good, however the interpretation and implementation of the grazing guidelines has been inconsistent between National Forests. The RHCA's and PACFISH buffers have been useful tools for protection of a variety of riparian values, unfortunately the rules were implemented in the mid-1990's after many trees within riparian areas had already been harvested. In those areas where trees were harvested before the rules went into effect, it will take decades for them to grow big enough to function as large wood and contribute to habitat parameters. Forest practices rules for private and state owned forest lands have guidelines for protection of riparian function, however they are less restrictive than those on federal lands. Adding additional wilderness areas and wild and scenic river segments will require designation by Congress. Designating additional RMA or adding to the current restrictions within RHCA's will be revisited during the Forest Plan Revision process that is currently underway. Cooperative and conservation agreements on private land are tools for protecting high quality habitats. ODFW has used cooperative agreements over the last 21 years to protect riparian corridors that have been fenced to exclude livestock grazing. Unfortunately those agreements are for only 15 years and there have not been funds or personnel needed to extend them for longer time periods. In the North Fork subbasin, a perpetual conservation agreement to prevent subdividing a 10,000 acre parcel is in place on Gilmore and Straight crs and includes approximately 3.3 miles of steelhead spawning and rearing habitat. NRCS programs that protect riparian areas and upland watersheds include the Conservation Reserve Program (CRP) and the Conservation Reserve Enhancement Program (CREP). The CRP program pays landowners not to farm highly erodible soils and the CREP program pays landowners for setting riparian corridors aside from grazing and farming. The long term effectiveness of both programs is limited by the relatively short duration of the contracts which ranges from 10 to 15 years.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain unimpaired passage and connectivity.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Remove or minimize use of push up dams	Cottonwood Cr/Fox drainage (1)	Impaired fish passage	Push up dams	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	Push up dams are common in the Cottonwood Cr drainage. Passage problems at culverts are widespread throughout all subbasins. Annual maintenance and construction of push up dams contributes to onsite and downstream channel stability, loss of pools and other structure, and increased sediment loads.
Remove or replace barriers blocking passage such as dams, road culverts and irrigation structures	For irrigation related passage issues: Cottonwood Cr/Fox drainage (1) For culverts: SF Trail, Meadowbrook (1), Upper Granite (2) crs	Impaired fish passage	Dams, culverts, instream structures	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	Push up irrigation dams, concrete diversions, in-channel stock ponds, and road culverts are located throughout the entire basin.
Construct ladders over existing permanent concrete or earth fill dams, or remove the barrier	None currently identified	Impaired fish passage	Dams	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	A comprehensive barrier assessment has not been completed for all private lands, so there may be a few barriers that are not currently identified
Provide screening at 100% of irrigation diversions	Cottonwood/Fox Cr (1).	Impaired fish passage	Irrigation diversions	Abundance, productivity, spatial structure	Emergent fry, juveniles, and smolts	All unknown existing screens meet criteria

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Remove or minimize use of push up dams	SWCD	Ongoing	Provide access to upstream habitat	Ongoing, but all push up dams not expected to be corrected for at least 15 years. A comprehensive barrier assessment has not bee completed.	Immediate	High, if comply with fish passage design criteria
Remove or replace barriers blocking passage such as dams, road culverts and irrigation structures	USFS, BLM, watershed councils, SWCDs, ODOT	Ongoing	Access to upstream habitat	Ongoing, replacing all culverts blocking fish passage expected to take 20 years. (see appendix – for list of culverts by each National Forest)	Immediate	High, if comply with fish passage design criteria
Construct ladders over existing permanent concrete or earth fill dams	ODFW, SWCDs	Ongoing	Provide access to upstream habitat	Ongoing, providing passage at all diversion and pond barriers will take many years. A comprehensive barrier assessment has not bee completed.	Immediate	High if comply with fish passage design criteria
Provide screening at 100% of irrigation diversions	ODFW, SWCDs	Ongoing	At point of diversion	Approximately 3 diversions need to be screened	Immediate	High if comply with fish passage design criteria

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
Soil and Water Conservation Districts	Irrigation dam improvements, culvert replacement or retrofits	Unscreened or poorly screened diversions throughout MaSAs	Yes in some areas, no in others	The Grant Soil and Water District is constrained by the construction window of opportunity. Other counties could expand the program but are constrained by funding and personnel
ODFW	Fish Passage/Screening	Unscreened or poorly screened diversions throughout MaSAs	No	The program completes a minimum of one project per year, but is dependent upon landowner cooperation and limited funding
USFS and BLM	Culvert replacement		No	Yes
Watershed Councils	Road Crossing Passage improvements, passage improvements		No	Yes
ODOT	Culvert replacement or retrofit			See Oregon State Agency's programmatic review.
BOR	John Day Basin Program		Yes	No
CTWSRO	John Day Basin Program		No	Yes, the tribe contracts with Soil and Water Districts to assist with consultation, permits, and monitoring

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

Most of the mainstem passage problems have been addressed, but there are many tributaries where adult passage is blocked and more areas where juvenile passage problems occur. Irrigation dams, stock ponds, and road culverts are the primary causes of passage issues. Soil and Water Districts are correcting passage at irrigation diversions and improperly installed culverts, but are constrained by funding and by personnel needed for construction oversight. Watershed councils and ODOT, who are the principal entities working on culverts are constrained primarily by funding. An inventory of road crossings on federal lands indicates juvenile passage problems are pervasive, particularly on National Forests, with approximately 300 culverts not meeting passage criteria on just the Malheur National Forest. The US Forest Service and BLM are constrained primarily by funding and the personnel needed for NEPA analysis. At the current rate of culvert replacements, it will take over 50 years to correct all passage problems on National Forests. Another constraint is that existing state laws do not require passage improvements at existing barriers unless there is a major change in the structure, such as reconstruction or significant modifications, so landowner cooperation is critical for improving passage throughout the basin.

The Malheur, Wallowa Whitman, Umatilla and Ochoco National Forests have culvert inventories for their lands. ODFW has an inventory of culverts on state and county-owned roads. Appendix A presents an inventory of culverts with known passage problems on state or county owned roads. The inventory shows there are four culverts on state owned roads and one culvert on county owned roads that do not meet fish passage criteria within the North Fork population boundary. There has not been an inventory of road culverts on private lands.

US Bureau of Reclamation, as required in the Columbia River Biological Opinion, is required to identify and assist with passage improvement design and flow restoration.

Currently, the ODFW Fish Passage and Screening program replaces about 20 irrigation diversion screens per year. More than 120 diversions in the John Day subbasin either do not meet current screening criteria or are unscreened, so it would take at least 6 years to replace them all. Of the 120 diversions, 75 have screens that do not meet NOAA screening criteria. Currently, highest priority is given to diversions that are unscreened with lower priority given to diversions that have screens, but do not meet the criteria. The program is constrained primarily by funding and personnel needed for implementation. Current law does not require water users to screen diversions less than 30 cubic feet per second and virtually all diversions in the John Day are less than 30 cfs, so landowner cooperation is essential to success of the program.

Strategy 3. Restore floodplain connectivity and function and maintain unimpaired connectivity and function.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Reconnect floodplains to channels	Camas Cr, from Wilkins Cr to Cable Cr (2), Owens Cr (1), Clear Cr below Ruby Cr (2), Olive Cr below Beaver Cr (1), Bull Run Cr (1), Crane Cr above Forest Rd 73 (2), lower Boulder Cr (Granite Cr trib) (2), Cottonwood Cr below EF Cottonwood (1)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity	Primarily fry and 0+	
Reconnect side channels and off-channel habitats to stream channels	Camas Cr from Wilkins Cr to Cable Cr (2), Owens Cr (1), Clear Cr below Ruby Cr (1), Olive Cr below Beaver Cr (2), Bull Run Cr (1), Crane Cr above Forest Rd 73 (2), lower Boulder Cr (Granite Cr trib) (2), Cottonwood Cr below EF Cottonwood (1)	Degraded floodplain, altered hydrology	Removal of side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity, spatial structure	Primarily fry and 0+	There has been a loss of off-channel and side-channel habitats that once provided habitat for spawning and rearing, and refugia from high flows.
Restore wet meadows	Cottonwood/Fox, Granite (1), Owens (2), Camas from Wilkins Cr to Cable Cr (2), Upper Wilson Cr (1)	Degraded floodplain, altered hydrology	Removal of wetlands	Abundance, productivity	Primarily fry and 0+	
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	Camas Cr from Wilkins Cr to Cable Cr (1), Owens Cr (1), Clear Cr below Ruby Cr (2), Rudio (1), Wall (1), Wilson (2), Olive Cr below Beaver Cr (2), Bull Run Cr (2), Boulder Cr (2), Crane Cr above Forest Rd 73 (2), lower Boulder Cr (Granite Cr trib) (2), Cottonwood (1), Fox Cr (1)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat	Abundance, productivity, spatial structure	Primarily fry and 0+	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Reconnect floodplain to channel	ODFW, watershed council, SWCD, USFS, BLM	Ongoing	For the treated stream reach	Short term, once identified	Physical response will be immediate; biological response up to 5-10 years	High
Reconnect side channels and off-channel habitats to stream channels	ODFW, watershed council, SWCD, USFS, BLM, CTUIR	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Long term, because of widespread need	5-15 years, depending upon frequency and duration of channel altering flows	Moderate, depending upon how extensive project is and frequency/duration of channel altering flows
Restore wet meadows	TNC, USFS, CTWSRO	Ongoing and planned	Benefits of improved channel morphology localized, improved water table and resulting increased stream flow and lower water temperatures have high dispersal downstream	Intermediate	5-15 years	Moderate
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	ODFW, CTWSRO, USFS, BLM	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Long term, due to acceptance by landowners and widespread need	Within 5 years once the dams are built	Moderate-high, dependent upon acceptance by landowners

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
ODFW	BPA Habitat Program		No	Yes, if specific needs cannot be addressed by passive restoration techniques
USFS, BLM	Stream enhancement program		Yes in some areas, no in others	Possibly
Watershed Councils	Watershed restoration		Dependent upon need and funding	Only if specific needs cannot be addressed by passive restoration techniques
Soil and Water Conservation Districts	Watershed restoration		Dependent upon need and funding	Only if specific needs cannot be addressed by passive restoration techniques
Nature Conservancy and other NGOs	Restoration projects		Yes	Yes
CTUIR	Watershed restoration			Yes
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				

Strategy 4. Restore degraded channel structure and complexity and maintain unimpaired structure and complexity.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural channel form	Camas Cr, from Wilkins Cr to Cable Cr (1), Owens Cr (2), Clear Cr below Ruby Cr (1), Olive Cr below Beaver Cr (1), Bull Run Cr (1), Crane Cr above Forest Rd 73 (2), lower Boulder Cr (Granite Cr trib) (2), Cottonwood Cr below EF Cottonwood (1).	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature, flows	Stream channelization, bank armoring, large wood removal, beaver removal, removal of riparian vegetation, livestock overgrazing in riparian areas	Abundance, productivity	Primarily fry and 0+	Passive restoration techniques, such as riparian fencing, are the preferred method for improving channel structure and stability. More active restoration techniques may be appropriate in these reaches.
Place stable wood and other large organic debris in streambeds	Camas Cr (2), Owens Cr (2), Clear Cr (1) below Ruby Cr, Olive Cr (1) below Beaver Cr, Bull Run Cr (1), Crane Cr (2) above Forest Rd 73, lower Boulder Cr (1) (Granite Cr trib), Cottonwood/Fox Cr (1), Desolation Cr (2), Rudio (2)	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	large wood removal channelization	Abundance, productivity	Primarily fry and 0+	More active restoration techniques, such as rootwad placement or channel reconfiguration, may be appropriate in these reaches when passive restoration techniques have not been successful
Stabilize streambanks	Camas Cr (1) from Wilkins Cr to Cable Cr, Owens Cr (2), Cottonwood Cr below EF Cottonwood (1).	Degraded channel structure and complexity, habitat diversity, sediment routing, flows	Stream channelization, berming, bank armoring, overgrazing in riparian areas	Abundance, productivity	Primarily eggs, fry and 0+	Some bank erosion is inevitable and beneficial. However, where erosion is actively taking place due to unnatural processes, stabilization may be needed to reduce fine sediments

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural channel form	ODFW, SWCDs, USFS, BLM, watershed councils	Ongoing and planned	For the treated stream reach	Short term, once identified	Physical response will be immediate, biological response may take 5-10 years	High
Place stable wood and other large organic debris in streambeds	ODFW, USFS, watershed councils, BLM, SWCDs	As needed	For the immediate stream reach	Once identified, short term	Immediate	High
Stabilize streambanks	ODFW, USFS, watershed councils, BLM, SWCDs	Ongoing	For the treated stream reach, physical benefits dispersed downstream	Passive stabilization techniques are referred and take longer to implement	With passive restoration the response may take 15 years	Medium to high, depending upon the extent of the treatments

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, no, uncertain)	Needs Expansion
ODFW	BPA Habitat Program		No	Yes, if specific needs cannot be addressed by passive restoration techniques
USFS, BLM	Stream enhancement program		Yes in some areas, no in others	Possibly
Watershed Councils	Watershed restoration		Dependent upon need and funding	Only if specific needs cannot be addressed by passive restoration techniques
Soil and Water Conservation Districts	Watershed restoration		Dependent upon need and funding	Only if specific needs cannot be addressed by passive restoration techniques
CTWSRO	Watershed restoration			
NGOs	Watershed restoration			
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				
Instream activities have not been identified as a high priority by the recovery planning team or the subbasin plan team except when identified as a need for specific sites. The planning team prefers that more passive approaches, such as riparian and upland improvements be emphasized. Typically, instream activities that would improve floodplain function and channel migration processes would include placement of rootwads, whole trees, or boulder clusters to improved habitat complexity and habitat diversity where those parameters are deficient and not expected to improve with passive restoration. Another structural activity would be to construct boulder or log weirs to raise the water table, but only where a passive approach has not worked.				

Strategy 5. Restore riparian condition and LWD recruitment and maintain unimpaired conditions.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural riparian vegetative communities	Rudio (2), Cottonwood below Fox Cr (1), Deerhorn (2), Jericho (2), Camas above Wilkins Cr (1), and Desolation from the mouth to Park Cr (2)	Degraded riparian area, channel structure and complexity, floodplain degradation, altered hydrology, sediment, water quality	Overgrazing of riparian area, channelization, stream bank armoring, tree harvest in riparian areas, changes in plant communities (including invasive plants), loss of beaver dams	Abundance, productivity	Primarily fry and 0+	Primary methods of riparian enhancement include riparian corridor fences to exclude livestock, changes in grazing management that promote riparian recovery, and planting of native shrubs.
Develop grazing strategies that promote riparian recovery	Rudio (2), Cottonwood below Fox Cr (1), Deerhorn (2), Jericho (2), Camas above Wilkins Cr (1), and Desolation from the mouth to Park Cr. (2)	Same as above	Livestock overgrazing of riparian area	Abundance, productivity	Primarily fry and 0+	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural riparian vegetative communities	ODFW, Watershed Councils, SWCDs, USFS, BLM, CTUIR	Ongoing	Riparian function will be limited to specific reach; water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years, (see above)	High, based upon experience with existing grazing management and riparian recovery projects
Develop grazing strategies that promote riparian recovery	NRCS, AFS, USFS, BLM, SWCDs, ODFW, Watershed Councils, CTUIR	Ongoing	Riparian function will be limited to specific reach; water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years, depending upon grazing plan adopted. Riparian corridor fencing and removal of riparian grazing has the fastest recovery rate.	High, based upon experience with existing grazing management and riparian recovery projects

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, no, uncertain)	Needs Expansion
ODFW	BPA Habitat Program		No	Yes
SWCD's	Upland improvements, riparian improvements		Yes in some areas, no in others	Yes
Watershed Councils	Upland improvements, riparian improvements		No	Yes
USFS and BLM	Upland improvements, riparian improvements		No	Yes
NRCS	Upland improvements, riparian improvements		Yes	No
ODA	Agricultural Water Quality Management Plans (AgWQM)			See Oregon State Agency's programmatic review.
CTUIR	Watershed restoration			Yes

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

In the last 20+ years ODFW, Watershed Councils, NRCS and Soil and Water Districts have implemented hundreds of miles of riparian improvements on private lands, primarily through construction of riparian corridor fences that exclude livestock grazing and development of off channel watering devices. Public land managers have implemented PACFISH and INFISH standards for protection and restoration of USFS and BLM lands. Even though hundreds of miles of riparian improvements have been completed there are nearly 2,800 miles of stream occupied by steelhead within the John Day River Basin and hundreds more miles of tributaries to these streams If only 10% of the stream reaches are degraded (which is probably low), it will take over 35 years to treat them if agencies proceed at the current rate. Bank stabilization using some rock is still infrequently occurring after high water events in the Upper John Day River, primarily along irrigated pastures and on Rock Cr (Gilliam County). The emphasis is the use of more passive approaches for stabilization, primarily through riparian vegetation improvements. Overgrazing of riparian areas by livestock continues, however it is not as widespread as historically. Interest by private landowners and public land managers in riparian improvement remains high.

Other projects that have been well accepted and will improve riparian condition are restoring historic cover types by removing juniper, reintroducing fire, enrollment into CREP, and control of invasive/noxious plants. Primary constraints on implementing additional projects for more riparian improvements are funding and personnel needed for planning, promotion, education of landowners, and implementation.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Implement agricultural water conservation measures	Cottonwood/Fox (1), lower Rudio Cr (1), Mainstem North Fork below Wall Cr (2)	Altered hydrology, low flows, high temperatures	Water withdrawals, land conversion on uplands, road network	Abundance, productivity	Fry and 0+	Cottonwood/Fox and lower Rudio Crs are the tributaries most affected by irrigation withdrawals. The mainstem North Fork below Wall Cr has numerous irrigation withdrawals, but warm water temperatures preclude steelhead from using for year long rearing.
Improve irrigation conveyance and efficiency	Cottonwood/Fox (1), lower Rudio Cr (1), Mainstem North Fork below Wall Cr (2)	low flows, high temperatures	Water withdrawals, loss during conveyance	Abundance, productivity	Fry and 0+	
Increase pool habitat (beaver ponds)	Cottonwood/Fox (1), Rudio (1), Granite (2), Olive (2), Clear (2), Owens (1), Desolation (2), Wilson (1), and Wall(1) crs, Camas Cr above Wilkins Cr (1)	Low flows, high temperatures	Water withdrawals, loss during conveyance	Abundance, productivity	Fry and 0+	
Floodplain aquifer recharge	Camas Cr above Wilkins Cr (1)	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Fry and 0+	
Lease or acquire water rights and convert to instream	Cottonwood/Fox (1), lower Rudio Cr (2), Mainstem North Fork below Wall Cr (2)	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Fry and 0+	
Monitor/regulate water withdrawals	All MaSAs	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Fry and 0+	Annual fluctuations in flow levels are intensified by irrigation withdrawals
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	All MaSAs	Altered hydrology, low flows, high temperatures, impaired natural functions and processes on uplands, floodplains, riparian areas	Degradation and conversion of uplands, floodplains, riparian areas	Abundance, productivity	Fry and 0+	Changes in the upland plant community due to fire suppression, invasive plants, and conversion of bunch grass prairies to wheat fields have resulted in lower precipitation infiltration rates, which results in higher peak flows and lower low flows. Some tributaries are now dry where they join the John Day River. Removal of large wood and channelizing streams also increases water velocities and reduces the ability of the stream to hold water for gradual release.

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Implement agricultural water conservation measures	SWCD, watershed councils, NRCS	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and dependent upon landowner willingness to participate and availability of projects	Immediate	High, if the saved water is protected from being appropriated to a downstream user
Improve irrigation conveyance and efficiency	SWCD, OWEB, watershed councils, NRCS, landowners	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and dependent upon landowner willingness to participate and availability of projects	Immediate	High, if the saved water is protected from being appropriated to a downstream user
Increase pool habitat (beaver ponds)	SWCD, ODFW, CTWSRO, USFS	Ongoing	High dispersal downstream	Unknown	Immediate increase in instream flow	High
Floodplain aquifer recharge	CTWSRO, SWCDs	Planned, some ongoing	Potentially high dispersal from recharge project site downstream for many miles	Long term, although opportunities for pilot projects is dependent upon willing landowner	Immediate	High, if the additional water is protected from being appropriated to a downstream user
Lease or acquire water rights and convert to instream	ODWR, Oregon Water Trust, others	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and highly dependent upon landowner willingness to lease.	Immediate	High, if the leased water is protected from being appropriated to a downstream user
Monitor/regulate water withdrawals	ODWR	Ongoing	Point of diversion downstream to mouth of John Day River	Long term, dependent upon ODWR enforcing the requirement to measure water usage	immediate	High if water use reporting and requirement for measuring devices is enforced
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	SWCD, USFS, OWRD, OWEB, ODFW, CTWSRO, landowners	Ongoing	MaSAs	Intermediate	Up to 15 years	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
ODFW	BPA Habitat Program, riparian improvements		No	Yes
OWRD	Stream Flow Monitoring and Regulation			See Oregon State Agency's programmatic review.
Oregon Water Trust and BOR	Leasing and Purchase of Water Rights		No	Yes
Soil and Water Conservation Districts	Improve irrigation efficiency, upland improvements, riparian improvements		Yes in some areas, no in others	Yes
Watershed Councils	Upland improvements, riparian improvements		No	Yes
NRCS	Upland improvements, riparian improvements		No	Yes

*Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
Many landowners have converted from flood to sprinkler or gated pipe irrigation, which makes more efficient use of the water and grows more palatable forage but there has not been an effective mechanism to protect saved water from being used by another irrigator downstream. Water measuring devices are just beginning to be required on irrigation withdrawals and while progress is being made there is considerable resistance from irrigators. Other projects that will improve flow are restoring historic cover types by removing juniper, reintroducing fire, enrollment into CRP, and control of invasive/noxious plants. Primary constraints on implementing additional projects are funding, instream water rights that are junior to most irrigation rights, and water laws that sometimes conflict with conservation practices. US Bureau of Reclamation is required in the Columbia River Biological Opinion to identify and assist with passage improvement design and flow restoration.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Increase riparian shading	North Fork John Day River below Camas Cr (2), Camas Cr. (1), Lower Cottonwood Cr. (1), Rudio Cr. (1), Owens Cr. (1), lower reaches of Wall (2), Desolation(2), and Wilson (2) Crks.	High water temperatures	Degraded riparian forests	Abundance, productivity	Eggs, fry, juveniles, adults	Elevated water temperature is a pervasive water quality problem for the North Fork John Day River population, with 39 stream reaches listed as water quality limited. Additional reaches would probably be listed if water temperature data was available. Camas, Cottonwood, and Owens crs and lower reaches of Wall, Desolation, and Wilson crs are relatively good producers of steelhead that are listed as water quality limited due to elevated water temperatures.
Manage return flow to reduce extreme stream temperatures	lower North Fork John Day River (2) Camas Cr. (1), Cottonwood Cr. (1), Rudio Cr. (1), Owens Cr. (2)	High water temperatures	Water withdrawals	Abundance, productivity	Eggs, fry, juveniles, adults	
Address contamination from mine related discharge	Granite Cr and tributaries (1)	Chemical contaminants	Heavy metal and mine waste pollution	Abundance, productivity	Eggs, fry, juveniles, adults	
Reduce chemical pollution inputs	None currently identified	Chemical pollution	Pesticides, fertilizers, herbicides, vehicle hydrocarbons, etc.	Abundance, productivity	Eggs, fry, juveniles, adults	
Apply BMPs to animal feeding operations	None currently identified	Degraded water quality	Animal feed operations	Abundance, productivity	Eggs, fry, juveniles, adults	

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	MaSAs and MiSAs	Degraded upland processes, floodplains, riparian areas, altered hydrology, altered sediment routing	Degradation and conversion of uplands, floodplains, riparian areas	Abundance, productivity	Eggs, fry, juveniles, adults	While irrigation is not common in the North Fork, there are some opportunities to use more efficient irrigation methods, which reduces the amount of surface water returning to the stream, and result in fewer nutrients from pastures reaching the North Fork John Day River and its tributaries. Reducing nutrient loads will contribute to increased water quality by reducing biological oxygen demand and algae blooms.
Continue TMDL monitoring	MaSAs and MiSAs	Degraded water quality, sediment routing	Land use practices, water withdrawals, pesticides, fertilizers, herbicides	Abundance, productivity	Eggs, fry, juveniles, adults	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Increase riparian shading	ODFW, Watershed Councils, SWCDs, USFS, BLM, CTUIR	Ongoing	water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years	High
Manage return flow to reduce extreme stream temperatures	SWCDs, watershed councils	Ongoing	Water quality improvement would have high dispersal downstream	Less than 5 years, once the project has been identified	Immediate	High, reduced temperatures has been well documented
Address contamination from mine related discharge	ODEQ, USFS	Ongoing	Primarily in contaminated reaches, with intermediate dispersal downstream	Long term, although actual treatment may take only a matter of days.	Immediate in the specific stream reach.	High, although contingent upon adequate maintenance
Reduce chemical pollution inputs	ODEQ, others	Ongoing		Ongoing	Reduce chemical pollution immediately	High
Apply BMPs to animal feeding operations	ODA	Ongoing	Water quality improvement would have high dispersal downstream	Some treatments could be done immediately. There are few animal feeding operations within the basin, only one of which has been identified as a problem	5-15 years	High, once a treatment has been agreed upon
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	SWCD	Ongoing	Basinwide, high dispersal downstream	Intermediate	Up to 15 years	High
Continue TMDL monitoring	USFS, ODFW, SWCD, ODEQ	Ongoing	Basinwide	Ongoing	Immediate	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, no, uncertain)	Needs Expansion
FSA	CREP, CRP		No	Yes
ODEQ	Mine Waste Program			See Oregon State Agency's programmatic review.
ODA	Confined animal feeding operations (CAFO), AgWQM			See Oregon State Agency's programmatic review.
ODEQ, ODA, SWCD, USFS	Sedimentation Monitoring (TMDL Development and Implementation)			See Oregon State Agency's programmatic review.

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

Heavy metal and other contaminants coming from historic and ongoing mining activity in the Granite Cr drainage has resulted in elevated levels of these contaminants found in sediments. ODFW biologists have observed dead fish and adult fish with gill lesions in the streams of this watershed. Although the cause of this mortality is not certain, elevated iron and heavy metal concentrations may be a contributing factor. Although recent surveys conducted by the UNF and U.S. Environmental Protection Agency (EPA) indicated that mercury was not present in high enough concentrations known to cause these types of effects, conditions at abandoned mine sites and abatement ponds may change yearly, increasing the amount of heavy metals released (NMFS 2004/0008). Low stream flows during the hottest part of the year exacerbate the already warm water temperatures. Opportunities for increasing stream flow through leasing of water rights, which often results in cooler water over a longer stream reach, are being pursued by Oregon Water Trust and US Bureau of Reclamation. Constraints for future projects include acceptance by landowners and a secure, long term funding source.

Reducing water temperatures through the use of improved riparian vegetation and more efficient methods of irrigation may take several years to provide measurable results. Many projects that improve water quality by reducing irrigation return water have been completed.

Strategy 8. Restore degraded upland processes to minimize unnatural rates of erosion and runoff, and maintain unimpaired natural upland processes.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore native upland plant communities	Cottonwood/Fox Cr (1), upper Rudio Cr (1), Deer Cr (1), Wilson Cr (2), Wall Cr (2).	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices, loss of water storage capacity	Abundance, productivity	Eggs, fry, and 0+	Upland improvements such as restoring native plant communities and controlling invasive weed species will improve precipitation infiltration rates and ultimately improve watershed health, including the hydrograph.
Upgrade or remove problem forest roads	Upper North Fork John Day River and tributaries above and including Trail Cr (1), Wilson Cr (2), Upper Camas Cr tributaries (2), Clear Cr and tributaries (1), Granite Cr (2)	Same as above	Road network	Abundance, productivity	Eggs, fry, and 0+	
Initiate demonstration projects	MiSA's and MaSA's	Same as above	Upland land use practices	Abundance, productivity	Eggs, fry, and 0+	
Mange vegetation, including juniper removal	Cottonwood/Fox Cr (1), upper Rudio Cr (2), Deer Cr (2), Wall Cr (1), Wilson Cr (2)	Altered hydrology, sediment routing	Invasive plants	Abundance, productivity	Eggs, fry, and 0+	
Employ BMPs to forest practices, livestock grazing, road management and agricultural practices	MaSAs	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices	Abundance, productivity	Eggs, fry, and 0+	Suppression of fires over the last 80 years has contributed to higher than normal tree densities and increased threat of high intensity fires. High intensity fires have greater potential for damaging watershed function than lower intensity fires. There are areas on National Forest Lands that have degraded conditions due to fire suppression, but they are difficult to quantify.

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Restore native upland plant communities	SWCD, USFS, BLM	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Long term		
Upgrade or remove problem forest roads	USFS, BLM, DOF, ODOT	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, many forest roads have legacy issues with regard to sediment transport and routing of runoff. Decommissioning may take many years	5-15 years	Moderate, although funding on public lands and landowner cooperation on private lands will determine rate of treatment
Initiate demonstration projects	ODFW, NOAA Fisheries, USFWS, USFS, BLM, CTWSRO, Watershed Councils, SWCD's	Ongoing	Entire basin	Long term	Variable lag time	unknown, depends upon action taken as a result of being more informed
Manage vegetation, including juniper removal	USFS, BLM, NRCS, SWCD's, Watershed Councils	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Juniper control can be done quickly, other strategies such as control of invasive plants may take more than 20 years	5-30 years	Moderate
Employ BMPs to forest practices, livestock grazing, road management and agricultural practices	SWCD, VSFS, ODA, CTWSRO, private landowners	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, dependent on implementation of Agricultural Water Quality Management Plans	0-20,years, depending upon treatments applied	Moderate, dependent upon voluntary landowner participation

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
NRCS/Farm Service Agency	CRP		No	Yes
SWCDs	Juniper control		No	Yes
ODFW	Green Forage		No	Very small program
USFS	Forest Plan		Uncertain	Yes
ODA	Agricultural Water Quality Management Plan			See Oregon State Agency's programmatic review.
CTUIR	Watershed Restoration		Uncertain	Yes
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				
Programs initiated by the NRCS, SWCDs and ODFW are relatively small, with the CRP program the largest and best funded; however all the programs are limited by funding and, to a lesser extent, acceptance by landowners. CRP has been in existence for 20 years and has been one of the better farm subsidy programs for watershed restoration. Juniper control programs have focused on areas where extensive juniper encroachment has occurred. Juniper control can be completed using several different methods, including controlled burns, cutting with chainsaws, or by removing with bulldozers or trackhoes. Although controlled burns are probably the most effective at controlling the spread of juniper, they are the most difficult to implement because of the threat of the fire getting out of control and costs. Another drawback to controlled burns is that livestock grazing should be excluded from burned areas for at least two growing seasons after the burn to ensure full recovery of desirable perennial grasses. There are opportunities to expand the juniper control program but the lack of a pasture to put livestock into for two years after burning has limited its acceptance. The ODFW Green Forage program provides a wildlife seed mixture of native grasses and desirable forage to landowners who have recently completed juniper clearing projects, logging projects or other ground disturbing activities. The primary purposes are to provide additional forage for deer and elk and to reduce deer and elk damage; however it also has benefits to watershed health by providing grasses that provide perennial ground cover.				

Table 17-6e. Recovery Strategies and Actions for South Fork John Day River Steelhead Population

Primary limiting factors: altered sediment routing, degraded channel structure and complexity (habitat quantity and diversity), altered hydrology and low flow, water temperature, and impaired fish passage.

Primary threats: riparian disturbance, stream channelization and relocation, grazing, timber harvest, road building, fish passage barriers (culverts, and other seasonal barriers), and irrigation withdrawals.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Protect high quality habitats through acquisition or conservation easements	Lower Murderers Cr tributaries draining the south side of Aldrich Mountain: Todd (1), Cabin (1), Dry Cabin (1), Duncan (1) and Dry Duncan (1); Black Canyon Cr (1); mainstem South Fork, north boundary of PW Schneider WMA to Izee Falls (2)	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing,	Many threats including livestock overgrazing of riparian area, channelization, stream bank armoring, agricultural practices (fertilizers, herbicides, sediments, changes in plant communities), water withdrawals, loss of beaver dams	Productivity, abundance	Primarily fry and 0+	Protecting base stream flows from further appropriations is a very important function of protecting existing high quality habitats. Protection of high quality habitats is the most cost effective way of ensuring fish have good quality habitat. Land acquisitions, easements, and cooperative agreements may also facilitate the implementation of active restoration projects.
Adopt and manage Cooperative Agreements	South Fork, north boundary of PW Schneider WMA to Dayville (1); South Fork above Izee Falls (2)	Same as above	Same as above	Productivity, abundance	Primarily fry and 0+	
Special management designations in forest and BLM plans	Public lands as identified in Forest Plan Revision	Same as above	livestock overgrazing of riparian area, changes in plant communities	Productivity, abundance	Primarily fry and 0+	
Designate additional wilderness and wild and scenic status	Public lands identified as meeting the criteria during the Forest Plan Revision process	Same as above	livestock overgrazing of riparian area, changes in plant communities	Productivity, abundance	Primarily fry and 0+	
Protect access to key habitats	Black Canyon Cr (1)	Passage barriers, altered hydrology, channel structure		Productivity, abundance, distribution	Primarily fry and 0+	Thoroughly review projects that may block fish passage. Current ODFW policy is to grant exemptions from fish passage requirements only if mitigation meets or exceeds the loss of habitat. Exemptions must be approved by the Fish and Wildlife Commission.
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	All MaSAs and MiSAs	All	Same as above	Productivity, abundance	Primarily fry and 0+	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Protect the highest quality habitats through acquisition or conservation easements	CTUIR, TNC, RMEF, John Day Basin Trust, SWCDs, CTWSRO, USFS, ODFW	Ongoing	Water quality improvement have high dispersal downstream, stream corridor and function improvements would be confined to the specific site	Existing conservation agreements are complete. Full implementation of conservation measures will take 5-15 years or more	5-15 years with passive restoration approaches	High, based on previous cooperative agreements
Adopt and manage Cooperative Agreements	ODFW, SWCDs, FSA	Ongoing	Same as above	Agreements are for 10 to 15 years	Immediate	High, although not in perpetuity
Special management designations in forest and BLM plans	USFS, BLM	Ongoing as identified	Same as above	Many complete, potentially subject to change in Forest Plan revisions	Immediate	High, although subject to change from Forest Plan or mgmt plan revision
Designate additional wilderness and wild and scenic status	Public lands identified as meeting the criteria in the Forest Plan Revision process	Same as above	livestock overgrazing of riparian area, changes in plant communities	Immediate depending on socio-political acceptance	5-15 years	High
Protect access to key habitats						
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	NRCS, SWCDs, USFS, ODFW, DOF, BLM, ODOT, CTWSRO, ODA, FSA, private landowners	Ongoing	All MaSAs and MiSAs	Long term	5-15 years	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
USFS and BLM	Wilderness Areas, Wilderness Study Areas, Wild and Scenic River corridors, Special Management designations, PACFISH and INFISH		Yes, for areas designated PACFISH and INFISH standards are good ,but implementation is inconsistent between forests	Yes
ODFW	Cooperative Agreements		No	Yes, the agreements are for only 10-15 years
FSA	CREP		No	Yes, the agreements are for only 10 or 15 years
NGOs	Lease or purchase of lands or instream water rights		Yes, although limited by acceptance from landowners	Yes, important to secure critical habitat and/or water rights
ODA	Agricultural Water Quality Management Plan			See Oregon State Agency's programmatic review.
CTWSRO	Watershed Restoration		Yes, although funding is uncertain	Yes
ODF	Oregon Forest Practice Act			See Oregon State Agency's programmatic review.
Local Government	City and County Planning and Zoning		Riparian setbacks are sufficient when enforced	Yes, particularly monitoring of compliance

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**
The John Day River has 248.6 miles designated as Federal Wild and Scenic River and 317 miles designated as State Wild and Scenic. Federally designated reaches include from Smokey Cr (RM 6.5) to the Malheur National Forest boundary (RM 52.5) on the South Fork. State designated reaches include the South Fork from the PW Schneider Wildlife Management Area Boundary (RM 5.5) to County Road 63 (RM 35). Although wild and scenic designation does not preclude development, it requires development to be consistent with protecting the Outstandingly Remarkable Values (ORV's) for which the river was designated, requires review of any activity that may affect ORV's within the ¼ mile river corridor, and protects the free flowing condition of the river. Designation as W&S essentially precludes construction of any major dam. A Management Plan was adopted by BLM and Oregon State Parks Department in 2001 for the designated rivers segments. Implementation of all the actions identified in the plan will likely take many years, however, grazing management plans for most of the allotments within corridor are complete. One of the reasons for purchase of ODFW's Philip W. Schneider Wildlife Management Area in the South Fork John Day River basin was for its value as a steelhead spawning and rearing area. The mixture of BLM and ODFW owned lands, along with the adjoining Malheur National Forest lands are under a Coordinated Resource Management Plan (CRMP). The mainstem South Fork John Day River, which runs through the CRMP lands has shown remarkable riparian recovery in the last 30 years, with 100% canopy closure on some reaches. Unfortunately several of the tributaries have not benefited as much from the same management strategy. Wilderness designation essentially prevents any development and offers the greatest opportunity for protection of high quality habitat. Wilderness areas within the South Fork population boundary include, Black Canyon Wilderness (13,400 acres)**.** Other special designated areas include the Utley Butte and Dry Cabin wildlife emphasis areas. Existing forest plans include special management designations for riparian habitat conservation areas (RHCA's). The forest plans and BLM plans have been amended by PACFISH and INFISH, both of which require 300 foot buffers on any fish bearing stream for tree removal, as well as specific guidelines for livestock grazing and riparian vegetation use. Compliance with the 300 foot buffer for timber harvest operations has been very good, however the interpretation and implementation of the grazing guidelines has been inconsistent between National Forests. The RHCA's and PACFISH buffers have been useful tools for protection of a variety of riparian values, unfortunately the rules were implemented in the mid-1990's after many trees within riparian areas had already been harvested. In those areas where trees were harvested before the rules went into effect, it will take decades for them to grow big enough to function as large wood and contribute to habitat parameters. Forest practices rules for private and state owned forest lands have guidelines for protection of riparian function, however they are less restrictive than those on federal lands. Adding additional wilderness areas and wild and scenic river segments will require designation by Congress. Designating additional RMA or adding to the current restrictions within RHCA's will revisited during the Forest Plan Revision process that is currently underway. Cooperative and conservation agreements on private land are tools for protecting high quality habitats. ODFW has used cooperative agreements over the last 21 years to protect riparian corridors that have been fenced to exclude livestock grazing. Unfortunately those agreements are for only 15 years and there have not been funds or personnel needed to extend them for longer time periods. Over 120 miles of stream throughout the basin have been protected under this program. Additional opportunities will be limited by availability of funds and by willingness of landowners to sign conservation easements and/or agreements. NRCS programs that protect riparian areas and upland watersheds include the Conservation Reserve Program (CRP) and the Conservation Reserve Enhancement Program (CREP). The CRP program pays landowners not to farm highly erodible soils and the CREP program pays landowners for setting riparian corridors aside from grazing and farming. The long term effectiveness of both programs is limited by the relatively short duration of the contracts which ranges from 10 to 15 years.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain unimpaired passage and connectivity.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Remove or minimize use of push up dams	South Fork John Day River mainstem (1); Wind Cr (2)	Impaired fish passage	Push up dams	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	Push up dams in the South Fork mainstem are scheduled for replacement within the next year. Annual maintenance and construction of push up dams contributes to onsite and downstream channel stability, loss of pools and other structure, and increased sediment loads.
Remove or replace barriers blocking passage such as dams, road culverts and irrigation structures	Culverts on Deer, Murderers (1), SF Murderers (2), Tex (1) and Thorn (2) crs; head cut on SF Murderers Cr. (1)	Impaired fish passage	Dams, culverts, instream structures	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	
Construct ladders over existing permanent concrete or earth fill dams	None identified below Izee falls	Impaired fish passage	Dams	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	
Provide screening at 100% of irrigation diversions	South Fork below PW Schneider boundary (1)	Impaired fish passage	Irrigation diversions	Abundance, productivity, spatial structure	Emergent fry	All known diversions in the drainage area currently screened.
Replace screens that do not meet criteria	South Fork John Day River (1)	Impaired fish passage	Irrigation diversions	Abundance, productivity, spatial structure	Emergent fry	Most irrigation diversions are in the Upper John Day drainage and it has been the major emphasis for replacement of non-criteria screens.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Remove or minimize use of push up dams	SWCD	Ongoing	Provide access to upstream habitat	Ongoing, but all push up dams not expected to be corrected for at least 15 years	Immediate	High, if comply with fish passage design criteria
Remove or replace barriers blocking passage – dams, road culverts and irrigation structures	USFS, BLM, watershed councils, SWCDs, ODOT	Ongoing	Access to upstream habitat	Ongoing, replacing all culverts blocking fish passage expected to take 20 years (see appendix A)	Immediate	High, if comply with fish passage design criteria
Construct ladders over existing permanent concrete or earth fill dams	ODFW, SWCDs	Ongoing	Provide access to upstream habitat	Ongoing, providing passage at all diversion and pond barriers will take many years. (none below Izee falls)	Immediate	High if comply with fish passage design criteria
Provide screening at 100% of irrigation diversions	ODFW, SWCDs	Ongoing	At point of diversion	No screening currently needed.	Immediate	High if comply with fish passage design criteria
Replace screens that do not meet criteria	ODFW	Ongoing	At point of diversion	Approximately 4 screens need to be replaced	Immediate	High if comply with fish passage design criteria

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
Soil and Water Conservation Districts	Irrigation dam improvements, culvert replacement or retrofits		Yes in some areas, no in others	The Grant Soil and Water District is constrained by the construction window of opportunity.
ODFW	Fish Passage/Screening		No	The program completes a minimum of one project per year, but is dependent upon landowner cooperation and limited funding
USFS and BLM	Culvert replacement		No	Yes
Watershed Councils	Road Crossing Passage improvements, passage improvements		No	Yes
ODOT	Culvert replacement or retrofit			See Oregon State Agency's programmatic review.
BOR	John Day Basin Program		Yes	No
CTWSRO	John Day Basin Program		No	Yes, the tribe contracts with Soil and Water Districts to assist with consultation, permits, and monitoring

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

Most of the mainstem passage problems have been addressed, but there are many tributaries where adult passage is blocked and more areas where juvenile passage problems occur. Irrigation dams, stock ponds, and road culverts are the primary causes of passage issues. Soil and Water Districts are correcting passage at irrigation diversions and improperly installed culverts, but are constrained by funding and by personnel needed for construction oversight. An inventory of road crossings on state and county roads in 1999 indicated no culverts on state owned roads and 10 culverts on county owned roads did not meet fish passage criteria within the South Fork population boundary. Appendix A presents an inventory of culverts with known passage problems on state or county owned roads. Some culverts have been replaced with structures that allow fish passage, but much work remains. Watershed councils and ODOT, who are the principal entities working on culverts are constrained primarily by funding. An inventory of road crossings on federal lands indicates juvenile passage problems are pervasive, particularly on National Forests, with approximately 300 culverts not meeting passage criteria on just the Malheur National Forest. The US Forest Service and BLM are constrained primarily by funding and the personnel needed for NEPA analysis. At the current rate of culvert replacements it will take over 50 years to correct all passage problems on National Forests. Another constraint is that existing state laws do not require passage improvements at existing barriers unless there is a major change in the structure, such as reconstruction or significant modifications, so landowner cooperation is critical for improving passage throughout the basin.

US Bureau of Reclamation is required in the Columbia River Biological Opinion to identify and assist with passage improvement design and flow restoration.

Currently, the ODFW Fish Passage and Screening program gives highest priority is given to diversions that are unscreened with lower priority given to diversions that have screens, but do not meet the criteria. The program is constrained primarily by funding and personnel. Current law does not require water users to screen diversions less than 30 cubic feet per second and virtually all diversions in the John Day are less than 30 cfs, so landowner cooperation is essential to success of the program.

Strategy 3. Restore floodplain connectivity and function and maintain unimpaired connectivity and function.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Reconnect floodplains to channels	Murderers Cr, Chickenhouse Gulch to Todd Cr (2); South Fork mainstem, Izee Falls upstream to Malheur NF boundary (1)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity	Primarily, fry and 0+.	Upper South Fork from Indian Cr upstream to the Malheur NF boundary no longer connected to its floodplain and deeply incised. Although this is above steelhead distribution, it would have substantial benefits to steelhead rearing in the SF below Izee falls.
Reconnect side channels and off-channel habitats to stream channels	Murderers Cr, Chickenhouse Gulch to Todd Cr (2); South Fork mainstem, Izee Falls upstream to Malheur NF boundary (1)	Degraded floodplain, altered hydrology	Removal of side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity, spatial structure	Primarily, fry and 0+.	There has been a loss of off-channel and side-channel habitats that once provided habitat for spawning and rearing, and refugia from high flows.
Restore wet meadows	SF Murderers (1); Murderers (2); Upper Deer Cr. (1)	Degraded floodplain, altered hydrology	Removal of wetlands	Abundance, productivity	Primarily, fry and 0+.	
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	Murderers Cr, Chickenhouse Gulch to Todd Cr (2); South Fork mainstem, Izee Falls upstream to Malheur NF boundary (1); SF Murderers (1); Wind (2); and Deer (1) crs	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat	Abundance, productivity, spatial structure	Primarily, fry and 0+.	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Reconnect floodplain to channel	ODFW, watershed council, SWCD, USFS, BLM	Ongoing	For the treated stream reach	Short term, once identified	Physical response will be immediate, biological response may take 5-10 years	High
Reconnect side channels and off-channel habitats to stream channels	ODFW, watershed council, SWCD, USFS, BLM, CTUIR	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Long term, because of widespread need	5-15 years, depending upon frequency and duration of channel altering flows	Moderate, depends upon how extensive the project is and frequency and duration of channel altering flows
Restore wet meadows	TNC, USFS, CTWSRO	Ongoing and planned	Benefits of improved channel morphology localized, improved water table and resulting increased stream flow and lower water temperatures have high dispersal downstream	Intermediate	5-15 years	Moderate
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	ODFW, CTWSRO, USFS, BLM	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Long term, due to acceptance by landowners and widespread need	Within 5 years once the dams are built	Moderate-high, depends upon acceptance by landowners

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, no, uncertain)	Needs Expansion
ODFW	BPA Habitat Program		No	Yes, if specific needs cannot be addressed by passive restoration techniques
USFS, BLM	Stream enhancement program		Yes in some areas, no in others	Possibly
Watershed Councils	Watershed restoration		Dependent upon need and funding	Only if specific needs cannot be addressed by passive restoration techniques
Soil and Water Conservation Districts	Watershed restoration		Dependent upon need and funding	Only if specific needs cannot be addressed by passive restoration techniques
Nature Conservancy and other NGOs	Restoration projects		Yes	Yes
CTUIR	Watershed restoration			Yes
*Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				

Strategy 4. Restore degraded channel structure and complexity and maintain unimpaired structure and complexity.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural channel form	Murderers Cr, Chickenhouse Gulch to Todd Cr (2); South Fork mainstem, Izee Falls upstream to Malheur NF boundary (1)	Degraded channel structure and complexity, habitat diversity, riparian area degradation, connectivity with floodplain, sediment routing, water temperature, flows	Stream channelization, bank armoring, large wood removal, beaver removal, removal of riparian vegetation, livestock overgrazing in riparian areas	Abundance, productivity	Primarily eggs, fry and 0+.	The upper South Fork from Indian Cr upstream to the Malheur NF boundary is no longer connected to its floodplain and is deeply incised.
Place stable wood and other large organic debris in streambeds	Murderers Cr, Chickenhouse Gulch to Todd Cr (1); South Fork mainstem, Izee Falls upstream to Malheur NF boundary 92); Deer (1); SF Murderers (1)	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	large wood removal channelization	Abundance, productivity	Primarily eggs, fry and 0+.	More active restoration techniques, such as rootwad placement or channel reconfiguration, may be appropriate in these reaches. Typical structures include rootwads, boulder clusters, whole trees, and rock weirs where appropriate.
Stabilize streambanks	South Fork mainstem from Izee Falls upstream to Malheur NF boundary (1)	Degraded channel structure and complexity, habitat diversity, sediment routing, flows	Stream channelization, berming, bank armoring, overgrazing in riparian areas	Abundance, productivity	Primarily eggs, fry and 0+.	Some bank erosion is inevitable and beneficial. However, where erosion is actively taking place due to unnatural processes, stabilization may be needed to reduce fine sediments

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Restore natural channel form	ODFW, SWCDs, USFS, BLM, watershed councils	Ongoing and planned	For the treated stream reach	Short term, once identified	Physical response will be immediate, biological response may take 5-10 years	High
Place stable wood and other large organic debris in streambeds	ODFW, USFS, watershed councils, BLM, SWCDs	As needed	For the immediate stream reach	Once identified, short term	Immediate	High
Stabilize streambanks	ODFW, USFS, watershed councils, BLM, SWCDs	Ongoing	For the treated stream reach, physical benefits dispersed downstream	Passive stabilization techniques are referred and take longer to implement	With passive restoration the response may take 15 years	Medium to high, depending upon the extent of the treatments

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
ODFW	BPA Habitat Program		No	Yes, when specific needs cannot be addressed by passive restoration techniques
USFS, BLM	Stream enhancement program		Yes in some areas, no in others	Possibly
Watershed Councils	Watershed restoration		Dependent upon need and funding	Only if specific needs cannot be addressed by passive restoration techniques
Soil and Water Conservation Districts	Watershed restoration		Dependent upon need and funding	Only if specific needs cannot be addressed by passive restoration techniques
CTWSRO	Watershed restoration			
NGOs	Watershed restoration			
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				
Instream activities have not been identified as a high priority by the recovery planning team or the subbasin plan team except when identified as a need for specific sites. The planning team prefers that more passive approaches, such as riparian and upland improvements be emphasized. Typically, instream activities that would improve floodplain function and channel migration processes would include placement of rootwads, whole trees, or boulder clusters to improved habitat complexity and habitat diversity where those parameters are deficient and not expected to improve with passive restoration. Another structural activity would be to construct boulder or log weirs to raise the water table, but only where a passive approach has not worked.				

Strategy 5. Restore riparian condition and LWD recruitment and maintain unimpaired conditions.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural riparian vegetative communities	Mainstem South Fork John Day above Izee falls (1); Murderers Cr between the lower USFS boundary up to Tex Cr (2); SF Murderers (1); Deer Cr, mouth to headwaters (1)	Degraded riparian area, channel structure and complexity, floodplain degradation, altered hydrology, sediment, water quality	Overgrazing of riparian area, channelization, stream bank armoring, tree harvest in riparian areas, changes in plant communities (including invasive plants), loss of beaver dams	Abundance, productivity	Primarily fry and 0+	Primary methods of riparian enhancement include riparian corridor fences to exclude livestock, changes in grazing management that promote riparian recovery, and planting of native shrubs.
Develop grazing strategies that promote riparian recovery	Mainstem South Fork John Day above Izee falls (1); Murderers Cr between the lower USFS boundary up to Tex Cr (2); SF Murderers (1); Deer Cr, mouth to headwaters (1)	Same as above	Livestock overgrazing of riparian area	Abundance, productivity	Primarily fry and 0+	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural riparian vegetative communities	ODFW, Watershed Councils, SWCDs, USFS, BLM, CTUIR	Ongoing	Riparian function will be limited to specific reach; water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years	High, based upon experience with existing grazing management and riparian recovery projects
Develop grazing strategies that promote riparian recovery	NRCS, AFS, USFS, BLM, SWCDs, ODFW, Watershed Councils, CTUIR	Ongoing	Riparian function will be limited to specific reach; water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years, depending upon grazing plan adopted. Riparian corridor fencing and removal of riparian grazing has the fastest recovery rate.	High, based upon experience with existing grazing management and riparian recovery projects

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, no, uncertain)	Needs Expansion
ODFW	BPA Habitat Program		No	Yes
SWCD's	Upland improvements, riparian improvements		Yes in some areas, no in others	Yes
Watershed Councils	Upland improvements, riparian improvements		No	Yes
USFS and BLM	Upland improvements, riparian improvements		No	Yes
NRCS	Upland improvements, riparian improvements		Yes	No
ODA	Agricultural Water Quality Management Plans (AgWQM)			See Oregon State Agency's programmatic review.
CTUIR	Watershed restoration			Yes

*Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
In the last 20+ years ODFW, Watershed Councils, NRCS and Soil and Water Districts have implemented hundreds of miles of riparian improvements on private lands, primarily through construction of riparian corridor fences that exclude livestock grazing and development of off channel watering devices. Public land managers have implemented PACFISH and INFISH standards for protection and restoration of USFS and BLM lands. Even though hundreds of miles of riparian improvements have been completed there are nearly 2,800 miles of stream occupied by steelhead within the John Day River Basin and hundreds more miles of tributaries to these streams If only 10% of the stream reaches are degraded (which is probably low), it will take over 35 years to treat them if agencies proceed at the current rate. Overgrazing of riparian areas by livestock continues, however it is not as widespread as historically. Interest by private landowners and public land managers in riparian improvement remains high. Other projects that improve riparian condition by restoring historic cover types include removing juniper, reintroducing fire, enrollment into CRP, and control of invasive/noxious plants. Primary constraints on implementing additional projects for more riparian improvements are funding and personnel needed for planning, promotion, education of landowners, and implementation.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Implement agricultural water conservation measures	Mainstem South Fork John Day above Izee falls (1); Murderers Cr between the lower USFS boundary up to Tex Cr (2); SF Murderers (1); Deer Cr, mouth to headwaters (1)	Altered hydrology, low flows, high temperatures	Water withdrawals, land conversion on uplands, road network	Abundance, productivity	Primarily fry and 0+	The lower and upper mainstem South Fork John Day is used extensively for irrigation purposes, small diversions are present on Wind and Murderers crs
Improve irrigation conveyance and efficiency	South Fork John Day River below PW Schneider WMA boundary (1); Upper South Fork John Day River (1); Wind (2) and Murderers (2) crs	Low flows, high temperatures	Water withdrawals, loss during conveyance	Abundance, productivity	Primarily fry and 0+	
Increase pool habitat (beaver ponds)	Lower South Fork John Day River (2); Upper South Fork John Day River 91); Wind (2); Deer (1); SF Murderers (1); and Murderers (1) crs				Primarily fry and 0+	
Floodplain aquifer recharge		Low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily fry and 0+	
Lease or acquire water rights and convert to instream	Lower South Fork John Day River (2); Upper South Fork John Day River (1); Wind (2) and Murderers (2) crs	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily fry and 0+	
Monitor/regulate water withdrawals	All MaSAs	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily fry and 0+	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Implement agricultural water conservation measures	SWCD, watershed councils, NRCS	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and dependent upon landowner willingness to participate and availability of projects	Immediate	High, if the saved water is protected from being appropriated to a downstream user
Improve irrigation conveyance and efficiency	SWCD, OWEB, watershed councils, NRCS, landowners	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and dependent upon landowner willingness to participate and availability of projects	Immediate	High, if the saved water is protected from being appropriated to a downstream user
Increase pool habitat (beaver ponds)	SWCD, ODFW, CTWSRO, USFS	Ongoing	High dispersal downstream	Unknown	Immediate increase in instream flow	High
Floodplain aquifer recharge	CTWSRO, SWCDs	Planned, some ongoing	Potentially high dispersal from recharge project site downstream for many miles	Long term, although opportunities for pilot projects is dependent upon willing landowner	Immediate	High, if the additional water is protected from being appropriated to a downstream user
Lease or acquire water rights and convert to instream	ODWR, Oregon Water Trust, others	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and highly dependent upon landowner willingness to lease.	Immediate	High, if the leased water is protected from being appropriated to a downstream user
Monitor/regulate water withdrawals	ODWR	Ongoing	Point of diversion downstream to mouth of John Day River	Long term, dependent upon ODWR enforcing the requirement to measure water usage	Immediate	High if water use reporting and requirement for measuring devices is enforced

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
ODFW	BPA Habitat Program, riparian improvements		No	Yes
OWRD	Stream Flow Monitoring and Regulation			See Oregon State Agency's programmatic review.
Oregon Water Trust and BOR	Leasing and Purchase of Water Rights		No	Yes
Soil and Water Conservation Districts	Improve irrigation efficiency, upland improvements, riparian improvements		Yes in some areas, no in others	Yes
Watershed Councils	Upland improvements, riparian improvements		No	Yes
NRCS	Upland improvements, riparian improvements		No	Yes
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				
Many landowners have converted from flood to sprinkler or gated pipe irrigation, which makes more efficient use of the water and grows more palatable forage but there has not been an effective mechanism to protect saved water from being used by another irrigator downstream. Water measuring devices are just beginning to be required on irrigation withdrawals and while progress is being made there is considerable resistance from irrigators. Flows are also improving because of projects that restore historic cover types by removing juniper, reintroducing fire, enrollment into CRP, and control of invasive/noxious plants. Primary constraints on implementing additional projects are funding, instream water rights that are junior to most irrigation rights, and water laws that sometimes conflict with conservation practices. US Bureau of Reclamation, as required in the Columbia River Biological Opinion, is required to identify and assist with passage improvement design and flow restoration.				

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Increase riparian shading	Upper South Fork and tributaries above Izee Falls (1); Lower South Fork near the town of Dayville (2); Deer (2); SF Murderers (1); Murderers (2) crs	High water temperatures	Degraded riparian forests	Abundance, productivity	Primarily fry and 0+	Elevated water temperature is a pervasive water quality problem for the South Fork John Day River population, with 6 stream reaches listed as water quality limited. Additional reaches would probably be listed if water temperature data were available.
Manage return flow to reduce extreme stream temperatures	Upper South Fork and tributaries above Izee Falls (1); Lower South Fork near the town of Dayville (2); Wind (2) and Murderers (1) crs	High water temperatures	Water withdrawals	Abundance, productivity	Primarily fry and 0+	
Reduce chemical pollution and nutrient inputs	Upper South Fork and tributaries above Izee Falls (1); Lower South Fork near the town of Dayville (2)	Chemical pollution	Pesticides, fertilizers, herbicides, vehicle hydrocarbons, etc.	Abundance, productivity	Primarily fry and 0+	Using more efficient irrigation methods, which reduces the amount of surface water returning to the stream, should result in fewer nutrients from pastures reaching the South Fork John Day River and tributaries. Reducing nutrient loads will contribute to increased water quality by reducing biological oxygen demand and algae blooms.
Apply BMPs to animal feeding operations	South Fork John Day River above Izee Falls (1)	Degraded water quality	Animal feed operations	Abundance, productivity	Eggs, fry, juveniles	
Continue TMDL monitoring	Upper South Fork and tributaries above Izee Falls (1) Lower South Fork near the town of Dayville (2)	Degraded water quality, sediment routing	Land use practices, water withdrawals, pesticides, fertilizers, herbicides	Abundance, productivity	Primarily fry and 0+	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Increase riparian shading	ODFW, Watershed Councils, SWCDs, USFS, BLM, CTUIR	Ongoing	Water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years	High
Manage return flow to reduce extreme stream temperatures	SWCDs, watershed councils	Ongoing	Water quality improvement would have high dispersal downstream	Less than 5 years, once the project has been identified	Immediate	High, reduced temperatures has been well documented
Reduce chemical pollution and nutrient inputs	ODEQ, others	Ongoing		Ongoing	Reduce chemical pollution immediately	High
Apply BMPs to animal feeding operations	ODA	Ongoing	Water quality improvement would have high dispersal downstream	Some treatments could be done immediately. There are few animal feeding operations within the basin, only one of which has been identified as a problem	5-15 years	High, once a treatment has been agreed upon
Continue TMDL monitoring	USFS, ODFW, SWCD, ODEQ	Ongoing	Basinwide	Ongoing	Immediate	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, no, uncertain)	Needs Expansion
FSA	CREP, CRP		No	Yes
ODEQ	Mine Waste Program			See Oregon State Agency's programmatic review.
ODA	Confined animal feeding operations (CAFO), AgWQM			See Oregon State Agency's programmatic review.
ODEQ, ODA, SWCD, USFS	Sedimentation Monitoring (TMDL Development and Implementation)			See Oregon State Agency's programmatic review.
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				
Low stream flows during the hottest part of the year exacerbate the already warm water temperatures. Opportunities for increasing stream flow through leasing of water rights, which often results in cooler water over a longer stream reach, are being pursued by Oregon Water Trust and US Bureau of Reclamation. Constraints for future projects include acceptance by landowners and a secure, long term funding source. Reducing water temperatures through the use of improved riparian vegetation and more efficient methods of irrigation may take several years to provide measurable results. Many projects that improve water quality by reducing irrigation return water have been completed.				

Strategy 8. Restore degraded upland processes to minimize unnatural rates of erosion and runoff, and maintain unimpaired natural upland processes.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore native upland plant communities	South Fork mainstem above Izee Falls (1); Deer Cr (1); Murderers Cr (1)	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices, loss of water storage capacity	Abundance, productivity	Primarily fry and 0+	Upland improvements such as restoring native plant communities and controlling invasive weed species will improve precipitation infiltration rates and ultimately improve watershed health, including the hydrograph.
Upgrade or remove problem forest roads	Forest lands	Same as above	Road network	Abundance, productivity	Primarily fry and 0+	
Initiate demonstration projects	South Fork mainstem above Izee Falls (1); Deer Cr (2); Murderers Cr (1)	Same as above	Upland land use practices	Abundance, productivity	Primarily fry and 0+	
Manage vegetation, including juniper removal	South Fork mainstem above Izee Falls (1); Deer Cr (2); Murderers Cr (1)	Altered hydrology, sediment routing	Invasive plants	Abundance, productivity	Primarily fry and 0+	
Employ BMPs to forest practices, livestock grazing, road management and agricultural practices	MaSAs	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices	Abundance, productivity	Primarily fry and 0+	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Restore native upland plant communities	SWCD, USFS, BLM	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Long term	5-15 years	Moderate, although funding on public lands and landowner cooperation on private lands will determine rate of treatment
Upgrade or remove problem forest roads	USFS, BLM, DOF, ODOT	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, many forest roads have legacy issues with regard to sediment transport and routing of runoff. Decommissioning may take many years	5-15 years	Moderate, although funding on public lands and landowner cooperation on private lands will determine rate of treatment
Initiate demonstration projects	ODFW, NOAA Fisheries, USFWS, USFS, BLM, CTWSRO, Watershed Councils, SWCD's	Ongoing	Entire basin	Long term	Variable lag time	unknown, depends upon action taken as a result of being more informed
Mange vegetation, including juniper removal	USFS, BLM, NRCS, SWCD's, Watershed Councils	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Juniper control can be done quickly, other strategies such as control of invasive plants may take more than 20 years	5-30 years	Moderate
Employ BMPs to forest practices, livestock grazing, road management and agricultural practices	SWCD, VSFS, ODA, CTWSRO, private landowners	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, dependent on implementation of Agricultural Water Quality Management Plans	0-20,years, depending upon treatments applied	Moderate, dependent upon voluntary landowner participation

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
NRCS/Farm Service Agency	CRP		No	Yes
SWCDs	Juniper control		No	Yes
ODFW	Green Forage		No	Very small program
USFS	Northwest Forest Plan			Yes
ODA	Agricultural Water Quality Management Plan			See Oregon State Agency's programmatic review.
CTUIR	Watershed Restoration			Yes

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

NRCS, SWCD and ODFW programs are relatively small, with the CRP program the largest and best funded. CRP has been in existence for 20 years and has been one of the better farm subsidy programs for watershed restoration. Juniper control programs have focused on areas where extensive juniper encroachment has occurred. Juniper control can be completed using several different methods, including controlled burns, cutting with chainsaws, or by removing with bulldozers or trackhoes. Although controlled burns are probably the most effective at controlling the spread of juniper, they are the most difficult to implement because of the threat of the fire getting out of control and costs. Another drawback to controlled burns is that livestock grazing should be excluded from burned areas for at least two growing seasons after the burn to ensure full recovery of desirable perennial grasses. There are opportunities to expand the juniper control program but the lack of a pasture to put livestock into for two years after burning has limited its acceptance. The ODFW Green Forage program provides a wildlife seed mixture of native grasses and desirable forage to landowners who have recently completed juniper clearing projects, logging projects or other ground disturbing activities. The primary purposes are to provide additional forage for deer and elk and to reduce deer and elk damage; however it also has benefits to watershed health by providing grasses that provide perennial ground cover.

The limitations to all the programs are funding and, to a lesser extent, acceptance by landowners.

Table 17-6f. Habitat Management Strategies and Actions for Recovery of Umatilla River Steelhead Population

Primary limiting factors: high water temperature, sediment routing, impaired fish passage, degraded channel structure and complexity and altered hydrology (low flow).

Primary threats: current land use practices that reduce habitat quality, quantity and disrupt ecosystem functions.

Table 9-3, behind the habitat strategy and action tables for the Umatilla, provides a cross reference of Geographic Areas and MaSAs/MiSAs. Table 9-4 identifies stream barriers to upstream steelhead passage in the Umatilla watershed.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Protect high quality habitats through acquisition, conservation easements and cooperative agreements	North Fork Umatilla R (1); Umatilla R., Meacham Cr. to forks (1); Buck Creek (1); NF Meacham Cr. (1); E. Meacham Cr (1); Thomas Cr.(1); W. Birch Cr., Bear Cr. to headwaters (1); E. Birch Cr., California Gulch to headwaters (1); SF Umatilla R., mouth to Thomas Cr.(1); Umatilla R., Butter Cr. to Westland Dam and Stanfield Dam to McKay Cr.(2); Umatilla R., Three Mile Dam to Butter Cr. (2)	Loss of habitat quantity and diversity, channel stability, sediment, low flow and high temperatures	Cultivation, forestry, grazing, urban development	Productivity, abundance	All	Agreements (conservation easements, cooperative agreements, etc.) could be made with private landowners in areas where priority habitats exist to maintain the current habitat values. Agreements in areas with priority habitats may include: Putting in no-cultivation riparian buffers on agricultural lands that are currently cultivated up to the channel's edge, increasing riparian buffer widths associated with forested areas, protecting unstable areas, or changing other types of management in riparian areas.
Continue existing protections and/or increase protection of Federal lands; implement Forest Practices Act and PACFISH/INFISH	North Fork Umatilla R (1); Umatilla R., Meacham Cr. to forks (1); Buck Creek (1); NF Meacham Creek (1); East Meacham Cr (1); Thomas Cr. (1); West Birch Cr., Bear Cr. to headwaters (1); E. Birch Cr., California Gulch to headwaters (1); SF Umatilla R., mouth to Thomas Cr. (1)	Same as above	Forestry, cultivation, grazing, urban development	Productivity, abundance	All	Current protections on USFS lands such as Riparian Habitat Conservation Areas should be continued and maintained. Protection on Federal lands may be increased through the NEPA process or ESA consultation. Aquatic habitat issues are addressed through both processes. Actions may include expanding riparian buffers, changing management within or near riparian areas, and identifying sensitive areas to avoid. All the options listed for added protection are directed through PACFISH program/management direction but would be considered "New" actions to be applied if/when the need is identified. Forest Plan management direction (landscape-scale) for Roadless areas, wildlife management emphasis and Wilderness are unlikely to change significantly in the near future.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Establish setbacks to protect waterways from forest management, agricultural activities, and other land use practices that would disrupt ecosystem function	Umatilla R., Meacham Cr. to forks ; Thomas Creek (1); West Birch Cr., Bear Cr. to headwaters (1); Bear Creek (West Birch) and tribs (1); E. Birch Cr., mouth to headwaters (1); SF Umatilla R., mouth to Thomas Cr. (1); Umatilla R., Butter Cr. to Westland Dam and Stanfield Dam to McKay Cr (2); Umatilla R., Three Mile Dam to Butter Cr. (2); Birch Cr., mouth to forks (2); Umatilla R., Mission Br. To Meacham Cr. (1); Meacham Cr., mouth to North Fork (1); West Birch Cr., mouth to Bear Cr. (1); Buckaroo Cr (1); Meacham Cr., Sheep Cr. to headwaters (1)	Same as above	Same as above	Productivity, abundance	All	Setbacks could include: no-cultivation riparian buffers on agricultural lands that are currently cultivated up to the channel's edge, increasing riparian buffer widths associated with forested areas, protecting unstable areas, or changing other types of management in riparian areas.
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	Basin-wide	Same as above	Same as above	Productivity, abundance	All	To prevent degradation of existing habitat, Best management Practices and existing laws that protect aquatic habitat should be applied across the basin with emphasis on areas of very high quality.
Review, modify and enforce existing land use planning documents and ordinances pertaining to riparian and floodplain management to better address habitat and water quality issues.	Basin-wide	Same as above	Urban development	Productivity, abundance	All	Enforce existing land use laws that affect aquatic habitat and update laws that do not provide adequate protection.
Incorporate priority habitat areas into the Natural Area Overlay Zone provision of the Umatilla County Development Ordinance	Umatilla R., Meacham Cr. to forks (1); W. Birch Cr., Bear Cr. to headwaters (1); Bear Creek (West Birch) and tribs (1); E. Birch Cr., mouth to headwaters (1); Umatilla R., Butter Cr. to Westland Dam and Stanfield Dam to McKay Cr. (1); Umatilla R., Three Mile Dam to Butter Cr. (1); Birch Cr., mouth to forks (1); Umatilla R., Mission Br. To Meacham Cr. (1); Meacham Cr., mouth to North Fork (1); West Birch Cr., mouth to Bear Cr. (1); Iskuulpa Cr., Bachelor Cyn to headwaters(1); Buckaroo C (1); Meacham Cr., Sheep Cr. to headwaters(1)	Same as above	Urban development	Productivity, abundance	Pro-ductivity, abun-dance	Incorporating MCR steelhead priority habitat areas into the Natural Area Overlay Zone provision of the Umatilla County Development Ordinance would allow the priority habitat areas to be protected while providing an expedient process for reviewing land uses.
Explore opportunities to incorporate priority areas into state legislation.	NF Umatilla R (1); Umatilla R., Meacham Cr. to forks (1); Buck Creek (1); NF Meacham Cr (1); East Meacham Cr (1); Thomas Cr (1); West Birch Cr., Bear Cr. to headwaters (1); E. Birch Cr., California Gulch to headwaters (1); SF Umatilla R., mouth to Thomas Cr. (1); Umatilla R., Butter Cr. to Westland Dam and Stanfield Dam to McKay Cr. (1); Umatilla R., Three Mile Dam to Butter Cr. (1)	Same as above	Rural and urban development	Productivity, abundance	All	Look for opportunities to make amendments that would incorporate increased protection for priority habitat areas.

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Protect high quality habitats through acquisition, conservation easements and cooperative agreements	CTUIR, ODFW, UBWC, TNC, RMEF, SWCDs	Ongoing	Water quality improvement have high dispersal downstream, stream corridor and function improvements would be confined to the specific site	Existing conservation agreements are complete. Full implementation of conservation measures will take 5-15 years or more	5 years to decades with passive restoration approaches	High, based on previous cooperative agreements
Continue existing protections and/or increase protection of Federal lands; implement Forest Practices Act and PACFISH/INFISH	USFS, ODF	Ongoing	Benefits accruing since 1995 for all streams in Umatilla Basin on USFS lands, including priority Gas. Forest Practices Act applies to all commercial timber operations on private lands	Long term	Maintenance/improvement of existing conditions	High
Establish setbacks to protect waterways from forest management, agricultural activities, and other land use practices that would disrupt ecosystem function	CTUIR, ODFW, USFS, FSA, NRCS, SWCD	When need identified	Riparian areas associated with priority habitat areas	Long term	Immediate with continued improvement for up to 50 years. After 50 years habitat effectiveness will be maintained.	High
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	USFS, SWCDs, ODA, FSA, NRCS, CTUIR, ODSL, USACE	ongoing	All priority areas within the Umatilla Subbasin	Long Term	Maintenance of existing conditions	Moderate
Review, modify and enforce existing land use planning documents and ordinances pertaining to riparian and floodplain management to better address habitat and water quality issues.	Municipalities	unknown	Mid and lower basin; High dispersal downstream	Ongoing – unknown	Response is uncertain	It is unknown to what extent governments will address this need.
Incorporate priority habitat areas into the Natural Area Overlay Zone provision of the Umatilla County Development Ordinance	Umatilla County, CTUIR, ODFW	When possible	All priority areas within the Umatilla Subbasin	Short term	Immediate with continued improvement for up to 50 years. After 50 years habitat effectiveness will be maintained.	Moderate, depends on implementation and enforcement
Explore opportunities to incorporate priority areas into state legislation.	ODFW, CTUIR	When funding is available and amendment is possible	All priority areas within the Umatilla Subbasin	Long term	Immediate with continued improvement for up to 50 years. After 50 years habitat effectiveness will be maintained.	Low

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
CTUIR	CTUIR Umatilla River Basin Anadromous Fish Habitat Enhancement Projects – Riparian Function	Birch Creek, Meacham Creek, Umatilla River	No	Yes, there is still potential for more conservation easements
ODFW	Umatilla River Subbasin Fish Habitat Improvement Program, Fish Management Program	Birch Creek, Meacham Creek, Umatilla River	No	Yes, there is still potential for more conservation easements
USFS	North Fork Umatilla River Wilderness	Meacham Creek, North and South Fork Umatilla River and tribs, Pearson Creek (East Birch Creek)	Yes	No
USFS	Inventoried Roadless Areas	Meacham Creek, North and South Fork Umatilla River and tribs,	Yes	No
USFS	Land Exchange Program	Meacham Creek, North and South Fork Umatilla River and tribs, Pearson Creek (East Birch Creek)	No, see discussion below	No
USFS	PACFISH/Umatilla Forest Plan	Meacham Creek, North and South Fork Umatilla River and tribs, Pearson Creek (East Birch Creek)	Yes	No
USFWS	Umatilla Wildlife Refuge	Umatilla Wildlife Refuge	Yes	No
US Army Corps of Engineers	Section 404/401 water alteration permitting	Basin-wide	No	Compliance validation and enforcement is inadequate due to lack of resources
ODSL	Waterway alteration permitting	Basin-wide		See Oregon State Agency's programmatic review.
ODA, SWCD	Agriculture Water Quality Management Program	Basin-wide		See Oregon State Agency's programmatic review.
FSA, NRCS, SWCD	CREP, CCRP, CSP, EQIP	Basin-wide	No	The potential coverage of these programs has not been realized in Umatilla County
CTUIR	Iskuulpa Creek	Iskuulpa Creek	Yes	Maintain existing program

*Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
CTUIR and ODFW conservation easement programs have been effective at protecting and improving riparian habitat condition in the Umatilla Subbasin. There is potential for considerable expansion of these programs. Emphasis should be placed on priority habitat areas for establishing easements. These agreements are typically 10 or 15 years in duration. Continuation of management and derived benefits are uncertain once agreements expire. The Umatilla National Forest should emphasize protecting priority areas during project planning and implementation. Ongoing management actions sufficiently protect high priority aquatic habitats. These existing protections should be continued. PACFISH/Forest Plan Programs per se are sufficiently protective for lands in current ownership and require changing management or increasing buffers only when need is identified site-specifically ("New" actions). Most of FS lands (Meacham watershed, SF and NF Umatilla R. are already essentially fully- protected under Forest Plan by protective management direction,- Roadless and Wilderness and Wildlife Emphasis Management Areas which prohibit road building and timber harvest except in rare circumstances; PACFISH protections apply to all such activities. Meacham and Umatilla watersheds (FS) are essentially unroaded and unharvested, majority of existing road system is located on ridgetops, very little in stream bottoms. When/if needs are identified, additional aquatic habitat could receive increased protective status and a "new action". Priority areas for habitat protection as listed above that reside within the Umatilla National Forest should be assessed as to whether administrative designations apply to the areas that will support protection of these areas over the long term. While permit processes implemented by the US Army Corps of Engineers are thorough and actions authorized are protective of aquatic resources, the program lacks personnel resources to insure that terms and conditions of permitted actions are followed. In addition, the agency lacks resources to adequately monitor waterways for non-permitted actions or act upon non-permitted situations reported by other agencies or private parties. See Oregon State Agency's programmatic review for comments on ODSL. The USFS land exchange program has the potential to bring existing private lands under federal ownership and PACFISH protections. However, this program is completely voluntary on the landowners part and the landowner would acquire public land and could very likely lower standards of resource protection. The land exchange is, however, a tool that could be used under very controlled circumstances to see increased protection of important aquatic habitats. But the purpose of the program is focused on consolidating land holdings and not necessarily protection of habitat. The Umatilla and Walla Walla Agricultural Water Quality Management (AgWQM) Area Rules require that management on agricultural lands allow the establishment, growth and maintenance of riparian or stream-side vegetation, consistent with site capability, to promote habitat and protect water quality by filtering sediment, stabilizing streambanks, naturally storing water, and providing shade. The AgWQM program is outcome-based rather than prescriptive, therefore allows landowners the flexibility to achieve water quality goals using available equipment, technology and innovation. The rules for each Management Area provide the enforceable backstop to the voluntary initiatives. The SWCDs are the local management agencies that provide the outreach, education and technical assistance. ODA is responsible for complaint investigations and enforcement actions. Technical and financial assistance is available through state and federal programs to landowners for establishing adequate riparian areas. The CREP program agreements are for durations of 10 or 15 years. There is no guarantee that the benefits and management actions will be continued beyond the duration of the agreements.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain unimpaired passage and connectivity.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Remove or replace barriers blocking passage such as dams, road culverts and irrigation structures	Per Table 2 Priority (1) Butter Creek system priority (2)	Impaired fish passage	Dams, culverts, instream structures	Abundance, productivity, spatial structure, diversity	Primarily adults and 0+juveniles	See Table 2 for list of known passage barriers. The most serious passage barriers on the mainstem of the Umatilla River have been addressed. The watershed with the greatest need for passage remediation is Birch Creek.
Construct ladders over existing permanent concrete or earth fill dams	Per Table 2 Priority (1) Butter Creek system priority (2)	Impaired fish passage	Dams	Abundance, productivity, spatial structure, diversity	Primarily adults and 0+juveniles	
Provide screening at 100% of irrigation diversions	Unscreened diversions within current steelhead distribution (1); Butter Creek system priority (2)	Impaired fish passage	Irrigation diversions	Abundance, productivity	All	There is only one gravity flow diversion known to not have inadequate screening in areas that are occupied by steelhead. However, it is not known to what extent pump diversion are adequately screened.
Replace screens that do not meet criteria	Diversions within current steelhead distribution (1); Butter Creek system priority (2)	Impaired fish passage	Irrigation diversions	Abundance, productivity	All	
Operate and Maintain fish passage facilities to meet criteria	Within current steelhead distribution (1); Butter Creek system priority (2)	Impaired fish passage and entrainment	Dams, culverts and irrigation diversions	Abundance, productivity, spatial structure, diversity	All	There are cooperative projects in place in the Umatilla Subbasin to both physically maintain the facilities and provide biological oversight so they are operated to maintain optimum fish passage conditions.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Remove or replace barriers blocking passage such as dams, road culverts and irrigation structures	ODFW, CTUIR, SWCD, UBWC, USFS, ODOT, Umatilla County, Municipalities, private landowners	Ongoing	Access upstream of obstruction	Within 5 years	Immediate	High
Construct ladders over existing permanent concrete or earth fill dams	ODFW, CTUIR, private landowners	Ongoing	Access upstream of obstruction	5-10 years	Immediate	High
Provide screening at 100% of irrigation diversions	ODFW, private landowners	Ongoing	Point of diversion	10-20 years	Immediate	High
Replace screens that do not meet criteria	ODFW, private landowners	Ongoing	Point of diversion	10-20 years	Immediate	High
Operate and Maintain fish passage facilities to meet criteria	CTUIR, ODFW, WID, private landowners	Ongoing	Facility site	Ongoing	Immediate	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, no, uncertain)	Needs Expansion
ODFW	BPA Habitat Program, Fish Management Program	Basin-wide	No	More funding/implementation needed
CTUIR	BPA Habitat Program	Basin-wide	No	More funding/implementation needed
ODFW	Fish Screening Program	Basin-wide	Yes for gravity diversions	Need to inventory and address pump screening
Westland Irrigation District	Fish facilities O and M	Lower Umatilla River	Yes	
CTUIR/ODFW	Fish passage operations	Lower Umatilla River	Yes	
USFS	Road Maintenance	Upper basin	No	More funding needed to address fish passage problems
SWCD, UBWC	Watershed Improvement	Basin-wide	No	More funding/implementation needed

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

McKay, Butter and Willow creeks all historically supported summer steelhead, but steelhead are not currently present due to passage obstructions, inadequate screening and low flow problems. McKay Dam, constructed to store water for irrigation in the 1920's, completely blocks upstream passage of fish at RM 6 on McKay Creek. Until recent years, McKay Creek downstream of McKay Dam was completely de-watered when the reservoir was being filled. Butter Creek has a series of large diversion dams that block upstream passage throughout the basin. In addition, water withdrawal for irrigation is so severe that water flows out of the mouth for only a few days or weeks in any given year. Willow Creek Dam Was constructed in 1980 on Willow Creek just upstream of Heppner (RM 56) for flood control. Willow Creek Dam completely blocks upstream passage of fish. In addition, to Willow Creek Dam, numerous irrigation diversion dams exist throughout the Willow Creek watershed that block passage. The lowest barrier in Willow Creek that blocks anadromous passage exists at RM 11. Steelhead are occasionally seen holding downstream of this dam. While the general condition of passage in these streams (McKay, Butter and Willow creeks) is understood, a thorough inventory and assessment is needed. This information can be used to pursue passage improvement for redband trout and to assess the feasibility of restoring passage for steelhead.

The USFS has identified passage barriers in addition to the ones listed in Table 2.

Screening of gravity-feed irrigation diversions within currently occupied steelhead habitat is thought to be adequate, with the exception of the lower six miles of McKay Creek and one site in the Birch Creek drainage that is known to not meet criteria. There is now documented use of steelhead juveniles in lower McKay Creek, but no efforts have been made in the past or present to screen water diversions there. It is not known to what extent pump-feed irrigation diversions are adequately screened. There is a critical need to inventory and screen all pump-feed irrigation diversions within currently occupied steelhead habitat. A comprehensive inventory of water diversions and screening needs has never been done in the Umatilla Basin. Thus, while it is not likely that there are gravity feed diversions that are not screened, there exists the possibility, lacking a thorough assessment of the situation. A comprehensive inventory of all water diversions should be done and inspection of these diversions to ensure adequate screening.

Strategy 3. Restore floodplain connectivity and function and maintain unimpaired connectivity and function.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Reconnect floodplains to channels	Umatilla R., Mission Br. To forks (1); Meacham Cr., mouth to North Fork (1); Birch Creek (1); West Birch, mouth to gorge (1); East Birch Creek mouth to Pearson Cr. (1).	Degraded floodplain, altered hydrology, altered sediment rout-ing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity	All	Watershed scale problems and riparian management issues should be considered before active stream channel restoration is employed.
Reconnect side channels and off-channel habitats to stream channels	Umatilla R., Mission Br. To forks (1); Meacham Cr., mouth to North Fork (1); Birch Creek (1); West Birch, mouth to gorge (1); East Birch Creek mouth to Pearson Cr. (1).	Degraded floodplain, altered hydrology, habitat quantity and diversity,	Removal of side channels, off-stream habitat	Abundance, productivity	All	Many streams in the basin are bordered by dikes and levies.
Remove dikes and levies	Umatilla R., Mission Br. To forks (1); Meacham Cr., mouth to North Fork. (1).	Degraded channel structure and complexity	Stream channelization, bank armoring	Abundance, productivity	All	Many streams in the basin are bordered by dikes and levies.

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Reconnect floodplain habitats	ODFW, UBWC,, SWCD, USFS, CTUIR	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Short term, once identified	Physical response will be immediate for some, others will develop over years to decades	High, but there is more risk with active restoration approaches in experiencing un-desirable outcomes
Remove dikes and levies	CTUIR, UBWC, CDs	When opportunity identified	Within the stream reach and reaches downstream for temp and sediment	> 10 years	Improved stream and floodplain functions – Some benefits will be realized immediately and others will develop over years	High, but there is more risk with active restoration approaches in experiencing un-desirable outcomes
Reconnect side channels and off-channel habitats to stream channels	ODFW, UBWC, SWCD, USFS, CTUIR	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Short term, once identified	Physical response will be immediate for some, others will develop over years to decades	High, but there is more risk with active restoration approaches in experiencing un-desirable outcomes

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, no, uncertain)	Needs Expansion
ODFW	BPA Habitat Program	Birch Creek, Meacham Creek, Umatilla River	No	Additional implementation needed
CTUIR	BPA Habitat Program	Birch Creek, Meacham Creek, Umatilla River	No	Additional implementation needed
SWCD, UBWC	Watershed Restoration	Basin-wide	No	Involvement is currently limited
Watershed Council	Watershed Restoration	Basin-wide	No	There is a continuing need for landowner assistance to insure that issues are dealt with appropriately.
*Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Intensive land uses within Umatilla subbasin flood plains and upslope habitats have led to dramatic changes in waterway characteristics since arrival of Euro-American pioneers to the area during the middle 1800's (Nagel 1997, unpublished; Beschta 1994). Channel alterations in the Umatilla Subbasin have resulted in 1) straight, incised channels with minimal woody riparian vegetation, and 2) wide channels with increased dynamics and minimal woody riparian vegetation. There is a need for continued implementation of measures to address limiting factors.				

Strategy 4. Restore degraded channel structure and complexity and maintain unimpaired structure and complexity.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural channel form	Umatilla River, Mission Br. to forks (1); Meacham Creek, mouth to North Fork (1); Birch Creek (2); West Birch Creek (1), mouth to Gorge; East Birch Cr. (1).	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature, flows	Stream channelization, bank armoring, large wood removal, loss of beaver dams, removal of riparian vegetation, livestock overgrazing in riparian areas	Abundance, productivity	All	Stream channel reconstruction and instream structures can be designed to correct channel stability problems. Where appropriate, passive treatments are preferred.
Place stable wood and other large organic debris in streambeds	Umatilla River, Mission Br. to forks (1); Meacham Creek, mouth to headwaters (1); North Fork Meacham Cr. (1); Birch Creek (1); West Birch Creek, mouth to Gorge (1); East Birch Creek (1); Bear Cr. (West Birch) (1).	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	Removal of large wood, beaver, trees in riparian areas; channelization and streambank armoring, livestock grazing	Abundance, productivity	Fry to adult	Aside from riparian vegetation, removal of large wood debris is one of the most pervasive habitat deficiencies in the Umatilla subbasin, either from direct removal or from removal of vegetation from riparian zones and floodplains. In areas where direct and immediate benefits to viability parameters can be addressed, large wood should be placed to improve overall ecosystem function. In areas where the lack of large wood is in addition to other habitat deficiencies such as flow and water quality, then restoration should focus on these over riding factors first.
Stabilize and protect streambanks	Umatilla River, Mission Br. to forks (1); Birch Creek (1); W. Birch Creek, mouth to Gorge (1); East Birch Cr. (1)	Degraded channel structure and complexity, habitat diversity, sediment routing, flows	Stream channelization, bank armoring, livestock grazing in riparian areas	Abundance, productivity	Eggs, fry and adults	Stream that have been altered by human activities such as grazing, removal of riparian vegetation, Channelization and bank armoring often have vertical and/or lateral erosion rates elevated above natural conditions, as well as coarse substrates that are not suitable for spawning.
Construct rock and log weirs to create pool habitats or elevate incised channels	Umatilla River, Mission Br. to forks (1); Meacham Cr, mouth to North Fork (1); Birch Cr (1); West Birch Cr, mouth to Gorge (1); East Birch Creek (1); Bear Cr. (West Birch) (1).	Degraded channel structure and complexity, habitat diversity, sediment routing, flows	Large wood removal, trees in riparian area	Abundance, productivity	Fry to adult	Pools should be constructed strategically where other alternatives are not likely to accomplish this need, or constraints will not allow natural processes to form them. Artificial enhancement of pools should only be performed in areas where other parameters, such as water quality, would allow immediate use/benefits to be realized.

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Restore natural channel form	ODFW, SWCDs, CTUIR,, UBWC	Ongoing; some needs identified in ODFW/CTUIR five-year action plan	Within the stream reach and reaches downstream for temp and sediment	25 years	Improved riparian vegetation and associated attributes and improved stream and floodplain structure and function – response time immediate to 10 years	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes
Place stable wood and other large organic debris in streambeds	ODFW, UBWC, CTUIR, SWCDs	Ongoing as needed	Reach affected	Short term	Improved instream channel habitat diversity – Some benefits will be realized immediately and others will develop in 1-5 years	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes
Stabilize and protect streambanks	ODFW, CTUIR, SWCD, UBWC, private landowners	Ongoing; when specific opportunity identified	Within the stream reach and reaches downstream for temp and sediment	> 10 years	Improved water quality – response time 1-5 years	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes
Construct rock and log weirs to create pool habitats or elevate incised channels	ODFW, CTUIR	Ongoing; current action planned for Meacham Cr.	Treatment site	25 years	Increased quantity of pool habitat and channel and floodplain function – response time Immediate to 5 years	High over short term, however structures often require maintenance
Remove dikes and levies	ODFW, CTUIR, SWCD, UBWC	When specific opportunities identified	Within the stream reach and reaches downstream for temp and sediment	Once specific action planned, short term	Some benefits will be realized immediately and others will develop over years to decades	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
ODFW	BPA Habitat Program	Birch Creek, Meacham Creek, Umatilla River	No	Additional implementation needed
CTUIR	BPA Habitat Program	Birch Creek, Meacham Creek, Umatilla River	No	Additional implementation needed
SWCD	Watershed Restoration	Basin-wide	Yes	Involvement is currently limited
Watershed Council	Watershed Restoration	Basin-wide	No	There is a continuing need for landowner assistance to insure that issues are dealt with appropriately.
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				
Intensive land uses within Umatilla subbasin flood plains and upslope habitats have led to dramatic changes in waterway characteristics since arrival of Euro-American pioneers to the area during the middle 1800's (Nagel 1997, unpublished; Beschta 1994). Channel alterations in the Umatilla Subbasin have resulted in 1) straight, incised channels with minimal woody riparian vegetation, and 2) wide channels with increased dynamics and minimal woody riparian vegetation. There is a need for continued implementation of measures to address limiting factors.				

Strategy 5. Restore riparian condition and LWD recruitment and maintain unimpaired conditions.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Restore natural riparian vegetative communities	Umatilla River, Mission Br. to forks (1); Meacham Creek, mouth to headwaters (1); Birch Cr (1); West Birch Cr, mouth to Gorge (1); East Birch Cr (1); Bear Cr. (West Birch) (1); Iskuulpa Cr. (1)	Degraded riparian area, channel stability, floodplain degradation, sediment, water temperature	Livestock grazing, channelization, stream bank armoring, cutting of trees in riparian areas, changes in plant communities (including invasive plants), loss of beaver dams	Abundance, productivity, diversity	All	Historically, bank armoring with rock and channelization were used to stabilize stream banks at the detriment of riparian vegetation growth. In the last 15 years the high economic and ecological cost of bank armoring with riprap and of channelization has been recognized, so the emphasis has shifted toward a more passive approach for stabilization, primarily through riparian vegetation improvements.
Develop grazing strategies that promote riparian recovery	Umatilla River, Mission Br. to forks (1); Meacham Creek, mouth to headwaters (1); Birch Cr (1); West Birch Cr, mouth to Gorge (1); East Birch Cr (1); Bear Cr. (West Birch) (1); Iskuulpa Cr. (1)	Degraded riparian area, channel stability	Livestock overgrazing of riparian area	Abundance, productivity, diversity	All	Grazing strategies, other than exclusion, should be developed to achieve riparian recovery in the next 10-15 years. Permanent or temporary exclusion of livestock from riparian areas remains the surest way to achieve riparian restoration where livestock have been the primary impact.
Develop no-cultivation riparian buffer on agricultural lands and establish riparian setbacks for structures in areas where activities could upset riparian function	Umatilla River, Mission Br. to Meacham (1); Birch Cr (1); West Birch Cr, mouth to Gorge (1); East Birch Cr (1); Bear Cr. (West Birch) (1)	Degraded riparian area, channel stability, floodplain degradation, sediment, water temperature	Degradation of riparian areas and function; residential development and cultivation	Abundance, productivity, diversity	All	In areas where development is occurring, that development should be adequately set back from streams so as not to interrupt natural stream processes.
Maintain existing widths of RHCAs on USFS lands.	Umatilla R. and tribs, Meacham Cr. To Forks (1); South Fork Umatilla and tribs (1); Buck Cr. and tribs (1); Thomas Cr. and tribs (1); North Fork Meacham and tribs (1); East Meacham and tribs (1); Butcher Creek and tribs (1)	Degraded riparian area, channel stability, floodplain degradation	cutting of trees in riparian areas, changes in plant communities	Abundance, productivity, diversity	All	
Riparian exclosure fencing	Umatilla River, Mission Br. to forks (1); Meacham Creek, mouth to headwaters (1); Birch Cr (1); West Birch Cr, mouth to Gorge (1); East Birch Cr (1); Bear Cr. (West Birch) (1)	Degraded riparian area, channel stability	Livestock grazing	Abundance, productivity, diversity	All	Excluding livestock from riparian areas remains the most effective tool of mitigating livestock impacts.
Close, remove, and restore riparian road prisms	Umatilla River, Mission Br. to forks (1); Meacham Creek, mouth to headwaters (1); Birch Cr (1); West Birch Cr, mouth to Gorge (1); East Birch Cr (1); Bear Cr. (West Birch) (1).	Degraded riparian area, channel stability, sediment	Roads	Abundance, productivity, diversity	All	In many areas of the Umatilla Subbasin, riparian roads have reduced riparian vegetation, confined stream channels, and continue to deliver fine sediment to channels. Regular road maintenance, or road relocation or elimination will restore allow natural riparian processes.

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Restore natural riparian vegetative communities	ODFW, CTUIR, NRCS/FSA , UBWC, SWCD, ODA, private landowners	Ongoing	High dispersal downstream from site	25 years	Improved riparian vegetation and associated attributes – response time 5 years to decades	Moderate – plant survival varies based on techniques used
Develop/implement grazing strategies that promote riparian recovery	ODA, NRCS, FSA, USFS, private landowners	Ongoing	High dispersal downstream from site	Long term	Improved riparian vegetation and associated attributes – response time 5 years to decades	Depends on diligence of management applications
Develop no-cultivation riparian buffer on agricultural in areas where activities could upset riparian function	CTUIR, landowners, FSA/NRCS, ODFW	Ongoing	Cultivated land in close proximity to priority habitat areas within the Umatilla Subbasin	Long term	Immediate with continued improvement for up to 50 years or until easement ends and management changes. After 50 years habitat effectiveness will be maintained.	High
Maintain existing widths of RHCAs on USFS land	USFS	Ongoing	Benefits accruing since 1995 for all streams in Umatilla Basin on USFS lands, including priority Gas.	Long Term	Maintenance/improvement of existing conditions	High
Increase riparian buffer widths associated with forested areas	CTUIR, ODFW, ODF, USFS, private landowners		Forested land in close proximity to priority habitat areas within the Umatilla Subbasin	Long term	Immediate with continued improvement for up to 50 years. After 50 years habitat effectiveness will be maintained.	High
Riparian exclosure fencing	ODFW, CTUIR, NRCS/FSA Watershed Council, SWCD, private landowners	Ongoing	High dispersal downstream from site	25 years	Improved riparian vegetation and associated attributes – response time 5 years to decades	High
Close, remove, and restore riparian road prisms	USFS, ODOT, Umatilla County, private landowners	Ongoing	Riparian areas within the subbasin where potential for riparian road closure and removal exists	Based on opportunity and need	Improved water quality – response time immediate with continued response for up to 50 years	High
Protect unstable riparian areas	USFS	Ongoing	Benefits accruing since 1995 for all streams in Umatilla Basin on USFS lands, including priority Gas.	Long Term	Maintenance/improvement of existing conditions	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
ODA, SWCD	Agriculture Water Quality Management Program	Basin-wide		See Oregon State Agency's programmatic review.
FSA, NRCS, SWCD	CREP, CCRP, CSP, EQIP	Basin-wide	No	The potential coverage of these programs has not been realized in Umatilla County
ODFW/CTUIR	BPA Habitat Program		No	Many additional miles of stream to be treated
USFS	Grazing management	Upper basin	Yes	
USFS	Vegetation management	Upper basin	Yes	
ODEQ	TMDL	Basin-wide		See Oregon State Agency's programmatic review.
Municipalities	Land use planning ordinances	Basin-wide	No	Yes
USFS, ODF	Road management	Upper basin		See Oregon State Agency's programmatic review.
ODOT	Road maintenance	Basin-wide		See Oregon State Agency's programmatic review.
ODF	Forest Practices Act	Basin-wide		See Oregon State Agency's programmatic review.
Umatilla County	Road maintenance	Basin-wide	No	Yes, needs expansion to better address water and sediment routing to waterways

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

The Umatilla and Walla Walla Agricultural Water Quality Management (AgWQM) Area Rules require that management on agricultural lands allow the establishment, growth and maintenance of riparian or stream-side vegetation, consistent with site capability, to promote habitat and protect water quality by filtering sediment, stabilizing streambanks, naturally storing water, and providing shade. The AgWQM program is outcome-based rather than prescriptive, therefore allows landowners the flexibility to achieve water quality goals using available equipment, technology and innovation. The rules for each Management Area provide the enforceable backstop to the voluntary initiatives. The SWCDs are the local management agencies that provide the outreach, education and technical assistance. ODA is responsible for complaint investigations and enforcement actions. Technical and financial assistance is available through state and federal programs to landowners for establishing adequate riparian areas.

The CREP program agreements are for durations of 10 or 15 years. There is no guarantee that the benefits and management actions will be continued beyond the duration of the agreements.

Continued development adjacent to waterways is not suitable to the recovery of Mid. Columbia steelhead. Fish managers need to review the issue with Umatilla County and municipalities and identify ways to resolve problems with current regulations or their implementation.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Implement Umatilla Basin Project Phase I and II	Umatilla River from mouth to McKay Cr. (1)	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity, diversity	Parr to adult	Agricultural water diversions constructed on the lower Umatilla in the early 20th century lead to dewatering of the channel throughout the spring, summer and fall. Implementation of the Umatilla Basin Water Exchange project has resulted in restoration of flows in the mainstem of the Umatilla River so that migration and rearing of steelhead is better supported, but conditions are r fully restored. Continued implementation and maintenance of this project is critical for providing migration and rearing.
Implement Umatilla Basin Project Phase III	Umatilla River from mouth to Thornhollow (1)	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity, diversity	Parr to adult	
File for additional ISWRs	Butter Creek system (2); Bear Cr. (West Birch) (1); South Canyon Cr. (East Birch) (1); Westgate Canyon (East Birch) (1); East Fork Meacham Cr. (1); Twomile Cr. (2); Butcher Cr. (1)	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity, spatial structure, diversity	Parr to adult	Most important spawning and rearing stream in currently utilized spawning and rearing habitat have instream water rights. However, no instream water rights exist in the Butter Cr. system
Implement agricultural water conservation measures	Butter Creek system (2); Umatilla River, Mission Br. to forks (2); Birch Creek (1); West Birch Creek, mouth to Gorge (1); East Birch Creek (1); Bear Cr. (West Birch)(1);	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity, diversity, spatial structure	All	The primary tributary streams where water withdrawals are affecting migration and rearing of steelhead include the Birch and Butter Creek watersheds. Dewatering and passage barriers are so severe in Butter Creek that steelhead are currently not documented to occur. Birch Creek continues to support steelhead, but water withdrawals are significantly impacting rearing and migration habitats.
Lease or acquire water rights and convert to instream	Butter Cr system (2); Umatilla River, Mission Br. to forks (2); Birch Cr (1); West Birch Cr, mouth to Gorge (1); East Birch Cr (1); Bear Cr. (W Birch) (1)	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity, diversity, spatial structure	Parr to adult	
Downstream water rights transfers	Umatilla River, Mission Br. to forks (2); Birch Creek (1); West Birch Creek, mouth to Gorge (1); East Birch Creek (1); Bear Cr. (West Birch) (1)	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity, diversity	Parr to adult	
Monitor/regulate water withdrawals	Basin-wide	low flows, high temperatures	Water withdrawals	Abundance, productivity	Parr to adult	Many streams that historically flowed year long are now intermittent, creating fish passage barriers in the dewatered reach. Many of these a due to water withdrawals

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Implement Umatilla Basin Project Phase I and II	BPA, BOR, OWRD, WEID, HID, SID, CTUIR, ODFW	Ongoing	From McKay Reservoir to mouth of the Umatilla River	Long Term	Improved water quality and flow – immediate response	High, but depends on continued BPA funding
Implement Umatilla Basin Project Phase III	BPA, BOR, OWRD, WID, CTUIR, ODFW	In-planning	From McKay Reservoir to mouth of the Umatilla River	Long Term	Uncertain	Uncertain
File for additional ISWRs	ODFW	On hold	Specific to the stream reach	Unknown	Maintenance of existing conditions	High, depends on how resource managers implement protection
Implement agricultural water conservation measures	SWCDs	Ongoing	Depends on means used to protect instream flows	Short Term	Improved instream flow – response immediate	Moderate – depends on how saved water is protected, if any.
Lease or acquire water rights and convert to instream	OWRD., Oregon Water Trust, water right holders	Ongoing, when opportunities arise	From point of diversion downstream	Long term	Improved instream flow – response immediate	High, depending upon priority date of water right
Downstream water rights transfers	OWRD, private landowners	Ongoing	Reach between old and new point of diversion	Long Term	Improved instream flow – response immediate	High
Monitor/regulate water withdrawals	OWRD	Ongoing	From the point of diversion downstream to the mouth of the Umatilla River	Long term	Maintenance or improvement of existing conditions – response to regulation immediate	Moderate, staffing levels are inadequate

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
BOR/BPA	Umatilla Basin Project	Lower Umatilla River	No	Additional water is needed to meet target flows established for the basin project
OWRD	Stream Flow Monitoring and Regulation	Basin-wide		See Oregon State Agency's programmatic review.
Oregon Water Trust and BOR	Leasing and Purchase of Water Rights	Umatilla River, Birch Cr. System and Butter Cr. System	No	Additional implementation would help meet flow restoration needs
SWCD, ODFW, CTUIR, Watershed Council	Improve irrigation efficiency	Umatilla River, Birch Cr. System and Butter Cr. System	No	Additional implementation would help meet flow restoration needs
UBWC, SWCD, ODFW, CTUIR, NRCS	Upland improvements, riparian improvements	Basin-wide	No	Additional implementation would help meet flow restoration needs
Umatilla County	Noxious weed control	Basin-wide	Yes	
ODF	Forest Practices Act	Basin-wide		See Oregon State Agency's programmatic review.
USFS	Forest Management	Upper Basin	Yes	

*Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
Phase I and II of the Umatilla Basin Project are currently meeting critical flow needs in the mainstem of the Umatilla River. This program should be continued to support migration and rearing of steelhead. Target flows for the Umatilla River mainstem were established as part of the Basin Project to the life history needs of Chinook and coho salmon and steelhead. The Basin Project as currently implemented does not provide adequate water to meet the target flows throughout the times needed by these species, and fails to provide any flow mitigation for a significant length of the river in July and August. BOR, CTUIR and WID are currently seeking to expand the Basin Project (Phase III) to better meet flow needs for migration and rearing. As Phase III of the Basin project is developed, priority should be given to providing additional flow at the time and locations to meet the needs of MCR steelhead. Significant efforts have been made in the lower Umatilla Basin to use more efficient means of applying water to agricultural crops. There has been less emphasis on irrigation efficiency in other areas of the subbasin. Efforts should be taken to improve irrigation efficiency in areas such as the Birch Creek watershed where flow is a primary limiting factor. The Oregon Water Trust has put significant effort into gaining instream water leases in the Umatilla Subbasin, with limited success. While it is unlikely that this approach could make a significant difference on the lower Umatilla River, tributary habitats could benefit substantially from water leasing. The Oregon Water Trust should maintain a "presence" in the subbasin to be in a position to capitalize on opportunities as they arise. While instream water rights have been established on many of the important spawning and rearing stream in the subbasin, some have not. Where important spawning and rearing streams have not been protected by instream water rights, appropriate instream flow studies should be conducted and instream water rights applied for. In addition, consideration should be given to protecting and restoring flows in the Butter Creek drainage, where steelhead are currently extinct. Projects to improve summer and fall streamflow and temperature by recharging shallow aquifers have been proposed, but none have been implemented to date. These types of projects are highly experimental in nature and should be accompanied by rigorous monitoring and evaluation to determine the net benefits of the action. The primary tributaries in need of flow restoration actions are Birch and Butter creeks.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Address point sources of water pollution	Umatilla River (1); Birch Creek (1)	Chemical pollution	Sewage, Pesticides, fertilizers, herbicides	Abundance, productivity	Egg to Smolt	Point sources of water pollution are direct impacts that should be corrected through implementation of the TMDL and associated water quality management plan.
Implement water quality management plans	Basin-wide	Degraded water quality, flows, sediment routing, water quality	Land use practices, water withdrawals, pesticides, fertilizers, herbicides	Abundance, productivity	All	The Umatilla River water quality management plan addresses many water quality problems in the drainage.

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Address point sources of water pollution	ODEQ, others	Ongoing		Ongoing	Reduce chemical pollution immediately	High
Implement water quality management plans	ODA, SWCD, Municipalities, Umatilla County, USFS, ODF, Irrigation Districts, private landowners, Industry, ODEQ	Ongoing	High dispersal downstream	Ongoing	Immediate	Moderate – degree of implementation is uncertain

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
FSA, NRCS, SWCD	CREP, CCRP, CRP, EQIP, CSP	Basin-wide	No	The potential coverage of these programs has not been realized in Umatilla County
ODFW	BPA Habitat Program	Umatilla R. Birch Cr., Meacham Cr.	No	There is a need for additional buffers
CTUIR	BPA Habitat Program	Umatilla R. Birch Cr., Meacham Cr.	No	There is a need for additional buffers
ODEQ	TMDL, NPDES	Basin-wide		See Oregon State Agency's programmatic review.
ODF	Forest Practices Act	Basin-wide		See Oregon State Agency's programmatic review.
USFS	Pacfish, Infish	Upper Basin	Yes	
SWCD	Landowner cost share programs for conservation farming practices	Basin-wide	Yes	More landowners could be included if funds were available
Umatilla County	Noxious weed control	Basin-wide	Yes	
US Army Corps of Engineers	Section 404/401 water alteration permitting	Basin-wide	No	Compliance validation and enforcement is inadequate due to lack of resources
ODSL	Waterway alteration permitting	Basin-wide		See Oregon State Agency's programmatic review.
ODA, SWCD	Agriculture Water Quality Management Plan	Basin-wide		See Oregon State Agency's programmatic review.

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

Although this threat is partially addressed by the Umatilla River Water Quality Management Areas Plan (WQMAP), the guidance provided to landowners on management of riparian areas is fairly general. There is also some uncertainty regarding the implementation of this plan's requirements, as enforcement is based on a complaint-driven system. There is a continuing need to establish more riparian buffers. Achievement of the TMDL targets is dependent of determination of system potential vegetation. During TMDL development, the best professional judgment of the team described the potential streamside shade-producing vegetation broadly, as continuous tree-belts on each side of the river.

The Umatilla and Walla Walla AgWQM Rules require control of sediment delivery to streams to acceptable levels, control of irrigation runoff, management of livestock grazing to prevent runoff of waste and sediment, and establishment and maintenance of riparian and streamside vegetation. Beginning in 2008, these land conditions will be enforceable by ODA. SWCD provides technical and financial assistance to private landowners.

The SWCD, in partnership from OSU Extension Service and NRCS, has been a leader in promoting adoption of high tech conservation farming practices. They have received grants to provide cost share for farmers to adopt direct seeding, variable rate fertilizer placement and selective weed control. This technology reduces tillage that results in less erosion and healthier soils, applies only the needed amount of fertilizer to crops and reduces the application of herbicides.

The CREP program agreements are for durations of 10 or 15 years. There is no guarantee that the benefits and management actions will be continued beyond the duration of the agreements.

While permit processes implemented by the US Army Corps of Engineers are thorough and actions authorized are protective of aquatic resources, this programs lacks personnel resources to insure that terms and conditions of permitted actions are followed. In addition, the agency lacks resources to adequately monitor waterways for non-permitted actions or act upon non-permitted situations reported by other agencies or private parties. See Oregon State Agency's programmatic review for ODSL.

Strategy 8. Restore degraded upland processes to minimize unnatural rates of erosion and runoff, and maintain unimpaired natural upland processes.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore native upland plant communities	Basin-wide	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices, loss of water storage capacity	Abundance, productivity	All	There are cooperative projects in place in the Umatilla Subbasin
Upgrade or remove problem forest roads	Basin-wide	Altered hydrology, sediment routing	Road network	Abundance, productivity	All	
Initiate demonstration projects	Basin-wide	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices	Abundance, productivity	All	
Employ BMPs to forest practices, livestock grazing, road management and agricultural practices	Basin-wide	Altered hydrology, sediment routing	Upland land use practices	Abundance, productivity	All	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore native upland plant communities	SWCD, USFS, NRCS, private landowners	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Long term	Decades	Moderate, although funding on public lands and landowner cooperation on private lands will determine rate of treatment
Upgrade or remove problem forest roads	USFS, BLM, ODF, private landowners	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, many forest roads have legacy issues with regard to sediment transport and routing of runoff. Decommissioning may take many years	5-15 years	Moderate, although funding on public lands and landowner cooperation on private lands will determine rate of treatment
Initiate demonstration projects	ODFW, USFS, CTUUIR, Watershed Councils, SWCD's	Ongoing	Entire basin	Long term	Variable lag time	unknown, depends upon action taken as a result of being more informed
Employ BMPs to forest practices, livestock grazing, road management and agricultural practices	SWCD, USFS, ODA, CTUIR, private landowners	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, dependent on implementation of Water Quality Management Plans and other plans	0-20,years, depending upon treatments applied	Moderate, dependent upon voluntary landowner participation

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
FSA, NRCS, SWCD	EQIP, CRP, CREP, CCRP	Basin-wide	No	The potential coverage of these programs has not been realized in Umatilla County
ODF	Forest Practices Act	Basin-wide		See Oregon State Agency's programmatic review.
USFS	Forest Management	Upper Basin	Yes	
ODFW/CTUIR	BPA Habitat Program	Umatilla R., Birch Cr., Meacham Cr.	No	Additional implementation is needed
SWCD, Watershed Council	Watershed Restoration, OWEB	Basin-wide	No	Additional implementation is needed
ODA, SWCD	AgWMP	Basin-wide		See Oregon State Agency's programmatic review.

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

The degree to which upland vegetation management issues are being addressed has not been summarized subbasin-wide so sufficiency is currently not well understood.

The AgWQM Area Plan addresses upland conditions, both on rangeland and cropland that must be met to prevent and control erosion and improve overall watershed health to achieve water quality goals. The Area Rules require control of soil erosion to acceptable levels, allowing riparian and stream-side vegetation to establish for bank stability, filtering and shade, and management of livestock to prevent runoff of sediment and animal wastes. SWCD and NRCS programs are providing incentives to landowners to adopt farming practices that are more environmentally protective.

The CREP program agreements are for durations of 10 or 15 years. There is no guarantee that the benefits and management actions will be continued beyond the duration of the agreements.

Table 9-3. Umatilla Subbasin Geographic Areas

GA	Stream	Segment	MaSA	MiSA
1	Umatilla River	Mouth to Three Mile Dam		
2	Umatilla River	Three Mile Dam to Butter Creek		
3	North Hermiston Drain	All		
4	Butter Creek	Mouth to Madison diversion	Butter	
5	Butter Creek	Madison Diversion to East Butter Creek	Butter	
6	Little Butter Creek	All	Little Butter	
7	East Fork Butter and tributaries	All	Butter	
8	Butter Creek	East Fork to Headwaters and Johnson Creek	Butter	
9	Umatilla River	Butter Creek to Westland Dam and Stanfield Dam to McKay Creek		
10	Stage Gulch	All		
11	Umatilla River	Westland Dam to Stanfield Dam		
12	Birch Creek	Mouth to forks including Stewart Creek		Birch, Stewart
13	West Birch Creek	Mouth to Bear Creek	West Birch	
14	Bear Creek	All, including tributaries	West Birch	
15	West Birch Creek	Bear Creek to top of gorge, including tributaries	West Birch	
16	West Birch Creek	Gorge to headwaters	West Birch	
17	East Birch Creek	Mouth to California Gulch	East Birch	
18	East Birch Creek	California Gulch to headwaters, including tributaries except Pearson Cr.	East Birch	
19	Pearson Creek	All	East Birch	
20	McKay Creek	Mouth to McKay Dam	McKay	
21	McKay Creek	McKay Dam to North Fork		
22	North Fork McKay	All, including tributaries	McKay	
24	McKay Creek	North Fork to headwaters, including tributaries	McKay	
25	Umatilla River	McKay Creek to Mission Bridge		
26	Wildhorse Creek	Mouth to Athena, including tributaries		Wildhorse
27	Widlhorse Creek	Athena to headwaters, including tributaries		Wildhorse
28	Umatilla River	Mission Bridge to Meacham Creek	Middle Umatilla	
29	Umatilla Tributaries	Mission, Cottonwood, Moonshine and Coonskin creeks	Middle Umatilla	
30	Buckaroo Creek	All	Middle Umatilla	
31	Iskuulpa Creek	Mouth to Bachelor Canyon	Middle Umatilla	
32	Iskuulpa Creek	Bachelor Canyon to headwaters, including tributaries	Middle Umatilla	
33	Meacham Creek	Mouth to North Fork	Meacham	
34	Meacham Creek	Tributaries from mouth to North Fork	Meacham	
35	North Fork Meacham	All, including tributaries	Meacham	
36	Meacham Creek	North Fork to Twomile Creek, including Sheep Creek	Meacham	
37	East Meacham	All including tributaries and Butcher Creek	Meacham	
38	Meacham Creek	Twomile Creek to headwaters, including Twomile Creek	Meacham	
39	Beaver Creek	All, including tributaries	Meacham	
40	Umatilla River	Meacham Creek to forks	Upper Umatilla	
41	Ryan Creek	All	Upper Umatilla	
42	North Fork Umatilla	Mouth to headwaters, including tributaries	Upper Umatilla	
43	South Fork Umatilla	Mouth to Thomas Creek	Upper Umatilla	
44	Buck Creek	All, including tributaries	Upper Umatilla	
45	Thomas Creek	All	Upper Umatilla	
46	South Fork Umatilla	Thomas Creek to headwaters, including Shimmiehorn Creek	Upper Umatilla	

Note: Minor spawning areas within the Umatilla Subbasin not represented include Cold Springs, Alkali, Speare, Mud Spring and Little McKay

Table 9-4. Barriers to Upstream Passage on Streams in the Umatilla River Subbasin (NPCC 2004)

Stream	River Mile	Barrier Type	Step Height Est. (m)	Degree	Recommended Action	Priority
Umatilla R.	1.5	Channel Mod.	0.7	Partial	Modify	L
Umatilla R.	2.4	Irrigation Dam	1.0	Partial	Modify	M
Umatilla R.	49	Irrigation Dam	1.2	Partial	Remove	M
Butter Creek	7.9	Flash Boards	2.3	Complete	Modify	L
Butter Creek	27.2	Irrigation Dam	1.4	Complete	Modify	L
Butter Creek	43.0	Irrigation Dam	1.2	Complete	Modify	L
Johnson Cr. (Butter Trib)	0.3	Culvert	0.8	Partial	Modify	M
Birch Creek	0.5	Pipe Casing	1.4	Partial	Modify	M
Birch Creek	2.5	Irrigation Dam	1.5	Partial	Modify/Remove	H
Birch Creek	5.0	Irrigation Dam	1.2	Partial	Modify/Remove	H
Birch Creek	10.0	Irrigation Dam	1.0	Partial	Remove	M
Birch Creek	11.0	Irrigation Dam	0.7	Partial	Remove	L
Birch Creek	12.0	Irrigation Dam	1.0	Partial	Modify	M
Birch Creek	15.0	Irrigation Dam	1.7	Partial	Remove	H
West Birch Cr.	1.0	Irrigation Dam	?	Partial	Modify	M
West Birch Cr.	3.5	Irrigation Dam	2.1	Partial	Modify	H
West Birch Cr.	3.8	Bridge	1.2	Partial	Modify	H
West Birch Cr.	5.5	Irrigation Dam	1.4	Partial	Remove	H
West Birch Cr.	8.5	Irrigation Dam	1.5	Partial	Remove	H
Bridge Cr. (West Birch)	2.0	Culvert	?	Complete	Modify	H
East Birch Cr.	4.0	Irrigation Dam	0.7	Partial	Remove	L
East Birch Cr.	9.0	Irrigation Dam	1.0	Partial	Remove	L
Jungle/Windy Spr. (Pearson)	0.1	Culvert	0.15	Partial	Modify	L
Wildhorse Cr.	0.1	Irrigation Dam	0.7	Partial	Modify	L
Wildhorse Cr.	18.8	Bridge	1.0	Partial	Modify	L
Greasewood Cr.	0.4	Irrigation Dam	0.6	Partial	Modify	L
Mission Cr.	0.9	Bedrock Drop	0.5	Partial	Modify	M
Mission Cr.	3.3	Bridge/Culvert	0.7	Partial	Modify	M
Coonskin Cr.	0.3	Bridge	0.5	Partial	Modify	M
Coonskin Cr.	0.9	Pipe Casing	1.1	Partial	Modify	M
Whitman Spr.	0.1	Culvert	0.5	Complete	Modify	L
Red Elk Can.	0.2	Culvert	0.8	Partial	Modify	L
Minthorn Spr.	0.1	Culvert	0.5	Partial	Modify	L
Unnamed Trib to SF Umatilla at RM 1.5	0.1	Culvert	0.5	Complete	Modify	M
Camp Creek	0.25	Irrigation Dam	1.3	Partial	Remove	M
Unnamed trib to Umatilla R. at RM 81.2	0.1	Culvert	0.6	Partial	Modify	L
Twomile Creek	1.25	Culvert	?	?	Modify	L

Table 17-6g. Habitat Strategies and Actions for Recovery of Walla Walla River Steelhead Population

Primary limiting factors: high water temperature, sediment routing, impaired fish passage, degraded channel structure and complexity, degraded floodplain connectivity and function, and altered hydrology (low flow).

Primary threats: current land use practices that reduce habitat quality and quantity and disrupt ecosystem functions.

Several tables are included after the habitat strategies and actions for the Walla Walla River steelhead population. Table 9-5 identifies barriers to upstream passage on streams in the Walla Walla Subbasin, only within the area inhabited by the Walla Walla steelhead population. Tables 9-6 and 9-7 show priorities for steelhead habitat restoration and protection. This prioritization was developed by applying the Ecosystem Diagnosis and Treatment Model, which determined limiting factors and the areas where the greatest increase in fish production could be realized from restoration and protection actions. Table 9-8 provides a cross reference of GA's and MaSA's/MiSA's.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Protect high quality habitats through acquisition, conservation easements and cooperative agreements	SF Walla Walla , Elbow to headwaters (1); SF Walla Walla Tribs (1) ; NF Walla Walla Little Meadows to headwaters (1); Walla Walla, Dry Cr. to Mill Cr.(2); Yellowhawk mainstem (2); Couse Cr. drainage (2)	Loss of habitat quantity and diversity, channel stability, sediment, low flow and high temperatures	Cultivation, forestry, grazing, urban development	Productivity, abundance	All	Agreements (conservation easements, cooperative agreements, etc.) could be made with private landowners in areas where priority habitats exist to maintain the current habitat values. Agreements in areas with priority habitats may include: Putting in no-cultivation riparian buffers on agricultural lands that are currently cultivated up to the channel's edge, increasing riparian buffer widths associated with forested areas, protecting unstable areas, or changing other types of management in riparian areas.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Continue existing protections and/or increase protection of Federal lands; implement Forest Practices Act and PACFISH/INFISH	SF Walla Walla, Elbow to headwaters; SF Walla Walla Tribs; NF Walla Walla Little Meadows to headwaters; All are first priority (1)	Same as above	Forestry, cultivation, grazing, urban development	Productivity abundance	All	Current protections on USFS lands such as Riparian Habitat Conservation Areas should be continued and maintained. Protection on Federal lands may be increased through the NEPA process or ESA consultation. Aquatic habitat issues are addressed through both processes. Actions may include expanding riparian buffers, changing management within or near riparian areas, and identifying sensitive areas to avoid. All the options listed for added protection are directed through PACFISH program/management direction but would be considered "New" actions to be applied if/when the need is identified. Forest Plan management direction (landscape-scale) for Roadless areas, wildlife management emphasis and Wilderness are unlikely to change significantly in the near future.
Establish setbacks to protect waterways from forest management, agricultural activities, and other land use practices that would disrupt ecosystem function	SF Walla Walla, mouth to headwaters (1); SF Walla Walla Tribs (1); NF Walla Walla mouth to headwaters (1); Walla Walla, Dry Cr. to forks (1); Yellowhawk mainstem (1); Couse Cr. drainage (1); Little Walla Walla System (2)	Same as above	Same as above	Productivity, abundance		Setbacks could include: no-cultivation riparian buffers on agricultural lands that are currently cultivated up to the channel's edge, increasing riparian buffer widths associated with forested areas, protecting unstable areas, or changing other types of management in riparian areas.
Protect and conserve rare and unique functioning habitats	Upper South Fork Walla Walla (1)	Same as above	Same as above	Productivity, abundance	All	Priority areas can be identified and appropriate protective action can be taken.
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	Basinwide	Same as above	Same as above	Productivity, abundance	All	To prevent degradation of existing habitat, Best management Practices and existing laws that protect aquatic habitat should be applied across the basin with emphais on areas of very high quality.
Review, modify and enforce existing land use planning documents and ordinances pertaining to riparian and floodplain management to better address habitat and water quality issues.	SF Walla Walla, mouth to headwaters (1); SF Walla Walla Tribs (1); NF Walla Walla mouth to headwaters (1); Walla Walla, Dry Cr. to forks (1); Yellowhawk mainstem (1); Couse Cr. drainage (1); Little Walla Walla System (2)	Same as above	Urban development	Productivity, abundance	All	Enforce existing land use laws that affect aqutic habitat and update laws that do not provide adequate protection.
Incorporate priority habitat areas into the Natural Area Overlay Zone provision of the Umatilla County Development Ordinance	SF Walla Walla, mouth to headwaters (1); SF Walla Walla Tribs (1); NF Walla Walla mouth to headwaters (1); Walla Walla, Dry Cr. to forks (1); Yellowhawk mainstem (1); Couse Cr. drainage (1); Little Walla Walla System (2)	Same as above	Urban development	Productivity, abundance	Productivity, abundance	Incorporating MCR steelhead priority habitat areas into the Natural Area Overlay Zone provision of the county development ordinance would allow the priority habitat areas to be protected while providing an expedient process for reviewing land uses.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Explore opportunities to incorporate priority areas into state legislation.	SF Walla Walla, mouth to headwaters (1); SF Walla Walla Tribs (1); NF Walla Walla mouth to headwaters (1); Walla Walla, Dry Cr. to forks (1); Yellowhawk mainstem (1); Couse Cr. drainage (1); Little Walla Walla System (2)	Same as above	Rural and urban development	Productivity, abundance	All	Examine opportunities to amend laws that would increase protection for priority habitat areas.

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Protect high quality habitats through acquisition, conservation easements and cooperative agreements	CTUIR, ODFW, WWBWC, WDFW,TNC, RMEF, SWCDs, CD's	Ongoing	Water quality improvement have high dispersal downstream, stream corridor and function improvements would be confined to the specific site	Existing conservation agreements are complete. Full implementation of conservation measures will take 5-15 years or more	5 years to decades with passive restoration approaches	High, based on previous cooperative agreements
Continue existing protections and/or increase protection of Federal lands; implement Forest Practices Act and PACFISH/INFISH	USFS, ODF, WDOE	Ongoing	Benefits accruing since 1995 for all streams in Umatilla Basin on USFS lands, including priority Gas. . Forest Practices Act applies to all commercial timber operations on private lands	Long Term	Maintenance/improvement of existing conditions	High
Establish setbacks to protect waterways from forest management, agricultural activities, and other land use practices that would disrupt ecosystem function	CTUIR, ODFW, WDFW, WDOE, USFS, FSA, NRCS, SWCD, CD's, WWBWC	When need identified	Riparian areas associated with priority habitat areas	Long term	Immediate with continued improvement for up to 50 years. After 50 years habitat effectiveness will be maintained.	High
Protect and conserve rare and unique functioning habitats	USFS	Protection ongoing	Affected area	Long term	Maintenance of existing conditions	High
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	USFS, SWCDs, WDOE, WDFW, ODFW, ODA, FSA, NRCS, CTUIR, ODSL, USACE, private landowners	Ongoing	All priority areas within the Walla Walla Subbasin	Long Term	Maintenance of existing conditions	Moderate
Review, modify and enforce existing land use planning documents and ordinances pertaining to riparian and floodplain management to better address habitat and water quality issues.	Municipalities, Counties	Unknown	Mid and lower basin; High dispersal downstream	Ongoing – unknown	Response is uncertain	It is unknown to what extent governments will address this need.

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Incorporate priority habitat areas into the Natural Area Overlay Zone provision of the Umatilla County Development Ordinance	Counties, CTUIR, ODFW, WDFW	When possible	All priority areas within the Umatilla Subbasin	Short term	Immediate with continued improvement for up to 50 years. After 50 years habitat effectiveness will be maintained.	Moderate, depends on implementation and enforcement
Explore opportunities to incorporate priority areas into state legislation.	ODFW, CTUIR, WDFW, WDOE	When funding is available and amendment is possible	All priority areas within the Umatilla Subbasin	Long term	Immediate with continued improvement for up to 50 years. After 50 years habitat effectiveness will be maintained.	Low

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
CTUIR	CTUIR Walla Walla River Basin Anadromous Fish Habitat Enhancement Projects – Riparian Function		No	Yes, there is still potential for more conservation easements
USFS	Roadless Areas		Yes	
ODF	Forest Practices Act			See Oregon State Agency's programmatic review.
BLM	South Fork Walla Walla ACEC		Yes	No
USFS	PACFISH, Umatilla Forest Plan		Yes	Existing actions are adequate as implemented, but additional protection areas should be added as the need is identified.
CTUIR	Rainwater		Yes	Maintain current project
USACE/ODSL/WDFW	Waterway work permitting		No	Yes, funding not adequate
ODA, SWCD	Walla Walla Ag.WQM rules			See Oregon State Agency's programmatic review.
SWCD/CDs/WWBWC/Tr-state Steelheaders	Watershed restoration		No	Yes
Municipalities	Land use ordinances		No	Yes
Counties	Comprehensive plan		No	Yes
FSA, NRCS, SWCD	CREP, CCRP, CSP, EQIP		No	The potential coverage of these programs has not been realized in Umatilla County
OLCD	Statewide planning goals			See Oregon State Agency's programmatic review.

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

CTUIR conservation easement programs have been effective at protecting and improving riparian habitat condition in the Walla Walla Subbasin. There is potential for considerable expansion of this program. Emphasis should be placed on priority habitat areas for establishing easements.

The Umatilla National Forest should emphasize protecting priority areas during project planning and implementation. Ongoing management actions sufficiently protect high priority aquatic habitats. These existing protections should be continued. PACFISH/Forest Plan Programs per se are sufficiently protective for lands in current ownership and require changing management or increasing buffers only when need is identified site-specifically ("New" actions). Most of FS lands are already essentially fully- protected under Forest Plan by protective management direction - Roadless and Wilderness and Wildlife Emphasis Management Areas which prohibit road building and timber harvest except in rare circumstances; PACFISH protections apply to all such activities. When/if needs are identified, additional aquatic habitat could receive increased protective status and a "new action". Priority areas for habitat protection as listed above that reside within the Umatilla National Forest should be assessed as to whether administrative designations apply to the areas that will support protection of these areas over the long term.

While permit processes implemented by the US Army Corps are thorough and actions authorized are protective of aquatic resources, the program lacks personnel resources to insure that terms and conditions of permitted actions are followed. In addition, this agency lacks resources to adequately monitor waterways for non-permitted actions or act upon non-permitted situations reported by other agencies or private parties. See Oregon State Agency's programmatic review for ODSL.

The USFS land exchange program has the potential to bring existing private lands under federal ownership and PACFISH protections. However, this program is completely voluntary on the landowners part and the landowner would acquire public land and could very likely lower standards of resource protection. The land exchange is, however, a tool that could be used under very controlled circumstances to see increased protection of important aquatic habitats. But the purpose of the program is focused on consolidating land holdings and not necessarily protection of habitat.

The Umatilla and Walla Walla Agricultural Water Quality Management (AgWQM) Area Rules require that management on agricultural lands allow the establishment, growth and maintenance of riparian or stream-side vegetation, consistent with site capability, to promote habitat and protect water quality by filtering sediment, stabilizing streambanks, naturally storing water, and providing shade. The AgWQM program is outcome-based rather than prescriptive, therefore allows landowners the flexibility to achieve water quality goals using available equipment, technology and innovation. The rules for each Management Area provide the enforceable backstop to the voluntary initiatives. The SWCDs are the local management agencies that provide the outreach, education and technical assistance. ODA is responsible for complaint investigations and enforcement actions. Technical and financial assistance is available through state and federal programs to landowners for establishing adequate riparian areas.

The CREP program agreements are for durations of 10 or 15 years. There is no guarantee that the benefits and management actions will be continued beyond the duration of the agreements.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain unimpaired passage and connectivity.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Remove or replace barriers blocking passage such as dams, bridges, road culverts and irrigation structures	Priorities shown in Table 3	Impaired fish passage	Dams, culverts, instream structures	Abundance, productivity, spatial structure, diversity	Primarily adults and 0+juveniles	A comprehensive on-the-ground survey of passage barriers in the Oregon portion of the subbasin has not been completed. All passage barriers in known steelhead habitat should be addressed in a prioritized fashion.
Construct ladders over existing permanent irrigation diversions	Priorities shown in Table 3	Impaired fish passage	Dams	Abundance, productivity, spatial structure, diversity	Primarily adults and 0+juveniles	
Operate and Maintain fish passage facilities	Diversions within current steelhead distribution are first priority (1)	Impaired fish passage and entrainment	Dams, culverts and Irrigation diversions	Abundance, productivity, spatial structure, diversity	All	There are cooperative projects in place in the Walla Walla Subbasin to both physically maintain the facilities and provide biological oversight so they are operated to maintain optimum fish passage conditions.
Provide screening at 100% of irrigation diversions	Unscreened diversions within current steelhead distribution are first priority (1)	Impaired fish passage	Irrigation diversions	Abundance, productivity	All	In Oregon, all known gravity flow diversions are screened to NOAA criteria. It is not known to what extent that pump diversions are screened in the Oregon part of the subbasin. Pump diversions should be inventoried and addressed as soon as possible. The Little Walla Walla system is screened at the point of diversion, but diversions within this system where steelhead could be present, by swimming up the outlet in Washington, are not currently screened.
Replace screens that do not meet criteria	Diversions within current steelhead distribution are first priority (1)	Impaired fish passage	Irrigation diversions	Abundance, productivity	All	There are cooperative projects in place in the Walla Walla Subbasin to maintain facilities and provide oversight so they are operated to maintain optimum fish passage conditions.

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Remove or replace barriers blocking passage such as dams, bridges, road culverts and irrigation structures	ODFW, WDFW, CTUIR, WWBWC, CDs, TSS, road epts.., private landowners	Ongoing	Fish access upstream of obstruction	Known issues addressed within 10 years	Immediate	High
Construct ladders over existing permanent irrigation diversions	ODFW, WDFW, CTUIR, WWBWC, CDs, TSS, private landowners	Ongoing	Fish access upstream of obstruction	Known issues addressed within 10 years	Immediate	High
Operate and Maintain fish passage facilities	CTUIR, ODFW, WDFW, HBDIC, GFID,, private landowners	Ongoing	Facility site	Ongoing	Immediate	High
Provide screening at 100% of irrigation diversions	ODFW, WDFW, CTUIR, private landowners	Ongoing	Point of diversion	Status of most pump diversions unknown, remediation up to10-20 yrs	Immediate	High
Replace screens that do not meet criteria	ODFW, WDFW, CTUIR, private landowners	Ongoing	Point of diversion	Status of most pump diversions unknown, remediation up to 10-20 yrs	Immediate	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
CTUIR	BPA Fish Passage program		No	More funding needed
ODFW	Fish Screening Program		Yes, for gravity diversions	Need to inventory and address pump screening
WDFW	Fish Screening Program		No	More funding needed to complete screening of diversions and maintain existing screens.
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				
It is currently unknown to what extent pump diversions in the Oregon portion of the subbasin are adequately screened. Pump diversion should be inventoried to determine screening status and all diversions screened to NOAA criteria. Washington currently has an initiative underway to provide landowners with funding to screen their diversions. This effort should be continued until all diversions are adequately screened. There is also a need for a comprehensive inventory of screening needs throughout the Oregon portion of the basin as this has not been done to date. Table 9-5 is a list of known passage barriers in the Walla Walla Subbasin in the area occupied by the Walla Walla steelhead population. These barriers should be addressed in a prioritized manner.				

Strategy 3. Restore floodplain connectivity and function and maintain unimpaired connectivity and function.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Reconnect floodplains to channels	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn (2).	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams.	Abundance, productivity	All	Watershed scale problems and riparian management issues should be considered before active stream channel restoration is employed.
Reconnect side channels and off-channel habitats to stream channels	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn (2); Little Walla Walla System (2); Yellowhawk System (2).	Degraded floodplain, altered hydrology, habitat quantity and diversity,	Removal of side channels, off-stream habitat	Abundance, productivity	All	Channel reconstruction, placement of instream structures and large wood debris in concert with riparian restoration can be used to restore functionality of stream channels. Watershed scale problems and riparian management issues should be considered before active stream channel restoration is employed. In areas where direct and immediate benefits to viability parameters can be addressed, large woody should be placed to improve ecosystem function. In areas where other habitat deficiencies, such as flow and water quality, also exist, restoration should focus on these other factors first.
Remove dikes and levies	Walla Walla R., Mill Cr. to forks (1)	Degraded floodplain connectivity, channel structure and complexity	Stream channelization, bank armoring	Abundance, productivity	All	Many streams in the basin are bordered by dikes and levies.
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	Basinwide	Degraded floodplain connectivity, channel structure/complexity, flow, water quality, sediment	Loss of beaver dams	Abundance, productivity	all	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Reconnect floodplains to channels	ODFW, WWBWC, SWCD, USFS, CTUIR, WDFW, Trii-state Steelheaders	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Short term, once identified	Physical response will be immediate for some, others will develop over years to decades	High, but there is more risk with active restoration approaches in experiencing un-desirable outcomes
Reconnect side channels and off-channel habitats to stream channels	ODFW, WWBWC, SWCD, USFS, CTUIR, , WDFW, Trii-state Steelheaders	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Short term, once identified	Physical response will be immediate for some, others will develop over years to decades	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes
Remove dikes and levies	CTUIR, WWBWC, COE, private landonwers	When opportunity identified	Within the stream reach and reaches downstream for temp and sediment	> 10 years	Improved stream and floodplain functions – Some benefits will be realized immediately and others will develop over years	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	ODFW, WDFW, private landowners	Ongoing	Basinwide	Long term	Undefined	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
CTUIR	BPA Habitat Program	Basinwide	No	Yes, more funding needed
SWCD, CD's, WWBWC/TSS	Watershed Restoration	Basinwide	No	More funding/implementation needed
ODOT, WDOT, County road dpts, Municipalities	Bridge maintenance	Basinwide		See Oregon State Agency's programmatic review.
FSA, NRCS, SWCD, CD's	CREP, CCRP, CRP, EQIP	Basinwide	No	Additional implementation needed

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

Intensive land uses within Walla Walla subbasin flood plains and upslope habitats have led to dramatic changes in waterway characteristics since arrival of Euro-American pioneers to the area during the middle 1800's. The common outcomes of intensive land use activities in the Walla Walla Subbasin include: 1) straight, incised channels with minimal woody riparian vegetation, and 2) wide channels with increased dynamics and minimal woody riparian vegetation.

Implementation of site specific measures will be implemented within the context of an overall hierarchical strategy for prioritizing restoration actions. As implementation actions are planned, consideration will be first given to actions that address watershed processes and passive techniques, but artificial enhancement methods will be used where previous watershed assessment (2004) indicate that such work will lead to significant benefits for MCR steelhead and alternative approaches are not available.

Strategy 4. Restore degraded channel structure and complexity and maintain unimpaired structure and complexity.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Restore natural channel form	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn. (1); Little Walla Walla System (2); Yellowhawk System (2)	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature, flows	Stream channelization, bank armoring, large wood removal, loss of beaver damsl, removal of riparian vegetation areas	Abundance, productivity	All	Stream channel reconstruction and instream structures can be designed to correct channel stability problems. Where appropriate, passive treatments are preferred.
Place stable wood and other large organic debris in streambeds	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn. (1)	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	Removal of large wood, trees in riparian areas; channelization and streambank armoring, livestock grazing	Abundance, productivity	Fry to adult	Large, complex pools and riffle habitats with appropriate sized spawning gravels are missing within many areas. The preferred approach is to allow natural processes to restore these habitat elements. EDT has identified locations where significant benefit would occur if pools were introduced.
Stabilize and protect streambanks	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn. (1); Little Walla Walla System (2); Yellowhawk System (2)	Degraded channel structure and complexity, habitat diversity, sediment routing, flows	Stream channelization, bank armoring, livestock grazing in riparian areas	Abundance, productivity	Eggs, fry and adults	Incised or over steepened stream channels that reduce riffle habitat should be repaired through passive and active approaches where water quality is currently adequate to support spawning and rearing.
Construct rock and log weirs to create pool habitats or elevate incised channels	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn. (1)	Degraded channel structure and complexity, habitat diversity, sediment routing, flows	large wood removal, loss of recruitment trees in riparian area	Abundance, productivity	Fry to adult	Pools should be constructed strategically where other alternatives are not likely to accomplish this need, or constraints will not allow natural processes to form them. Artificial enhancement of pools should only be performed in areas where other parameters such as water quality would allow immediate use/benefit to be realized.
Implement bridge maintenance BMPs	Basinwide	Degraded channel structure and complexity	Stream channelization, bank armoring	Abundance, productivity	All	Many streams in the basin are bordered by dikes and levies.
Educate landowners on importance of LWD	Basinwide	Loss of pool habitat, channel structure and complexity	Large wood removal	Abundance and productive	all	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Restore natural channel form	ODFW, SWCDs, CTUIR, WWBWC, CDs, WDFW	Ongoing; some needs identified in ODFW/CTUIR five-year action plan	Within the stream reach and reaches downstream for temp and sediment	25 years	Improved riparian vegetation and associated attributes and improved stream and floodplain structure and function; response time immediate to 10 years	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes
Place stable wood and other large organic debris in streambeds	ODFW, WWBWC, CTUIR, CDs, WDFW, TSS	Ongoing as needed	Reach affected	Short term	Improved instream channel habitat diversity – Some benefits will be realized immediately and others will develop in 1-5 years	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes
Stabilize and protect streambanks	ODFW, CTUIR, SWCD, CDs, WWBWC, private landowners	Ongoing; when specific opportunity identified	Within the stream reach and reaches downstream for temp and sediment	> 10 years	Improved water quality – response time 1-5 years	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes
Construct rock and log weirs to create pool habitats or elevate incised channels	ODFW, CTUIR, CDs, WWBWC, WDFW, TSS	Ongoing; current action planned for Meacham Cr.	Treatment site	25 years	Increased quantity of pool habitat and channel and floodplain function – response time Immediate to 5 years	High over short term, however structures often require maintenance
Implement bridge maintenance BMPs	USFS, ODOT, WDOT, County road departments.	Ongoing	Site specific	Long term	Improved LWD and water quality; slow response time	Moderate, depends on compliance with BMPs
Educate landowners on importance of LWD	Stellar, WWBWC, ODFW, CTUIR	ongoing	Basin-wide	Long term	Variable lag time depending on actions	Moderate

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
CTUIR	BPA Habitat Program		No	Yes, more funding needed
SWCD, CD's	Watershed Restoration		No	Involvement is currently limited
WWBWC/Tri-state Steelheaders	Watershed Restoration		No	There is a continuing need for landowner assistance to insure that issues are dealt with appropriately.
ODOT, WDOT, County road dpts	Bridge maintenance			See Oregon State Agency's programmatic review.
FSA, NRCS, SWCD, CD's	CREP, CCRP, CRP, EQIP		No	Additional implementation needed

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

Intensive land uses within Walla Walla subbasin flood plains and upslope habitats have led to dramatic changes in waterway characteristics since arrival of Euro-American pioneers to the area during the middle 1800's. The common outcomes of intensive land use activities in the Walla Walla Subbasin include: 1) straight, incised channels with minimal woody riparian vegetation, and 2) wide channels with increased dynamics and minimal woody riparian vegetation.

Implementation of site specific measures will be implemented within the context of an overall hierarchical strategy for prioritizing restoration actions. As implementation actions are planned, consideration will be first given to actions that address watershed processes and passive techniques, but artificial enhancement methods will be used where previous watershed assessment (2004) indicate that such work will lead to significant benefits for MCR steelhead and alternative approaches are not available.

Strategy 5. Restore riparian condition and LWD recruitment and maintain unimpaired conditions.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural riparian vegetative communities	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn. (1); Little Walla Walla System (2); Yellowhawk System (2)	Degraded riparian area, channel stability, floodplain degradation, sediment, water temperature	Livestock grazing, channelization, stream bank armoring	Abundance, productivity, diversity	All	Historically, bank armoring with rock and channelization were used to stabilize stream banks at the detriment of riparian vegetation growth. In the last 15 years the high economic and ecological cost of bank armoring with riprap and of channelization has been recognized, so the emphasis has shifted toward a more passive approach for stabilization, primarily through riparian vegetation improvements and bioengineering treatments
Develop grazing strategies that promote riparian recovery	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn. (1); Little Walla Walla System (2); Yellowhawk System (2)	Degraded riparian area, channel stability	Livestock overgrazing of riparian area	Abundance, productivity, diversity	All	Grazing strategies, other than exclusion, should be developed to achieve riparian recovery in the next 10-15 years. Permanent or temporary exclusion of livestock from riparian areas remains the surest way to achieve riparian restoration where livestock have been the primary impact.
Develop no-cultivation riparian buffer on agricultural lands and establish riparian setbacks for structures in areas where activities could upset riparian function	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn. (1); Little Walla Walla System (2); Yellowhawk System (2)	Degraded riparian area, channel stability, floodplain degradation, sediment, water temperature	Degradation of riparian areas and function; residential development and cultivation	Abundance, productivity, diversity	All	In areas where development is occurring, that development should be adequately set back from streams so as not to interrupt natural stream processes. Ordinances pertinent to fish habitat and water quality must be enforced.
Riparian exclosure fencing	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn. (1); Little Walla Walla System (2); Yellowhawk System (2)	Degraded riparian area, channel stability	Livestock grazing	Abundance, productivity, diversity	All	Excluding livestock from riparian areas remains the most effective tool of mitigating livestock impacts.
Close, remove, and restore riparian road prisms	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn. (1); Little Walla Walla System (2); Yellowhawk System (2)	Degraded riparian area, channel stability, sediment	Roads	Abundance, productivity, diversity	All	In many areas of the Walla Walla Subbasin, riparian roads have reduced riparian vegetation, confined stream channels, and continue to deliver fine sediment to channels. Relocating roads outside riparian and sensitive areas or eliminating roads from riparian and sensitive areas has a positive effect on steelhead habitat by allowing natural riparian processes to be restored.
Protect high quality riparian habitats and unstable areas	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn. (1); Little Walla Walla System (2); Yellowhawk System (2)	Degraded riparian area, channel stability, floodplain degradation, sediment, water temperature	All	Abundance, productivity, diversity	All	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Restore natural riparian vegetative communities	CTUIR, NRCS/FSA, WWBWC, SWCD, CDs, TSS, private landowners	Ongoing	High dispersal downstream from site	25 years	Improved riparian vegetation and associated attributes – response time 5 years to decades	Moderate – plant survival varies based on techniques used
Develop grazing strategies that promote riparian recovery	ODA, NRCS, USFS, CDs, private landowners	Ongoing	High dispersal downstream from site	Long term	Improved riparian vegetation and associated attributes – response time 5 years to decades	Depends on diligence of management applications
Develop no-cultivation riparian buffer on agricultural in areas where activities could upset riparian function	CTUIR, ODFW, WWBWC, WDFW, WDOE, private landowners, TSS, FSA/NRCS	Ongoing	Cultivated land in close proximity to priority habitat areas within the Umatilla Subbasin	Long term	Immediate with continued improvement for up to 50 years or until easement ends and management changes. After 50 years habitat effectiveness will be maintained.	High
Riparian exclosure fencing	CTUIR,ODFW, NRCS/FSA, WWBWC, SWCD, CDs, private landowners, TSS	Ongoing	High dispersal downstream from site	25 years	Improved riparian vegetation and associated attributes – response time 5 years to decades	High
Close, remove, and restore riparian road prisms	USFS, ODOT, WDOT, counties, private landowners	Ongoing	Riparian areas within the subbasin where potential for riparian road closure and removal exists	Based on opportunity and need	Improved water quality – response time immediate with continued response for up to 50 years	High
Protect high quality riparian habitats and unstable areas	CTUIR, ODFW, NRCS/FSA, SWCD, USFS, WWBWC, CDs	Ongoing	High dispersal downstream	Long Term	Depends on specific situation	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
ODA, SWCD	Agriculture Water Quality Management Plan	Basinwide		See Oregon State Agency's programmatic review.
FSA, NRCS, SWCD, CD's, WWBWC	CREP, CCRP, CSP, EQIP	Basinwide	No	Greater participation by landowners is needed in Oregon. Many more stream miles to be treated.
WDFW	Fish Mgmt and habitat programs	Basinwide	Yes	
ODFW	Fish Mgmt Program	Basinwide	Yes	
CTUIR	BPA Habitat Program		No	Many additional miles of stream to be treated
ODEQ	TMDL			See Oregon State Agency's programmatic review.
ODF	Forest Practices Act			See Oregon State Agency's programmatic review.
USFS, BLM	Grazing management, Forest Plan, PACFISH		Yes	

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

The Oregon Walla Walla River Water Quality Management Areas Plan (WQMAP) provides general guidance to landowners on management of riparian areas and there is some uncertainty regarding the implementation of this plan's requirements, as enforcement is based on a complaint-driven system. While there are ongoing programs to restore riparian vegetation, determination of limiting factors through use of the EDT model indicates that additional coverage is necessary.

The Umatilla and Walla Walla Agricultural Water Quality Management (AgWQM) Area Rules require that management on agricultural lands allow the establishment, growth, and maintenance of riparian or stream-side vegetation, consistent with site capability, to promote habitat and protect water quality by filtering sediment, stabilizing streambanks, naturally storing water, and providing shade. The AgWQM program is outcome-based rather than prescriptive, therefore allows landowners the flexibility to achieve water quality goals using available equipment, technology and innovation. The rules for each Management Area provide the enforceable backstop to the voluntary initiatives. The SWCDs are the local management agencies that provide the outreach, education and technical assistance. ODA is responsible for complaint investigations and enforcement actions. Technical and financial assistance is available through state and federal programs to landowners for establishing adequate riparian areas.

The CREP program agreements are for durations of 10 or 15 years. There is no guarantee that the benefits and management actions will be continued beyond the duration of the agreements.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Investigate feasibility of water storage or exchange to improve instream flows for steelhead	Walla Walla River, mouth to Little Walla Walla diversion (1)	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity, diversity	Parr to adult	
Close areas to appropriation of new water uses	Walla Walla R., Mill Cr. To forks (1); SF Walla Walla mouth to Elbow Cr (2); NF Walla Walla R., mouth to Little Meadows Cyn (1). Little Walla Walla System (1)	Flows	Water withdrawals	Abundance, productivity, diversity	Parr to adult	Surface water flows are over appropriated in many areas of the Walla Walla Subbasin. The various legal means available should be used to increase streamflows where assessments indicate that there is on-going take, or where steelhead production could be increased
File for additional ISWRs	Pine Cr. (2), Birch Cr. (1), Cottonwood Cr. (1), Walla Walla R. downstream of Little Walla Walla (1)	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity, diversity	Parr to adult	
Set criteria to protect flows for fish habitat from new appropriations	Basinwide in Washington	Flows, water quality	Water withdrawals	Abundance, productivity	Parr to adult	High flow events are critical for maintaining quality instream habitat, and water quality. With increasing water demands for agricultural, industrial, municipal and domestic uses, the potential for mining of high flow increases. It is important that planners realize the importance of high flows for the maintenance of aquatic habitats and water quality, and that these flows are protected.
Improve irrigation conveyance and efficiency	Walla Walla R., Mill Cr. To forks (1); SF Walla Walla mouth to Elbow Cr (2); NF Walla Walla R., mouth to Little Meadows Cyn (1); Little Walla Walla System	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity	all	
Enhance hyporheic flows and spring inputs	Walla Walla R., Mill Cr. To forks (1); SF Walla Walla mouth to Elbow Cr (2); NF Walla Walla R., mouth to Little Meadows Cyn (1).	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity, diversity, spatial structure	all	
Implement shallow aquifer recharge	Little Walla Walla system (1)	Flow, temperature	Water withdrawals	Abundance, productivity	all	While progress has been made, many streams that historically flowed year- long are now intermittent, creating fish passage barriers in the dewatered reaches. Many of these are due to water withdrawa for agricultural, industrial, municipal and domestic uses.
Aquifer storage and recovery	Lower Mill Cr. (1)	Flow, temperature	Water withdrawals	Abundance, productivity	all	
Lease or acquire water rights and convert to instream	Walla Walla R., Mill Cr. To forks (1); SF Walla Walla mouth to Elbow Cr (2); NF Walla Walla R., mouth to Little Meadows Cyn (1).	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity, diversity, spatial structure	Parr to adult	
Downstream water rights transfers	Walla Walla R., Mill Cr. To forks (1); SF Walla Walla mouth to Elbow Cr (2); NF Walla Walla R., mouth to Little Meadows Cyn (1).	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity, diversity	Parr to adult	
Monitor/regulate water withdrawals	Basinwide (1)	low flows, high temperatures	Water withdrawals	Abundance, productivity	Parr to adult	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Investigate feasibility of water storage or exchange to improve instream flows for steelhead	COE/CTUIR	Ongoing	Mid and lower Walla Walla	Uncertain	Improvements to flow depend on timing, magnitude and location of flow enhancement	Now in planning stage; actual implementation actions and potential funding are unknown
Close areas to appropriation of new water uses	OWRD, WDOE	On hold	Affected reaches and downstream	Uncertain	Maintenance of existing conditions	High
File for additional ISWRs	ODFW, OWRD	On hold	Specific to the stream reach	Unknown	Maintenance of existing conditions	High, depends on how resource managers implement protection
Set criteria to protect flows for fish habitat from new appropriations	WDOE, WDFW	Ongoing	Affected reaches and downstream	Uncertain	Maintenance of existing conditions	Unknown
Enhance hyporheic flows and spring inputs	WWBWC, CTUIR, CDs	Ongoing	On site and downstream	Long term	Improved instream flow and water quality – response time depends on specific action	Depends upon specific approach used
Improve irrigation conveyance and efficiency	SWCD, WWBWC, private landowners, irrigation districts	Ongoing	Depends on means used to protect instream flows	Short term	Improved instream flow; response immediate	Moderate – depends on how saved water is protected, if any.
Implement shallow aquifer recharge	WWBWC, WDOE, HBDIC, GDID, WWRID, private landowners		Down gradient	Long term	Improved instream flow – uncertain response time	Undetermined
Aquifer storage and recovery	City of Walla Walla	Ongoing	Downstream of Mill Creek POD	Long term	Improved instream flow – uncertain response time	Long term effectiveness is unknown
Lease or acquire water rights and convert to instream	OWRD., Oregon Water Trust, water right holders	Ongoing, when opportunities arise	Depends on means used to protect instream flows	10-15 years	Immediate	moderate, depending upon how saved water is protected
Downstream water rights transfers	OWRD, private landowners, irrigation districts	Ongoing	Reach between old and new point of diversion	Long Term	Improved instream flow; response immediate	High
Monitor/regulate water withdrawals	OWRD, WDOE	Ongoing	From the point of diversion downstream to the mouth of Walla Walla River	Long term	Maintenance or improvement of existing conditions; response to regulation immediate	Moderate, staffing levels are inadequate

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
COE/CTUIR	Flow Restoration Feasibility Study	Lower Walla Walla	Unknown	
OWRD	Stream Flow Monitoring and Regulation	Basinwide		See Oregon State Agency's programmatic review.
Oregon Water Trust and BPA	Leasing and Purchase of Water Rights	Walla Walla River	No	Yes
SWCD, Watershed Council, WWRID, HBDIC, GFID	Improve irrigation efficiency	Walla Walla R., Mill Cr. To forks ; SF Walla Walla mouth to Elbow Cr .; NF Walla Walla R., mouth to Little Meadows Cyn.	No	Yes
NRCS, Watershed Council	Upland improvements, riparian improvements	Basinwide	No	Yes
ODF	Forest Practices Act	Basinwide		See Oregon State Agency's programmatic review.
BPA	Columbia Basin Water Transaction Prgm	Walla Walla R., Mill Cr. To forks; SF Walla Walla mouth to Elbow Cr .; NF Walla Walla R., mouth to Little Meadows Cyn.	No	Yes
WDOE	Water Mgmt Initiative	Walla Walla R., Mill Cr. To forks	No	Yes
USFS	Forest Plan, PACFISH	Upper Basin	Yes	
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				
Significant progress has been made regarding flow issues on the mainstem Walla Walla River as a result of the Civil Penalty Agreement between the USFWS and three irrigation districts. However, significant flow issues remain along the Walla Walla River, NF Walla Walla R., Couse Cr., Dry and Pine creeks (Oregon) and Mill Creek.				

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Address point sources of water pollution	Pine Creek (1), Walla Walla River (1)	Chemical pollution	Pesticides, fertilizers, herbicides	Abundance, productivity	All	Point sources of water pollution are direct impacts that should be corrected through implementation of the TMDL and associated water quality management plan.
Implement pest management plans for fruit growers	Walla Walla R., Mill Cr. To forks (1); SF Walla Walla mouth to Elbow Cr (1); NF Walla Walla (1)	Water quality	Pesticides, fertilizers, herbicides	Abundance, productivity	All	
Improve municipal stormwater management and treatment	Walla Walla R., Mill Cr. To forks (1)	Water quality	Stormwater management	Abundance, productivity	All	
Permit waterway alteration activities and enforce rules	Basinwide					
Implement water quality management plans	Walla Walla River (1)	Degraded water quality, flows, sediment routing, water quality	Land use practices, water withdrawals, pesticides, fertilizers, herbicides	Abundance, productivity	All	
Permit and enforce actions that could affect water quality	Basinwide	Water quality	Land use practices,	Abundance, productivity, diversity	All	Directed actions at known sources of thermal pollution and sediment should be addressed through BMP's and improvement projects.

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Address point sources of water pollution	ODEQ, WDOE	Ongoing	Basinwide	Ongoing	Reduce chemical pollution immediately	High
Implement pest management plans for fruit growers	ODEQ, OSU, Ext. WWBWC, fruit growers	Ongoing	NF, SF, mainsteam Walla Walla and Little Walla Walla system	Long Term	Reduced mortality of food items and issues with fish toxicology – minor response expected	Moderate
Improve municipal stormwater management and treatment	municipalities	Ongoing	Within city limits. High dispersal downstream	Long term	Improved water quality – immediate response	Uncertain
Permit waterway alteration activities and enforce rules	USACE, ODSL, WDFW	Ongoing	Basinwide	Ongoing	Variable lag time depending on actions	Moderate, current implementation of permit requirements are very specific and conservative
Implement water quality management plans	ODA, SWCD, Municipalities, CDs, USFS, ODF, Irrigation Districts, private landowners, Industry, ODEQ, WDOE	Ongoing	High dispersal downstream	Ongoing	Immediate	Moderate – degree of implementation is uncertain
Permit and enforce actions that could affect water quality	ODEQ, WDOE	Ongoing	basinwide	Ongoing	Variable lag time depending on actions	Ability of agencies to enforce water quality violations appears limited by staffing.

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
ODA, SWCD	AgWQMP	Basinwide		See Oregon State Agency's programmatic review.
FSA, NRCS, SWCD, CD, WWBWC	CREP, CCRP, CSP, EQIP	Basinwide	No	Greater participation by landowners is needed in Oregon. Many additional miles of stream to be treated.
CTUIR	BPA Habitat Program	Walla Walla R., Mill Cr. To forks (1); SF Walla Walla mouth to Elbow Cr (2).; NF Walla Walla R., mouth to Little Meadows Cyn (1).	No	Many additional miles of stream to be treated
USFS, BLM	Grazing management, Forest Plan, PACFISH	Upper Basin	Yes	
USACE/ODSL/WDFW	Waterway work permitting	Basinwide		See Oregon State Agency's programmatic review.
ODF	Forest Practices Act	Basinwide		See Oregon State Agency's programmatic review.
ODEQ	Water Quality	Basinwide		See Oregon State Agency's programmatic review.
ODEQ, EPA, WDOE	Pesticides/Toxics	Basinwide		See Oregon State Agency's programmatic review.
Municipalities	Public Works		No	

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

Although this threat is partially addressed by the Oregon Walla Walla River Water Quality Management Areas Plan (WQMAP), the guidance provided to landowners on management of riparian areas is fairly general. There is also some uncertainty regarding the implementation of this plan's requirements, as enforcement is based on a complaint-driven system. While there are ongoing programs to restore riparian vegetation, determination of limiting factors through use of the EDT model indicates that additional coverage is necessary.

The Umatilla and Walla Walla Agricultural Water Quality Management (AgWQM) Area Rules require that management on agricultural lands allow the establishment, growth and maintenance of riparian or stream-side vegetation, consistent with site capability, to promote habitat and protect water quality by filtering sediment, stabilizing streambanks, naturally storing water, and providing shade. The AgWQM program is outcome-based rather than prescriptive, therefore allows landowners the flexibility to achieve water quality goals using available equipment, technology and innovation. The rules for each Management Area provide the enforceable backstop to the voluntary initiatives. The SWCDs are the local management agencies that provide the outreach, education and technical assistance. ODA is responsible for complaint investigations and enforcement actions. Technical and financial assistance is available through state and federal programs to landowners for establishing adequate riparian areas.

The TMDL's set loading capacity to achieve water quality standards. To address high summer water temperatures, near stream vegetation disturbance, channel widening and low flows are the existing sources of increased solar radiation loading. Achievement of the TMDL targets is dependent of determination of system potential vegetation. During TMDL development, the best professional judgment of the team described the potential streamside shade-producing vegetation broadly, as continuous tree-belts on each side of the river.

The CREP program agreements are for durations of 10 or 15 years. There is no guarantee that the benefits and management actions will be continued beyond the duration of the agreements.

While permit processes implemented by the US Army Corps of Engineers are thorough and actions authorized are protective of aquatic resources, the program lacks personnel resources to insure that terms and conditions of permitted actions are followed. In addition, this agency lacks resources to adequately monitor waterways for non-permitted actions or act upon non-permitted situations reported by other agencies or private parties. See Oregon State Agency's programmatic review for ODSL.

Strategy 8. Restore degraded upland processes to minimize unnatural rates of erosion and runoff, and maintain unimpaired natural upland processes.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore native upland plant communities	Walla Walla R., Mill Cr. To forks (1); SF Walla Walla mouth to Elbow Cr (1); NF Walla Walla R., mouth to Little Meadows Cyn (1).	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Forestry, roads, overgrazing, agricultural practices, noxious weeds	Abundance, productivity	All	
Upgrade or remove problem forest roads	NF Walla Walla (1), SF Walla Walla (1)	Altered hydrology, sediment routing	Road network	Abundance, productivity	All	
Control noxious weeds through physical removal and chemical and biological agents	Basinwide	Loss of native vegetation and watershed function	Noxious weed	Abundance, productivity	All	Control of noxious weeds is generally an issue that is not currently being addressed adequately at a regional scale.
Implement CREP and CCRP buffers	Walla Walla R., Mill Cr. To forks (1); SF Walla Walla mouth to Elbow Cr (1); NF Walla Walla R., mouth to Little Meadows Cyn (1)	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Agricultural practices	Abundance, productivity	All	
Initiate demonstration projects	Basinwide	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices	Abundance, productivity	All	
Conduct outreach to resource users and managers	Basinwide	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices	Abundance, productivity	all	
Apply BMPs to forest practices, livestock grazing, road management and agricultural practices	Basinwide	Altered hydrology, sediment routing	Forestry, roads, overgrazing, agricultural practices, noxious weeds	Abundance, productivity	All	Upland land management practices affect the hydrologic function of the watershed, by causing rapid runoff rather than infiltration. BMP's should be implemented to insure that the watershed functions to its potential, given the anthropogenic influence in the watershed.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore native upland plant communities	SWCD, USFS, NRCS, BLM, ODF, Counties, private landowners	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Long term		

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Upgrade or remove problem forest roads	USFS, BLM, DOF, private landowners	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, many forest roads have legacy issues with regard to sediment transport and routing of runoff.	5-15 years	Moderate, although funding on public lands and landowner cooperation on private lands will determine rate of treatment
Control noxious weeds through physical removal and chemical and biological agents	County public works dept., public and private landowners, USFS, BLM	Ongoing	Basinwide	Long term	Improvements to water quality expressed in decades	Uncertain. This is a broad landscape issue that is currently under funded.
Implement CREP and CCRP buffers	FSA, NRCS, SWCD, CDs, private landowners	Ongoing, when opportunities available	High dispersal downstream	Depends on funding availability	5 years to decades	High
Initiate demonstration projects	ODFW, WDFW, NMFS, USFWS, USFS, BLM, CTUIR, WWBWC, WDOE, SWCDs, CDs, TSS	Ongoing	Entire basin	Long term	Variable lag time	unknown, depends upon action taken as a result of being more informed
Conduct outreach to resource users, managers, general public	ODFW, WDFW, NMFS, USFWS, USFS, BLM, CTUIR, WWBWC, WDOE, SWCDs, CDs	Ongoing	Entire basin	Long term	Variable lag time depending on actions	Unkown
Appy BMPs to forest practices, livestock grazing, road management and agricultural practices	NRCS, ODF, WDOE, SWCD, CDs, ODA, CTUIR, private landowners	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term	Improvements to water quality expressed in years to decades; improvements in riparian vegetation and all associated attributes response time 5 years to decades	Moderate, depends on participation

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
CTUIR	Rainwater	Basinwide	Yes	Maintain current project
County Public Works	Weed Control	Basinwide	No	Funding not adequate to meet the needs
ODA	Ag water quality mgmt plan	Basinwide		See Oregon State Agency's programmatic review.
WDOE	Forestry	Basinwide	?	
ODF	Forest Practices Act	Basinwide		See Oregon State Agency's programmatic review.
SWCD/CD's	Watershed restoration	Basinwide	No	
FSA,NRCS, SWCD, CD's	CREP,CCRP,CRP,EQIP	Basinwide	No	Needs more coverage
WDOT/ODOT	Weed control	Basinwide		See Oregon State Agency's programmatic review.
Municipalities	Public Works	Basinwide	No	Additional improvements needed
SWCD	Direct Seed Program		No	Additional landowner assistance needed
USFS	Forest Plan, PACFISH		Yes	
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				
Additional effort is needed to protect native plant communities and associated watershed functions. Vegetation management across the watershed varies in approach widely.				

Table 9-5. Barriers to Upstream Passage on Streams in the Walla Walla Subbasin, Only Within the Area Inhabited by the Walla Walla River Steelhead Population

Stream	Description	River Mile /1	Priority	Lat.	Long.
Pine Cr.	Bevans Irrigation Dam	6.5	2	45.9903984	-118.57524108
Pine Cr.	Grade Control Structure on County Road 707	7.1	2	45.98669815	-118.56809997
Pine Cr.	Bevans and Young Irrigation Dam	7.5	2	45.98413848	-118.56359863
Pine Cr.	Irrigation Dam	8.1	2		
Pine Cr.	Irrigation Ditch Diversion	10.8	2		
Pine Cr.	Bridge on County Road 708	11.0	2	45.9595	-118.5372
Pine Cr.	Culvert at Johnson Road	23.6	2	45.8337	-118.4354
Pine Cr.	Culvert at Hwy 11	23.9	2	45.83039855	-118.43309783
Pine Cr.	Pine Cr. Rd Culvert	27	2	45.78490066	-118.40599822
Pine Cr.	Spring Reservoir Dam 1	28.7	2	45.77669906	-118.39499664
Pine Cr.	Spring Reservoir Dam 2	30.6	2	45.77603149	-118.36067962
Dry Cr.	Cockburn and Ray Irrigation Dam	1.0	2	45.9645195	-118.51821136
Dry Cr.	Marlatt-Shaw-Kelty Irrigation Dam	3.0	2	45.95537948	-118.48547363
Dry Cr.	Earnest Key Irrigation Dam	5.25	2	45.93603897	-118.45072174
Dry Cr.	Hohn and Phillips Irrigation Dam	5.75	2	45.93013	-118.44455718
Dry Cr.	Unnamed Dam	6.75	2	45.92193984	-118.43679809
Dry Cr.	Unnamed Dam	8.75	2	45.90356063	-118.41124725
Dry Cr.	Unnamed Dam	12.0	2	45.85702896	-118.40177154
Dry Cr.	Upper Dry Creek Rd Culvert	13.3	2	45.84577941	-118.38316345
Little Dry Cr.	Winn Rd Culvert	0.75	2	45.84624862	-118.4035263
Little Dry Cr.	Winn Power Dam	1.5	2	45.8399887	-118.40193176
Dry Cr. (Walla Walla)	Bridge at Lower Waitsburg Rd.	18.4	2		
Dry Cr. (Walla Walla)	Cement box culvert just upstream of Sapolil Rd.	24.1	2		
Mud Cr. (Dry Cr. Trib nr Dixie		1.4	2		
East Little Walla Walla	Locust Rd Culvert		2	45.95819854	-118.39649963
East Little Walla Walla	Appleton Rd Culvert		2	45.96920013	-118.40000152
East Little Walla Walla	Crockett Road Culvert		2	45.97299957	-118.39969635
East Little Walla Walla	Ballou Rd Culvert		2	45.98740005	-118.40440368
East Little Walla Walla	Stateline Rd Culvert		2	46.00040054	-118.4083023
West Little Walla Walla	Winesap Rd Culvert		2	45.96900177	-118.41320037
West Little Walla Walla	Appleton Rd Culvert		2	45.96920013	-118.41390228
West Little Walla Walla	Sunquist Rd Culvert		2	45.99110031	-118.42350006
West Little Walla Walla	Stateline Rd culvert		2	46.00049972	-118.43969726
Middle Branch Mud Cr.	Triangle Rd Culvert		2	45.97399902	-118.4287033
Middle Branch Mud Cr.	County Rd 332 Culvert		2	45.9748001	-118.43389892
Middle Branch Mud Cr.	County Rd 332 Culvert		2	45.97660064	-118.43779754
Mill Cr.	Stiller Ditch Diversion Dam	2.1	1		
Mill Cr.	Gose St. Dam and Concrete Apron	5.4	1		
Mill Cr.	Concrete Channel, velocity and light barriers	5.4 to 9.3	1		
Mill Cr.	Concrete capped weirs and diked channel from Gose St. to Bennington Dam	5.4 to 12.3	1		
Titus Cr.	Culvert at mouth	0	2		
Mill Cr.	Yellowhawk Division Dam and Ladder	11.4			
Mill Cr.	Bennington Dam and ladder	12.3	1		
Mill Cr.	Kooskooskie Dam	23.0	1		

Stream	Description	River Mile [1]	Priority	Lat.	Long.
Mill Cr.	City Water Intake – fishway needs upgrading		1	45.99021148	-118.04837036
Garrison Cr.	Larch and Lyon's ponds	3.7	2		
Stone Cr.	Pond Dam	1.1	2		
Big Spring Cr.	Railroad crossing	0.7	2		
Unnamed spring	Railroad crossing	0.3	2		
Russell Cr.	Old irrigation diversion dam	0.9	2		
Russell Cr.	CCC Dam, complete obstruction	5.6	2		
Yellowhawk Cr.	Yellowhawk-Garrision Division Dam	7.8	1		
Doan Cr.	Underground pipe in which creek is confined	2.1	2		
Birch Cr.	Waterfall	0.4	1	45.99863815	-118.36891174
Birch Cr.	Culvert at Powerline Rd.	3.9	1	45.9824	-118.3139
Walla Walla R.	Nursery Bridge Dam – Additional improvements needed	46.8	1		
Couse Cr.	Culvert at gravel pit entrance	1.1	1	45.8967514	-118.36978149
Cup Gulch (NF Walla Walla	NF Walla Walla River Road Culvert		2	45.89690017	-118.25279998

Note: This list is based on a combination of archived records and field observation. A comprehensive on-the-ground inventory of passage barriers in the subbasin has not been done. As a result, the accuracy of this list is unknown.

Table 9-6. Restoration Priority Geographic Areas from the Walla Walla Subbasin Plan (NPCC 2004)

GA	Description
27	Walla Walla River, Mill Cr. to East Little Walla Walla
31	Walla Walla River, East Little Walla Walla to Tumalum Bridge
35	Walla Walla River, Tumalum Bridge to Nursery Bridge
36	Walla Walla River, Nursery Bridge to Little Walla Walla Diversion
37	Walla Walla River, Little Walla Walla Diversion to forks
41	South Fork Walla Walla, mouth to Elbow Creek
39	North Fork Walla Walla, mouth to Little Meadows Canyon (plus Little Meadows Can.)
3	Coppei Drainage
4	Touchet River, Coppei to forks
10	South Fork Touchet Mainstem
11	South Fork Touchet Tribs
6	North Fork Touchet Mainstem
7	North Fork Touchet Tribs (excluding Wolf Fork)
8	Wolf Fork, mouth to Coates (plus Robinson and Coates)
9	Wolf Fork, Coates to access limit (plus Whitney)

Table 9-7. Protection priority geographic areas from the Walla Walla Subbasin Plan (NPCC 2004)

GA	Description
	All Priority Restoration Geographic Areas
43	South Fork Walla Walla, Elbow to access limit
45	Skiphorton and Reser Creek Drainages
42	Lower SF Wall Walla Tribs (Flume Canyon, Elbow)
44	Upper SF Walla Walla Tribs (excluding Skiphorton and Reser)
40	North Fork Walla Walla, Little Meadows to access limit (plus Big Meadows)
5	Patit Drainage
17	Walla Walla River, Dry to Mill
32	Yellowhawk mainstem (mouth to source)
	Headwaters**
38	Couse Creek Drainage

**Headwaters is an assemblage of reaches covering the bull trout bearing (present or potential) waters upstream of the present reaches designated through the EDT process.

Table 9-8. Walla Walla Subbasin Geographic Areas

GA	Stream	Segment	MaSA	MiSA
1	Walla Walla River	Mouth to Touchet River		
2	Touchet River	Mouth to Coppei Creek	NA	NA
3	Coppei Drainage	Mouth to presumed Steelhead access limit	NA	NA
4	Touchet River	Coppei to forks, including Whiskey Creek	NA	NA
5	Patit Drainage	Mouth to presumed steelhead access limit	NA	NA
6	North Fork Touchet	Mouth to presumed steelhead access limit	NA	NA
7	North Fork Touchet tribs	Rodgers, Jim, Weidman, Lewis and Spangler creeks; all from mouths to presumed steelhead access limit	NA	NA
8	Wolf Fork	Mouth to Coates Creek; also includes Robinson Cr and Coates Cr; mouths to presumed steelhead access limit	NA	NA
9	Wolf Fork	Coates Cr to presumed steelhead access limit; also includes Whiskey Cr mouth to presumed steelhead access limit	NA	NA
10	South Fork Touchet	Mouth to presumed steelhead access limit	NA	NA
11	South Fork Touchet tribs	Dry Fork SF Touchet, Griffin Fork, North Griffin Fork, Beaver Slide, Green Fork and Burnt Fork; mouths to presumed steelhead access limits	NA	NA
12	Walla Walla River	Mouth Touchet River to Dry Cr, including Mud Cr mouth to presumed steelhead access limit		
13	Pine Creek	Mouth to presumed steelhead access limit and Swartz Cr mouth to presumed steelhead access limit	Pine	
14	Dry Creek Drainage (Pine)	Dry Cr (trib to Pine) mouth to presumed steelhead access limit	Pine	
15	Lower Dry Cr	Dry Cr (trib to Walla Walla), mouth to Sapolil Rd crossing	Dry	
16	Upper Dry Cr	Dry Cr (trib to Walla Walla). Sapolil Rd crossing to confluence of NF and SF Dry creeks	Dry	
17	Dry Cr tribs	Mud Cr (trib to Lower Dry Cr) , Mud Cr (trib to Upper Dry Cr, NF Dry Cr and SF Dry Cr; mouths to presumed steelhead access limit	Dry	
18	Walla Walla River	Dry Cr to Mill Cr		
19	West Little Walla Walla	West Little Walla Walla River Drainage and Walsh Cr drainage		
20	Mill Cr	Mouth to start of US Army Corps of Engineers project at Gose St near Walla Walla	Mill	
21	Mill Cr	Gose St to Bennington Dam	Mill	
22	Mill Cr	Bennington Dam to Blue Cr and Titus Cr drainage	Mill	
23	Blue Cr Drainage	Mouth to presuemed steelhead access limit and Little Blue Cr mouth to presumed steelhead access limit	Mill	
24	Mill Cr	Blue Cr to City of Walla Walla water intake	Mill	
25	Middle Mill Cr tribs	Henry Canyon Cr, Webb Canyon Cr, Tiger Canyon Cr; mouth to presumed steelhead access limit	Mill	
26	Mill Cr	City of Walla Walla Water intake to presumed steelhead access limit	Mill	

GA	Stream	Segment	MaSA	MiSA
27	Upper Mill Cr tribs	NF Mill Cr, Low Cr, Broken Cr, paradise Cr; mouth to presumed steelhead access limit	Mill	
28	Walla Walla River	Mill Cr to East Little Walla Walla River and McEvoy Cr and Springbranch		
29	Garrison Cr Draininage	Includes Bryant Cr and all Walla Walla Urban streams	Cottonwood	
30	Stone Cr Drainage	All	Cottonwood	
31	East Little Walla Walla Drainage	East Little Walla Walla Drainage; Unnamed Spring; Big Spring Cr, mouth to presumed steelhead access limit		
32	Walla Walla River	East Little Walla Walla To Tumalum Bridge	Walla Walla	
33	Yellowhawk mianstem	Yellowhawk drainage mouth to source	Cottonwood	
34	Cottonwood Cr Drainage	Including NF, MF and SF, mouth to presumed steelhead access limit	Cottonwood	
35	Birch Creek Drainage	Mouth to presumed steelhead access limit	Walla Walla	
36	Walla Walla River	Tumalum Br to Nursery Br	Walla Walla	
37	Walla Walla River	Nursery Br to Little Walla Walla Diversion	Walla Walla	
38	Walla Walla River	Little Walla Walla Diversion to forks	Walla Walla	
39	Couse Cr	Mouth to presumed steelhead access limit	Walla Walla	
40	North Fork Walla Walla	Mouth to Little Meadows Canyon and Little Meadows Canyon mouth to presumed steelhead access limit	Walla Walla	
41	North Fork Walla Walla	Little Meadows Canyon to Big Meadows Canyon and Big Meadows Canyon mouth to presumed steelhead access limit	Walla Walla	
42	South Fork Walla Walla	Mouth to Elbow Cr	Walla Walla	
43	Lower SF Walla Walla tribs	Flume Canyon Cr and Elbow Cr, mouth to presumed steelhead access limit	Walla Walla	
44	South Fork Walla Walla	Elbow Cr to presumed steelhead access limit	Walla Walla	
45	Upper South Fork Walla Walla tribs	Bear Cr, Kees Canyon Cr, Burnt Cabin Gulch, Swede Canyon, Table Cr, Husky Spring Cr, Bear Trap Springs; mouth to presumed steelhead access limit	Walla Walla	
46	Skiphorton & Reser Creek drainages	Mouth to presumed steelhead access limit	Walla Walla	

Note: Minor spawning areas within the Walla Walla Subbasin not represented include Woodward Canyon, Switzler, Vansyckle Canyon, Juniper, Spring Valley and Below Spring Valley.

Table 17-6h. Recovery Strategies and Actions for Upper Mainstem John Day River Steelhead Population

Primary limiting factors: degraded channel structure and complexity (habitat quantity and diversity), degraded riparian areas and LWD recruitment, altered sediment routing, water temperatures, altered hydrology and degraded floodplain function and connectivity. Impaired fish passage is also a priority limiting factor in Beech and Laycock creeks.

Primary threats: agricultural practices, overgrazing by livestock, removal of large trees from the riparian corridor, wetland draining and conversion, stream channelization and diking, mining, and dredging.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Protect high quality habitats through acquisition or conservation easements	EF and Middle Fork of Canyon Cr (1), tributaries draining the north side of Strawberry Wilderness (2), upper McClellan Cr (tributary to John Day River) (2), McClellan Cr (tributary to EF Beech Cr) (2), upper Fields Cr (2), John Day River above Blue Mt. Hot Springs (1) and tributaries Rail (1), Roberts (1), Reynolds (1), Deardorff (1), and Call (1) crs.	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing,	Many threats including livestock overgrazing of riparian area, channelization, stream bank armoring, agricultural practices (fertilizers, herbicides, sediments, changes in plant communities), water withdrawals, loss of beaver dams	Productivity, abundance	Primarily fry and 0+	Protecting base stream flows from further appropriations is a very important function of protecting existing high quality habitats. Protection of high quality habitats is the most cost effective way of ensuring fish have good quality habitat. Land acquisitions, easements, and cooperative agreements may also facilitate the implementation of active restoration projects.
Adopt and manage Cooperative Agreements	Grub Cr (2), John Day River between John Day and Blue Mt. Hot Springs (1), Indian Cr (2), Beech Cr (2), Cummings Cr (2), Canyon Cr (1)	Same as above	Same as above	Productivity, abundance	Primarily fry and 0+	
Special management designations in forest and BLM plans	Riparian Habitat Conservation Areas identified in existing Forest Plans	Same as above	livestock overgrazing of riparian area, changes in plant communities	Productivity, abundance	Primarily fry and 0+	
Designate additional wilderness and wild and scenic status	Public lands identified in the Forest Plan Revision process	Same as above	livestock overgrazing of riparian area, changes in plant communities	Productivity, abundance	Primarily fry and 0+	

Strategy. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Protect access to key habitats	Mainstem John Day River above Prairie City (1)	Passage barriers, altered hydrology, channel structure	Irrigation withdrawals, channelization	Productivity, abundance, distribution	Primarily fry and 0+	Thoroughly review projects that may block fish passage. Current ODFW policy is to grant exemptions from fish passage requirements only if mitigation meets or exceeds the loss of habitat. Exemptions must be approved by the Fish and Wildlife Commission
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	All MaSAs and MiSAs	All	Same as above	Productivity, abundance	All	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Protect the highest quality habitats through acquisition or conservation easements	CTUIR, TNC, RMEF, John Day Basin Trust, SWCDs, USFS, CTWSRO, ODFW	Ongoing	Water quality improvement have high dispersal downstream, stream corridor and function improvements would be confined to the specific site	Existing conservation agreements are complete. Full implementation of conservation measures will take 5-15 years or more	5-15 years with passive restoration approaches	High, based on previous cooperative agreements
Adopt and manage Cooperative Agreements	ODFW, SWCDs, FSA	Ongoing	Same as above	Agreements are for 10 to 15 years	immediate	High, although not in perpetuity
Special management designations in forest and BLM plans	USFS, BLM	Ongoing as identified	Same as above	Many complete, potentially subject to change in Forest Plan revisions	immediate	High, although subject to change from Forest Plan or mgmt plan revision
Designate additional wilderness and wild and scenic status	Public lands identified in Forest Plan Revision	Same as above	livestock overgrazing of riparian area, changes in plant communities	Production, abundance	All	
Protect access to key habitats	ODFW, SWCD, Oregon Water Resources					
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	NRCS, SWCDs, USFS, ODFW, DOF, BLM, ODOT, CTWSRO, ODA, FSA, private landowners	Ongoing	All MaSAs and MiSAs	Long term	5-15 years	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, no, uncertain)	Needs Expansion
USFS and BLM	Wilderness Areas, Wilderness Study Areas, Wild and Scenic River corridors, Special Management designations, PACFISH and INFISH		Yes, for areas designated PACFISH and INFISH standards are good ,but implementation is inconsistent between forests	Yes
ODFW	Cooperative Agreements		No	Yes, the agreements are for only 10-15 years
FSA	CREP		No	Yes, the agreements are for only 10 or 15 years
NGOs	Lease or purchase of lands or instream water rights		Yes	Yes, important to secure critical habitat and/or water rights
ODA	Agricultural Water Quality Management Plan			See Oregon State Agencie's programmatic review.
CTWSRO	Watershed Restoration			Yes
ODF	Oregon Forest Practice Act			See Oregon State Agencie's programmatic review.
Local Government	City and County Planning and Zoning			Yes

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

The John Day River has 248.6 miles designated as Federal Wild and Scenic River and 317 miles designated as State Wild and Scenic. Federally designated reaches include the mainstem John Day from Tumwater Falls (RM 10) to Service Cr (RM 157). State designated reaches include the mainstem John Day from Tumwater Falls to Parrish Cr (RM 170).

Existing forest plans include special management designations for riparian habitat conservation areas (RHCA's). The forest plans and BLM plans have been amended by PACFISH and INFISH, both of which require 300 foot buffers on any fish bearing stream for tree removal, as well as specific guidelines for livestock grazing and riparian vegetation use. Compliance with the 300 foot buffer for timber harvest operations has been very good, however the interpretation and implementation of the grazing guidelines has been inconsistent between National Forests. Forest practices rules for private and state owned forest lands have guidelines for protection of riparian function, however they are less restrictive than those on federal lands. The Strawberry Mountain Wilderness encompasses 68,700 acres and protects the headwaters of several tributaries that drain into the John Day River above the town of John Day. Adding additional wilderness areas and wild and scenic river segments will require designation by Congress. Designating additional RMA's or adding to the current restrictions within RHCA's will be revisited during the Forest Plan Revision process that is currently underway.

Cooperative and conservation agreements on private land are tools for protecting high quality habitats. ODFW has used cooperative agreements over the last 21 years to protect riparian corridors that have been fenced to exclude livestock grazing. Unfortunately those agreements are for only 15 years and there have not been funds or personnel needed to extend them for longer time periods. Over 120 miles of stream throughout the basin have been protected under this program. Additional opportunities will be limited by availability of funds and by willingness of landowners to sign conservation easements and/or agreements.

The CTWSRO owns a mitigation property (3,365 acres) on the Mainstem John Day River above Prairie City which is managed for the benefit of fish and wildlife.

NRCS programs that are used within this population to protect riparian areas and upland watersheds include the Conservation Reserve Enhancement Program (CREP). The CREP program pays landowners for setting riparian corridors aside from grazing and farming. The long term effectiveness of the program is limited by the relatively short duration of the contracts which ranges from 10 to 15 years.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain unimpaired passage and connectivity.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Remove or minimize use of push up dams	Warrens (2), Bridge (2), Birch (2), Belshaw (2), Fields (1), Moon (2), McClellan (2), Beech (1), Canyon (1), Strawberry (1), Dixie (1), Isham (2), Dads (2), and Reynolds (1) crs.	Impaired fish passage	Push up dams	Abundance, productivity, spatial structure	primarily adults and 0+juveniles	Push up dams are most common in the Upper John Day and tributaries. Annual maintenance and construction of push up dams contributes to onsite and downstream channel stability, loss of pools and other structure, and increased sediment loads.
Remove or replace barriers blocking passage such as dams, road culverts and irrigation structures	Irrigation or water storage related issues: Warrens (2), Bridge (2), Birch (2), Belshaw (2), Fields (1), Moon (2), McClellan (2), Beech (1), Canyon (1), Strawberry (1), Dixie (1), Isham (2), Dads (2), and Reynolds (1) crs. Culverts: Canyon Cr and tributaries (1), Reynolds Cr (1), John Day River above Blue Mt Hot Springs (2), and Fields Cr (2)	Impaired fish passage	Dams, culverts, instream structures	Abundance, productivity, spatial structure	primarily adults and 0+juveniles	Push up irrigation dams, concrete diversions, in-channel stock ponds, and road culverts are located throughout the entire basin. Passage problems at culverts are widespread throughout all subbasins.
Construct ladders over existing permanent concrete or earth fill dams	Beech Cr (1),	Impaired fish passage	Dams	Abundance, productivity, spatial structure	primarily adults and 0+juveniles	Concrete structures are located primarily in the Rock Cr (Lower John Day) drainage although there are a number of structures scattered throughout other parts of the basin, including Beech Cr and Reynolds Cr.
Provide screening at 100% of irrigation diversions	Dans (2), Jeff Davis (2), Strawberry (2), Pine (1), Ingles (2), Moon (1), Canyon (1), Cummings (1), Widows (2), Laycock (1) crs.	Impaired fish passage	Irrigation diversions	Abundance, productivity, spatial structure	Emergent fry, smolts	
Replace screens that do not meet criteria	Beech (1), Canyon (1), Dixie (2), Fields (1), Indian (1), Upper John Day River (1), Roberts (1) crs.	Impaired fish passage	Irrigation diversions	Abundance, productivity, spatial structure	Emergent fry	Most irrigation diversions are in the Upper John Day drainage and it has been the major emphasis for replacement of non-criteria screens.

Strategy. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain unimpaired passage and connectivity.						
Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Remove or minimize use of push up dams	SWCD	Ongoing	Provide access to upstream habitat	Ongoing, but all push up dams not expected to be corrected for at least 15 years. A comprehensive survey has not been completed.	Immediate	High, if comply with fish passage design criteria
Remove or replace barriers blocking passage – dams, road culverts and irrigation structures	USFS, BLM, watershed councils, SWCDs, ODOT	ongoing	Access to upstream habitat	Ongoing, replacing all culverts blocking fish passage expected to take 20 years. (see appendix --)	Immediate	High, if comply with fish passage design criteria
Construct ladders over existing permanent concrete or earth fill dams	ODFW, SWCDs	Ongoing	Provide access to upstream habitat	Ongoing, providing passage at all diversion and pond barriers will take many years.	Immediate	High if comply with fish passage design criteria
Provide screening at 100% of irrigation diversions	ODFW, SWCDs	Ongoing	At point of diversion	Approximately 39 diversions need to be screened	Immediate	High if comply with fish passage design criteria
Replace screens that do not meet criteria	ODFW	Ongoing	At point of diversion	Approximately 47 screens need to be replaced, should take – years	Immediate	High if comply with fish passage design criteria

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
Soil and Water Conservation Districts	Irrigation dam improvements, culvert replacement or retrofits		Yes in some areas, no in others	The Grant Soil and Water District is constrained by the construction window of opportunity.
ODFW	Fish Passage/Screening		No	The program completes a minimum of one project per year, but is dependent upon landowner cooperation and limited funding
USFS and BLM	Culvert replacement		No	Yes
Watershed Councils	Road Crossing Passage improvements, passage improvements		No	Yes
ODOT	Culvert replacement or retrofit			See Oregon State Agencie's programmatic review.
BOR	John Day Basin Program		Yes	No
CTWSRO	John Day Basin Program		No	Yes, the tribe contracts with Soil and Water Districts to assist with consultation, permits, and monitoring

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

Most of the mainstem passage problems have been addressed, but there are many tributaries where adult passage is blocked and more areas where juvenile passage problems occur. Irrigation dams, stock ponds, and road culverts are the primary causes of passage issues. In the Upper John Day subbasin, the Grant Soil and Water Conservation District has implemented many passage improvement projects and currently has a waiting list of landowners who want them to correct passage problems at irrigation diversions on tributaries as well as the few remaining mainstem problem areas. The Grant SWCD is currently constrained by a relatively short in-water work period (4-6 weeks), so it will likely take another 10 years to address most of the tributary passage problems. Other Soil and Water District are also correcting passage at irrigation diversions and improperly installed culverts, but are constrained by funding and by personnel needed for construction oversight. An inventory of road crossings on state and county roads in 1999 indicated 14 culverts on state owned roads and 43 culverts on county owned roads within the Upper John Day population boundaries did not meet fish passage criteria. Appendix A presents an inventory of culverts with known passage problems on state or county owned roads. Some of those culverts have been replaced with structures that do meet the fish passage criteria, but much work remains. Watershed councils and ODOT, who are the principal entities working on culverts are constrained primarily by funding. An inventory of road crossings on federal lands indicates juvenile passage problems are pervasive, particularly on National Forests, with approximately 300 culverts not meeting passage criteria on just the Malheur National Forest. The US Forest Service and BLM are constrained primarily by funding and the personnel needed for NEPA analysis. At the current rate of culvert replacements it will take over 50 years to correct all passage problems on National Forests. Another constraint is that existing state laws do not require passage improvements at existing barriers unless there is a major change in the structure, such as reconstruction or significant modifications, so landowner cooperation is critical for improving passage throughout the basin.

US Bureau of Reclamation is required in the Columbia River Biological Opinion to identify and assist with passage improvement design and flow restoration.

Currently, highest priority is given to diversions that are unscreened with lower priority given to diversions that have screens, but do not meet the criteria. The program is constrained primarily by funding and personnel. Current law does not require water users to screen diversions less than 30 cubic feet per second and virtually all diversions in the John Day are less than 30 cfs, so landowner cooperation is essential to success of the program.

Strategy 3. Restore floodplain connectivity and function and maintain unimpaired connectivity and function.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Reconnect floodplains to channels	Mainstem John Day River from Dayville to Blue Mt. Hot Springs (1)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity	Primarily fry and 0+	Restoring channel migration processes will require a landowner willing to sacrifice irrigated pastureland. Opportunities may be limited to property owned by CTWSRO, above Prairie City.
Reconnect side channels and off-channel habitats to stream channels	Mainstem John Day River from Dayville to Blue Mt. Hot Springs (1), Canyon (1), Indian (2), and Pine (2) crs,	Degraded floodplain, altered hydrology	Removal of side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity, spatial structure	Primarily fry and 0+	There has been a loss of off-channel and side-channel habitats that once provided habitat for spawning and rearing, and refugia from high flows.
Restore wet meadows	Canyon (2), EF Beech (2), Upper Belshaw (1)	Degraded floodplain, altered hydrology	Removal of wetlands	Abundance, productivity	Primarily fry and 0+	
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	Canyon (1), Fields (1), Belshaw (2), Dixie (2), Strawberry (2)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat	Abundance, productivity, spatial structure	Primarily fry and 0+	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Reconnect floodplain to channel	ODFW, watershed council, SWCD, USFS, BLM	Ongoing	For the treated stream reach	Short term, once identified	Physical response will be immediate, biological response may take 5-10 years	High
Reconnect side channels and off-channel habitats to stream channels	ODFW, watershed council, SWCD, USFS, BLM, CTUIR	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Long term, because of widespread need	5-15 years, depending upon frequency and duration of channel altering flows	Moderate, depends upon how extensive the project is and frequency and duration of channel altering flows
Restore wet meadows	TNC, USFS, CTWSRO	Ongoing and planned	Benefits of improved channel morphology localized, improved water table and resulting increased stream flow and lower water temperatures have high dispersal downstream	Intermediate	5-15 years	Moderate
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	ODFW, CTWSRO, USFS, BLM	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Long term, due to acceptance by landowners and widespread need	Within 5 years once the dams are built	Moderate-high, dependent upon acceptance by landowners

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, no, uncertain)	Needs Expansion
ODFW	BPA Habitat Program		No	Yes, if specific needs cannot be addressed by passive restoration techniques
USFS, BLM	Stream enhancement program		Yes in some areas, no in others	Possibly
Watershed Councils	Watershed restoration		Dependent upon need and funding	Only if specific needs cannot be addressed by passive restoration techniques
Soil and Water Conservation Districts	Watershed restoration		Dependent upon need and funding	Only if specific needs cannot be addressed by passive restoration techniques
Nature Conservancy and other NGOs	Restoration projects		Yes	Yes
CTUIR	Watershed restoration			Yes
*Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				

Strategy 4. Restore degraded channel structure and complexity and maintain unimpaired structure and complexity.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural channel form	Mainstem John Day River from Dayville to Blue Mt. Hot Springs (1), Indian (1), Pine (1), lower Beech (1), lower McClellan (2), lower Moon (2), lower Laycock (2), middle Canyon (1), lower Fields (2), lower Strawberry (1), lower Dixie (2), lower Isham (2), lower Dans (2) crs	Degraded channel structure and complexity, habitat diversity, riparian area degradation, connectivity with floodplain, sediment routing, water temperature, flows	Stream channelization, bank armoring, large wood removal, beaver removal, removal of riparian vegetation, livestock overgrazing in riparian areas	Abundance, productivity	Primarily fry and 0+	Restoring channel migration processes will require a landowner willing to sacrifice irrigated pastureland. Opportunities may be limited to property owned by CTWSRO, above Prairie City.
Place stable wood and other large organic debris in streambeds	Mainstem John Day River from Dayville to Blue Mt. Hot Springs (2), Indian (1), Pine (1), lower Beech (1), lower McClellan (2), lower Moon (2), lower Laycock (2), middle Canyon (1), lower Fields (2), lower Strawberry (1), lower Dixie (2), lower Isham (2), lower Dans (2), crs	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	Large wood removal channelization	Abundance, productivity	Primarily fry and 0+	More active restoration techniques, such as rootwad placement or channel reconfiguration, may be appropriate in these reaches. Typical structures include rootwads, boulder clusters, whole trees, and rock weirs where appropriate.
Stabilize streambanks	Mainstem John Day River from Dayville to Blue Mt. Hot Springs (1), lower Beech (2), lower Indian (2)	Degraded channel structure and complexity, habitat diversity, sediment routing, flows	Stream channelization, berming, bank armoring, overgrazing in riparian areas	Abundance, productivity	Primarily eggs, fry and 0+	Some bank erosion is inevitable and beneficial. However, where erosion is actively taking place due to unnatural processes, stabilization may be needed to reduce fine sediments

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Restore natural channel form	ODFW, SWCDs, USFS, BLM, watershed councils	Ongoing and planned	For the treated stream reach	Short term, once identified	Physical response will be immediate, biological response may take 5-10 years	High
Place stable wood and other large organic debris in streambeds	ODFW, USFS, watershed councils, BLM, SWCDs	As needed	For the immediate stream reach	Once identified, short term	Immediate	High
Stabilize streambanks	ODFW, USFS, watershed councils, BLM, SWCDs	Ongoing	For the treated stream reach, physical benefits dispersed downstream	Passive stabilization techniques are referred and take longer to implement	With passive restoration the response may take 15 years	Medium to high, depending upon the extent of the treatments

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
ODFW	BPA Habitat Program		No	Yes, if specific needs cannot be addressed by passive restoration techniques
USFS, BLM	Stream enhancement program		Yes in some areas, no in others	Possibly
Watershed Councils	Watershed restoration		Dependent upon need and funding	Only if specific needs cannot be addressed by passive restoration techniques
Soil and Water Conservation Districts	Watershed restoration		Dependent upon need and funding	Only if specific needs cannot be addressed by passive restoration techniques
CTWSRO	Watershed restoration			
NGOs	Watershed restoration			
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				
Instream activities have not been identified as a high priority by the recovery planning team or the subbasin plan team except when identified as a need for specific sites. The planning team prefers that more passive approaches, such as riparian and upland improvements be emphasized. Typically, instream activities that would improve floodplain function and channel migration processes would include placement of rootwads, whole trees, or boulder clusters to improved habitat complexity and habitat diversity where those parameters are deficient and not expected to improve with passive restoration. Another structural activity would be to construct boulder or log weirs to raise the water table, but only where a passive approach has not worked.				

Strategy 5. Restore riparian condition and LWD recruitment and maintain unimpaired conditions.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population

Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural riparian vegetative communities	Some reaches of the upper mainstem John Day River (1) and Ingle (2), Harper (2), Beech (1), Bear (1), Birch (2), Dans (2), and Reynolds (2) crs; the lower reaches of Fields (1), Belshaw (1), Cummings (2), Moon (2), Riley (1), Strawberry (2), Pine (2), and Laycock (2) crs	Degraded riparian area, channel structure and complexity, floodplain degradation, altered hydrology, sediment, water quality	Overgrazing of riparian area, channelization, stream bank armoring, tree harvest in riparian areas, changes in plant communities (including invasive plants), loss of beaver dams	Abundance, productivity	Primarily fry and 0+	Primary methods of riparian enhancement include riparian corridor fences to exclude livestock, changes in grazing management that promote riparian recovery, and planting of native shrubs.
Develop grazing strategies that promote riparian recovery	Some reaches of the upper mainstem John Day River (1) and Ingle (2), Harper (2), Beech (1), Bear (1), Birch (2), Dans (2), and Reynolds (2) crs; the lower reaches of Fields (1), Belshaw (1), Cummings (2), Moon (2), Riley (1), Strawberry (2), Pine (2), and Laycock (2) crs	Same as above	Livestock overgrazing of riparian area	Abundance, productivity	Primarily fry and 0+	

Action Implementation

Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural riparian vegetative communities	ODFW, Watershed Councils, SWCDs, USFS, BLM, CTUIR	Ongoing	Riparian function will be limited to specific reach; water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years, (see above)	High, based upon experience with existing grazing management and riparian recovery projects
Develop grazing strategies that promote riparian recovery	NRCS, AFS, USFS, BLM, SWCDs, ODFW, Watershed Councils, CTUIR	Ongoing	Riparian function will be limited to specific reach; water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years, depending upon grazing plan adopted. Riparian corridor fencing and removal of riparian grazing has the fastest recovery rate.	High, based upon experience with existing grazing management and riparian recovery projects

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
ODFW	BPA Habitat Program		No	Yes
SWCD's	Upland improvements, riparian improvements		Yes in some areas, no in others	Yes
Watershed Councils	Upland improvements, riparian improvements		No	Yes
USFS and BLM	Upland improvements, riparian improvements		No	Yes
NRCS	Upland improvements, riparian improvements		Yes	No
ODA	Agricultural Water Quality Management Plans (AgWQM)			See Oregon State Agencie's programmatic review.
CTUIR	Watershed restoration			Yes

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

Riparian improvements have been documented to improve many fish habitat parameters. For these reasons, in the last 20+ years ODFW, Watershed Councils, NRCS and Soil and Water Districts have implemented hundreds of miles of riparian improvements on private lands, primarily through construction of riparian corridor fences that exclude livestock grazing and development of off channel watering devices. Public land managers have implemented PACFISH and INFISH standards for protection and restoration of USFS and BLM lands. Even though hundreds of miles of riparian improvements have been completed there are nearly 2,800 miles of stream occupied by steelhead within the John Day River Basin and hundreds more miles of tributaries to these streams If only 10% of the stream reaches are degraded (which is probably low), it will take over 35 years to treat them if agencies proceed at the current rate. Bank stabilization using some rock is still infrequently occurring after high water events in the Upper John Day River, primarily along irrigated pastures and on Rock Cr (Gilliam County). These bank stabilization projects have historically relied on riprap and large rock, however in recent years the high economic and ecological cost of bank armoring with riprap and of channelization has been recognized, so the emphasis has shifted toward a more passive approach for stabilization, primarily through riparian vegetation improvements. Overgrazing of riparian areas by livestock continues, however it is not as widespread as historically. Interest by private landowners and public land managers in riparian improvement remains high.

Other projects to restore historic cover types include removing juniper, reintroducing fire, enrollment into CREP, and control of invasive/noxious plants. Primary constraints on implementing additional projects for more riparian improvements are funding and personnel needed for planning, promotion, education of landowners, and implementation.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	**Geographic Locations (1-first priority, 2-second priority)**	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
Implement agricultural water conservation measures	Fields (1), Indian (1), McClellan (2), Pine (1), Beech (1), Bear (2), Strawberry (1), Isham (2), Dean (2), Moon (2), Laycock (1), Dog (2), Ingle (2), and Riley (2)crs; John Day River, Dayville to Mt. Vernon (1)	Altered hydrology, low flows, high temperatures	Water withdrawals, land conversion on uplands, road network	Abundance, productivity	Primarily, fry and 0+	Fields, Indian, McClellan, Pine, Beech, Bear, Strawberry, Isham, Dean, Moon, Laycock, Dog, Ingle, and Riley crs (all Upper John Day) have significantly less than naturally available flow or are either dry or intermittent in their lower reaches due to irrigation withdrawals. During low water years, the mainstem John Day River from Dayville to Mt. Vernon is intermittent.
Improve irrigation conveyance and efficiency	Fields (1), Indian (1), McClellan (2), Pine (1), Beech (1), Bear (2), Strawberry (1), Isham (2), Dean (2), Moon (2), Laycock (1), Dog (2), Ingle (2), and Riley (2)crs; John Day River, Dayville to Mt. Vernon (1)	Low flows, high temperatures	Water withdrawals, loss during conveyance	Abundance, productivity	Primarily, fry and 0+	
Increase pool habitat (beaver ponds)	Fields (2), Indian (1), McClellan (2), Pine (1), Beech (1), Bear (1), Strawberry (2), Isham (2), Dean (2), Moon (2), Laycock (1), Dog (2), Ingle (2), and Riley (1)crs				Primarily, fry and 0+	
Floodplain aquifer recharge		Low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily, fry and 0+	
Lease or acquire water rights and convert to instream	Fields (1), Indian (1), McClellan (2), Pine (1), Beech (1), Bear (2), Strawberry (1), Isham (2), Dean (2), Moon (2), Laycock (2), Dog (2), Ingle (2), and Riley (2)crs; John Day River, Dayville to Mt. Vernon (1)	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily, fry and 0+	The Upper John Day River does not meet requested in stream water right flows for all of August and the first half of September during irrigation season. Some tributaries are dry where they join the John Day River.
Monitor/regulate water withdrawals	All MaSAs	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily, fry and 0+	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Implement agricultural water conservation measures	SWCD, watershed councils, NRCS	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and dependent upon landowner willingness to participate and availability of projects	Immediate	High, if the saved water is protected from being appropriated to a downstream user
Improve irrigation conveyance and efficiency	SWCD, OWEB, watershed councils, NRCS, landowners	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and dependent upon landowner willingness to participate and availability of projects	Immediate	High, if the saved water is protected from being appropriated to a downstream user
Increase pool habitat (beaver ponds)	SWCD, ODFW, CTWSRO, USFS	Ongoing	High dispersal downstream	unknown	Immediate increase in instream flow	High
Floodplain aquifer recharge	CTWSRO, SWCDs	Planned, some ongoing	Potentially high dispersal from recharge project site downstream for many miles	Long term, although opportunities for pilot projects is dependent upon willing landowner	Immediate	High, if the additional water is protected from being appropriated to a downstream user
Lease or acquire water rights and convert to instream	ODWR, Oregon Water Trust, others	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and highly dependent upon landowner willingness to lease.	Immediate	High, if the leased water is protected from being appropriated to a downstream user
Monitor/regulate water withdrawals	ODWR	Ongoing	Point of diversion downstream to mouth of John Day River	Long term, dependent upon ODWR enforcing the requirement to measure water usage	Immediate	High if water use reporting and requirement for measuring devices is enforced

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
ODFW	BPA Habitat Program, riparian improvements		No	Yes
OWRD	Stream Flow Monitoring and Regulation			See Oregon State Agencie's programmatic review.
Oregon Water Trust and BOR	Leasing and Purchase of Water Rights		No	Yes
Soil and Water Conservation Districts	Improve irrigation efficiency, upland improvements, riparian improvements		Yes in some areas, no in others	Yes
Watershed Councils	Upland improvements, riparian improvements		No	Yes
NRCS	Upland improvements, riparian improvements		No	Yes

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

Many landowners have converted from flood to sprinkler or gated pipe irrigation, which makes more efficient use of the water and grows more palatable forage but there has not been an effective mechanism to protect saved water from being used by another irrigator downstream. Water measuring devices are just beginning to be required on irrigation withdrawals and while progress is being made there is considerable resistance from irrigators, particularly in the Upper John Day. Flows are also improving because of projects that restore historic cover types by removing juniper, reintroducing fire, enrollment into CRP, and control of invasive/noxious plants. Primary constraints on implementing additional projects are funding, instream water rights that are junior to most irrigation rights, and water laws that sometimes conflict with conservation practices.

US Bureau of Reclamation, as required in the Columbia River Biological Opinion, is required to identify and assist with passage improvement design and flow restoration. They have partnered with Oregon Water Trust on several water leases, most notably in Standard Cr, tributary to Dixie Cr.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Increase riparian shading	Mainstem John Day River (1), Beech (1), EF Beech (2), Canyon (1), Grub (2), Indian (1), Pine (1), Laycock (2), Belshaw (1), Fields (1), Strawberry (2), lower Dans (2), Riley (1), Ingle (1), Harper (1), and Bear (2) crs	High water temperatures	Degraded riparian forests	Abundance, productivity	Primarily fry, juveniles	Elevated water temperature is the most pervasive water quality problem for the Upper John Day River population, with 27 stream reaches listed as water quality limited. Additional reaches would probably be listed if water temperature data were available.
Manage return flow to reduce extreme stream temperatures	Mainstem John Day River,from South Fork to Blue Mt Hot Springs (1).	High water temperatures	Water withdrawals	Abundance, productivity	Primarily fry, juveniles	Many projects that improve water quality by reducing irrigation return water have been completed, particularly between the town of John Day and the National Forest Boundary above Blue Mt. Hot Springs.
Reduce chemical pollution and nutrient inputs	Mainstem John Day River from the South Fork to Blue Mt Hot Springs (1).	Chemical pollution	Pesticides, fertilizers, herbicides, vehicle hydrocarbons, etc.	Abundance, productivity	Primarily fry, juveniles	Using more efficient irrigation methods, which reduces the amount of surface water returning to the stream, should result in fewer nutrients from pastures reaching the John Day River. Reducing nutrient loads will contribute to increased water quality by reducing biological oxygen demand and algae blooms.
Apply BMPs to animal feeding operations	John Day River between the South Fork and Blue Mt. Hot Springs (1)	Degraded water quality	Animal feed operations	Abundance, productivity	Primarily fry, juveniles	There are very few feedlots, but extensive use of riverside meadows for winter feeding operations
Continue TMDL monitoring	Temperature: Mainstem John Day River (1), Beech (1), EF Beech (2), Canyon (2), Grub (2), Indian (1), Laycock (1), Belshaw (2), Fields (2), and Bear (2) crs Sediment: Indian Cr (from burned area) (1)	Degraded water quality, sediment routing	Land use practices, water withdrawals, pesticides, fertilizers, herbicides	Abundance, productivity	Primarily fry, juveniles	

Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Increase riparian shading	ODFW, Watershed Councils, SWCDs, USFS, BLM, CTUIR	Ongoing	water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years	High
Manage return flow to reduce extreme stream temperatures	SWCDs, watershed councils	Ongoing	Water quality improvement would have high dispersal downstream	Less than 5 years, once the project has been identified	Immediate	High, reduced temperatures has been well documented
Reduce chemical pollution and nutrient inputs	ODEQ, others	Ongoing		Ongoing	Reduce chemical pollution immediately	High
Apply BMPs to animal feeding operations	ODA	Ongoing	Water quality improvement would have high dispersal downstream	Some treatments could be done immediately. There are few animal feeding operations within the basin, only one of which has been identified as a problem	5-15 years	High, once a treatment has been agreed upon
Continue TMDL monitoring	USFS, ODFW, SWCD, ODEQ	Ongoing	basinwide	Ongoing	Immediate	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, no, uncertain)**	**Needs Expansion**
FSA	CREP, CRP		No	Yes
ODEQ	Mine Waste Program			See Oregon State Agencie's programmatic review.
ODA	Confined animal feeding operations (CAFO), AgWQM			See Oregon State Agencie's programmatic review.
ODEQ, ODA, SWCD, USFS	Sedimentation Monitoring (TMDL Development and Implementation)			See Oregon State Agencie's programmatic review.
***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**				
Reducing water temperatures through the use of improved riparian vegetation and more efficient methods of irrigation may take several years to provide measurable results. Many projects that improve water quality by reducing irrigation return water have been completed. Opportunities for additional irrigation return water cooling projects exist above and below the town of John Day. Low stream flows during the hottest part of the year exacerbate the already warm water temperatures. Opportunities for increasing stream flow through leasing of water rights, which often results in cooler water over a longer stream reach, are being pursued by Oregon Water Trust and US Bureau of Reclamation. Constraints for future projects include acceptance by landowners and a secure, long term funding source.				

Strategy 8. Restore degraded upland processes to minimize unnatural rates of erosion and runoff, and maintain unimpaired natural upland processes.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore native upland plant communities	Bear (2), Grub (1), Beech (1), Belshaw (1), Cummings (1), Pine (2), Indian (2), Strawberry (2), and Laycock (2) crs	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices, loss of water storage capacity	Abundance, productivity	Primarily fry, juveniles	Upland improvements such as restoring native plant communities and controlling invasive weed species will improve precipitation infiltration rates and ultimately improve watershed health, including the hydrograph.
Upgrade or remove problem forest roads	Forest lands	Same as above	Road network	Abundance, productivity	Primarily fry, juveniles	
Initiate demonstration projects	Bear (2), Grub (1), Beech (1), Belshaw (1), Cummings (1), Pine (2), Indian (2), Strawberry (2), and Laycock (2)crs	Same as above	Upland land use practices	Abundance, productivity	Primarily fry, juveniles	
Manage vegetation, including juniper removal	Bear (2), Grub (1), Beech (1), Belshaw (1), Cummings (1), Pine (2), Indian (2), Strawberry (2), and Laycock (2) crs	Altered hydrology, sediment routing	Invasive plants	Abundance, productivity	Primarily fry, juveniles	
Employ BMPs to forest practices, livestock grazing, road management and agricultural practices	MaSAs	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices	Abundance, productivity	Primarily fry, juveniles	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore native upland plant communities	SWCD, USFS, BLM	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Long term		
Upgrade or remove problem forest roads	USFS, BLM, DOF, ODOT	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, many forest roads have legacy issues with regard to sediment transport and routing of runoff. Decommissioning may take many years	5-15 years	Moderate, although funding on public lands and landowner cooperation on private lands will determine rate of treatment
Initiate demonstration projects	ODFW, NOAA Fisheries, USFWS, USFS, BLM, CTWSRO, Watershed Councils, SWCD's	Ongoing	Entire basin	Long term	Variable lag time	unknown, depends upon action taken as a result of being more informed
Manage vegetation, including juniper removal	USFS, BLM, NRCS, SWCD's, Watershed Councils	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Juniper control can be done quickly, other strategies such as control of invasive plants may take more than 20 years	5-30 years	Moderate
Employ BMPs to forest practices, livestock grazing, road management and agricultural practices	SWCD, VSFS, ODA, CTWSRO, private landowners	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, dependent on implementation of Agricultural Water Quality Management Plans	0-20,years, depending upon treatments applied	Moderate, dependent upon voluntary landowner participation

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, no, uncertain)	Needs Expansion
NRCS/Farm Service Agency	CRP		No	Yes
SWCDs	Juniper control		No	Yes
ODFW	Green Forage		No	Very small program
USFS	Forest Plan		Yes, but highly dependent upon funding and monitoring	Yes, particularly monitoring
ODA	Agricultural Water Quality Management Plan			See Oregon State Agencie's programmatic review.
CTUIR	Watershed Restoration		Continued funding is uncertain	Yes

***Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)**

NRCS, SWCD and ODFW programs are relatively small, with the CRP program the largest and best funded. CRP has been in existence for 20 years and has been one of the better farm subsidy programs for watershed restoration. Juniper control programs have focused on areas where extensive juniper encroachment has occurred. Juniper control can be completed using several different methods, including controlled burns, cutting with chainsaws, or by removing with bulldozers or trackhoes. Although controlled burns are probably the most effective at controlling the spread of juniper, they are the most difficult to implement because of the threat of the fire getting out of control and costs. Another drawback to controlled burns is that livestock grazing should be excluded from burned areas for at least two growing seasons after the burn to ensure full recovery of desirable perennial grasses. There are opportunities to expand the juniper control program but the lack of a pasture to put livestock into for two years after burning has limited its acceptance. The ODFW Green Forage program provides a wildlife seed mixture of native grasses and desirable forage to landowners who have recently completed juniper clearing projects, logging projects or other ground disturbing activities. The primary purposes are to provide additional forage for deer and elk and to reduce deer and elk damage complaints, however, it also has benefits to watershed health by providing grasses that provide perennial ground cover.

The limitations to all the programs are funding and, to a lesser extent, acceptance by landowners.

Chapter 18
Other Federal Actions to Conserve Listed Species

TABLE OF CONTENTS

LIST OF TABLES

18. OTHER FEDERAL ACTIONS TO CONSERVE LISTED SPECIES

The Action Agencies have been coordinating the development of this Comprehensive Analysis with other Federal agencies. In an effort to disclose other Federal actions being undertaken to conserve listed species, the Action Agencies requested and received information from the Natural Resources Conservation Service (NRCS), the Farm Service Agency (FSA), the U.S. Environmental Protection Agency (EPA), the Bureau of Land Management (BLM), and the U.S. Forest Service (USFS). The information they provided is found in the following sections.

18.1 NRCS PRIVATE LANDS CONSERVATION ASSISTANCE IN THE COLUMBIA RIVER BASIN

NRCS assists private landowners in maintaining their land's quality and productivity through voluntary conservation programs. The agency's goal through the planning process is to improve watershed health while addressing various natural resource concerns. NRCS program participants frequently apply upland conservation practices that provide direct benefits to the environment and improve the productivity and sustainability of their agricultural operations. These on-farm or ranch actions may also indirectly provide habitat benefits for various wildlife species.

NRCS programs are fully voluntary and completely dependent on producer participation. Many conservation practices are eligible for financial assistance available through a variety of Farm Bill programs. Some of those programs provide producers with up to 50 percent cost incentives. Land managers who choose to participate in these programs also invest significant resources of their own.

Conservation practices in the designated watersheds occur primarily in the uplands. Those that affect instream habitat conditions are consulted upon with the National Marine Fisheries Service (NMFS, also known as the National Oceanic and Atmospheric Administration [NOAA] Fisheries) and/or the U.S. Fish and Wildlife Service (USFWS) under Section 7 of the Endangered Species Act (ESA).

Some of the benefits of conservation practices on rangeland, cropland, and forestland include:

- Protection and restoration of soil quality including increased organic matter;
- Increased resistance to and reduction of soil erosion caused by water or wind;
- Increased water retention in the soil profile of the watershed;
- Decreased nutrient and pesticide runoff, and/or groundwater contamination; and
- Improved plant health and vigor.

Further information is available on the NRCS Web site at http://www.nrcs.usda.gov/.

18.2 FARM SERVICE AGENCY CONSERVATION RESERVE ENHANCEMENT PROGRAM

The following discusses the FSA's Conservation Reserve Enhancement Program (CREP) in the states of Oregon, Idaho, and Washington.

18.2.1 Oregon

This State-wide CREP project provides for the enrollment of "Filter Strip" practices (Conservation Practice [CP]22), "Riparian Buffer" practices (CP22 and CP29) and "Wetland Restoration" practices (CP23 and CP23A) along streams and in wetlands primarily for the purpose of improving water quality for salmon and steelhead. Currently, there are about 27,000 acres enrolled state-wide; the project allows for enrollment of up to 100,000 acres.

For a better summary of this project's design and goals regarding how the project increases salmon habitat please see the Fact Sheet, Q&A Backgrounder, and CREP Agreement posted at the links below:

http://www.fsa.usda.gov/FSA/newsReleases?area=newsroom&subject=landing&topic=pfs&newstype=prfactsheet&type=detail&item=pf_19980901_consv_en_or.html

http://content.fsa.usda.gov/pas/news/releases/1998/10/0428.htm

http://content.fsa.usda.gov/dafp/cepd/crep/orok.htm

18.2.2 Idaho

This relatively new Eastern Snake River Plain Aquifer CREP is primarily intended to conserve water in the aquifer. Aquatic wildlife improvement is a secondary benefit of this project. This project conserves water through the enrollment of small and larger irrigated cropland fields using mostly "whole-field" practices "Establishment of Permanent Native Grasses" (CP2) and "Permanent Wildlife Habitat" (CP4D). Currently there are about 13,000 acres enrolled state-wide; the project allows for enrollment of up to 100,000 acres of primarily center-pivot circles and dryland corners.

For a better summary of this project's design and goals regarding water saving and related natural resource benefits see the Press Release, Fact Sheet, and Q&A at:

http://content.fsa.usda.gov/pas/FullStory.asp?StoryID=2309
http://www.fsa.usda.gov/FSA/newsReleases?area=newsroom&subject=landing&topic=pfs&newstype=prfactsheet&type=detail&item=pf_20060501_consv_en_idaho06.html

http://www.fsa.usda.gov/FSA/newsReleases?area=newsroom&subject=landing&topic=ner&newstype=newsrel&type=detail&item=nr_20060519_rel_1453.html

Because this is a new CREP, there is no Monitoring and Evaluation Report available at this time.

18.2.3 Washington

This State-wide CREP project provides for the enrollment of Riparian Buffer practices (CP-22) along streams primarily for the purpose of improving water quality for salmon and steelhead. Currently there are about 10,000 acres enrolled state-wide; the project allows for enrollment of up to 100,000 acres (or about 3,000 stream miles). County-level and Watershed-level reports of enrollment are available.

For a more detailed summary of the State-wide project's design and goals regarding how it increases salmon habitat, please see the Fact Sheet, Q&A Backgrounder, and CREP Agreement posted at the links below.

http://www.fsa.usda.gov/FSA/newsReleases?area=newsroom&subject=landing&topic=pfs&newstype=prfactsheet&type=detail&item=pf_19981001_consv_en_wash.html

http://content.fsa.usda.gov/pas/news/releases/1998/10/0431.htm

http://content.fsa.usda.gov/dafp/cepd/crep/waok.htm

http://filecab.scc.wa.gov/CREP/CREP_Report_2006.pdf

18.2.4 Summary

In summary, the total acres in CREP in counties (Asotin, Benton, Chelan, Clark, Columbia, Douglas, Ferry, Franklin, Garfield, Lincoln, Pacific, Spokane, Wahkiakum, Walla Walla, Whitman, Yakima counties) in the Snake River and Columbia River drainages are approximately 7,780.5 acres with approximately 430 total stream miles. In addition to CREP, a number of acres are enrolled in the Continuous Conservation Reserve Program as riparian buffers. These would also benefit salmon. The number of acres is approximately 18,000 in the counties draining into the Snake and Columbia River drainages.

For all three States, County-level and Watershed-level reports of enrollment are available on FSA's public Web page through the CREP report menu, bullets 13 to 20, at:

http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp-rt

18.3 EPA

EPA works with a variety of State and local agencies to assist in protecting and restoring water quality in the Columbia River Basin, which is essential for the long-term recovery of the ESA-listed fish species. In a letter dated June 14, 2007 to the Action Agencies, the EPA Region 10 describes their activities in a number of ongoing programs to either protect high-quality waters or restore impaired waters. These include the following:

- **Water Quality Standards and Total Maximum Daily Loads.** EPA works with the States of Oregon, Idaho, and Washington on changes to water quality standards and approves the States' total maximum daily loads (TMDLs) that are designed to improved impaired water bodies.
- **Water Program Funding.** EPA provides funding to States and Tribes to support salmon recovery work through core water programs including Section 319 Nonpoint Source Grants, Section 104(b)(3) Water Quality Cooperation Grants, Clean Water State Revolving Fund, Wetlands Program Development Grants, and the Indian Environmental General Assistance Program.
- **Willamette Partnership.** EPA funds a multi-year grant to develop innovative approaches to meet water temperature standards in Oregon's Willamette River.
- **Monitoring Funding.** EPA funds water quality monitoring in the mid-Columbia River Basin through the Regional Environmental Monitoring and Assessment Program.
- **Lower Columbia River Estuary Partnership.** EPA provides funding to the Lower Columbia River Estuary Partnership (LCREP) to develop management plans and support restoration efforts in the estuary.

18.4 BUREAU OF LAND MANAGEMENT AND U.S. FOREST SERVICE

The USFS and BLM have developed the Management and Conservation Framework, which comprises programs that contribute to recovery of ESA-listed salmon and steelhead on Federal lands. These include:

- A diverse body of environmental laws and regulations; for example, the Clean Water and Endangered Species Acts;
- Agency policies;
- Land Management Plans with associated aquatic strategies; and
- Guidance and procedures for project design, implementation, and monitoring.

Collectively, this existing Management and Conservation Framework represents the "baseline" that governs land management, contributing to both short and long-term recovery goals for ESA-listed anadromous salmonids on Federal lands. While elements of the framework may be revised or amended over time (e.g., Congress may pass new statutes or agencies may revise plans), the interwoven nature of statutes, regulations, and policies – as well as interagency and public processes –maintains the integrity and overall effectiveness of the framework in providing meaningful contributions to salmon and steelhead recovery. The foundation of this Management and Conservation Framework are two aquatic strategies known as PACFISH[1] and the Northwest Forest Plan – Aquatic Conservation Strategy (NWFP-ACS). PACFISH was incorporated into USFS and BLM Land Management Plans in 1995 and the NWFP-ACS amended (USFS and BLM) plans west of the Cascade mountain range in 1994. These aquatic strategies provide for the protection and appropriate management of physical or biological features essential to recovery of ESA-listed salmon and steelhead on Federal lands.

The following describes the primary building blocks in the Management and Conservation Framework the USFS and BLM apply to Federally managed lands within the Pacific Northwest (States of Idaho, Oregon, and Washington) that contribute to salmon and steelhead recovery goals and objectives, and guide recovery actions.

18.4.1 Land Management Plans

Forest Service Land and Resource Management Plans and BLM Resource Management Plans, collectively referred to as Land Management Plans, contribute to recovery by providing assurances that public lands are managed in accordance with the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1701 *et seq.*) (FLPMA); the National Forest Management Act (NFMA) of 1986; and other applicable laws, regulations, and policy. These legal and policy requirements ensure the Federal land-managing agencies make informed decisions and provide for the responsible management of public land resources, including ESA-listed species.

Both USFS and BLM Land Management Plans describe broad, multiple-use guidance for managing public lands and mineral estates. Plan decisions are made at a broad scale and guide site-specific project design and approval. Land Management Plans highlight goals and objectives for resource management and establish management guidance needed to achieve them. Plans also identify what public and commercial uses are appropriate and where they should occur.

[1] Aquatic Strategy for Managing National Forest System and Bureau of Land Management Anadromous Fish Producing Watersheds in Eastern Oregon, Washington, Idaho, and portions of Northern California.

Land Management Plans contain protective management direction, in some cases even stronger than PACFISH or the NWFP-ACS. Applicable to specific large blocks of land, these additional protections include Congressionally designated Wilderness, Wild and Scenic Rivers, and municipal watersheds. In addition, some types of management areas also receive strong watershed-scale protections based on land use decisions contained in land management plans. Examples include allocations and management direction for non-motorized dispersed recreation areas, and Scenic Areas. All Land Management Plans are developed with public involvement, and impacts of a plan are analyzed in an appropriate National Environmental Policy Act (NEPA) document. Plans also contain a monitoring component to provide continuous feedback on the efficacy of direction in meeting plan objectives. In the near future, BLM will be completing a Draft Environmental Impact Statement (EIS) revising six of their Westside Land Management Plans, currently under the NWFP-ACS.

PACFISH and the NWFP-ACS are described individually in more detail below:

18.4.2 PACFISH

In February 1995, USFS and BLM administrative units with anadromous fish, outside the range of the northern spotted owl covered by the NWFP-ACS in Oregon, modified their Land Management Plans through amendment by PACFISH. PACFISH was developed as an ecosystem-based, interim strategy designed to arrest the degradation of habitat and begin restoration of instream and riparian habitats on lands administered by the USFS and BLM in eastern Oregon and Washington, Idaho, and portions of northern California. The intent of the strategy was to allow for “passive” restoration of the ecological health and productivity of watersheds that contain present or potential anadromous fish habitat through the application of riparian standards and guidelines to both proposed and ongoing actions. PACFISH was to remain in place until longer-term aquatic conservation strategies were completed through Land Management Plan amendment or revisions (USFS and BLM 1995). Those revisions have not yet occurred, and PACFISH still applies wherever NWFP-ACS does not already apply.

PACFISH contains the following components that are applied to USFS and BLM management actions to maintain and restore ecological processes that support high quality habitat for salmon and steelhead:

- Riparian Goals – establishes an expectation of the characteristics of healthy, functioning watershed, riparian areas, and associated fish habitats.
- Riparian Management Objectives (RMOs) – quantitative RMOs for stream channel, riparian, and watershed conditions were developed to provide the criteria against which attainment or progress toward attainment of the riparian goals are measured. RMOs provide measurable targets toward which managers are aiming as they conduct resource management activities across the landscape. The objectives are time specific to reflect the ecological capabilities of specific ecosystems.
- Delineation of streamside areas (Riparian Habitat Conservation Areas [RHCAs] that are important to maintenance of high-quality aquatic habitat and where special management considerations are applied – PACFISH requires that proposed actions within RHCAs do not prevent or retard attainment of RMOs. RHCAs include traditional riparian corridors, wetlands, intermittent streams, and other areas that help maintain the integrity of aquatic ecosystems by (1) influencing the delivery of coarse sediment, organic matter, and woody debris to streams; (2) providing root strength for channel stability; (3) shading the stream; and (4) protecting water quality. RHCA widths vary depending upon the aquatic and riparian resources to be protected in each stream reach, based on stream and riparian characteristics.
- Standards and/or guidelines to ensure to the extent legally possible, that projects do not prevent or retard attainment of riparian goals and management objectives.

- Designation of Key or Priority watersheds – areas where additional management emphasis and/or watershed analysis is required to ensure that salmon and steelhead habitat is maintained or provided priority for restoration.
- Watershed analyses – to provide sufficient context for designing actions that support maintenance or restoration of aquatic habitats needed for recovery of ESA-listed salmon and steelhead.
- Watershed restoration efforts focused through watershed analysis.
- Monitoring program to evaluate project implementation (compliance) and effectiveness of PACFISH as a strategy for protecting and improving aquatic habitat conditions on Federal lands. See http://www.fs.fed.us/rm/boise/research/techtrans/projects/pacfish_home.shtml for additional information.

PACFISH, combined with underlying Land Management Plans and BLM Rangeland Health Standards, and complemented by consultation programs conducted for compliance with the ESA, provides the program guidance needed to protect and conserve salmon and steelhead and their habitat on Federal lands. The protective guidance provided by these programs is applied on every USFS and BLM project during project development and implementation. The plans have been determined to be sufficient in terms of their intended purpose of protecting habitat for ESA-listed salmon and steelhead to the extent permitted by law, thereby promoting recovery of the species and their habitats.

PACFISH provides a framework for minimizing adverse effects from land management activities on aquatic resources through the assessment of proposed or ongoing management actions, within RHCAs, with Riparian Goals and RMOs. Standards and Guidelines are applied to actions within RHCAs to ensure that they do not prevent or retard attainment of high-quality aquatic habitat (RMOs). The use of Watershed Analysis and special considerations provided in Key watersheds (priority populations) provide another level of management consideration that increases certainty of outcomes for protection and meeting of both short- and long-term recovery goals.

Preliminary results from broad-scale aquatic habitat status and trend monitoring of USFS and BLM lands within the interior Columbia River Basin since 2001 indicate conditions have improved over the past 5 years, continuing the habitat recovery presumed to have begun in 1995 as a result of the protections PACFISH instituted. Implementation and Effectiveness Monitoring will both continue to evaluate the overall long-term effectiveness of PACFISH policy and program directives at preventing further degradation of habitat for native anadromous and resident salmonids, and its effectiveness at restoring near-natural rates of habitat and species recovery on actively managed USFS and BLM lands, particularly within streamside riparian areas on streams affected by ongoing livestock grazing.

18.4.3 Northwest Forest Plan's Aquatic Conservation Strategy and Protective Land Allocations in Oregon and Washington

The NWFP-ACS was designed to incorporate all elements of an aquatic and riparian ecosystem necessary to maintain its natural disturbance regime. The NWFP-ACS applies to all USFS and BLM lands within western Washington, Oregon, and the east slope of the Cascades in Washington. The NWFS-ACS will apply until USFS and BLM Land Management Plans are revised or amended.

Aquatic ecosystem elements embedded in the NWFP-ACS include maintenance of hydrologic function, high water quality, adequate amounts of coarse woody debris, complex stream channels that provide a diversity of aquatic habitat types, and riparian areas with suitable microclimate and vegetation. These elements directly or indirectly correspond to each of the physical and biological attributes of "Primary Constituent Elements" identified as characterizing salmon and steelhead designated critical habitat: water quality and quantity; substrates; shade; large wood; cover; conditions suitable for forage production; channel form and connectivity with floodplains; and unobstructed migration corridors. Since being amended to USFS and BLM Land Management Plans in the eastern Cascades in 1994, the NWFP-ACS has created a connected system of aquatic and riparian habitats throughout the plan area that is assumed to be reversing the trend of aquatic and riparian habitat degradation and has begun the long recovery process for these habitats over the past 12 years.

Most primary program components of the NWFP-ACS are similar to those found in PACFISH. NWFP-ACS components include:

- Aquatic Goals and Objectives - each project must maintain or restore the physical and biological processes required by riparian dependent-resources at the watershed scale or broader to comply with the ACS.
- Riparian Reserves – portions of watersheds where riparian-dependent resources receive primary emphasis. The extensive Riparian Reserves within the Northwest Forest Plan area protect the stream and adjacent riparian areas critical to maintaining a highly functioning aquatic ecosystem.
- Standards and Guidelines – Standards and Guidelines prohibit and regulate activities in Riparian Reserves that retard or prevent attainment of the ACS aquatic/riparian objectives. Use of these provides assurances that a project cannot have a negative impact in the long-term on riparian-dependent resources or ecological processes in the Riparian Reserves at the watershed scale.
- Key Watershed network – serves as refugia for anadromous salmonids.
- Watershed analyses – to provide sufficient context for designing actions that support maintenance or restoration of aquatic habitats needed for recovery of ESA-listed salmon and steelhead.
- Watershed Restoration Strategy – a formal restoration strategy based on watershed analysis.
- Monitoring – a formal long-term broad-scale monitoring program.
- Adaptive Management – ongoing adjustments in management based on monitoring and other new information as it becomes available.

18.4.3.1 Riparian Reserves

The NWFP-ACS provides the foundation for the conservation and recovery of anadromous fish species on Federally managed lands through use of Riparian Reserves. Riparian Reserves are portions of watersheds where riparian-dependent resources receive primary emphasis. In conjunction with the Key Watershed network, these areas serve as refugia for ESA-listed and non-listed anadromous fish.

18.4.3.2 Land Allocations

The NWFP-ACS, with additional protective land allocations, collectively provides an extensive network of Riparian Reserves and watersheds contributing to the protection and restoration of aquatic ecosystems on Federally managed lands.

Large proportions of Federal lands within the NWFP area in Oregon are in some form of Reserve or Special Management status. Reserve or Special Management status lands are those where land management actions are largely prohibited or significantly shaped by application of protective Standards and Guidelines for land management activities. These specially managed lands are located both within and outside Key Watersheds. Federal lands outside of Key Watersheds are also protected under other land allocations including Riparian Reserves; Congressional Reserves such as Wild and Scenic River corridors; Wilderness and/or Municipal Watersheds; spotted owl Late-Successional Reserves (LSRs); and Areas Withdrawn from active management (USFS).

NWFP-ACS Standards and Guidelines are also required to be applied within LSRs, providing increased protection for all stream types. Because LSRs have late-successional characteristics, and are overlain with Riparian Reserves, they serve as core areas of high-quality stream habitat, fish refugia, and centers from which degraded aquatic systems can be recolonized once they are restored. Streams within these reserves may also be particularly important for endemic or locally distributed fish species and stocks. Collectively, these protective upland land allocations (non-riparian Reserve; not located in Key Watersheds) comprise 1,331,636 acres or 17 percent of Federally managed lands within the area of designated critical habitat for anadromous fish in Oregon and Washington. In the near future, BLM will be completing a Draft EIS revising six of its Westside Land Management Plans, currently under the NWFP-ACS.

18.4.3.3 Watershed Analysis and Watershed Restoration

Watershed analysis, a requirement of the NWFP-ACS, provides an understanding of aquatic habitat conditions and processes. This informs land management decisions regarding the timing, location, and magnitude of activities on the landscape to protect and/or restore the physical and biological features essential to the conservation of anadromous fish. Watershed analysis also provides information on priorities for watershed restoration. The USFS has made significant investments in watershed restoration in the NWFP area since its inception in 1994 to meet aquatic habitat objectives. Activities have emphasized restoration of fish passage; reductions in the delivery of fine sediments to stream channels; placement of large wood debris in stream channels; riparian plantings and thinning to accelerate large wood recruitment/increase shade/improve nutrient cycling; and control of noxious weeds, either by obliteration or high-level maintenance.

18.4.3.4 Monitoring

The NWFP-ACS also contains a long-term monitoring component to evaluate progress towards goals for protection and management of physical and biological features essential to long-term conservation of ESA-listed salmon and steelhead. In the NWFP-ACS, monitoring is considered an essential component of management as the information it provides helps to evaluate the overall success of the applied strategies and allows for needed adjustments. Four types of monitoring are conducted by the USFS and BLM, in coordination with NMFS and the USFWS:

- Implementation monitoring – to determine if activities (i.e., timber sales, silvicultural projects, or watershed restoration) were implemented as planned and whether or not they meet NWFP-ACS Standards and Guidelines.
- Effectiveness monitoring – evaluate if NWFP-ACS Standards and Guidelines are meeting the strategy's goals and objectives (see www.reo.gov/monitoring/watershed).
- Validation monitoring is primarily research-oriented and directed at testing underlying assumptions upon which management strategies are based (see http://www.reo.gov/monitoring/10yr-report/documents/synthesis-reports/all.pdf., http://ocid.nacse.org/nbii/density/pubs.html, http://www.fs.fed.us/pnw/publications/index.shtml).
- Local –many of the local USFS and BLM administrative units conduct additional annual monitoring (implementation, effectiveness) to address local management issues.

18.4.3.5 Adaptive Management

Adaptive Management is described in the NWFP (USFS and BLM 1994) as a continuing process of action-based planning, monitoring, researching, evaluating, and adjusting with the objective of improving the implementation and achieving the goals of the Standards and Guidelines. Using this process, new information is evaluated, which serves as the basis for decisions on needed adjustments to management. Adjustments may also result in the refinement of Standards and Guidelines, land-use allocations, or amendments to USFS and BLM Land Management Plans.

Collectively, these NWFP-ACS program components emphasize aquatic habitat management for protection and recovery of ESA-listed anadromous salmonid Evolutionarily Significant Units (ESUs) on USFS and BLM lands. This program will remain in place until USFS and BLM Land Management Plans are revised or amended through NEPA.

18.5 BUREAU OF LAND MANAGEMENT 2004-2006 CONTRIBUTIONS TO THE CONSERVATION OF ESA-LISTED ANADROMOUS SALMONIDS WITHIN THE COLUMBIA AND SNAKE RIVER BASINS

The BLM manages over 1,700 miles of streams and rivers within the range of anadromous salmonids in Idaho, Oregon, and Washington.

18.5.1 Oregon and Washington

The BLM manages public land and its resources within the Oregon and Washington portions in support of the recovery of ESA-listed salmon and steelhead. Multiple-use programs, such as grazing, timber management, minerals, and recreation are managed to be consistent with aquatic conservation strategies NWFP-ACS of Resource Management Plans (RMP). The strategies incorporated into the RMPs guide project design, implementation, and monitoring activities to protect fish habitat and water quality. Consultations under Section 7 of the ESA are undertaken to ensure that actions individually or cumulatively do not jeopardize the continued existence of an ESA-listed salmon species or adversely modify its critical habitat. There were no significant changes in BLM programs and practices in the time period 2004 to 2006. Consequently, this narrative provides information for that entire time period.

On BLM lands within the Columbia River Basin, land management practices have been developed and implemented over the past 20 years that are more protective of fish habitat, water quality, and riparian areas. For example, management strategies currently implemented to reduce impacts of cattle grazing include 1) reducing the number of animals per allotment; 2) changing the season of use; 3) constructing fences to exclude or defer animal use within riparian areas; 4) developing alternative water sources; 5) resting allotments for one or more years; 6) rotating animals between pastures; and 7) closing allotments permanently. Timber sales, road construction, and other activities incorporate design criteria and standards to minimize or avoid impacts to water quality, riparian vegetation, and fish habitat. Recreation management has improved to reduce or eliminate human use at undesignated campsites and on “unofficial” roads within riparian areas.

Restoration actions target upland, riparian, and in-channel stream conditions to improve runoff characteristics, water quality, riparian vegetation, and instream habitat. Examples of projects undertaken by the BLM during the 2004 to 2006 time period include: 1) treating upland and riparian invasive plants and re-introducing native grasses, shrubs, and trees; 2) erosion control on stream-adjacent road segments; 3) culvert replacements for fish passage; 4) placing boulders and logs to create pools and hiding cover; 5) reconnecting historical side-channel habitat with mainstem river habitat to provide over-wintering refugia; and 6) construction of a boat ramp while closing multiple uncontrolled river access points. Table 18-1 describes projects completed from 2004 to 2006 within the Oregon geographical area of the Mid-Columbia River Steelhead ESU.

Additional BLM actions to conserve salmon and steelhead habitat and improve the understanding of habitat conditions and the effects of land management activities include 1) research; 2) monitoring; 3) stream inventories; and 4) participation in interagency efforts such as subbasin planning, watershed analyses, and ESA recovery plans.

Following are representative Oregon/Washington BLM Restoration Projects in the Columbia River Basin (2004 to 2006).

Table 18-1. BLM Habitat Restoration Projects in Oregon Mid-Columbia River Steelhead ESU Population Areas, 2004 to 2006

Stream Name	Project Description	Quantity	Year	Project Leader
Lower mainstem John Day	Green Fence #2 riparian fencing	3 miles	2006	BLM
Lower mainstem John Day	Stanley ag. field/John Day River riparian fencing	1 mile	2006	BLM
Little Pine Creek, Upper Mainstem John Day	Culvert replacement for fish passage	1 culvert	2005	BLM
Cottonwood Creek, Upper Mainstem John Day	Riparian fence	1 mile	2006	BLM
Little Pine Creek, Upper Mainstem John Day	Re-route valley bottom road; obliterate and re-contour old roadbed	1 mile	2006	BLM
N. Fk. John Day	Buckaroo Flats riparian fencing	1 mile	2006	BLM
Soda Creek, S. Fk. John Day	Riparian fence	2 miles	2006	BLM
N. Fk. Walla Walla	Riparian exclosure fence	0.5 miles	2005	BLM

18.5.1.1 Stoneman Side-Channel Restoration, Spokane District

A Yakima River, Washington, fish habitat restoration cooperative project was completed on private land adjacent to BLM land in 2005. This cooperative project included private landowner Jon Stoneman, BLM fish biologist Joe Kelly, Brent Renfrow of the WDFW, and a local chapter of Trout Unlimited. The Yakima River Watershed Analysis identified lack of side channel rearing habitat for juvenile salmonids as a “limiting factor” in salmon and steelhead recovery in the Yakima River Basin.

The project excavated and reconnected a side channel that originates on BLM property. The side channel was filled in by the 1948 flood, and what was formerly an island was connected to the Stoneman property. The side channel was filled in with silt, sediment, and debris, with only isolated pools of water and no reliable connectivity to the Yakima River.

The side channel is 1,100 feet long and was filled with approximately 2 to 3 feet of silt and mud. The design, which was surveyed in by Mr. Stoneman, called for excavating the whole channel to a depth of 18 to 24 inches between deeper pools, with a downstream gradient flowing into the Yakima River. BLM paid for the heavy equipment rental, consulted with regulatory agencies, and acquired the necessary permits.

Four pools were excavated to a depth of approximately 4 feet. A 3-inch trash pump was used to pump excess water and silt into a nearby settling pond. The excavation intercepted ground water flow from the

Yakima River. Brush removed to allow access for a tracked backhoe was then bundled and weighted with rock-filled wire baskets and sunk in the pools for hiding cover for fish.

The side channel was sampled in 2006 and it was determined that juvenile steelhead and Chinook salmon were utilizing the new habitat. A maintenance project also took place in 2006. A trench was excavated along the bank at the head of the side channel at the depth of the summer low flow water level of the Yakima River. About 120 feet of perforated pipe was buried within the trench to intercept additional groundwater and thereby increase flow within the side channel.

18.5.1.2 Green Fence Number 2 Riparian Exclosure, Prineville District

The Green Fence No. 2 project was completed in 2006 and excludes livestock grazing from a portion of the Wild and Scenic section of the lower mainstem John Day River. It consists of 1.3 miles of fencing. The project benefits the Mid-Columbia River steelhead, which uses this section of river as a travel corridor and for rearing, and is listed under ESA as "threatened." The fence meets the mandates of the Record of Decision (ROD) for the John Day River Management Plan, Two Rivers, John Day, and Baker Resource Management Plan Amendments, February 2001. It controls livestock grazing along 2.6 miles of the John Day River. The project benefits habitat for the Mid-Columbia River steelhead, water quality, 2.6 miles of riparian area, and approximately 1,400 acres of upland habitat.

18.5.1.3 Little Pine Creek Culvert Replacement, Prineville District

The Little Pine Creek culvert replacement project was completed in the summer of 2006. Little Pine Creek is a small tributary of the mainstem John Day River in central Oregon. The John Day River flows into the Columbia River. The stream has excellent water quality, but historic placer mining degraded the channel in many locations. The original 30-inch culvert was installed many years ago, probably by private landowners as the culvert site is on a right-of-way. The steep stream gradient caused the channel to degrade at the outlet of the culvert and resulted in a 30-inch drop. This created a barrier to resident westslope cutthroat trout (BLM sensitive species), although they persisted upstream from the culvert. It is also a barrier to upstream migration of Mid-Columbia River Steelhead.

The culvert was replaced with an open-bottom arch sized for a 100-year event. Pre-fabricated footings were used and native material was placed for the natural stream bottom. The arch gradient is approximately 7 percent, which matches the stream channel in this location. The new culvert increases the range of Mid-Columbia River Steelhead by at least 1 mile and corrects the last known culvert fish passage barrier on BLM land in the John Day River watershed.

18.5.1.4 Grande Ronde River Riparian Restoration, Vale District

This project was implemented from 2004 to 2006 and included a variety of restoration treatments within the Grande Ronde River and tributaries: 1) treatment of noxious weeds; 2) revegetation using native conifers, hardwoods, shrubs and grasses; 3) construction of grazing exclosures; and 4) placement of large woody debris. The project benefits habitat for ESA-listed Snake River Pacific salmon species.

18.5.2 Idaho

The Idaho Program consists of three categories: 1) Habitat Protection and Restoration; 2) Research, Inventory/Monitoring, Assessment and Evaluation; and 3) ESA Consultation/Project Planning/NEPA/General Coordination.

18.5.2.1 Habitat Protection and Restoration

This category includes three program elements: 1) stream/riparian projects completed, 2) stream/riparian projects maintained, and 3) miles of stream/riparian treatments.

Stream/Riparian Projects Completed

This includes the project planning and implementation of restoration and enhancement projects specific to the fisheries and riparian programs (including Special Status Species - Salmon) on stream/river habitat. Table 18-2 summarizes the accomplishments by BLM in Idaho from 2004 to 2006.

Table 18-2. Stream/Riparian Projects Completed by BLM in Idaho (2004 to 2006)

Basin Groups	Fiscal Year	# Projects Completed
Upper Salmon	2004	1
& Pahsimeroi	2005	5
& East Fork	2006	2
Lemhi	2004	14
& Mid Salmon	2005	6
	2006	10
Lower Salmon	2004	6
& Clearwater	2005	3
	2006	3

Stream/Riparian Projects Maintained

This includes the maintenance of all project work specific to the fisheries and riparian programs (including Special Status Species - Salmon) for stream/river habitats. Table 18-3 summarizes the accomplishments by BLM from 2004 to 2006 in Idaho.

Table 18-3. Stream/Riparian Projects Maintained by BLM in Idaho (2004 to 2006)

Basin Groups	Fiscal Year	# Projects Maintained
Upper Salmon	2004	14
& Pahsimeroi	2005	6
& East Fork	2006	5
Lemhi	2004	63
& Mid Salmon	2005	30
	2006	30
Lower Salmon	2004	6
& Clearwater	2005	4
	2006	4

Miles of Stream/Riparian Treatments

This includes implementation of stream/river and riparian work specific to the fisheries (included Special Status Species - Salmon) and riparian programs (Table 18-4).

The treatments are usually designated by the number of miles of stream or associated riparian areas treated to promote restoration of ecological processes and conditions. Treatments are both riparian associated within the stream influence zone and direct in-channel activities that result in improved conditions over the long term and typically do not require maintenance. Examples of treatments include riparian planting for streambank stabilization, fertilization through carcass seeding or artificial nutrient drips, barrier removal, riparian thinnings, dropping large woody debris (LWD) into a stream if the LWD is not anchored in place, or providing LWD to others for instream use on non-BLM lands.

Table 18-4. Miles of Stream/Riparian Treatments in Idaho by BLM (2004 to 2006)

Basin Groups	Fiscal Year	Miles of Treatments
Upper Salmon	2004	15
& Pahsimeroi	2005	0
& East Fork	2006	1
Lemhi	2004	16
& Mid Salmon	2005	30
	2006	30
Lower Salmon	2004	6
& Clearwater	2005	1
	2006	1

18.5.2.2 Research, Inventory/Monitoring, Assessment and Evaluation

This category includes two program elements: 1) Miles of Stream/Riparian Inventories, and 2) Miles of Stream/Riparian Monitoring.

Miles of Stream/Riparian Inventories

Table 18-5 summarizes the accomplishments by BLM from 2004 to 2006 in Idaho. This includes data collection that focuses on understanding the condition of instream aquatic habitat, channel morphology, hydrology, and streambank riparian resources; and presence/absence, abundance, range, and/or distribution of riparian-dependent or aquatic species (including Special Status Species) in order to describe existing conditions. The inventories are usually designated by the number of miles of stream/river habitat or riparian vegetation inventoried.

Table 18-5. Miles of Stream/Riparian Inventories by BLM in Idaho (2004 to 2006)

Basin Groups	Fiscal Year	Miles of Inventory
Upper Salmon	2004	0
& Pahsimeroi	2005	0
& East Fork	2006	15
Lemhi	2004	40
& Mid Salmon	2005	12
	2006	0
Lower Salmon	2004	47
& Clearwater	2005	3
	2006	3

Miles of Stream/Riparian Monitored

This work includes the collection, evaluation, and reporting of information on streams and river habitat (including Special Status Species) necessary to determine if management decisions have been implemented and objectives are being met. It includes implementation, effectiveness, and validation monitoring components. Monitoring is separate from information collected as part of recurring or ongoing inventory programs. Habitat monitoring is typically based on species habitat parameters and is directly relevant to a species of interest. Table 18-6 summarizes the activities by BLM from 2004 to 2006 in Idaho.

Table 18-6. Miles of Stream/Riparian Monitored by BLM in Idaho (2004 to 2006)

Basin Groups	Fiscal Year	Miles Monitored
Upper Salmon	2004	25
& Pahsimeroi	2005	57
& East Fork	2006	45
Lemhi	2004	254
& Mid Salmon	2005	120
	2006	120
Lower Salmon	2004	90
& Clearwater	2005	24
	2006	24

18.5.2.3 ESA Consultation/Project Planning/NEPA/General Coordination

This category includes: 1) Costs associated with resource data collection for compliance with NEPA; 2) Preparation of Section 7 Biological Assessments under the ESA; 3) ESA consultation; and environmental site assessments (Project Planning and NEPA) reports. Program elements vary according to the project type. Examples include:

- Land use planning
- Abandoned mined land restoration
- Burned area rehabilitation
- Land exchanges
- Road construction and maintenance
- Train construction and maintenance
- Culvert fish barrier replacement
- Noxious weed treatments
- Stream/riparian projects
- Fuels treatments
- Vegetation treatments
- Shrub/grass/forest restoration projects

18.6 U.S. FOREST SERVICE 2004 TO 2006 CONTRIBUTIONS TO THE CONSERVATION OF ESA-LISTED ANADROMOUS SALMONIDS WITHIN THE COLUMBIA AND SNAKE RIVER BASINS

18.6.1 State of Idaho

18.6.1.1 Northern Rockies Region

The Northern Rockies Region of the USFS has three National Forests (Clearwater, Nez Perce, and Bitterroot) that are located within the Idaho portion of the Snake River Spring/Summer Chinook and Snake River Steelhead ESUs. Activities implemented in tributaries providing benefits to these two ESUs include those designed to restore and enhance aquatic habitats. Examples include stream habitat projects;

watershed condition projects; road improvements; and Knutson-Vandenburg (K-V) Fund money from timber sale receipts. The Bitterroot National Forest is primarily within designated wilderness areas.

The three National Forests also implement activities that may provide indirect benefits in support of recovery. These include, for example, aquatic inventory and monitoring; maintenance of forest management plans; managing grazing permits; minerals operation projects; hazardous fuels reduction; and hazardous materials management.

Tributary aquatic habitat restoration activities are documented in miles of stream and acres of lake habitats improved.

Table 18-7 displays aquatic restoration accomplishments, specific to portions of the three National Forests within the region:

More details on actions contributing to ESA-listed anadromous salmonid recovery are provided below for the Clearwater and Nez Perce National Forests:

Table 18-7. Habitat Restoration/Enhancement Activities by the USFS in Idaho for Clearwater, Nez Perce, and Bitterroot National Forests (2004 to 2006)

Fiscal Year	2004	2005	2006
Miles of stream restored	42	16	33
Acres of lake enhanced	17	12	0

18.6.1.2 Clearwater National Forest

Over the past 10 years, aquatic recovery objectives have focused on riparian protection and restoration, watershed restoration, and fish passage improvement projects. The overall goal of watershed recovery and subsequent stream habitat improvement is being achieved directly through culvert replacements and removals, riparian habitat protection, and, indirectly, through road decommissioning projects.

Within the Clearwater National Forest, restoration activities during 2004, 2005, and 2006 focused on addressing two primary factors: high water temperature; and high sediment levels limiting ESA-listed anadromous salmonid recovery. The reduction of summer water temperatures and anthropogenic sediment sources has and will continue to contribute to steelhead trout and bull trout recovery efforts.

Following are examples of projects conducted for ESA-listed anadromous fish species.

Potlatch River Drainage: Steelhead

From 1992 to 2006, approximately 19.4 miles of road were decommissioned in Potlatch River drainage; this included approximately 1.1 miles in 2005 and 2006. To reduce long-term or “chronic” sedimentation to streams and begin streambank stabilization in out-years, the Clearwater National Forest has finalized planning and NEPA compliance for decommissioning over 25 miles of road during 2008 to 2010, dependent on adequate funding and staffing levels.

During 2006, riparian plantings along fish-bearing streams and LWD placements in headwater stream channels within the Potlatch River drainage, will contribute to long-term protection and restoration of approximately 7.5 miles of stream and adjacent riparian areas. Also during this period, ongoing riparian fence maintenance projects protected approximately 9.75 miles of riparian areas, including streambanks and stream channels.

Lolo Creek: Steelhead

During 2001-2006, the USFS replaced 14 culverts and removed four culverts in the Lolo Creek drainage (nine replacements and three removals were completed during the time period 2004 to 2006). These projects provided access for westslope cutthroat trout, steelhead, bull trout, and other native aquatic biota in approximately 28 miles of stream (approximately 14 miles of stream were accessed in 2004 to 2006).

During 2007, the USFS will be completing three culvert replacements to provide access to approximately 2.5 miles of stream. During the summers of 2008 to 2010, the USFS proposes to replace 10 culverts and remove 62 culverts via watershed restoration activities, depending on adequate staffing and funding. The replacement of six culverts on unnamed, perennial streams will provide access to an additional 5.2 miles of tributary habitat within the Lolo Creek drainage.

From 1997 to 2005, approximately 103 miles of road were decommissioned in the Lolo Creek drainage; this included approximately 35 miles within the Eldorado Creek and 44 miles in the Musselshell Creek watersheds. The 103 miles of road decommissioning consisted of approximately 57 miles of road obliteration, 30 miles of abandonment (no major drainage or stabilization work needed), and 16 miles of intermittent storage (road stabilized and drainages removed). Approximately 7 miles were decommissioned during 2004 to 2005. No road decommissioning projects were completed in the Lolo Creek drainage in 2006. During 2008 to 2010, the Forest has finalized the design and completed NEPA compliance for decommissioning approximately 16.2 miles of road within the Lolo Creek drainage upstream Musselshell Creek, dependent on adequate funding and staffing.

Middle Fork Clearwater River: Steelhead

From 1997 through 2005, approximately 9.3 miles of road were decommissioned in the Middle Fork Clearwater River drainage (5.0 of the 9.3 miles was accomplished during 2005). The USFS has completed NEPA compliance and is proposing to replace one culvert that would provide access to an additional 1.5 miles of steelhead spawning and rearing habitat, depending on adequate staffing and funding.

Lochsa River: Steelhead

During the period 2000 to 2006, the USFS replaced 17 culverts and removed two culverts in the Lochsa River drainage (five replacements and two removals were accomplished in the period 2004 to 2006). These projects provided access to spawning and rearing habitat to approximately 30 miles of stream for westslope cutthroat trout, steelhead trout, bull trout, and other native aquatic biota (approximately 6.5 of the 30 miles was accomplished during the period 2004 to 2006). During 2007, the USFS will be completing four culvert replacements that will provide access to approximately 8 miles of stream. The USFS has completed NEPA compliance for the proposed replacement of four culverts during the summers of 2008-2009, providing access to additional 4.2 additional miles of aquatic habitat, dependent on adequate funding and staffing.

From 1997-2006, approximately 334 miles of road were decommissioned in the Lochsa River drainage; this includes approximately 291 miles within the upper Lochsa River drainage and 43 miles in the lower Lochsa River drainage. The 334 miles of road decommissioning consisted of approximately 264 miles of road obliteration, 45 miles of abandonment (no major drainage or stabilization work needed), and 25 miles of intermittent storage (road stabilized and drainages removed). During 2004 to 2006, approximately 59 of the 334 miles of road were decommissioned. The USFS has completed NEPA compliance and is proposing to complete an additional 100 miles of road decommissioning in the lower Lochsa River drainage during the summers of 2008 to 2010, dependent on adequate funding and staffing.

18.6.1.3 Nez Perce National Forest

Over the past 20 years, the Nez Perce National Forest has been actively involved in aquatic restoration efforts on Forest lands. For the past 10 years, the Nez Perce Tribe has been an active partner in much of this restoration work.

Aquatic restoration objectives have been developed to contribute to recovery of native, aquatic biota that includes ESA-listed anadromous salmonids. Restoration efforts have focused on riparian protection and rehabilitation, watershed restoration, and fish passage improvement projects. The overall goal of watershed recovery and subsequent stream habitat improvement is being achieved directly through instream and riparian improvement, culvert replacements and removals, or indirectly through road decommissioning projects and other sediment source rehabilitation.

Within the Nez Perce National Forest, restoration activities have focused on the two primary factors (habitat simplification and excessive sedimentation) limiting ESA-listed anadromous salmonid recovery. These activities include increasing habitat complexity (addressing legacy mining impacts) and reducing sediment to increase juvenile survival.

South Fork Clearwater: Steelhead

The South Fork Clearwater subbasin has been the primary focus of the aquatic restoration program on the Nez Perce National Forest, based on the inherent value of the streams in the area to support anadromous fish, and the impacts to these areas from legacy mining activities and roads. The aquatic restoration program has been focused in Crooked River, Newsome Creek, Red River, American River, Meadow Creek, and Mill Creek. Additional restoration activities have also taken place in other drainages throughout the subbasin.

Instream improvement and riparian restoration activities to address the impacts from historical dredge mining have been completed, or are underway, in Crooked River, Newsome Creek, Red River, and American River (to a lesser extent in the American River drainage given the land ownership pattern, much of the aquatic restoration in American River has and is being accomplished by the BLM). Passage barrier removal and replacement projects have taken place (or are planned) in Mill Creek (four projects), Meadow Creek (five), Newsome Creek (two), Crooked River (four), and Red River (five). Road decommissioning, and other sediment source rehabilitation, has taken place (or is underway) in Meadow Creek (96 miles), Crooked River (37 miles), Red River (116 miles), Newsome Creek (28 miles), and American River (8 miles).

Selway River: Steelhead

A majority of the Selway River subbasin is contained in the Selway-Bitterroot Wilderness area, with limited human-caused impacts to the aquatic conditions. The lower quarter of the subbasin is outside of the Wilderness and is the focus of the aquatic restoration activities in this area. O'Hara Creek is an important anadromous watershed where aquatic restoration activities have included instream improvement and road decommissioning. Currently, four passage barriers at the mouths of tributaries to the lower Selway River are proposed for replacement (Boyd, Glover, Cache, and Twenty-Three Mile creeks) with implementation dependent on adequate funding and staffing.

Lower Salmon River: Chinook Salmon and Steelhead

The aquatic restoration in the Lower Salmon River subbasin, including portions of the Little Salmon subbasin on National Forest lands, has focused on the larger tributary drainages in this area that support Snake River Chinook salmon, Snake River steelhead, and Columbia River bull trout.

The Slate Creek watershed and the White Bird Creek watershed have been the primary focus of the aquatic restoration program in this subbasin. Restoration in the Slate Creek watershed has included road decommissioning (26 miles), road improvement to the main road along Slate Creek (Road #354), passage barrier removal (Little Van Buren, Slide Creek), and riparian restoration (Clean Slate). The Gold Lake Tunnel rehabilitation project is a passage project currently being implemented.

Future restoration activities are proposed to include a suite of restoration associated with the ongoing Little Slate NEPA project, with implementation dependent on funding and staffing levels. In the White Bird Creek watershed, aquatic restoration activities have included passage barrier replacement (Little White Bird Creek), and 23 miles of road decommissioning (Burnt Flats Restoration).

Middle Salmon River: Chinook Salmon and Steelhead

The aquatic restoration activities in the Middle Salmon – Chamberlin subbasin have been limited because the larger high-value anadromous watersheds in this area (e.g., Bargamin Creek, Sabe Creek, Crooked Creek) are some of the watersheds that fall within this category.

18.6.1.4 Intermountain Region

The Intermountain Region of the USFS has four National Forests (Payette, Boise, Sawtooth, and Salmon-Challis) that are located within the Idaho portion of the Snake River Spring/Summer Chinook Salmon and Snake River Steelhead ESUs. Activities implemented in tributaries providing recovery benefits to these two ESUs include those designed to restore and enhance aquatic habitats. Examples include stream habitat projects; watershed condition projects; road improvements; and K-V funds from timber sale receipts. The Bitterroot National Forest is primarily within designated Wilderness Areas.

The four National Forests implement activities that may provide indirect benefits in support of recovery. These include aquatic inventory and monitoring; maintenance of forest management plans; managing grazing permits; minerals operation projects; hazardous fuels reduction; and hazardous materials management.

During Fiscal Years 2004, 2005, and 2006, there were 31 total projects completed for ESA-listed anadromous salmonids within these two ESUs, with the majority in partnership with others. Accomplishments include:

- 13.6 miles of stream habitat restored,
- 12 acres of lake habitat restored,
- 144 miles of stream habitat inventoried,
- 12 administrative studies completed, and
- 2 monitoring plans completed.

Details on these accomplishments for individual years are presented in Table 18-8.

Table 18-8. USFS Intermountain Region Accomplishments for Salmon and Steelhead for Fiscal Years 2004 to 2006

Fiscal Years	2004	2005	2006	Totals
Number of Projects	9	9	13	31
Stream Habitat Restoration (Miles)	1	1.8	10.8	13.6
Lake Habitat Acres	5	0	7	12
Stream habitat Inventoried (Miles)	65	13	66	144
Administrative Studies	4	4	4	12
Monitoring Plans	0	0	2	2

18.6.2 Oregon and Washington

18.6.2.1 Pacific Northwest Region

The Pacific Northwest Region covers 12 National Forest within the Columbia River Basin of the States of Oregon and Washington that manage tributary habitat for ESA-listed anadromous salmonids. Eleven of the Forests are currently accessible to anadromous fish (the Colville National Forest lies upstream of Grand Coulee Dam). The Deschutes and Ochoco National Forests are upstream of the Pelton-Round Butte Dam complex on the Deschutes River, where experimental fish passage and reintroduction measures have been initiated.[2] The National Forests provide much of the best remaining aquatic habitat for anadromous salmon and steelhead.

Activities implemented in tributaries providing recovery benefits to ESA-listed salmonid ESUs include those designed to restore and enhance aquatic habitats. Examples include stream habitat projects; watershed condition projects; road improvements; and K-V funds from timber sale receipts.

The 12 National Forests also implement activities that may provide indirect benefits in support of recovery. These include aquatic inventory and monitoring; maintenance of forest management plans; managing grazing permits; minerals operation projects; hazardous fuels reduction; and hazardous materials management.

The Pacific Northwest Region tracks direct fisheries/watershed improvement activities designed to restore/ enhance aquatic habitats for ESA-listed fish species and other native aquatic biota using a shared Federal reporting system: the Interagency Restoration Database (IRDA). (Note: this database is not available in the Intermountain and Northern Rockies Regions.)

Only activities where aquatic resource condition improvement is a primary objective are recorded in IRDA. Accomplishments are tracked in the following activity areas: instream structure (miles improved); fish passage (miles accessed); riparian (miles and acres improved through fencing, planting, thinning, fertilization, etc); road decommissioning (miles); road improvements (miles); and wetland acres created/improved.

During Fiscal Years 2004, 2005, and 2006, a total of 48 projects reported to benefit ESA-listed salmonids by the USFS and/or partners were implemented. Accomplishments for this period include:

- 52.8 miles of stream habitat improved;
- 56.8 miles of stream habitat accessed through fish passage;
- 1,191.3 acres of riparian habitat improved along 99.1 miles of stream;
- 108.6 miles of road decommissioning, reducing sediment and restoring natural drainage patterns;
- 447.1 miles of road improvements (cross drainage, erosion control, and other measures to reduce sediment and restore natural drainage patterns);
- 1,416 acres of upland watershed improvement (e.g., soil decompaction, erosion control, sideslope stabilization); and
- 84 acres of wetland creation and improvement.

[2] Habitat improvement in areas on the Deschutes and Ochoco made accessible through these experimental efforts has been included in this summary.

Accomplishments by year are presented in Table 18-9.

Table 18-9. USFS, Pacific Northwest Region, Habitat Improvement Accomplishments for Salmon and Steelhead, Fiscal Years 2004 to 2006

Year	# Projects	Instream Miles, Structure	Instream Miles, Passage	Riparian (Acres)	Riparian (Miles)	Upland Acres	Road Miles Decom	Roads Miles Improv	Wetland Acres Improv
2004	15	17.1	26.2	298.5	30.9	66	17.9	33.4	17
2005	22	27.6	19.3	238.6	60.5	1343	83.5	287.5	5
2006	11	8.1	11.3	654.2	7.7	7	7.2	126.2	62

Chapter 19
Salmon and Steelhead Designated Critical Habitat in the Columbia River Basin

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

19.1 INTRODUCTION

This chapter addresses the analysis of the effects of the proposed Federal Columbia River Power System (FCRPS) Reasonable and Prudent Alternative (RPA) and the Upper Snake River Proposed Actions (PA) on designated critical habitat for salmon and steelhead in the Columbia River Basin. This analysis relies on the statutory provisions of the ESA. It further relies on National Marine Fisheries Service (NMFS, also called National Oceanic and Atmospheric Administration [NOAA] Fisheries) guidance (NMFS 2005h) and Judge Redden's Opinions and Orders remanding the FCRPS and Upper Snake River Biological Opinions (BiOps). The chapter:

- describes the range-wide status of designated critical habitat for 13 Endangered Species Act (ESA)-listed salmon Evolutionarily Significant Units (ESUs) [for steelhead, this is often also referred to as Distinct Population Segments (DPSs)] in the Columbia River Basin, in terms of the essential features or primary constituent elements (PCEs) that are present, their current status, and the cause of their current condition;
- assesses the effects of the FCRPS Proposed RPA and the mainstem effects of the U.S. Bureau of Reclamation's (Reclamation's) projects in the Columbia River Basin, including the proposed Upper Snake River actions on the conservation value of the essential features and PCEs of designated critical habitat;
- discusses the cumulative effects on the conservation value of the essential features and PCEs of designated critical habitat in the action area; and
- provides conclusions based on the analysis.

To provide appropriate background and context, the chapter first discusses the geographic extent of designated critical habitat in the Snake and Columbia rivers for 12 of 13 ESUs. Organizationally, the chapter initially discusses the potential effects of the FCRPS Proposed RPA and Upper Snake River PA on PCEs of designated critical habitat in the mainstem Snake and Columbia rivers, and follows with a discussion of the potential effects on PCEs of designated critical habitat in tributaries where specific actions are proposed.

The mainstem and tributaries are considered and discussed separately since the potential effects of the Hydro Actions on the conservation value of PCEs of designated critical habitat is primarily limited to the mainstem, whereas other Actions occur primarily but not exclusively in tributaries. Proposed Hydro Actions (i.e., the operation and maintenance [O&M]) of the FCRPS and the mainstem effects of Reclamation's projects] consist of numerous elements that have both system-wide and local effects that may affect essential features or PCEs of designated critical habitat of multiple species in similar ways. Proposed Habitat Actions in the tributaries consist of numerous elements that may have different effects on the conservation value of essential features or PCEs of designated critical habitat for different ESUs.

Conclusions for the effects of the FCRPS Proposed RPA and Upper Snake River PA on designated critical habitat for 12 listed Snake and Columbia river salmon and steelhead species are summarized in Table 19-1. This summary table is intended to provide an overview of conclusions aggregated across numerous essential features and PCEs. The operation of the FCRPS and the Upper Snake River projects have caused adverse effects to PCEs of designated critical habitat for ESA-listed Snake and Columbia river salmon and steelhead. Adverse effects are expected to continue into the future; however, the suite of FCRPS and Reclamation actions proposed by the Action Agencies is expected to reduce these adverse effects to some degree and improve species survival. Critical habitat is expected to serve the intended conservation role for the species. This summary includes both actions in the mainstem migratory corridor

Table 19-1. Generalized Conclusions Regarding the Effects of the FCRPS Proposed RPA and Reclamation Upper Snake River PA on Listed Snake and Columbia River Salmon and Steelhead Critical Habitat (Compared to Current Conditions)

Listed Species	Conclusion
Snake River Spring/Summer Chinook Salmon, Snake River Fall Chinook Salmon, Snake River Steelhead	Safe passage improved, some spawning and rearing habitat improved; FCRPS Proposed RPA and Upper Snake River PA improve species survival and are expected to support the intended conservation role of critical habitat
Snake River Sockeye Salmon	Snake River Sockeye Salmon exist in low numbers and are supported for the most part by an intensive artificial propagation program conducted by the Idaho Department of Fish and Game. FCRPS Proposed RPA and Upper Snake River PA that improve safe passage in the hydropower system for juvenile outmigrants should improve safe passage for migrating juvenile sockeye salmon.
Upper Columbia River Spring Chinook Salmon, Upper Columbia River Steelhead, Middle Columbia River Steelhead, Lower Columbia River Chinook Salmon, Lower Columbia River Steelhead, Columbia River Chum salmon	Safe passage improved, some spawning and rearing habitat improved; FCRPS Proposed RPA and Upper Snake River PA improve species survival and are expected to support the intended conservation role of critical habitat
Upper Willamette River Chinook salmon, Upper Willamette River Steelhead	Safe passage improved to the extent predation management scenarios reduce predation; FCRPS Proposed RPA and Upper Snake River PA improve species survival and are expected to support the intended conservation role of critical habitat

and in tributary spawning and rearing habitat portions of the action areas, and includes the effects of both the FCRPS and the Upper Snake River projects.

19.2 RANGE-WIDE STATUS OF DESIGNATED CRITICAL HABITAT

19.2.1 Geographic Extent of Designated Critical Habitat

NMFS designated critical habitat for ESA-listed salmon and steelhead species in the Snake and Columbia rivers in two groups. Critical habitat for Snake River Spring/Summer and Fall Chinook and Sockeye Salmon was designated in 1993 (NMFS 1993, 58 FR 68543-68554, December 28, 1993); critical habitat for the remaining species was designated in 2005 (70 FR 52630). NMFS has not designated critical habitat for Lower Columbia River Coho Salmon (Table 19-2).

The following describes the designated critical habitat for the 12 ESUs (or DPSs).

Snake River Spring/Summer Chinook Salmon ESU – Critical habitat in the Columbia River is designated to extend 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 rivers and all Snake River reaches from the confluence with the Columbia River upstream to Hells Canyon Dam. Critical habitat also includes river reaches presently or historically accessible (except reaches above impassable natural falls (including Napias Creek Falls) and Dworshak and Hells Canyon

Table 19-2. ESU or DPS ESA Listing Status and Critical Habitat Designation

ESU or DPS	ESA Status	Critical Habitat Status[1/] (Date of Designation)
Snake River Fall Chinook Salmon ESU	Threatened	12/28/1993
Snake River Spring/Summer Chinook Salmon ESU	Threatened	10/25/1999
Snake River Sockeye Salmon ESU	Endangered	12/28/1993
Snake River Basin Steelhead DPS	Threatened	9/2/2005
Upper Columbia River Spring Chinook Salmon ESU	Endangered	9/2/2005
Upper Columbia River Steelhead DPS	Endangered	9/2/2005
Middle Columbia River Steelhead DPS	Threatened	9/2/2005
Columbia River Chum Salmon ESU	Threatened	9/2/2005
Lower Columbia River Chinook Salmon ESU	Threatened	9/2/2005
Lower Columbia River Coho Salmon ESU	Threatened	Under Review by NMFS
Lower Columbia River Steelhead DPS	Threatened	9/2/2005
Upper Willamette River Chinook Salmon ESU	Threatened	9/2/2005
Upper Willamette River Steelhead DPS	Threatened	9/2/2005

1/ See http://www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations for additional information about critical habitat and listings.

dams) to Snake River Spring/Summer Chinook Salmon. The riparian zones of the aforementioned waterways are also considered critical habitat, extending outward 300 feet from the normal high water mark. Riparian areas provide shade, sediment and nutrient/chemical regulation, streambank stability, and input of large woody debris (LWD)/organic matter to aquatic habitat.

Snake River Fall Chinook Salmon ESU – Critical habitat in the Columbia River is designated to extend 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 rivers; the Snake River, all river reaches from the confluence with the Columbia River, upstream to Hells Canyon Dam; the Palouse River from its confluence with the Snake River upstream to Palouse Falls; the Clearwater River from its confluence with the Snake River upstream to its confluence with Lolo Creek; and the North Fork Clearwater River from its confluence with the Clearwater River upstream to Dworshak Dam. Critical habitat also includes river reaches presently or historically accessible (except reaches above impassable natural falls, and Dworshak and Hells Canyon dams) to Snake River Fall Chinook Salmon.

Snake River Sockeye Salmon ESU – Critical habitat is designated to include 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 upstream to the confluence of the Columbia and Snake rivers; all Snake River reaches from the confluence of the Columbia River upstream to the confluence of the Salmon River; all Salmon River reaches from the confluence of the Snake River upstream to Alturas Lake Creek; Stanley, Redfish, Yellow Belly, Pettit, and Alturas Lakes (including their inlet and outlet creeks); Alturas Lake Creek; and that portion of Valley Creek between Stanley Lake Creek and the Salmon River. Critical habitat comprises all river lakes and reaches presently or historically accessible (except reaches above impassable natural falls, and Dworshak and Hells Canyon dams) to Snake River Sockeye Salmon.

Upper Columbia River Spring Chinook Salmon ESU – Critical habitat is designated for this ESU in the Chief Joseph, Methow, upper Columbia/Entiat, and Wenatchee subbasins; and the Columbia River migration corridor. There are 31 watersheds within the range of this ESU. Five watersheds received a medium rating and 26 received a high rating of conservation value to the ESU (70 FR 52630). The Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in 15 of the high value watersheds identified above. Of the 1,002 miles of habitat areas eligible for designation, only 974 miles of stream and 4 square miles of lake are designated. Area designated is of high conservation value.

Upper Columbia River Steelhead DPS – Critical habitat is designated for this DPS in the Chief Joseph, Okanogan, Similkameen, Methow, upper Columbia/Entiat, Wenatchee, Lower Crab, and Upper Columbia/Priest Rapids subbasins; and the Columbia River migration corridor. There are 42 watersheds within the range of this DPS. Three watersheds received a low rating, 8 received a medium rating, and 31 received a high rating of conservation value to the DPS (70 FR 52630). The Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in 11 of the high value watersheds identified above. Of the 1,332 miles of habitat areas eligible for designation, only 1,262 miles of stream and 7 square miles of lake are designated. Area designated is of high conservation value.

Snake River Steelhead DPS – Critical habitat is designated for this DPS in the Hells Canyon, Imnaha River, Lower Snake/Asotin, Upper Grande Ronde River, Wallowa River, Lower Grande Ronde, Lower Snake/Tucannon, Upper Salmon, Pahsimeroi, Middle Salmon-Panther, Lemhi, Upper Middle Fork Salmon, Lower Middle Fork Salmon, Middle Salmon-Chamberlain, South Fork Salmon, Lower Salmon, Little Salmon, Upper Selway, Lower Selway, Lochsa, Middle Fork Clearwater, South Fork Clearwater, and Clearwater subbasins; and the Lower Snake/Columbia River migration corridor. There are 289 watersheds within the range of this DPS. Fourteen watersheds received a low rating, 44 received a medium rating, and 231 received a high rating of conservation value to the DPS (70 FR 52630). The lower Snake/Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in 15 of the high value watersheds identified above. Of the 8,225 miles of habitat areas eligible for designation, only 8,049 miles of stream and 4 square miles of lake are designated. Area designated is of high conservation value (rearing/migration).

Middle Columbia River Steelhead DPS – Critical habitat is designated for this DPS in the Upper Yakima, Naches, Lower Yakima, Middle Columbia/Lake Wallula, Walla Walla, Umatilla, Middle Columbia/Hood, Klickitat, Upper John Day, North Fork John Day, Middle Fork John Day, Lower John Day, Lower Deschutes, Trout, and Upper Columbia/Priest Rapids subbasins; and the Columbia River migration corridor. There are 114 watersheds within the range of this DPS. Nine watersheds received a low rating, 24 received a medium rating, and 81 received a high rating of conservation value to the DPS (70 FR 52630). The lower Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in three of the high value watersheds identified above. Of the 6,529 miles of habitat areas eligible for designation, only 5,815 miles of stream are designated. Area designated is of high conservation value (rearing/migration).

Lower Columbia River Chinook Salmon ESU – Critical habitat is designated for this ESU in the Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Upper Cowlitz, Cowlitz, Lower Columbia, Clackamas, and Lower Willamette subbasins; and the Lower Columbia River migration corridor. There are 48 watersheds within the range of this ESU. Four watersheds received a low rating, 13 received a medium rating, and 31 received a high rating of conservation value to the ESU (70 FR 52630). Of the 1,655 miles of habitat areas eligible for designation, only 1,311 miles of stream and 33 square miles of lake are designated critical habitat. Area designated is of high conservation value.

Lower Columbia River Steelhead DPS – Critical habitat is designated for this DPS in the Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Upper Cowlitz, Cowlitz, Clackamas, and Lower Willamette subbasins; and the Lower Columbia River migration corridor. There are 32 watersheds within the range of this DPS. Two watersheds received a low rating, 11 received a medium rating, and 29 received a high rating of conservation value to the DPS (70 FR 52630). The lower

Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in one of the high value watersheds identified above. Of the 2,673 miles of habitat areas eligible for designation, only 2,324 miles of stream and 27 square miles of lake are designated. Area designated is of high conservation value.

Upper Willamette River Chinook Salmon ESU – Critical habitat is designated for this ESU in the Middle Fork Willamette, Upper Willamette, McKenzie, North Santiam, South Santiam, Middle Willamette, Molalla/Pudding, and Clackamas subbasins; and the Lower Willamette/ Columbia River migration corridor. There are 60 watersheds within the range of this ESU. Nineteen watersheds received a low rating, 18 received a medium rating, and 23 received a high rating of conservation value to the ESU (70 FR 52630). The lower Willamette/Columbia River rearing/migration corridor downstream of the spawning range is also considered to have a high conservation value and is the only habitat designated in four of the high value watersheds. Of the 1,796 miles of habitat areas eligible for designation, only 1,472 miles of stream and 18 square miles of lake are designated.

Upper Willamette River Steelhead DPS – Critical habitat is designated for this DPS in the Upper Willamette, North Santiam, South Santiam, Middle Willamette, Yamhill, Molalla/ Pudding, and Tualatin subbasins; and the Lower Willamette/ Columbia River migration corridor. There are 38 watersheds within the range of this DPS. Seventeen watersheds received a low rating, 6 received a medium rating, and 15 received a high rating of conservation value to the DPS (70 FR 52630). The lower Willamette/Columbia River rearing/migration corridor downstream of the spawning range is also considered to have a high conservation value and is the only habitat area designated in four of the high value watersheds identified above. Of the 1,830 miles of habitat areas eligible for designation, only 1,276 miles of stream and 2 square miles of lake are designated. Area designated is of high conservation value (rearing/migration).

Columbia River Chum Salmon ESU – Critical habitat is designated for this ESU in the Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Lower Cowlitz, Lower Columbia subbasins; and the Lower Columbia River migration corridor. There are 20 watersheds within the range of this ESU. Three watersheds received a medium rating and 17 received a high rating of conservation value to the ESU (70 FR 52630). The lower Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in one of the high value watersheds identified above. Of the 725 miles of habitat areas eligible for designation, only 708 miles of stream are designated. Area designated is of high conservation value.

19.2.2 Conservation Role of Designated Critical Habitat

The conservation role of critical habitat in the survival and recovery of listed species is defined based on the condition of the essential features and PCEs of the habitat. Essential habitat features and PCEs are the physical and biological elements of the habitat that are required for survival of one or more life stages of the listed species. The essential features of mainstem and tributary habitat for three species of Snake River salmon are shown in Table 19-3.

Table 19-3. Essential Features of Habitat Components Identified for Snake River Sockeye, Spring/Summer Chinook, and Fall Chinook Salmon

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

Source: NMFS 1993

NMFS (2005h) has identified the following PCEs for the nine other ESUs of Columbia River Basin salmonids.[1]

1. **Freshwater spawning sites** with water quantity, and water 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 water quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation,

[1] A fifth category in 70 FR 52630, "nearshore marine areas," refers to areas designated in Puget Sound (i.e., is not applicable to Columbia River Basin salmonids).

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 non-feeding 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.

19.2.3 Current Condition of Designated Critical Habitat

Many factors, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century, as well as the conservation value of essential features and PCEs of designated critical habitat. Salmon habitat has been altered through activities such as urban development, logging, grazing, power generation, and agriculture. These habitat alterations have resulted in the loss of important spawning and rearing habitat and the loss or degradation of migration corridors (Table 19-4).

- Since critical habitat was designated for three Snake River salmon ESUs in 1993, numerous actions have been taken by the Action Agencies to address and improve the conservation value of the PCEs that in turn lead to improved survival of the ESA-listed salmon and steelhead juvenile outmigrants. For example, the essential feature of safe passage for ESA-listed outmigrating juvenile salmonids was affected by flow and temperature conditions, inadequate guidance of juvenile outmigrants through or around lower Snake and lower Columbia river hydropower

Table 19-4. Major Factors Limiting the Conservation Value of Designated Critical Habitat by ESU/DPS

ESU/DPS	Major Limiting Factors
Snake River Spring/Summer Chinook Salmon ESU	• Mainstem lower Snake and Columbia River hydropower system mortality • Reduced tributary stream flow • Altered tributary channel morphology • Excessive sediment in tributaries • Degraded tributary water quality
Snake River Fall Chinook Salmon ESU	• Mainstem lower Snake and Columbia River hydropower system mortality • Degraded water quality • Reduced spawning/rearing habitat due to mainstem lower Snake River hydropower system

Table 19-4. Major Factors Limiting the Conservation Value of Designated Critical Habitat by ESU/DPS

ESU/DPS	Major Limiting Factors
Snake River Sockeye Salmon ESU	• Mainstem lower Snake and Columbia River hydropower system mortality • Reduced tributary stream flow • Impaired tributary passage and blocks to migration
Snake River Steelhead DPS	• Mainstem lower Snake and Columbia River hydropower system mortality • Reduced tributary stream flow • Altered tributary channel morphology • Excessive sediment in tributaries • Degraded tributary water quality
Upper Columbia River Spring Chinook Salmon ESU	• Mainstem Columbia River hydropower system mortality • Tributary riparian degradation and loss of in-river wood • Altered tributary floodplain and channel morphology • Reduced tributary stream flow and impaired passage
Upper Columbia River Steelhead ESU	• Mainstem Columbia River hydropower system mortality • Reduced tributary stream flow • Tributary riparian degradation and loss of in-river wood • Altered tributary floodplain and channel morphology • Excessive sediment • Degraded tributary water quality
Middle Columbia River Steelhead DPS	• Mainstem lower Columbia River hydropower system mortality • Reduced tributary stream flow • Impaired passage in tributaries • Excessive sediment • Degraded tributary quality • Altered channel morphology
Lower Columbia River Chinook Salmon ESU	• Reduced access to spawning/rearing habitat in tributaries • Loss of habitat diversity and channel stability in tributaries • Excessive sediment in spawning gravel • Elevated water temperature in tributaries
Lower Columbia River Steelhead DPS	• Degraded floodplain and stream channel structure and function • Reduced access to spawning/rearing habitat • Altered streamflow in tributaries • Excessive sediment and elevated water temperatures in tributaries

Table 19-4. Major Factors Limiting the Conservation Value of Designated Critical Habitat by ESU/DPS

Columbia River Chum Salmon ESU	• Altered channel form and stability in tributaries • Excessive sediment in tributary spawning gravels • Altered streamflow in tributaries and mainstem Columbia • Loss of some tributary habitat types • Harassment of spawners in tributary and mainstem
Upper Willamette River Chinook Salmon ESU	• Reduced access to spawning/rearing habitat in tributaries • Altered water quality and temperature in tributaries • Lost/degraded floodplain connectivity and lowland stream habitat • Altered streamflow in tributaries
Upper Willamette River Steelhead DPS	• Reduced access to spawning/rearing habitat in tributaries • Altered water quality and temperature in tributaries • Lost/degraded floodplain connectivity and lowland stream habitat • Altered streamflow in tributaries

Source: NMFS 2005

projects, predation by northern pikeminnow and other piscivorous fish; predation by Caspian terns in the estuary that began to increase substantially in the late 1980s, as well as other factors. Key improvements since 1993 include the following:

- Construction of shallow water habitat in the lower Snake River for use by juvenile Fall Chinook Salmon;
- Flow deflectors and removable spillway weirs (RSWs) that reduce total dissolved gas (TDG) and use less spill to achieve a similar survival rate for juvenile outmigrants;
- Various habitat restoration actions in the estuary to provide additional and improved habitat conditions for migrating and rearing ESA-listed juvenile salmonids;
- Major improvements have also been made to fish passage facilities at lower Snake and lower Columbia river hydro projects, including installation of surface bypass facilities such as RSWs at Lower Granite and Ice Harbor dams and the Bonneville Dam Corner Collector. Increased survival of Snake River fish through the hydrosystem is now equivalent to what it was in the 1960s, when only four Federal dams were in place on the Columbia and lower Snake rivers. Passage time of juveniles through the hydrosystem has also been reduced;
- The fish passage spill program at lower Snake and lower Columbia river hydropower projects;
- Flow improvements from drafting Dworshak Reservoir from approximately elevation 1600 feet to approximately elevation 1520 feet throughout the summer for temperature moderation in the lower Snake River in August, the dedicated spill program at several Snake and Columbia River hydropower projects;
- Additional flow augmentation using up to 487,000 acre-feet from the upper Snake River;
- The northern pikeminnow sport reward fishery has reduced the abundance of an important predator of juvenile salmonids, the Caspian tern colony breeding on Rice Island has been relocated to East Sand Island, reducing predation on juvenile salmonids;

- Minimum operation pool (MOP) operations at Snake River dams that are intended to reduce juvenile salmon migration travel time; and
- Habitat work in the estuary contributes to and improves the conservation value of both the safe passage and freshwater rearing.

19.2.3.1 Water Quantity

The BiOps issued in the 1990s, especially starting with the 1995 FCRPS BiOp (NMFS 1995), established flow targets in the mainstem Snake and lower Columbia rivers. To move toward these flow targets, the BiOp established "refill dates" by which the reservoirs behind the dams had to be filled to the maximum extent possible in a given water year (consistent with flood control rule curves). Refill dates ensure that as much water as possible is stored so that it will be available for the flow targets and/or other biological needs of listed fish.

The Action Agencies have altered operations to make more water available for fish during their migratory season. Figure 19-1 shows a 60-year average regulated flow at The Dalles Dam, with and without fish operations – i.e., pre-1995 BiOp to post-1995 BiOp. Historically, the FCRPS dams were operated primarily to meet flood control, energy production, navigation, recreation, and irrigation needs. Energy production was greatest in the winter, when energy needs are highest, and much less water was available for the spring and summer migration periods. Recommended flow levels for fish operations were increased substantially in the 1995 BiOp.

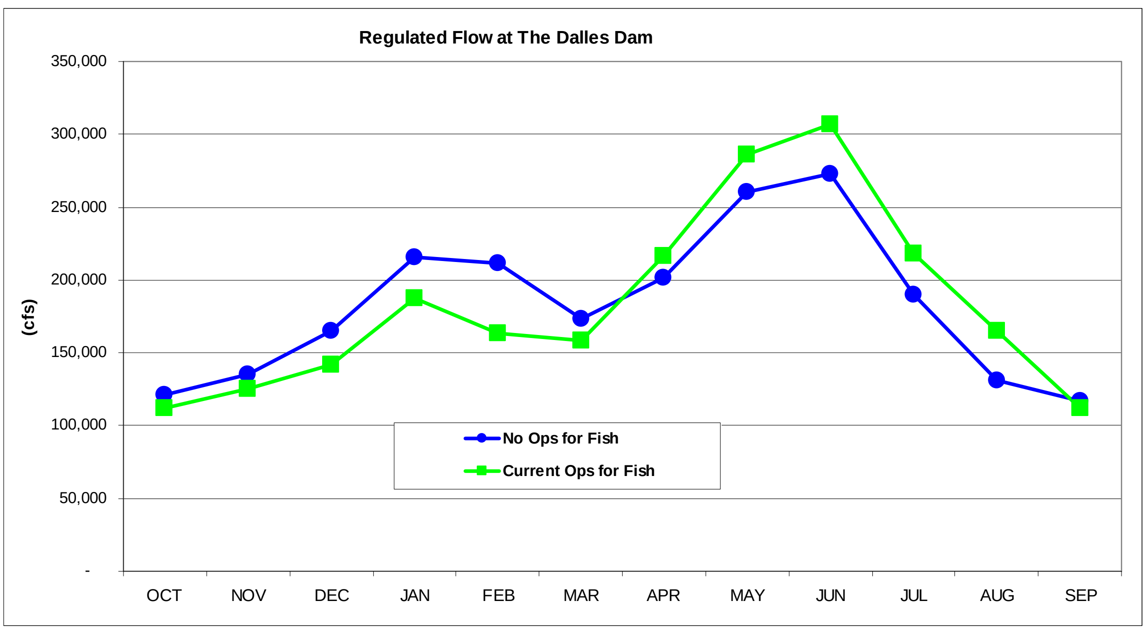

Figure 19-1. 60-year Average Regulated Flow at The Dalles Dam, with and without Fish Operations

The Action Agencies negotiated access to 1 million acre-feet (MAF) of Canadian water through the Columbia River Treaty. When available, the 1 MAF is released in the May through July period to assist juvenile migration in the United States. This equates to an additional flow of 16,000 cubic feet per second (cfs) for one month, equal to about 6 percent of the spring flow objective ranging from 220,000 to 260,000 cfs as measured at McNary Dam, or about 8 percent of the summer flow objective of 200,000 cfs at McNary Dam.

Since about 1993, the Action Agencies have also been involved in a tributary water acquisition program. While the volume of water is small in comparison to the Treaty storage water, this program supplies additional water in small tributary rivers where it is effective at meeting spawning, rearing, or migration needs of salmon and steelhead. Reclamation has also secured some 140,000 acre-feet of storage space or natural flow rights on the upper Snake River.

The operators also provide operations (water quantity) to protect habitat for spawning Columbia River Chum salmon and Hanford Reach Fall Chinook Salmon. By shaping water from Grand Coulee Dam, and through the Vernita Bar Agreement, the Action Agencies help provide sufficient flow below Bonneville and Priest Rapids dams to keep redds submerged until juvenile fish hatch and emerge in the spring. Flow, in this instance, also helps to provide cover and shelter, space, and water quality (more appropriate water temperatures).

Flood control procedures have been modified to the extent possible without unduly increasing risk. At storage reservoirs behind Libby and Hungry Horse dams, operators adopted an interim flood control procedure called VARQ (i.e., VAR [variable] Q [flow]) Flood Control in 2003, which is intended to result in increased spring flows to benefit several ESA-listed fish.

VARQ Flood Control entails maintaining higher levels of water in certain reservoirs from January through April when the water supply forecast (WSF) for April through August is 120 percent of average or less. By this means, operators can provide flood control while ensuring that more water is available for ESA-listed adult Kootenai River white sturgeon and juvenile Columbia River salmon and steelhead outmigration in spring and summer. When the April-August WSF is less than 80 percent of average, reduced winter drawdown guidelines under VARQ are in effect, but in actuality, due to minimum outflow requirements, the water in these reservoirs may not attain the higher rule curve elevation. When the April-August WSF is greater than 120 percent of average, the reservoirs are drafted more deeply, similar to what had previously been done under Standard Flood Control.

19.2.3.2 Water Quality

Dam operations effect water temperature and levels of TDG. Temperature is discussed in Section 19.2.3.4. TDG, and the related operation of spill, has been a major focus of dam operations in recent years, and will be discussed in the section on safe passage. A major objective of the BiOp efforts throughout the 1990s, and continuing to the present, has been to increase spill at lower Snake and Columbia River mainstem dams. Increasing spill (which, to a point and under specific conditions, improves juvenile fish survival) may increase the level of TDG that occurs and persists downstream in the mainstem Snake and Columbia rivers. The spill limit is currently capped by TDG levels of 115 percent of saturation in the forebay and 120 percent in the tailrace of each dam, approved by the states under their Clean Water Act (CWA) authorities delegated by the U.S. Environmental Protection Agency (EPA). The explicit purpose for allowing TDG above 110 percent has been to improve the survival of juveniles through the system by providing spill at the hydropower projects.

19.2.3.3 Water Velocity

Increasing flows as established in the 1995 FCRPS BiOp were estimated to increase water particle travel time, thereby reducing juvenile salmonid travel time. Increased flow may also increase turbidity to some degree, providing cover for outmigrating juveniles, and thus reducing predation.

Another mechanism to increase water particle travel time, also included in the BiOps beginning in 1992, is lowering the operating range of some FCRPS run-of-river mainstem dams. Currently, five of the run-of-the-river dams lower their operating pools during the juvenile migration season, which reduces the cross-section of the reservoir. Since 1992, during much of the juvenile migration season, the lower Snake River reservoirs have been operating within one foot of MOP, while the John Day pool has been operated between elevations 262.5 to 264 msl. This is believed to decrease water particle travel time, which in turn is thought to reduce the in-river migration travel time for juvenile migrants, and potentially lower the levels of predation by fish and avian predators.

19.2.3.4 Water Temperature

Flow augmentation from Dworshak Dam which has selective withdrawal capability allows cool water to be released down the Clearwater River to the Snake River that moderates water temperature during the summer months when some juveniles and adults are migrating through the mainstem. Reduced water temperature also reduces the rate at which piscivorous predators prey upon listed fish.

19.2.3.5 Safe Passage

With the ESA listing of Snake River Sockeye Salmon in 1991, the Action Agencies implemented a variety of operational and structural measures to improve the survival of listed stocks. The NMFS 1992 FCRPS BiOp called for providing summer releases of available water for flow augmentation for migrating juvenile salmon. Spill for juvenile fish passage at the lower Snake River projects was limited to Lower Monumental and Ice Harbor dams. In 1994, the program was further expanded in response to the NMFS' request to expand the spill program. Spill at the mainstem dams has become an annual operation that supports the conservation value of mainstem critical habitat.

"Spill Operations" were established to guide migrating juvenile salmon and steelhead through spillways rather than through turbines to improve survival. In 1993 and earlier, the objective of the FCRPS operators was to attain fish passage efficiency (FPE) – the number of fish avoiding turbines - of 70 percent for spring migrants, and 50 percent for summer migrants. To accomplish this, spill was provided at three dams. The other dams met the goal without spill. In the longer term, the plan was to complete structural bypass systems at the four lower Snake River and four lower Columbia River dams to improve in-river juvenile migrant survival.

In the 1995 FCRPS BiOp, the objective was raised to achieve 80 percent FPE at all eight projects by spilling water during the spring months. Timing and volume of spill at each project was designed to achieve biological benefits, with a cap to avoid harmful levels of TDG. Because most summer juvenile migrants were being transported from the lower Snake River, spill was only provided in summer months at Ice Harbor Dam in this reach. Spill did continue at the three lower Columbia River dams (Bonneville, The Dalles, and John Day dams), where no fish are collected for transport.

The use of spill has increased substantially in duration and volume since the 1995 FCRPS BiOp. Notable are the substantial increases in spring and summer spill in 1995 and again in 2000, along with the addition of biological performance standards balancing gas saturation, tailrace conditions and adult passage. Also in 2004, emphasis turned to 24-hour surface spill through RSWs and the Corner Collector at Bonneville Dam. A court order in 2005 established summer spill at Lower Granite, Little Goose, and Lower Monumental dams on the Snake River and at McNary Dam on the Columbia River that was also implemented in 2006 and is being implemented in 2007.

Spill has been modified over time based on biological results. Studies have shown that more spill is not always better, and can sometimes be worse, for juvenile fish survival. High dissolved gas levels, noted above, can be an issue. Certain high levels of spill can also impede adult passage at projects, so spill levels and FPE must be calibrated dam by dam with biological performance in mind. Starting with the 2000 BiOp based annual spill programs on "the best available monitoring and evaluation data concerning project passage, spill and system survival research." That principle was extended to the 2004 FCRPS

BiOp, further increasing the reliance on biological performance to set spill levels at each project. Dam by dam and system performance objectives were established to guide spill and dam modifications.

As referenced above, the U.S. District Court of Oregon in 2005 issued an order directing the lower Snake River and McNary projects to spill to benefit outmigrating Snake River Fall Chinook Salmon. The Court action had been initiated by the filing of a motion for injunctive relief by the National Wildlife Federation (NWF) and others seeking both more flow and spill. The Court found that summer spill at the lower Snake River projects was necessary for Snake River Fall Chinook Salmon to ensure that unauthorized take was avoided. The Court declined to rule on the requested flow measures, leaving those issues to be worked out through the Remand Process.

The Action Agencies have made numerous structural and operational changes to lower the TDG levels created by spill. These alternatives consist of spillway flow deflectors at Ice Harbor and John Day dams; additional deflectors at Bonneville, McNary, and Lower Monumental dams; RSW installation at Lower Granite and Ice Harbor dams; and spill pattern changes at all eight dams. The completion of 10 spillway flow deflectors at Ice Harbor in 1998 lowered peak TDG production levels of near 170 percent to less than 125 percent for similar spill levels. The completion of 18 spillway flow deflectors at John Day in 1999 resulted in similar reductions. The new spill patterns at Little Goose and Lower Monumental have reduced TDG by 5 to 10 percent. These actions have all substantially improved the safe passage PCE of critical habitat in the mainstem.

Because of the success of the early gas abatement improvements, decisions were made to move forward with the implementation of additional flow deflectors at all projects where possible. The Dissolved Gas Abatement Fast-Track (Deflector Optimization) Program was therefore established and funded and is currently ongoing. The history and anticipated FCRPS project modifications that are expected to result from the Fast-Track Deflector Optimization Program are summarized in Table 19-5.

In addition to reducing TDG, the Action Agencies have also improved the conservation value of the mainstem habitat by constructing various types of bypass facilities. As a result, survival of juvenile outmigrants has increased to between 90-95 percent at each dam. The latest bypass technology, RSWs, can achieve survival rates as high as 97 percent while spilling less water. The Bonneville Dam Corner Collector, operational since 2004, results in nearly100 percent survival for yearling and subyearling Chinook and steelhead.

Table 19-5. Summary of the Current Status of the Corps' Gas Abatement Fast-Track Deflector Optimization Program

Project	Pre-1995 Number of Spillways with Deflectors	Post-2003 Number of Deflectors	Total Number of Spillways
Bonneville	13	18	18
The Dalles	SIS[1]	SIS[1]	22
John Day	0	18	20
McNary	18	22	22
Ice Harbor	0	10	10
Lower Monumental	6	8	8
Little Goose	6	6	8
Lower Granite	8	8	8

[1] SIS – Spillway Improvement Study is underway and will analyze various spillway modifications designed to improve juvenile fish survival through The Dalles spillway passage route. Improvements currently being considered include modifications to the baffle blocks and endsill, construction of spillway deflectors and training walls and spill pattern modification.

As an example, the flow and spill programs, along with improvements in the physical facilities, have and continue to improve the conservation value of the mainstem Snake and Columbia rivers as demonstrated by increased in-river survival of juvenile Snake River Spring/Summer Chinook Salmon and steelhead, as shown on Figure 19-2. Please note that steelhead, which show less improvement in in-river survival than Chinook for reasons that are not well understood, are largely transported for higher system survivals.

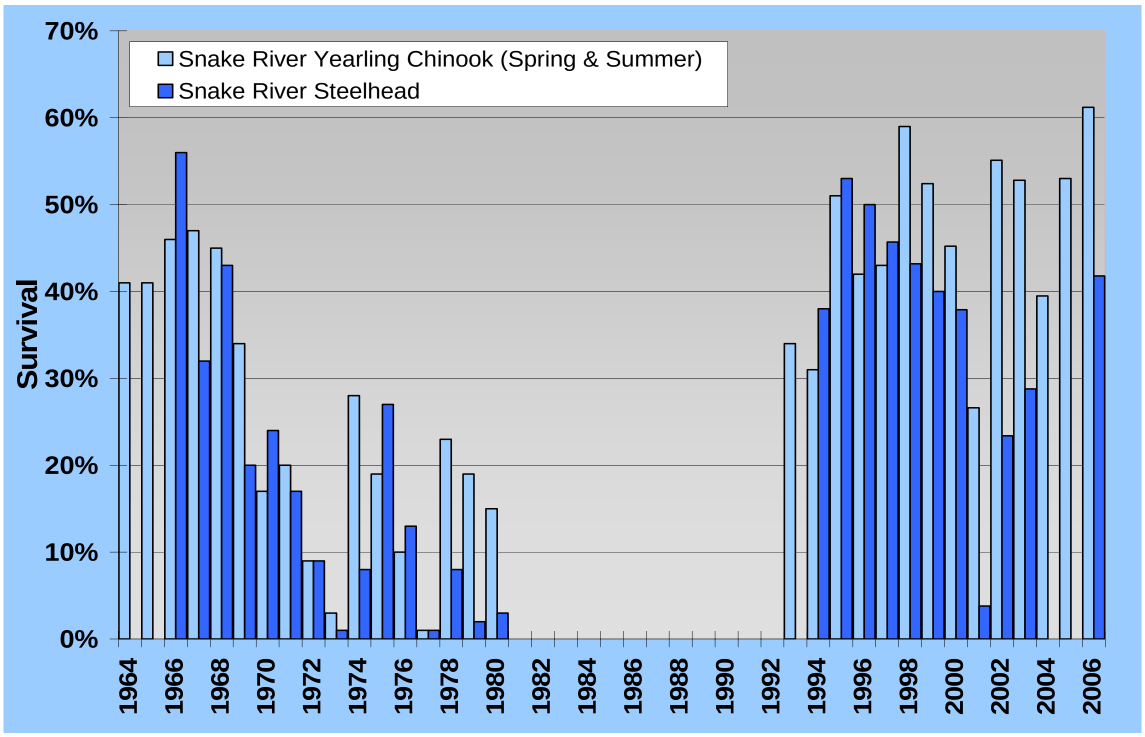

Figure 19-2. Changes in Survival of Snake River Spring/Summer Chinook Salmon and Steelhead Resulting in Part from Actions that Improved the Conservation Value of the Safe Passage PCE

In addition to spill and bypass systems, the Action Agencies have also implemented major programs to reduce avian and fish predation. Relocation of the Caspian tern colony nesting in the estuary has reduced predation on outmigrating juvenile salmonids.

The conservation value of some other essential features of designated critical habitat (e.g., spawning gravel, food, cover and shelter, riparian vegetation, and space) and PCEs (such as freshwater spawning and rearing habitat) has been improved by specific habitat mitigation projects. Many of these habitat projects have been implemented in tributaries to the Columbia and Snake rivers where most salmon and steelhead adults spawn and juveniles hatch and grow until they begin their migration to the ocean as smolts.

Since the 2000 BiOp, Reclamation, the Bonneville Power Administration (BPA), and many other entities working with the Action Agencies and independently, have continued to improve tributary habitat for salmon and steelhead populations throughout most Columbia River Basin tributary subbasins by removing passage barriers and performing other channel improvements to improve the access to and condition of spawning and rearing areas; screening diversions to prevent fish entrainment; securing instream flows to improve tributary migration and spawning and rearing flows, and to help maintain water quality; and protecting and enhancing the ecological functions of riparian areas to support streambank and channel integrity, decrease water temperatures, and increase nutrient sources.

The Action Agencies have spent over $100 million since 2000 to restore passage to 1,280 miles of stream, screen 85 diversions, acquire 530 cfs of water for instream flow, and protect and restore more than 1,000 miles of riparian habitat just for priority populations specified for the 2000 and 2004 FCRPS BiOps for Upper Columbia River Spring Chinook Salmon and Steelhead in the Methow, Entiat, Wenatchee, and Okanogan subbasins, Mid-Columbia River Steelhead in the John Day subbasin, and Snake River Spring/summer Chinook Salmon and Steelhead in the Lemhi, Upper Salmon, and Little Salmon subbasins. The Action Agencies also provided funding and technical assistance to implement tributary habitat projects for salmon and steelhead populations in many other Columbia River subbasins that were not associated with the 2000 or 2004 FCRPS BiOps.

In addition to projects implemented in tributary subbasins, the Corps and BPA have implemented projects to protect and enhance habitat along and adjacent to the mainstem Columbia River below Bonneville Dam and in tidal wetlands. In the case of tributary habitat, the Action Agencies are placing a greater emphasis on these efforts, and propose to implement actions that NMFS agrees will improve the conservation value of PCEs to provide survival improvements for ESA-listed ESUs.

The range-wide status of designated critical habitat for salmon and steelhead in the Snake and Columbia rivers has improved substantially since critical habitat was first designated in 1993. However, despite these improvements, the conservation value of some aspects of critical habitat can still be further improved to meet the needs of the listed ESUs.

19.2.4 Current Conservation Role of Critical Habitat

Habitat conditions throughout the range of listed species have improved from previously degraded conditions that did not always support the conservation role of critical habitat in the survival and recovery of listed species. These are the result of literally hundreds of Federal and non-Federal actions both in the mainstem Snake and Columbia rivers and in the major tributaries.

Currently, the conservation role of critical habitat throughout its range remains diminished compared with natural river conditions and habitat, but the extent of this diminishment cannot be well quantified. Passage conditions, as well as water quantity, and water quality affected by human development limit the conservation role of critical habitat to some degree compared with a natural habitat. Improvements in fish passage facilities at mainstem hydropower projects have substantially reduced but not eliminated mortality at the projects. Freshwater spawning and rearing sites are to some extent degraded, although implementation of tributary habitat projects has improved these PCEs in some locations. Although substantial improvements in critical habitat have occurred, the extent of improvement in essential features and PCEs still remains qualitative, and the conservation role of critical habitat is currently not fully realized. More improvements are possible and underway.

19.3 BASELINE

The past and present effects of the FCRPS Proposed RPA, the mainstem effects of Reclamation's projects in the Columbia River Basin, and Reclamation's Upper Snake River Projects have been covered at length in other documents and are not repeated here. Summary baseline information can be found in Chapter 2 of this report. The reader is referred to the 2005 Upper Snake River Biological Assessment (BA) and BiOp and the 2000 FCRPS BiOp for further information on both baseline and general effects of the actions on Columbia River listed species.

Specific information on the status of the PCEs can be found in: 2007 Reference File: Mainstem and Tributary Habitat Baseline Information. Generally, habitat features and PCEs in many places throughout the Columbia River Basin were, to some degree, degraded prior to the 1980s by human activities throughout the area. Since the mid to late 1980s, actions by many entities have improved or stabilized habitat features including those associated with freshwater spawning and rearing, and migration corridors.

19.4 EFFECTS OF THE PROPOSED FCRPS RPA AND RECLAMATION'S UPPER SNAKE RIVER PROPOSED ACTIONS ON CRITICAL HABITAT

19.4.1 Introduction

This effects section describes the prospective status of critical habitat compared to current status. Because the analysis is compared to current conditions, the emphasis was placed on any new proposed actions related to the FCRPS or the mainstem effects of Reclamation's projects (including the upper Snake Projects). Many of the actions (as described in the FCRPS BA, Appendices B.1 and B.2 and the 2007 Upper Snake River BA [Reclamation 2007]) are ongoing and are part of current conditions. Ongoing impacts to habitat related to the FCRPS RPA and Reclamation's actions were described in the baseline; these impacts are expected to continue into the future and are incorporated into the final conclusions.

Following the Effects section is the Conclusions section; here, the critical habitat analysis makes no distinction between the Federal actions, the baselines, or cumulative effects. All impacts are combined in the Conclusions section.

This Comprehensive Analysis does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, it relies upon the statutory provisions of the ESA and the 2005 *NMFS Guidance on Destruction and Adverse Modification of Critical Habitat* (NMFS 2005g)

This section summarizes the direct and indirect effects of the FCRPS Proposed RPA and Upper Snake River PA on the conservation role of designated critical habitat. The effects of the FCRPS Proposed RPA and Upper Snake River PA on the likelihood of survival and the prospects of recovery of the listed species are summarized in the biological analyses for the listed species (Chapters 4 through 16, this document).

In evaluating the effects of the FCRPS Proposed RPA and Upper Snake River PA on designated critical habitat, emphasis is placed on how the PCEs or habitat qualities essential to the conservation of the listed species will likely be affected and, in turn, how that will influence both the function and the conservation role of the affected critical habitat within the action area. For the purposes of this evaluation, the FCRPS Proposed RPA and Upper Snake River PA are considered in a geographic context of those affecting mainstem habitat (including the estuary) and those affecting tributary habitat. Actions considered in the category of mainstem habitat include hydro configuration and operations, fish facility operation and maintenance, water management, improved physical habitat conditions in the estuary, and predator management. Actions considered in the category of tributary habitat cover a range of activities including water acquisitions to improve stream flow, screening of water diversions, improved fish passage and access, improved instream habitat, and improved riparian conditions.

Summary tables of the expected effects of the FCRPS Proposed RPA and Upper Snake River PA on the essential features and PCEs of critical habitat are provided here as an overview of this section. Tables 19-6 and 19-7 show potential effects of the proposed Hydro and Estuary Habitat Actions in the mainstem, while Tables 19-8 and 19-9 show potential effects of the Tributary Habitat Actions.

Table 19-6. Summary of Expected Effects of the Proposed Hydro and Estuary Actions on Essential Features of Mainstem Designated Critical Habitat for Listed Snake River Salmon ESUs[1/]

ESU	Spawning and Juvenile Rearing Areas	Juvenile Migration Corridors	Areas for Growth and Development to Adulthood	Adult Migration Corridors
Snake River Spring/ Summer Chinook Salmon	No effect	Safe passage improved	NA	Safe passage improved
Snake River Sockeye Salmon	No effect	Safe passage improved	NA	Safe passage improved
Snake River Fall Chinook Salmon	E+	E+	NA	Safe passage improved

[1/] Effects Compared to Current Conditions.
Note: E+ = beneficial effect, NA = not applicable

Table 19-7. Summary of Expected Effects of Proposed Hydro and Estuary Actions on PCEs of Mainstem Designated Critical Habitat for Listed Columbia River Salmon ESUs and Steelhead DPSs[1/]

ESU/DPS	Freshwater Spawning	Freshwater Rearing	Freshwater Migration	Estuarine Areas
Snake River Steelhead	No effect	No effect	Safe passage improved	Safe passage improved
Upper Columbia River Spring Chinook Salmon	No effect	No effect	Safe passage improved	Safe passage improved
Upper Columbia River Steelhead	No effect	No effect	Safe passage improved	Safe passage improved
Middle Columbia River Steelhead	No effect	No effect	Safe passage improved	Safe passage improved
Lower Columbia River Chinook Salmon	E+ water quantity	E+ water quantity	Safe passage improved	Safe passage improved
Lower Columbia River Steelhead	Uncertain or no effect	Uncertain or no effect	Safe passage improved	Safe passage improved
Columbia River Chum Salmon	E+ water quantity	E+ water quantity	Uncertain or no effect	E+ water quantity, quality, cover,
Upper Willamette River Chinook Salmon	No effect	No effect	Uncertain or no effect	Safe passage improved
Upper Willamette River Steelhead	No effect	No effect	Uncertain or no effect	Safe passage improved

[1/] Effects Compared to Current Conditions
Note: E+ = beneficial effect, NA = not applicable

Table 19-8. Summary of Expected Effects of the Proposed Tributary Habitat Actions on Essential features of Tributary Designated Critical Habitat for Listed Snake River Salmon ESUs[1/]

ESU/DPS	Spawning and Juvenile Rearing Areas	Juvenile Migration Corridors	Areas for Growth and Development to Adulthood	Adult Migration Corridors
Snake River Spring/Summer Chinook Salmon	E+	Safe passage improved	NA	Safe passage improved
Snake River Sockeye Salmon	No effect	Safe passage improved	NA	Safe passage improved
Snake River Fall Chinook Salmon	No effect	No effect	NA	No effect

[1/] Effects Compared to Current Conditions
Note: E+ = beneficial effect, NA = not applicable

Table 19-9. Summary of Expected Effects of Proposed Tributary Habitat Actions on PCEs of Tributary Designated Critical Habitat for Listed Columbia River Salmon ESUs and Steelhead DPSs[1/]

ESU/DPS	Freshwater spawning	Freshwater Rearing	Freshwater Migration	Estuarine Areas
Snake River Steelhead	E+	E+	Safe passage improved	No effect
Upper Columbia River Spring Chinook Salmon	E+	E+	Safe passage improved	No effect
Upper Columbia River Steelhead	E+	E+	Safe passage improved	No effect
Middle Columbia River Steelhead	E+	E+	Safe passage improved	No effect
Lower Columbia River Chinook Salmon	No effect	No effect	No effect	No effect
Lower Columbia River Steelhead	No effect	No effect	No effect	No effect
Columbia River Chum Salmon	No effect	No effect	No effect	No effect
Upper Willamette River Chinook Salmon	No effect	No effect	No effect	No effect
Upper Willamette River Steelhead	No effect	No effect	No effect	No effect

[1/] Effects Compared to Current Conditions
Note: E+ = beneficial effect, NA = not applicable

19.4.2 Methods

A strictly quantitative analysis of the expected effects of the FCRPS Proposed RPA and Upper Snake River PA on the essential features of critical habitat is not technically feasible given available information and the lack of suitable metrics that can be applied across all habitat features. However, a general understanding of how salmonids use specific types of habitat and how changes to those habitats may affect their short-term and long-term survival, and their prospects for recovery can be evaluated and used to inform scientific judgments on whether the essential habitat features of critical habitat will be adversely modified or destroyed by the FCRPS Proposed RPA and Upper Snake River PA. This understanding of how the listed species use habitats in the action area and how the FCRPS Proposed RPA and Upper Snake River PA are expected to affect the essential features and PCEs of the designated critical habitat (i.e., whether they will be positively or negatively affected, or whether they will retain their current level of functionality, is the basis for this effects evaluation).

Although the evaluation of the likely effects of the FCRPS Proposed RPA and Upper Snake River PA on the habitat features and PCEs of designated critical habitat is largely qualitative in nature, quantitative information is used to inform the evaluation where available. Specifically, for the hydro portion of the RPA where empirical data are available to make semi-quantitative estimates of benefits on "safe passage" in juvenile and adult migration corridors, these data were explicitly considered. These were the same data used in the current-to-prospective adjustments in the species survival and recovery analyses (i.e., the biological analyses for the several species). Other examples of such data are the reach and project survival estimates made as new passage facilities were completed, and the modeled or estimated benefits of predator removal or alternative predator management scenarios. For some interior Columbia River Basin ESUs, COMPASS passage modeling results were used for current to prospective adjustments.

Fish transportation, hatcheries, and harvest are not considered here because these Actions generally do not affect habitat.

Also explicitly considered in the analysis of the FCRPS Proposed RPA and Upper Snake River PA on habitat features and PCEs were the quantitative estimates of changes in lifecycle survival developed for the current-to-prospective adjustments in the survival and trend toward recovery analysis. These estimates are summarized in Table 19-10. In using these estimates, the following should be noted.

- A prospective improvement in lifecycle survival for the Snake River Sockeye Salmon ESU was not estimated because this ESU is maintained by a captive broodstock program that has prevented extinction of the ESU and has produced a twenty-fold benefit; however, the number of returning adult fish is still extremely low.
- For the Snake River Steelhead DPS, the negative lifecycle improvement stems from empirical data that suggests that in-river migrants return as adults at a lower rate than transported fish.
- The lifecycle improvements for hydro for Upper Columbia River Spring Chinook Salmon and Steelhead was estimated based on the difference between the estimated survival under the current operation (defined as the period 2001 to 2006) and the estimated survival following implementation of the FCRPS Proposed RPA (see Upper Columbia River Spring Chinook Salmon biological analysis in Chapter 8).
- The estimated prospective lifecycle improvements in the hydro category include the combined effects of several Hydro Actions.

Table 19-10. Current-to-Prospective Estimated Improvements in Lifecycle Survival for Snake and Columbia River ESA-Listed Salmon and Steelhead.

ESU/DPS	Hydro	Northern Pikeminnow	Terns	Estuary Habitat	Tributary Habitat
Snake River Spring/ Summer Chinook Salmon	8.2%	1.0%	2.1%	5.7%	1-41%
Snake River Fall Chinook Salmon	NA	1.0%	0.7%	9.0%	NA
Snake River Sockeye Salmon					
Snake River Steelhead	-11.92%	1.0%	3.4%	5.7%	1-17%
Upper Columbia Spring Chinook Salmon	9.42%	1.0%	2.1%	5.7%	1-22%
Upper Columbia Steelhead	12.46%	1.0%	3.4%	5.7%	4-14%
Middle Columbia River Steelhead	5.2-12.3%	1.0%	3.4%	5.7%	0.3-4.0%
Lower Columbia River Chinook Salmon	0.3%	1.0%	2.1%	5.7-9.0%	0.0%
Lower Columbia River Steelhead	0.3%	1.0%	3.4%	5.7%	0.0%
Columbia River chum salmon	0.3%	1.0%	0.0%	9.0%	0.0%
Upper Willamette River Chinook Salmon	NA	1.0%	2.1%	5.7%	NA
Upper Willamette River Steelhead	NA	1.0%	3.4%	5.7%	NA

Source: COMPASS passage model results and species biological analyses in Comprehensive Analysis. N/A = Information not available

Another consideration in the evaluation of the effects of the FCRPS Proposed RPA and Upper Snake River PA was the degree to which the FCRPS Proposed RPA and Upper Snake River PA might affect PCEs that were already degraded within the action area. Salmon and steelhead have been adversely affected over the last century by many activities including human population growth, introduction of exotic species, over fishing, developments of cities and other land uses in the floodplains, water diversions for all purposes, dams, mining, farming, ranching, logging, hatchery production, predation, ocean conditions, loss of habitat, and other causes (Lackey et al. 2006).

Finally, in evaluating the effects of the FCRPS Proposed RPA and Upper Snake River PA on PCEs, the listed species were considered slightly differently based on NMFS' differing descriptions of essential features or PCEs, as described in Section 19.2.2. That is, critical habitat for Snake River salmon ESUs was designated in 1993 using descriptions of "essential features" of critical habitat (58 FR 68543); designations for Snake River Steelhead and listed upper and lower Columbia River salmon and steelhead except Lower Columbia River Coho Salmon was designated in 2005 using the term "primary constituent elements" (70 FR 52630).

19.4.3 Mainstem Habitat

This section of the critical habitat analysis summarizes the likely effects of the FCRPS Proposed RPA and Upper Snake River PA on essential habitat features and PCEs provided in the mainstem Columbia and Snake rivers. The mainstem actions are divided into two groups (hydro and other mainstem) and include the following Actions:

Hydro

- configuration and operation of the FCRPS
- O&M of FCRPS dams and fish facilities

- water management (FCRPS, including flow augmentation and all flow effects related to the Upper Snake River PA)

Other mainstem

- modified physical habitat conditions in the estuary
- management of predators

As a group, these Actions are expected to affect both juvenile and adult life stages of the listed species as they migrate to and from the Pacific Ocean and for some (especially those in the lower river) juveniles rearing in the mainstem and estuary. The habitat features or PCEs expected to be affected are water quality, water quantity, water velocity, water temperature, and safe passage.

19.4.3.1 Hydro Actions – Configuration and Operation of the FCRPS

Summary of the Actions

The Action Agencies are committed to an aggressive program of making capital investments and operational changes needed to provide safe passage and other essential features of critical habitat for juvenile and adult salmon and steelhead migrants, as well as to a continued program to evaluate passage survival at FCRPS dams. For downstream migrating fish, these improvements fall into several general categories:

- surface flow passage
- juvenile bypass system improvements
- turbine and powerhouse improvements
- spillway survival improvements

Adult passage improvements include:

- modifications to ladder systems that decrease passage times
- increased adult passage system reliability
- implementation of configuration and operation changes that provide surface passage routes during late fall and winter operation to provide safer downstream passage conditions for steelhead kelts, overwintering steelhead, and adult fish that overshoot their natal streams as demonstrated by feasibility studies.

The Action Agencies will continue to develop and implement water quality improvement measures including actions identified in the comprehensive *Water Quality Plan for Total Dissolved Gas and Water Temperature in the Mainstem Columbia and Snake Rivers* (Corps et al. 2004) to make further progress towards meeting water quality standards for TDG and water temperature. The Action Agencies will continue to develop and use spill patterns and will manage spill to minimize TDG while providing effective juvenile passage. Surface bypass facilities such as RSWs, behavioral guidance structures (BGSs), and similar devices that require lower spill volumes, thereby reducing gas entrainment while maintaining or improving safe passage for juvenile migrants, will also be implemented as determined by future study and investigation.

The Action Agencies will also consider spillway training walls designed to reduce TDG supersaturation of powerhouse discharge, concurrent with spill reducing measures such as RSWs or other surface bypass structures. Flow deflectors are being constructed at Chief Joseph Dam and others may be evaluated for modifications to improve fish survival and improving TDG management.

The Action Agencies will continue research to determine water temperature effects on both juvenile and adult salmonids and implement solutions where appropriate.

Beneficial and Adverse Effects of the Proposed Hydro Actions

The proposed Hydro Actions for configurations and operations are estimated to benefit listed ESUs as summarized in Tables 19-11 and 19-12. As a group, these are Actions that are expected mostly to affect the PCEs for safe passage at the dams for juvenile and adult migrants. Although the Actions provide additional mitigation for previous adverse effects, they do not completely offset the existing adverse effects. They are expected to improve the conservation role of the PCEs and ameliorate existing adverse effects, increase survival of listed species enough to improve the prospects for recovery.

An example of how the proposed Hydro Actions are expected to contribute to safe passage is shown in Table 19-11. The suite of Actions at each project for improving passage success is anticipated to yield absolute survival increases for yearling Chinook salmon, steelhead, and subyearling Chinook salmon (Table 19-13). In addition, these Actions are anticipated to improve dam passage survival for all species and are expected to decrease the environmental stress on fish that may influence latent mortality.

A more specific example is at John Day Dam where the Action Agencies are proposing to install a surface flow bypass system along with tailrace improvements. Surface flow bypass will provide near-field velocities and other hydraulic characteristics that better attract downstream migrating salmon and steelhead juveniles than do deeper passage routes, such as standard spillbays or turbine intake screened bypass systems. This is expected to improve safe passage at the dam.

In the case of adult passage, the proposed Hydro Actions would similarly be expected to affect the PCEs of water quality, water temperature, and in particular safe passage. These changes would all be considered beneficial and result in reducing migration delay at dams and improve the conservation role of the essential feature and PCE of designated critical habitat, supporting a trend towards recovery.

At lower river projects, the Action Agencies have proposed to investigate the use of sluiceways to pass adult steelhead (both pre-spawners and kelts) during winter months. Radiotelemetry studies suggested that many adult steelhead, particularly Snake River, Salmon River, and Clearwater River populations, overwinter in the FCRPS. Many of these fish fall back at FCRPS dams at a time when turbines are the only downstream route. Furthermore, steelhead that fall back during the winter at FCRPS dams appear to have lower escapement than steelhead that do not. Operation of sluiceways during winter months has the potential to increase adult steelhead escapement, thereby improving the PCE of safe passage.

Table 19-11. Summary of Effects of the Proposed FCRPS and Upper Snake River Hydro Actions on Essential Features of Designated Critical Habitat for Listed Snake River Salmon ESUs in the Mainstem Snake and Columbia Rivers

Essential Features	Snake River Sockeye Salmon			Snake River Spring/Summer Chinook Salmon			Snake River Fall Chinook Salmon		
	HCO [1]	**FFOM**	**WM [2]**	**HCO**	**FFOM**	**WM**	**HCO**	**FFOM**	**WM**
Spawning and juvenile rearing areas	NA	NA	NA	NA	NA	NA		NA	
1) spawning gravel	-	-	-	-	-	-	U	-	-
2) water quality	-	-	-	-	-	-	E	-	U
3) water quantity	-	-	-	-	-	-	-	-	U
4) cover/shelter	-	-	-	-	-	-	-	-	E
5) food	-	-	-	-	-	-	-	-	-
6) riparian vegetation	-	-	-	-	-	-	-	-	-
7) space	-	-	-	-	-	-	-	-	-
8) access	-	-	-	-	-	-	-	-	-
Juvenile migration corridors	E+	E+	E+	E+	E+	E+	E+	E+	E+
1) substrate	-	-	-	-	-	-	-	-	-
2) water quality	E+	-	E+	E+	-	E+	E+	-	E+
3) water quantity	E+	-	E+	E+	-	E+	E+	-	E+
4) water temperature	E	-	E	E	-	E	E	-	E
5) water velocity	E	-	E	E	-	E	E	-	E
6) cover/shelter	-	-	-	-	-	-	-	-	-
7) food	-	-	-	-	-	-	-	-	-
8) riparian vegetation	-	-	-	-	-	-	-	-	-
9) space	-	-	-	-	-	-	-	-	-
10) safe passage conditions	E+	E+	E+	E+	E+	E+	E+	E+	E+
Areas for growth and development to adulthood	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adult migration corridors	E+	E+	E+	E+	E+	E+	E+	E+	E+
1) substrate	-	-	-	-	-	-	-	-	-
2) water quality	E+	-	E+	E+	-	E+	E+	-	E+
3) water quantity	E	-	E	E	-	E	E	-	E
4) water temperature	E	E	E	E	E	E	E	E	E
5) water velocity	-	-	-	-	-	-	-	-	-
6) cover/shelter	-	-	-	-	-	-	-	-	-
7) riparian vegetation	-	-	-	-	-	-	-	-	-
8) space	-	-	-	-	-	-	-	-	-
9) safe passage conditions	E+	E+	E+	E+	E+	E+	E+	E+	E+

[1] HCO = Hydro Configuration and Operations; FFOM = Fish Facility O&M; WM = Water Management.
Note: NA or - = not applicable or no effect; E = effect (some effect is anticipated but may not be quantifiable), E+ = positive effect, U = uncertain if there would be an effect.
[2] FCRPS water management incorporates the mainstem effects of Reclamation's 18 projects and the Upper Snake River projects.

Table 19-12. Summary of Effects of Proposed Hydro Actions on PCEs of Designated Critical Habitat for Listed Salmon ESUs and Steelhead DPSs in the Mainstem Snake and Columbia Rivers

PCEs	Snake River Steelhead			UCR Spring Chinook Salmon			UCR Steelhead			Mid-Columbia River Steelhead			Lower Columbia River Chinook			Lower Columbia River Steelhead			Columbia River Chum Salmon			UW Chinook Salmon			UW Steelhead		
	HC	**FF**	**WM**	**HC**	**FF**	**WM**	**HC**	**FF**	**WM**	**HC**	**FF**	**WM**	**HC**	**FF**	**WM**	**HC**	**FF**	**WM**	**HC**	**FF**	**WM**	**HC**	**FF**	**WM**	**HC**	**FF**	**WM**
Freshwater spawning sites	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	E+	E	E+	-	-	-	E+	E	E+	NA	NA	NA	NA	NA	NA
Water quality	-	-	-	-	-	-	-	-	-	-	-	-	E+	E	E	-	-	-	E+	E	E	-	-	-	-	-	-
Water quantity	-	-	-	-	-	-	-	-	-	-	-	-	E	-	E+	-	-	-	E	-	E+	-	-	-	-	-	-
Spawning substrate	-	-	-	-	-	-	-	-	-	-	-	-				-	-	-	-	-	-	-	-	-	-	-	-
Freshwater rearing sites	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	E	U	E	-	-	-	E	-	E	NA	NA	NA	NA	NA	NA
Water quantity	-	-	-	-	-	-	-	-	-	-	-		-	-	E	-	-	-	U	-	E	E	-	E	E	-	E
floodplain connectivity	-	-	-	-	-	-	-	-	-	-	-		U	-	U	-	-	-	-	-	-	-	-	-	-	-	-
Water quality	-	-	-	-	-	-	-	-	-	-	-		E	U	E	-	-	-	E	-	E	E	-	E	E	-	E
forage	-	-	-	-	-	-	-	-	-	-	-		U	-	-	-	-	-	U	-	U	-	-	-	-	-	-
natural cover	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater migration corridors	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+
Water quantity	E	-	E	E	-	E	E	-	E	E	-	E	E	-	E	E	-	E	E	-	E	E	-	E	E	-	E
Water quality	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E	E+	-	E+	E+	-	E+
natural cover	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Estuarine areas	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+
Water quality	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+	E+	-	E+

Table 19-12. Summary of Effects of Proposed Hydro Actions on PCEs of Designated Critical Habitat for Listed Salmon ESUs and Steelhead DPSs in the Mainstem Snake and Columbia Rivers

PCEs	Snake River Steelhead			UCR Spring Chinook Salmon			UCR Steelhead			Mid-Columbia River Steelhead			Lower Columbia River Chinook			Lower Columbia River Steelhead			Columbia River Chum Salmon			UW Chinook Salmon			UW Steelhead		
	HC	**FF**	**WM**	**HC**	**FF**	**WM**	**HC**	**FF**	**WM**	**HC**	**FF**	**WM**	**HC**	**FF**	**WM**	**HC**	**FF**	**WM**	**HC**	**FF**	**WM**	**HC**	**FF**	**WM**	**HC**	**FF**	**WM**
Water quantity	-	-	E	-	-	E	-	-	E	-	-	E	-	-	E	-	-	E	-	-	E	-	-	E	-	-	E
salinity	-	-	U	-	-	U	-	-	U	-	-	U	-	-	U	-	-	U	-	-	U	-	-	U	-	-	U
natural cover	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
juvenile and adult forage	-	-	E	-	-	E	-	-	E	-	-	E	-	-	E	-	-	E	-	-	E	-	-	E	-	-	E

HC = Hydro Configuration and Operations; FF = Fish Facility O&M; WM = Water Management; UCR = Upper Columbia River; UWR = Upper Willamette River
Note: NA or - = not applicable or no effect; E = effect (although magnitude may be unknown); E+ = positive effect; U = uncertain; N = no effect

Table 19-13. Estimated Range of Dam Survival Increases for Yearling Chinook Salmon, Steelhead, and Subyearling Chinook Salmon as a Result of Implementing the Proposed Configuration and Operation Changes at FCRPS Hydropower Projects

Project	Anticipated Range of Survival Changes for Configuration and Operation Actions		
	Yearling Chinook	**Steelhead**	**Subyearling Chinook**
Bonneville	Up to 1.5%	Up to 2.8%	Up to 4.9%
The Dalles	2.0 - 4.7%	2.0 - 4.7%	2.4 - 7.1%
John Day	1.4 - 2.7%	1.4 - 4.1%	4.4 - 6.4%
McNary	-0.2 - 0.1%	-0.2 - 0.2%	-0.2 - 0.2%
Ice Harbor	0.1 - 1.3%	>0.1- 0.9%	0.1 - 1.3%
Lower Monumental	0.6 - 3.4%	0.5 - 3.3%	1.3 – 4.2%
Little Goose	0.2 - 1.7%	0.3 - 1.6%	0.9 – 2.1%
Lower Granite	>0.1 – 0.5%	>0.1 – 0.2%	>0.1 – 0.4%

Nature, Distribution, Magnitude, Duration, Timing, Intensity, Frequency, and Proximity of the Effects

Implementing the proposed configuration and operations actions is expected to improve water quality, reduce water temperature in fish ladders and juvenile bypass systems, and generally improve dam passage survival. Increased passage survival is expected in each of the dams where passage improvements are made. For example, installation of an RSW at Lower Monumental Dam for 2008 operations is expected to improve survival of juveniles that pass through the spillway by 1.9 to 3.7 percent. Installation of stilling basin improvements at The Dalles Dam in 2010 is expected to increase the survival of juvenile salmonids that pass the dam by 1.0 to 7.1 percent. The proposed configuration and operations actions that result in species survival improvements support the long-term trend toward recovery.

Resulting Trend of PCEs

The essential habitat features and PCEs affected by the configuration and operational actions are all expected to be affected in a positive way, with very little or no short-term negative impact. The proposed spill regime ensures that safe passage for juvenile salmonids is optimized. In addition, surface bypass facilities to address safe passage have been installed at several projects: RSWs at Lower Granite and Ice Harbor; Bonneville Corner Collector; two prototype temporary spillway weirs at McNary; and, the Lower Monumental RSW will be installed in fall 2007.

To address water quality, flow deflectors are being constructed at Chief Joseph Dam and are expected to allow spill at the project to help meet flow objectives while minimizing TDG saturation. The effect of lower gas levels would persist downstream to Priest Rapids Dam.

Degree to Which the Effects of the Actions are Degrading Factors that are Already Limiting the Conservation Value of Designated Critical Habitat Within the Action Area

The proposed Hydro Actions in the category of configuration and operation are not expected to degrade any essential features of habitat or PCEs that have been identified by NMFS as limiting factors from their current condition. To the contrary, impaired juvenile passage has been identified as a factor limiting survival and recovery of Columbia and Snake river listed salmon and steelhead. The proposed configuration and operations actions are expected to directly improve the PCEs of safe passage and water quality (primarily by reducing TDG concentrations), improve the conservation value of critical habitat, and support the trend towards recovery.

19.4.3.2 Hydro Actions – Fish Facilities Operation and Maintenance

Summary of the Hydro Actions

The Action Agencies will continue to operate and emphasize proactive maintenance of adult and juvenile fish passage facilities to ensure safe migration conditions for adult and juvenile migrants. Fish passage facilities and project operations are monitored regularly during the fish passage season to ensure they are operating properly and within criteria. To keep passage facilities in good working order, they are regularly monitored and any necessary repairs are made promptly.

If the facilities are not monitored and maintained adequately, conditions such as buildup of debris or damaged system components could occur that would injure or kill juvenile migrants. Outages or shutdowns for regular facility maintenance are scheduled during periods when the fewest salmonid migrants are expected to be present. Each project has trained staff to perform the day-to-day O&M requirements. Emergency outages are addressed on a case-by-case basis.

The Fish Passage Operations and Maintenance Team (FPOM) consisting of Federal, State, and Tribal representatives, recommends operational priorities and operating criteria that are summarized in the Fish Passage Plan (FPP). The FPP includes project-specific criteria and dates to operate and maintain fish facilities, turbine operating priorities, and spill patterns; fish transportation criteria; and turbine operations within the 1 percent of best efficiency range. Transportation has long been viewed as a tool to decrease direct mortality of juvenile fish as they migrate through the FCRPS. Results of transport research have been debated for many years and this debate continues. The ESA is clear that the Action Agencies must use the best available data to make its decisions. By using this information, the Action Agencies understand that the various species of transported fish have various responses to transport, and that what benefits some species during one part of the year may not be beneficial at another time. Where data appear to be more certain (i.e., in low flow years and during May in most years), transportation is relied on, and this rationale is further based on directing operations specifically at the species that the Action Agencies are managing for. This includes a modified, sliding scale to both the initiation and curtailment of summer operations towards better managing for Snake River Fall Chinook Salmon.

This transportation strategy should be considered as an interim strategy. When implementation of surface passage structures is complete at the collector projects, this strategy will need to be re-evaluated through RM&E efforts. The FPP is updated by the Action Agencies annually and implemented by project personnel and others involved with river operations. It can be referenced at

<http://www.nwd-wc.usace.army.mil/tmt/documents/fpp/>.

Beneficial and Adverse Effects of the Actions

The estimated benefit of the Actions considered under the category of fish facility O&M are summarized along with the other Hydro Actions in Tables 19-11 and 19-12. As a group, these are Actions that are expected mostly to affect the PCEs of safe passage in the migration corridor, particularly in juvenile bypass systems and fish ladders. Although the proposed Actions provide additional mitigation for previous adverse effects, they do not completely offset the existing adverse effects. They are, however, expected to improve the conservation role of the PCEs and ameliorate existing adverse effects, increasing survival of listed species enough to support a trend towards recovery.

The Hydro Actions will ensure that fish passage facilities are operating properly and that conditions do not develop that would delay, injure, or kill juvenile migrants. For example, river-born debris can occlude portions of downstream migrant passage facilities at dams. When this occurs in high-velocity areas, juvenile fish mortality and injury can result. Daily inspections of all fish facility components at

FCRPS dams are necessary to ensure that passage facilities are free of debris and functioning within other operating criteria that provide safe and efficient passage.

Describe the Nature, Distribution, Magnitude, Duration, Timing, Intensity, Frequency, and Proximity of the Effects

Implementing the proposed fish facility O&M actions is expected to improve safe passage for juvenile migrants; this will reduce the adverse effect of direct hydrosystem mortality that occurs between the upper extent of Lower Granite reservoir and the tailrace of Bonneville Dam and indirect or delayed mortality due to hydrosystem passage that occurs in a subsequent life stage. All fish facilities, spillways, and turbine units are inspected twice daily at each lower Snake and Columbia River dam during the fish passage season. For adult facilities this season extends from March 1 to December 31, and for juvenile facilities the season runs from April 1 through December 15. Maintenance of adult and juvenile facilities is scheduled to occur outside these seasons and provides insurance against in-season break-downs.

Resulting Trend of PCEs

The essential habitat features and PCEs for safe passage that will be affected by the fish facility O&M actions will be affected in a positive way. For example, improved fish facility O&M is expected to ensure that the fish screens, bypass systems, and ladders are operating properly.

Degree to Which the Effects of the Actions are Degrading Factors that are Already Limiting the Conservation Value of Designated Critical Habitat Within the Action Area

Impaired juvenile passage has been identified as a factor limiting survival and recovery of Columbia and Snake river listed salmon and steelhead. The proposed fish facility O&M actions are expected to directly improve the PCE of safe passage by ensuring the passage improvements at the dams are functioning properly, and improving the conservation value of critical habitat.

19.4.3.3 Hydro Actions -- Water Management

Summary of the Hydro Actions

The Action Agencies' water management strategy to operate the FCRPS storage projects (Dworshak, Grand Coulee, Hungry Horse and Libby) to shape spring and summer flows to the extent possible to benefit fish migration and operate certain run-of-the-river projects to minimize water travel time through the lower Columbia and Snake rivers, will maintain or improve water quality, water quantity, and water velocity. This includes actions as identified in the comprehensive *Water Quality Plan for Total Dissolved Gas and Water Temperature in the Mainstem Columbia and Snake Rivers* (Corps et al. 2004) that will make further progress towards meeting water quality standards for TDG and water temperature.

The operations and maintenance of Reclamation's Upper Snake River projects, and the upper Snake River flow augmentation, is described in the 2007 Upper Snake River BA (Reclamation 2007). Reclamation is reviewing alternative release schedules for the flow augmentation to better meet the needs of listed fish below Hells Canyon Dam. Reclamation proposes to use an adaptive management approach with respect to its flow augmentation releases from the upper Snake River and can shift releases to an earlier timeframe if NMFS confirms biological benefits to listed fish.

For water quantity, the FCRPS Action Agencies will manage storage reservoirs to ensure they are as full as possible at the start of each fish passage season (spring and summer), recognizing the reservoir operations, flood control requirements, emergency provisions or other requirements for dam safety, to make available as much water as possible for the spring migration period. Specific operational commitments are identified, providing "buckets of water" or a variable water budget, depending on water year. This water budget represents the Action Agencies' flow commitments, rather than numerical flow targets. This is because numerical flow targets are goals and guides for in-season management of water, but are not physically achievable under many water year conditions due to the limited storage in the Columbia River Basin.

For water velocity, Snake River reservoirs will be operated at MOP with a 1-foot operating range, and John Day Reservoir will be operated at minimum pool necessary to meet irrigation needs (with a 1.5-foot operating range between elevation 262.5 and 264 feet) during the spring and summer salmon migration periods, April 10 to September 30.

The Action Agencies will manage the concentration of TDG in the mainstem Columbia and Snake rivers by providing specific spill levels for juvenile fish passage at each project, not to exceed established TDG levels (either the 110 percent TDG standard, or as modified by state water quality waivers, up to 115 percent TDG in the dam forebay and up to 120 percent TDG in the project tailwater). Additionally, the Action Agencies will manage spill on a system basis according to a priority list. In high runoff conditions, this distributes spill across the region and prevents dissolved gas supersaturation "hotspots."

The Action Agencies will continue to work with the Water Quality Team (WQT) subcommittee to plan development of a water temperature model for the Snake River. The goal is to develop a tool to evaluate alternative Snake River operations for improved in-season and future river temperature management. The Action Agencies are continuing to evaluate the temperature effects on adult Snake River Steelhead and Fall Chinook Salmon of drafting Dworshak Reservoir to elevation 1520 feet and extending the draft period into September. Dworshak Reservoir drafts to elevation 1535 feet by the end of August and the remaining 200,000 acre-feet from elevation 1535 feet to elevation 1520 feet are released in September. This operation has proven to be an effective tool to cool the temperature at the tailwater of the Lower Granite Dam and should maintain or improve the water quality essential feature of designated critical habitat in the Snake River.

The Action Agencies will implement annually several FCRPS project operations to benefit fish at or near a given project or its reservoir. These reservoir operations vary by project and include the following:

- minimum recommended project outflows for ESA-listed resident fish,
- limited outflow fluctuations to avoid stranding fish,
- lower Snake River reservoirs maintained at or above their MOP,
- John Day pool levels in the summer that would still provide for irrigation, and
- flow augmentation and cool water releases to improve downstream water quality.
- These operations are expected to improve safe passage and water quality essential features.

Beneficial and Adverse Effects of the Actions

The estimated beneficial effects of the Actions considered under the category of Water Management are summarized along with those of the other Hydro Actions in Table 19-11 and 19-12. As a group, the Water Management Actions are expected to mostly affect the PCEs of water quality in the migration corridor, support spawning and rearing habitat for fish spawning in the mainstem, and improve water temperatures in juvenile bypass systems and fish ladders. Spill for fish is managed to stay within TDG standards.

The Water Management Actions will also benefit the water quantity essential feature and PCE by managing the system to more closely approximate the shape of the natural hydrograph, providing summer cooling to the Snake River, minimizing total dissolved gas consistent with state waivers. The Water Management Actions therefore are expected to increase the conservation value of these PCEs. Although the Actions proposed provide additional mitigation for previous adverse effects, they do not completely offset the existing adverse effects. They are, however, expected to improve the conservation role of the PCEs and ameliorate existing adverse effects, increasing survival of listed species enough to support a trend towards recovery.

Water Management Actions, including those used to keep chum salmon redds protected downstream of Bonneville Dam during the winter, those that provide improved temperatures for fish migrating through the lower Snake River with temperature augmentation from Dworshak Reservoir, and operating Chief Joseph and Grand Coulee dams to minimize TDG production, are anticipated to provide benefits to many of the PCEs for ESUs within the basin.

Nature, Distribution, Magnitude, Duration, Timing, Intensity, Frequency, and Proximity of the Effects

The proposed FCRPS Water Management Actions will shape spring and summer flows to benefit fish migration and improve water quality, as well as spawning and early rearing in the lower Columbia River. The FCRPS Proposed RPA will be timed to provide the optimum benefit for migrating fish. The Water Management Actions will optimize flows during juvenile migration and reduce mainstem water temperatures during the summer. The effects will be realized systemwide during migration as flows at the FCRPS projects are managed in concert with flows from Dworshak Dam on the North Fork Clearwater River.

Resulting Trend of PCEs

The essential habitat features and PCEs affected by the Water Management Actions in the action areas are all expected to be affected in a positive way.

Degree to which the Effects of the Proposed Water Management Actions are Degrading Factors that are Already Limiting the Conservation Value of Designated Critical Habitat within the Action Area

Impaired juvenile passage has been identified as a factor limiting survival and recovery of Columbia and Snake river ESA-listed salmon and steelhead. The proposed Water Management Actions are expected to directly improve the PCE of safe passage by improving water quantity and water quality, thereby improving the conservation value of critical habitat.

The prospective in-river survival changes from the current for several interior Columbia River Basin listed species from the COMPASS passage model (see COMPASS tables in Appendix B). The positive change in in-river survival shown for interior Columbia River species improves the safe passage essential feature of designated critical habitat that is expected to result from FCRPS Proposed RPA and Upper Snake River PA at Snake and Columbia River hydropower projects. A more detailed description of the COMPASS passage modeling effort is described in Appendix B of the Comprehensive Analysis, “Analysis of Effects of Hydro Actions.” COMPASS passage modeling results are not available for Snake River fall Chinook and sockeye salmon and lower Columbia River listed salmon and steelhead stocks.

19.4.3.4 Other Mainstem Actions -- Estuarine Habitat Restoration

This section of the critical habitat analysis summarizes the likely effects of Estuary Habitat Actions on essential features and PCEs. As a group, these Actions are expected to affect critical habitat for both juveniles and adults of the listed species as they migrate to and from the Pacific Ocean and as the former rear in the estuary. The affected habitat features or PCEs are water quality, water quantity, and safe passage, rearing areas, natural cover, and forage.

Summary of the Estuary Habitat Actions

The objective of the Estuary Habitat Actions is to protect and increase the distribution of high-quality habitat for ESA-listed salmon and steelhead by protecting and restoring habitat in the estuary. The Action Agencies will implement an estuary habitat program that is expanded from the program under the 2004 BiOp to improve the conservation value of PCEs of designated critical habitat to benefit listed ESUs.

For the near-term, the Action Agencies plan to implement approximately more than 30 habitat improvement projects in the estuary. Additional projects will be identified based on research and regional coordination and developed following the Action Agencies Restoration Plan and Estuary Plan over the near-term. Complete details of the proposed Estuary Habitat Actions are found in Appendix B.2.2 of the FCRPS BA.

The following Actions, or similar types of projects, will be implemented in Fiscal Year (FY) 2007to 2009:

- Rehabilitation of approximately 380 acres of off-channel rearing habitat for a variety of salmonid populations, including management of the riparian habitat to enhance its value for salmon as well as watershed function;
- A 45-acre floodplain reconnection project (tide gate removal);
- Acquisition of a 45-acre floodplain intended for future restoration activities (dike breaching);
- A 50-acre floodplain reconnection project (dike breaching);
- Acquisition of 320 acres of tidelands and 119 acres of riparian/upland forest;
- Restoration of 30 acres of riparian area, including 2 linear miles of fencing;
- Approximately 15 BPA-funded FY 2007 to 2009 projects that are undergoing preliminary scoping and sponsor development.; and
- Pile dike removal—Preliminary scoping ongoing with funding for implementation beginning in FY 2008.

Additional near-term projects will be identified through the Lower Columbia River Estuary Partnership's (LCREP) *Strategic Habitat Restoration Prioritization Framework, Estuary Plan and the Recovery Plan* (Evans et al. 2006). When implemented, these projects will restore and enhance salmonid habitat. Actions include:

- Restoring habitat-forming processes to enhance salmon and steelhead populations in the Grays River;
- Retrofitting and installing tide gates to increase tidal flushing and fisheries access;
- Re-establishing hydrologic connectivity to the Lower Columbia Slough to reclaim and improve floodplain wetland functions, improving hydrologic flushing and salmonid access to 3,200-acre Sturgeon Lake on Sauvie Island, Oregon; and

- Protecting and restoring approximately 5 to 10 acres of emergent wetland and riparian forest habitat.

Some riparian planting projects will also be implemented.

The Corps expects to complete additional projects that will provide similar benefits that will be identified during the FY 2007 to 2009 period.

Estuary Habitat Actions 2010 to 2017

Additional projects for longer-term implementation will be identified based on research and regional coordination, providing greater benefits in the future. For the 2010 to 2017 time period, BPA will commit approximately $3.5 million every year for these priority habitat projects, working through the LCREP program. The Corps expects to continue to fund estuary habitat projects at a level similar to current funding (approximately $2 million per year), but actual funding will be dependent on Congressional appropriations. Projects will be selected based on biological effectiveness criteria consistent with the Willamette/Lower River Recovery Plan (Recovery Plan). The Recovery Plan, LCREP, and other local resources will be used to help identify projects.

Beneficial and Adverse Effects of the Actions

The estimated beneficial effects to critical habitat of the proposed Estuary Habitat Actions are summarized in Tables 19-14 and 19-15. As a group, these Actions are expected to mostly affect the PCEs of water quality in the migration corridor, and especially contribute to safe passage. Additionally, for those listed species that use estuarine habitat for rearing (e.g., subyearling migrants such as fall Chinook salmon), the Estuary Habitat Actions are expected to affect the PCEs of water quality, natural cover/shelter, and forage. Although the Actions provide additional mitigation for previous adverse effects, they do not completely offset the existing adverse effects. They are expected to improve the conservation role of the PCEs and ameliorate existing adverse effects, increasing survival of listed species enough to support a trend towards recovery.

Estuary Habitat Actions proposed for 2007 to 2009 and 2020 to 2017 are expected to further increase and improve shallow water rearing habitat. Moreover, the Action Agencies will continue to implement actions that include protecting and restoring riparian areas, protecting remaining high-quality off-channel habitat, breaching or lowering dikes and levees and installing fish-friendly tide gates to improve access to off-channel habitat, and reducing noxious weeds,. As research and monitoring activities continue to improve the understanding of ecosystem interactions in the estuary, the Action Agencies will be better able to target the amount and types of habitat that would help improve further the intended conservation role of the PCEs (see Appendix B.2.6 of the FCRPS BA for additional details on research and monitoring activities).

Prospective improvements in lifecycle survival attributable to the Estuary Habitat Actions is about 4 percent for stream type fish and about 7 percent for ocean-type fish (Comprehensive Analysis Chapter 12).

Table 19-14. Summary of Effects of the Proposed Estuary Habitat Actions on Essential Features of Designated Critical Habitat for Listed Snake River Salmon in the Columbia River Estuary

Essential Features	Snake River Sockeye Salmon	Snake River Spring/Summer Chinook Salmon	Snake River Fall Chinook Salmon
Spawning and juvenile rearing areas	NA	NA	E+
1) spawning gravel	-	-	-
2) water quality	-	-	E
3) water quantity	-	-	-
4) cover/shelter	-	-	E+
5) food	-	-	E+
6) riparian vegetation	-	-	E+
7) space	-	-	E+
8) access	-	-	E+
Juvenile migration corridors	E+	E+	E+
1) substrate	U	U	U
2) water quality	E	E	E
3) water quantity	-	-	-
4) water temperature	-	-	-
5) water velocity	-	-	-
6) cover/shelter	E	E	E
7) food	E	E	E
8) riparian vegetation	U	U	E
9) space	U	U	E+
10) safe passage conditions	E+	E+	E+
Areas for growth and development to adulthood	NA	NA	NA
Adult migration corridors			
1) substrate	-	-	-
2) water quality	-	-	-
3) water quantity	-	-	-
4) water temperature	-	-	-
5) water velocity	-	-	-
6) cover/shelter	-	-	-
7) riparian vegetation	-	-	-
8) space	-	-	-
9) safe passage conditions	E	E	E

Note: - = no effect or not applicable; E = effect (some effect is anticipated but may not be quantifiable), E+ = positive effect; U = uncertain if there would be an effect.

Table 19-15. Summary of Effects of Proposed Estuary Habitat Actions on PCEs of Designated Critical Habitat for Listed Salmon ESUs and Steelhead DPSs in the Columbia River Estuary

PCEs	SR Steelhead	UCR Spring Chinook Salmon	UCR Steelhead	MCR Steelhead	LCR Chinook Salmon	LCR Steelhead	CR Chum Salmon	UWR Chinook Salmon	UWR Steelhead
Freshwater spawning sites	-	-	-	-	-	-	E+	-	-
Water quality	-	-	-	-	-	-	E+	-	-
Water quantity	-	-	-	-	-	-	E+	-	-
Spawning substrate	-	-	-	-	-	-	U	-	-
Freshwater rearing sites	-	-	-	-	E+	-	E+	-	NA
Water quantity	-	-	-	-	-	-	E+	-	-
floodplain connectivity	-	-	-	-	E	U	E+	E	U
Water quality	-	-	-	-	E	U	E+	E	U
Forage	-	-	-	-	E+	U	U	E	U
natural cover	-	-	-	-	E+	U	E+	E	U
Freshwater migration corridors	-	-	-	-	E	E	E	E	E
Water quantity	-	-	-	-	-	-	-	-	-
Water quality	-	-	-	-	-	-	-	-	-
natural cover	-	-	-	-	E	E	E	E	E
Estuarine areas	E+	E+	E+	E+	E+	E+	E+	E+	E+
Water quality	E	E	E	E	E	E	E+	E	E
Water quantity	-	-	-	-	-	-	E+	-	-
Salinity	U	U	U	U	U	U	U	U	U
natural cover	E	E	E	E	E	E	E+	E	E
Juvenile and adult forage	E+	E+	E+	E+	E+	E+	E+	E+	E+

Note: NA or - = not applicable; E = effect (although magnitude may be unknown); E+ = positive effect; U = uncertain; N = no effect; SR = Snake River; LCR = Lower Columbia River; UCR = Upper Columbia River; MCR = Mid Columbia River; CR = Columbia River; UWR = Upper Willamette River

Nature, Distribution, Magnitude, Duration, Timing, Intensity, Frequency, and Proximity of the Effects

Estuary Habitat Actions include the rehabilitation of off-channel rearing habitat, breaching dikes or using fish friendly tide gates to reconnect floodplains and side channels, restoration of riparian areas, acquisition of tidelands and other riparian habitats, and various other activities that will occur throughout the estuary and continue during the period of the BiOp. Project implementation will be phased. The projects are expected to improve the conservation value of the habitat for ESA-listed species.

The Estuary Habitat Actions will likely result in short-term localized disturbance and reduction of water quality at freshwater rearing sites and freshwater migration corridors, primarily through temporary increases in turbidity and possibly blocked access (due to the short-term presence of obstructions such as cofferdams or construction features) during project construction. In-water work is generally scheduled and conducted during recommended work windows when few or no listed fish are expected to be present to minimize impacts to listed species.

Resulting Trend of PCEs

The long-term effects of the Estuary Habitat Actions will be an overall improvement in the conservation value of designated critical habitat in the estuary. The PCE of estuarine areas free of obstructions will be improved with additional areas being made accessible and improved quantity and quality of aquatic vegetation, natural cover in side-channels, wetlands and shallow water in the main channel, and forage from both plant and invertebrate production. These improvements are expected to reduce predation and contribute to increased growth potential for juvenile salmonids in the estuary. The Habitat Actions are not expected to affect PCEs used by adult salmon during their migration through the estuary.

Recent habitat actions in the estuary (2000 to 2006) provided an array of habitat improvements ranging from providing unrestricted fish passage to quality habitat, acquiring and protecting off-channel and side channels and riparian habitats, restoring access to historical floodplain by breaching dikes, removing culverts, installing fish friendly tide gates and other actions described in the Estuary Habitat section. These actions have incrementally improved the conservation value of essential features and PCEs of designated critical habitat for ESA-listed salmon and steelhead in the estuary.

The short-term and long-term Estuary Habitat Actions planned by the Action Agencies are expected to further increase and improve shallow-water rearing and migration habitat. The Action Agencies will continue to implement actions such as protecting and restoring riparian areas, protecting remaining high quality off-channel habitat, breaching or lowering dikes and levees and installing fish-friendly tide gates to improve access to off-channel habitat, and reducing noxious weeds, among others. As the estuary studies continue to improve our understanding of ecosystem interactions in the estuary, the Action Agencies will be better able to target the amount and types of habitat that would help improve further the conservation value of the PCEs to benefit the critical habitat of listed species.

Degree to which the Effects of the Estuary Habitat Actions are Degrading Factors that are Already Limiting the Conservation Value of Designated Critical Habitat within the Action Area

Impaired juvenile passage and lack of estuarine rearing habitat have been identified as factors limiting survival and recovery of Columbia and Snake river listed salmon and steelhead. The Actions are expected to directly improve the PCE of safe passage, quantity and quality of rearing habitat, and improve the conservation value of critical habitat.

19.4.3.5 Other Mainstem Actions -- Northern Pikeminnow Management

Summary of the Actions

As part of the FCRPS Proposed RPA, the Action Agencies propose to continue implementation of the base Northern Pikeminnow Management Program (NPMP) that began in 1990. In addition, the Action Agencies propose to continue implementation of the increased reward schedule implemented in 2004. Average exploitation rates (the percentage of the targeted size fish annually removed) in the NPMP, including the increased emphasis on the NPMP in 2001 and 2004 to 2006, have averaged approximately 11 percent for the last 16 years. The observed exploitation rate on pikeminnow since increasing the monetary incentives has averaged 18 percent, an over 50 percent improvement. The increase above the baseline is above the base benefits assumed in the analyses at present. The marginal benefit of any increase in exploitation rate resulting from increases in program incentives should be separate and above base-period benefits.

Beneficial and Adverse Effects of the Proposed Predation Management Actions

The Action Agencies continued implementation of a general increase in the reward structure for northern pikeminnow has increased the percentage of the targeted size pikeminnow removed from the mainstem Snake and Columbia rivers. This reduction of the number of larger, predatory pikeminnow throughout the Columbia and Snake rivers directly improves the survival of outmigrating juvenile salmon and steelhead by about 1 percent. The proposed Predation Management Actions for northern pikeminnow will primarily improve the conservation value and PCE of safe passage in the migration corridor for both yearling and subyearling migrants. Although the Actions proposed provide additional mitigation for previous adverse effects, they do not completely offset the existing adverse effects. They are expected to improve the conservation role of the PCEs and ameliorate existing adverse effects, increasing survival of listed species enough to support a trend towards recovery.

Nature, Distribution, Magnitude, Duration, Timing, Intensity, Frequency, and Proximity of the Effects

Juvenile salmonids are the major dietary component of northern pikeminnow greater than 250 millimeter (mm) fork length. The importance of salmonids in the diet of northern pikeminnow does vary seasonally; however, all migrating juvenile salmonids receive benefit from the long-term NPMP.

Resulting Trend of PCEs

The essential habitat features and PCEs affected by the Predation Management Actions for northern pikeminnow are expected to be affected in a positive way, with no adverse effect. Specifically, reduction in the numbers of the larger, predatory pikeminnow is expected to improve safe passage.

Degree to which the Effects of the Actions are Degrading Factors that are Already Limiting the Conservation Value of Designated Critical Habitat within the Action Area

Predation by fish, birds, and marine mammals has been identified as a key factor limiting survival and recovery of Columbia and Snake river ESA-listed salmon and steelhead. The proposed Predation Management Actions for northern pikeminnow are expected to directly improve the conservation value and safe passage PCEs by reducing the number of large pikeminnow that consume migrating juvenile salmonids.

The proposed Predation Management Actions for northern pikeminnow are expected to provide a lifecycle improvement in survival of about one percent and over the long term would provide a benefit to safe passage for juvenile outmigrants of listed ESUs. The implementation of the NPMP will therefore contribute to and improve safe passage for juvenile migrants and support a trend toward recovery.

19.4.3.6 Other Mainstem Actions -- Caspian Tern Management

Summary of Proposed Predation Management Actions for Caspian Tern

The Caspian tern management plan calls for redistributing the tern population in the lower Columbia River by creating or enhancing nesting habitat at six alternate sites in Oregon and California and reducing nesting habitat on East Sand Island as the alternate sites are developed. The amount of nesting habitat remaining on East Sand Island will range from 1.5 to 2 acres.

It is expected that by reducing the Caspian tern population in the estuary, predation on outmigrating juvenile listed salmon and steelhead will be reduced, contributing to and improving the conservation value of the safe passage essential feature and PCE for rearing and migrating juvenile salmonids in the estuary, especially stream-type fish that migrate in the deeper water channels near islands with breeding bird colonies.

Beneficial and Adverse Effects of the Actions

The estimated beneficial and/or adverse effects of the proposed Predation Management Actions for Caspian terns range from 0.7 to 3.4 percent survival improvement, as indicated by the prospective lifecycle improvements in the biological analyses. The prospective lifecycle improvements are a reflection of the improved conservation value of the critical habitat. The Action is expected to affect the PCE of safe passage in the migration corridor. Although the proposed Actions provide additional mitigation for previous adverse effects, they do not completely offset the existing adverse effects. They are expected to improve the conservation role of the PCEs and ameliorate existing adverse effects, increasing survival of listed species enough to support a trend towards recovery.

Nature, Distribution, Magnitude, Duration, Timing, Intensity, Frequency, and Proximity of the Effects

Implementing the proposed Predation Management Actions for Caspian terns will substantially reduce or eliminate the number of Caspian terns in the estuary resulting from a redistribution of the colony. This reduction in numbers is expected to provide long-term reduction in avian predation for most ESUs migrating through the estuary. The reduction in avian predation is expected to improve the survival of yearling juvenile steelhead outmigrants in the estuary by up to 3.4 percent, 1 percent for subyearling migrants, 2.1 percent for Snake River Spring/Summer Chinook Salmon, and 7.8 percent for Lower Columbia River Coho Salmon. The improved survival of ESA-listed salmon and steelhead would reflect an improvement in the conservation value of the safe passage essential feature and PCE of critical habitat.

Resulting Trend of PCEs

The essential habitat features and PCEs affected by the Predation Management Actions for Caspian terns are expected to be affected in a positive way, with little or no downside. Any disturbances will be to upland habitat used by the birds, and not salmonids. Reduction in avian predation is expected to improve safe passage for juvenile migrants, and improve the conservation value of critical habitat. Improved lifecycle survival from implementation of the Caspian tern management plan improves safe passage for juvenile migrants.

19.4.3.7 Degree to which the Effects of the Proposed Predation Management Actions for Caspian Terns are Degrading Factors that are Already Limiting the Conservation Value of Designated Critical Habitat within the Action Area

The proposed Predation Management Actions for Caspian terns are not expected to adversely affect any essential features of habitat or PCEs that have been identified by NMFS as limiting factors to the survival or recovery of the ESA-listed Snake and Columbia river species. To the contrary, impaired juvenile passage survival has been identified as an important factor limiting survival and recovery of Columbia and Snake river listed salmon and steelhead, and the Actions are expected to directly improve the PCE of safe passage, and improve the conservation value of critical habitat.

19.4.4 Tributary Habitat

This section of the critical habitat analysis summarizes the likely effects of the proposed Tributary Habitat Actions on essential features and PCEs provided by tributary habitat. These Actions are expected to affect both adult and juvenile listed species as they spawn, rear, and migrate. The habitat features or PCEs expected to be affected are cover/shelter, riparian vegetation, space, access, water quality, water quantity, and safe passage to the extent that Tributary Habitat Actions provide a safer migration route in the tributaries.

19.4.4.1 Summary of the Proposed Tributary Habitat Actions

The objective of the proposed Tributary Habitat Actions is to protect and improve mainstem tributary habitat, including side-channels and floodplains used for spawning, rearing, and migration. The Action Agencies will implement actions designed to address the factors limiting the conservation value of essential features and PCEs.

The primary types of actions proposed to address limiting factors include:

- Increase streamflow through water acquisitions,
- Address entrainment through screening,
- Provide fish passage and access,
- Improve mainstem and side channel habitat conditions,
- Protect and enhance riparian conditions, and
- Improve water quality.

The Action Agencies proposed Tributary Habitat Actions include the following:

- Broaden the geographic scope of the actions consistent with the scope of the 2000 and 2004 BiOps to include ESUs and populations with greatest biological need based on most current science;
- Make commitments to address key limiting factors to make progress toward meeting habitat quality improvement targets for ESA-listed anadromous fish;
- Identify specific projects for implementation in 2007 to 2009, including opportunities to provide additional habitat improvements to improve habitat quality for specific populations of upper Columbia, Snake River, and Mid-Columbia ESUs; and
- For 2010 to 2017, the Action Agencies propose to continue the broadened scope of the tributary habitat program and to target populations with low productivity where habitat potential exists

(those with highest biological need) and to achieve commitments to improved habitat quality by 2017.

A more detailed description of the actions can be found in Appendix B.2.2 of the FCRPS BA. Criteria for prioritizing projects will be consistent with recovery plan implementation and with the Council process.

19.4.4.2 Beneficial and Adverse Effects of the Actions, including any Proposed Mitigation, on PCEs

The FCRPS proposed Tributary Habitat Actions will improve the freshwater spawning, rearing, and migration PCEs and safe passage and water quantity, and water quality essential features of designated critical habitat for ESA-listed salmon and steelhead. For example, Reclamation's proposed Action of securing streamflow through water purchase or lease will aid both juvenile and adult migration, and improve rearing habitat and water quality by improving water quantity.

The FCRPS Proposed RPA involving screening of irrigation diversions to current criteria will reduce entrainment and contributes to safe passage. Providing access at irrigation diversions by replacing culverts and replacing permanent or temporary irrigation diversion structures that block access with more permanent structures designed, constructed, and operated to provide fish passage improves safe passage and access to additional spawning and rearing habitat. Although the proposed Actions provide additional mitigation for previous adverse effects, they do not completely offset the existing adverse effects. They are expected to improve the conservation role of the PCEs and ameliorate existing adverse effects, increasing survival of listed species enough to support a trend towards recovery.

Improving and restoring channel complexity by remediating for levees, dikes, and culverts to rehabilitate current channel conditions or re-establish natural channel-forming processes, and reconnecting side-channels and floodplains to the main channel of tributary rivers improves juvenile and adult migration and spawning and rearing PCEs, and can also improve water quality and quantity. Riparian protection and enhancement actions such as planting vegetation, fencing livestock, and remediating channel crossings improves spawning, rearing, and migration and can improve water quality and quantity. The extent of benefits from these improvements varies by each population for each species as described in the Tributary Habitat Actions.

The Action Agencies will provide funding or technical assistance for tributary habitat projects for the 2007 to 2009 period that addresses the majority of populations of listed ESUs throughout the Columbia River Basin. For example, the Columbia River Basin Water Transactions Program (CRBWTP) funded by BPA (project no. 200201301) and implemented through the Council provides $3.5 million per year for 2007 to 2009 for water acquisitions and riparian easements in areas used by anadromous fish in the Columbia River Basin. Some examples for these selected populations with particularly acute biological needs are discussed below.

Tributary Habitat Actions can result in relatively short-term disturbance and reduction of water quality at freshwater rearing sites and freshwater migration corridors, primarily through temporary increases in turbidity and possibly blocked access (due to the short-term presence of obstructions such as cofferdams or construction features) during project construction. Effects of Tributary Habitat Actions are mitigated through individual consultation with the Federal regulatory agencies, site-specific permits, and in-water work is generally scheduled and conducted during recommended work windows when few or no fish are expected to be present to minimize impacts to listed species.

19.4.4.3 Nature, Distribution, Magnitude, Duration, Timing, Intensity, Frequency, and Proximity of the Effects

Implementation of the proposed Tributary Habitat Actions is expected to improve spawning and juvenile rearing areas, juvenile migration corridors, and adult migration corridors for Snake River Spring/Summer Chinook Salmon and freshwater spawning and rearing sites and freshwater migration corridors for Upper Columbia River Spring Chinook Salmon and Snake River, Upper Columbia, and Mid-Columbia River Steelhead over the long term. For example, BPA project no. 200703400 was established to improve fish passage by screening diversions to reduce entrainment to and improve safe passage for Methow, Entiat, and Wenatchee populations of Upper Columbia River Steelhead and Spring Chinook Salmon. BPA project no. 199202601 (plus additional funding commitment above 2007-2009 Council solicitation process funding) targets improving safe passage by remediating barriers for the Catherine Creek and Upper Grande Ronde populations of Snake River Spring/Summer Chinook Salmon. BPA project no. 199604200 (plus additional funding commitment above 2007-2009 Council solicitation process funding) will restore channel complexity to Salmon Creek to benefit spawning and rearing habitat and water quantity in Salmon Creek for the Okanogan population of Upper Columbia River Steelhead.

BPA project nos. 198402500 and 199202601 (plus additional funding commitment above 2007-2009 Council solicitation process funding) provide funding to protect and enhance riparian conditions that improve spawning and rearing habitat and can improve water quality for the upper Grande Ronde and Catherine Creek populations of Snake River Spring/Summer Chinook Salmon. Actions that improve passage or reduce entrainment provide immediate benefits in the near term. Channel complexity and riparian protection and enhancement actions accrue benefits to listed salmon and steelhead essential features and PCEs of designated critical habitat that continue to increase for many years into the future and support a trend toward recovery.

BPA is funding a project to remove the Hemlock Dam on Trout Creek, a tributary of the Wind River. This project will restore unimpeded fish passage (safe passage) and improve water quality and habitat for adult and juvenile Lower Columbia Steelhead.

Another project, 199802100 Hood River Fish habitat will improve habitat for Lower Columbia River Coho Salmon, and Lower Columbia Spring Chinook and Steelhead. This project will restore channel complexity, install fences, and plant vegetation which will improve spawning and rearing habitat and water quality. It will also remove obstructions to fish passage and will make passage safer for the targeted adult and juvenile fish.

19.4.4.4 Resulting Trend of PCEs

As tributary habitat projects continue to be implemented, the PCEs are expected to assume a positive trend as indicated in Tables 19-16 and 19-17. Some relatively temporary habitat effects may occur as a result of implementation or construction of Tributary Habitat Actions; these effects are controlled via site specific permits as discussed under 19.4.4.2.

19.4.4.5 Degree to Which the Effects of the Proposed Tributary Habitat Actions are Degrading Factors that are Already Limiting the Conservation Value of Designated Critical Habitat within the Action Area

Proposed Tributary Habitat Actions are expected to improve, not degrade, factors that are limiting the conservation value of designated critical habitat within the action area. The specific Actions that address entrainment, improving mainstem and side channel habitat conditions, and protecting and enhancing

Table 19-16. Summary of Effects of the Proposed Tributary Habitat Actions on Essential Features of Designated Critical Habitat for Listed Snake River Salmon ESUs in Snake River Tributaries

Essential Features	Snake River Sockeye Salmon	Snake River Spring/Summer Chinook Salmon	Snake River Fall Chinook Salmon
Spawning and juvenile rearing areas	NA	E+	NA
1) spawning gravel		U	
2) water quality		E+	
3) water quantity		E+	
4) cover/shelter		E+	
5) food		E+	
6) riparian vegetation		E+	
7) space		E+	
8) access		E+	
Juvenile migration corridors			NA
1) substrate			
2) water quality			
3) water quantity			
4) water temperature			
5) water velocity			
6) cover/shelter			
7) food			
8) riparian vegetation			
9) space			
10) safe passage conditions	E+	E+	
Areas for growth and development to adulthood	NA	NA	NA
Adult migration corridors			NA
1) substrate			
2) water quality		E+	
3) water quantity		E+	
4) water temperature		E+	
5) water velocity		E+	
6) cover/shelter		E+	
7) riparian vegetation		E+	
8) space			
9) safe passage conditions	E+	E+	

Note: NA = not applicable; E+ = positive effect; U = uncertain;

Table 19-17. Summary of Effects of FCRPS Proposed Tributary Habitat Actions on PCEs of Designated Critical Habitat for Listed Salmon ESUs and Steelhead DPSs in Snake and Columbia River Tributaries

PCEs	SR Steelhead	UCR Spring Chinook Salmon	UCR Steelhead	MCR Steelhead	LCR Chinook Salmon	LCR Steelhead	CR chum Salmon	UWR Chinook Salmon	UWR Steelhead
Freshwater spawning sites	E+	E+	E+	E+	NA	NA	NA	NA	NA
Water quality									
Water quantity									
Spawning substrate									
Freshwater rearing sites	E+	E+	E+	E+	NA	NA	NA	NA	NA
water quantity									
floodplain connectivity									
water quality									
forage									
natural cover									
Freshwater migration corridors	E+	E+	E+	E+	NA	NA	NA	NA	NA
water quantity									
water quality									
natural cover									
Estuarine areas	NA	NA	NA	NA	NA	NA	NA	NA	NA
water quality									
water quantity									
salinity									
natural cover									
juvenile and adult forage									

Note: NA = not applicable; E+ = positive effect; CR = Columbia River; LCR = Lower Columbia River; MCR = Mid Columbia River; SR = Snake River; UCR = Upper Columbia River; UWR = Upper Willamette River riparian conditions are expected to improve directly the conservation value of the PCEs of freshwater spawning and rearing area. The actions of improving streamflow through water acquisitions and providing fish passage and access are expected to improve the conservation value of freshwater migration.

19.5 CUMULATIVE EFFECTS

Cumulative effects, as defined in 50 CFR Section 402.02, “are those effects of future state or private activities, not involving Federal activities that are reasonably certain to occur within the action area.” Future Federal actions require separate consultations pursuant to Section 7 of the ESA and are considered separately.

The States and Tribes participating in the BiOp Remand Collaboration Process are implementing a range of salmon restoration and recovery activities. All parties to the Remand Process wanted to identify and account for those State and Tribal actions. Therefore, the BiOp Remand Framework provided that the effects of the FCRPS Proposed RPA would be combined with the effects of the non-Federal actions, or the cumulative effects, referred to as reasonably certain to occur non-Federal actions.

The States of Washington, Oregon, and Idaho provided extensive information on their recovery actions that were reasonably certain to occur in areas where ESA-listed salmonids affected by the FCRPS are present. These mainly include non-Federal actions involving, for example, fish passage improvements, habitat restoration, screening of water supply intakes, best management practices (BMPs), water quality improvements, and culvert replacement, and will likely positively affect recovery efforts in the FCRPS. The Action Agencies have evaluated this information described in detail in Chapter 17 and included the qualitative effects of these reasonably certain to occur actions in the biological analyses for each of the affected listed ESUs.

The State of Idaho has habitat-related activities in 10 watersheds separated into three categories: screening program, state habitat projects, and projects on private lands. These projects are expected to benefit Snake River Spring/Summer Chinook Salmon and Snake River Steelhead.

The State of Washington has identified existing and expected projects in 14 watersheds that likely affect salmon or steelhead in the FCRPS. These projects are expected to benefit Snake River Spring/Summer Chinook Salmon, Snake River Steelhead, Upper Columbia River Spring Chinook Salmon, Upper Columbia River Steelhead, Middle Columbia River Steelhead, Lower Columbia River Chinook Salmon, Lower Columbia River Steelhead, Lower Columbia River Coho Salmon, and Lower Columbia River Chum Salmon.

The State of Oregon categorizes the existing or reasonably certain to occur information in eight watersheds in comprehensive programs and specific habitat strategies. Comprehensive State and Federal programs are likely to positively affect salmon and steelhead recovery efforts in the FCRPS. These programs are described by recovery area, population, limiting factor/effect on fish or habitat, management strategy, agency and program. Specific habitat management strategies and actions exist or will be conducted that are expected to affect salmon and steelhead in the FCRPS in a positive way.

Refer to the cumulative effects section in Chapter 17 for more detail.

19.6 CONCLUSIONS (RANGE-WIDE)

The following section presents conclusions regarding critical habitat for each of the listed species of Columbia River Basin salmonids. For each of the listed species the Action Agencies have considered the combined effects of the environmental baseline, the FCRPS Proposed RPA and Upper Snake River PA, and cumulative effects on the conservation value of critical habitat, emphasizing the degree to which factors limiting recovery are addressed. The standard for judging whether adverse modification of critical habitat has been avoided is reaching a conclusion that critical habitat remains functional or at least retains the current ability for the PCEs to become functionally established and serve the intended conservation role for the species.

In addition, in reaching these conclusions the Action Agencies have explicitly considered the potential for short-term negative effects of the FCRPS Proposed RPA and Upper Snake River PA in the context of the species' lifecycle and migration patterns and have determined that the prospects for short-term survival are high, and that the species'continued survival are not jeopardized by the proposed Actions. In addition, we have been careful not to rely on uncertain long-term improvements to offset short-term degradation within the action areas. The evaluation of whether critical habitat is sufficient for the purposes of recovery is based, in part, on the population level biological analyses contained within chapters 4 to 16 of the Comprehensive Analysis, which indicate that the prospective improvements in lifecycle survival anticipated to follow the Hydro, Habitat, and Predation Management Actions will support survival and a trend toward recovery. Also considered are recent year adult returns and the substantial efforts by the states to implement habitat improvement projects for salmon and steelhead (as described in Chapter 17, Cumulative Effects).

In drawing these conclusions, the Action Agencies acknowledge that the hydropower projects, mainstem effects of Reclamation's projects, and storage and diversion of water in the upper Snake River, along with other activities, have adversely affected the conservation role of some aspects of freshwater spawning, rearing, and migration habitat for ESA-listed species of Columbia River Basin salmon and steelhead. The past adverse effects of these actions have been mitigated to some degree by numerous measures implemented by Action Agencies over the last decade or more. Although the Actions proposed by the Action Agencies in the Biological Assessments provide additional mitigation for previous adverse effects, they do not completely offset the existing adverse effects. They are expected to improve the conservation role of the PCEs and ameliorate existing adverse effects, increasing survival of listed species adequate to support a trend towards recovery.

19.6.1 Snake River Spring/Summer Chinook Salmon

The existence, operation, and maintenance of the FCRPS dams, the mainstem effects of Reclamation's projects in the Columbia River Basin, the operation of Reclamation's Upper Snake River projects, and other mainstem actions have adversely affected some aspects of critical habitat (e.g., safe passage) of Snake River Spring/Summer Chinook Salmon in the mainstem migration corridor. However, the proposed actions for ESA-listed fish are expected to reduce this negative impact.

The FCRPS Proposed RPA and Upper Snake River PA are expected to have both positive and negative effects on the conservation role of safe passage for outmigrating juvenile fish. The positive effects result primarily from actions that improve mainstem passage conditions (spill and surface passage improvements) and thus reduce mortality through the hydropower system, and are based in part on an estimated 8.2 percent improvement in lifecycle survival from the current (COMPASS modeling results, Aug. 6, 2007).

There are negative effects attributable to flow depletions from Reclamation's Upper Snake River PA that leave less water in the Snake River below Hells Canyon Dam; Snake River Spring/Summer Chinook Salmon enter the mainstem action area at the mouth of the Salmon River. FCRPS and upper Snake River flow augmentation, coupled with other measures, are expected to improve the conservation role of safe passage. Increased flow is expected to provide lower water temperatures particularly from Dworshak Reservoir and slightly reduce juvenile travel time. Water temperature in the Snake River in the action area remains below 20°C until about the end of June above Lower Granite Reservoir; the yearling juvenile outmigration peaks at Lower Granite Dam about the first week in May and is essentially completed by the middle of June. Therefore, water temperature would remain functional to serve its intended conservation role.

The conservation role of the adult upstream migration corridor is functional and is expected to improve due to the hydro configuration and water management components of the proposed FCRPS Hydro Actions. Neither the proposed FCRPS Hydro Actions nor Reclamation's Upper Snake River PA will affect the conservation role of spawning and juvenile rearing areas essential features of critical habitat for Snake River Spring/Summer Chinook Salmon because, for this ESU, these essential features are found in the tributaries rather than the mainstem.

The proposed FCRPS Predation Management Action of continuing the NPMP and implementation of the preferred alternative in the Caspian Tern EIS (USFWS 2005) (affecting predation in the estuary) are expected to improve the PCE of safe passage. Combined, both programs are expected to reduce predation by 3.1 percent from the current (Comprehensive Analysis Chapter 5).

The proposed FCRPS Estuary Habitat Actions including rehabilitation of off-channel habitat, improved management of riparian habitat, and restored floodplain connectivity are expected to benefit critical habitat for this ESU by improving and increasing the conservation role of rearing habitat, cover and shelter, riparian conditions, and food availability. The total estuary survival benefit from the numerous estuarine actions is estimated to be a 6 percent improvement in lifecycle survival from the current. From a biological diversity perspective, the availability of diverse and functioning habitat in the estuary is expected to improve the expression of a full range of life history variation.

The proposed FCRPS Tributary Habitat Actions consist of a range of flow, screening diversions, providing access, channel complexity, riparian protection, and enhancement measures that are expected to improve the conservation role of spawning and juvenile rearing areas by making short- and long-term improvements in water quality and quantity, cover/shelter, and riparian vegetation. Improvements as estimated from the prospective relative lifecycle survival adjustment range from < 1 to 41 percent from the current for 14 Snake River Spring/Summer Chinook Salmon populations. Juvenile migration corridors as well as rearing areas will benefit from the screening of diversions and channel complexity actions. A reduction in water quality due to an increase in sediment may briefly occur during construction of improvements at diversions or channel complexity actions, but is not expected to reduce the function of critical habitat. These short-term effects would be the subject of site-specific consultations and permit processes that reduce or eliminate impacts to listed species. The conservation role of safe passage in adult migration corridors should improve as water quantity, and water quality improve. These improvements are expected to increase the quantity and quality of spawning and rearing habitat.

All of the proposed actions for ESA-listed species are intended to improve the survival and enhance the recovery potential of listed salmonids. The actions proposed in the biological assessments and discussed here and in Chapter 5, address the following limiting factors for this ESU identified by NMFS (2005i):

- Mainstem lower Snake and Columbia hydropower system mortality,
- Reduced tributary stream flow,
- Altered tributary channel morphology,
- Excessive sediment in tributaries, and
- Degraded tributary water quality.

As discussed in Chapter 17 (Cumulative Effects) Washington, Oregon, and Idaho all report habitat improvement efforts that will improve conditions for Snake River Spring/Summer Chinook Salmon. Actions by other Federal agencies (Chapter 18) are also expected to improve habitat conditions for this species.

Given the range-wide status of critical habitat, the effects of the FCRPS Proposed RPA and Upper Snake River PA, the environmental baseline, and cumulative effects, the PCE most affected, safe passage, is expected to function adequately during the juvenile and adult migration period to serve the intended conservation role for the species.

19.6.2 Snake River Fall Chinook Salmon

The existence, operation, and maintenance of the FCRPS dams, the mainstem effects of Reclamation's projects in the Columbia River Basin, the operation of Reclamation's Upper Snake River projects, and other mainstem actions have adversely affected some aspects of critical habitat of Snake River Fall Chinook Salmon in the mainstem. The Proposed RPA and Upper Snake River PA for ESA-listed fish are expected to reduce this negative impact.

Critical habitat for Snake River Fall Chinook Salmon below the Hells Canyon Complex has been adversely affected by the flow depletions resulting from the Upper Snake River projects (and other causes) and is expected to continue to be adversely affected in the future with the proposed Actions. Depletions attributable to Reclamation's Upper Snake River projects is about 2 million acre-feet annually, or about a 14 percent change in annual inflow to Brownlee Reservoir and about 2 percent of the annual flow at McNary Dam. The percent change diminishes progressively downstream. Chapter 3 of the Upper Snake River Projects BA (Reclamation 2007) provides additional information on Snake River hydrology. Measures are in place to maintain adequate flow below Hells Canyon Dam during Snake River Fall Chinook Salmon spawning and incubation. FCRPS and upper Snake River flow augmentation are expected to improve the conservation role of rearing and safe passage. Upper Snake River flow augmentation affects river flows beginning at the toe of Hells Canyon Dam. Early rearing for those fish that spawn immediately downstream from Hells Canyon Dam should not be affected by the FCRPS proposed Hydro Actions until the rearing and migrating juveniles move downstream and encounter the upstream-most reservoir in the FCRPS. Some of the FCRPS Proposed RPA and Upper Snake River PA actions are intended to ameliorate warm water conditions during critical periods.

Further downstream the FCRPS proposed Hydro Actions are expected to have both positive and negative effects on the conservation role of spawning and juvenile rearing areas as well as safe passage for outmigrating juvenile fish, the former by improving in-river rearing and passage conditions and thus reducing mortality through the hydropower system. The estimated change in subyearling salmon survival as a result of implementing the proposed configuration and operation changes at all FCRPS hydropower projects except McNary Dam range from 0.1 to 7.1 percent; at McNary Dam it ranges from -0.2 to 0.2 percent (Table 19-13). The juvenile subyearling outmigration peaks in early June and tapers off into July and is essentially complete by the end of July about the time water temperatures exceed 20°C; some of those juveniles still in the river tend to hold up as water temperature increases beyond 20°C. It is possible that some of these fish adopt the newly described "reservoir-type" life history strategy.

Spawning and early rearing for those fish that spawn in the Clearwater River downstream from Dworshak Dam will be affected by water management hydro actions. The conservation role of the adult upstream migration corridor is functional and is expected to improve due to the hydro configuration and water management components of the proposed FCRPS Hydro Actions.

The FCRPS proposed Predation Management Action of continuing the NPMP and implementation of the preferred alternative in the Caspian Tern EIS (affecting predation in the estuary) are expected to improve the PCE of safe passage. Combined, both programs are expected to reduce predation by 1.7 percent on this ESU from the current (Comprehensive Analysis Chapter 4).

The FCRPS proposed Estuary Habitat Actions including rehabilitation of off-channel habitat, improved management of riparian habitat, and restored floodplain connectivity are expected to benefit critical habitat for this ESU by improving and increasing the conservation role of rearing habitat, cover and shelter, riparian conditions, and food availability. The total ocean-type estuary survival benefit from the numerous Estuary Habitat Actions is estimated to be 9 percent improvement in lifecycle survival from the current (Comprehensive Analysis Chapter 4). From a biological diversity perspective, the availability of diverse and functioning habitat in the estuary is expected to improve the expression of a full range of life history variation.

The FCRPS Proposed RPA and Upper Snake River RPA are intended to improve the survival and enhance the recovery potential of listed salmonids. The Actions proposed in the Biological Assessments and discussed here and in Chapter 4, address the following limiting factors for this ESU identified by NMFS (2005i):

- Mainstem lower Snake and Columbia hydropower system mortality,
- Degraded water quality, and
- Reduced spawning/rearing habitat due to mainstem lower Snake River hydropower system.

Given the range-wide status of critical habitat, the effects of the FCRPS Proposed RPA and Upper Snake River PA, the environmental baseline, and cumulative effects, the PCEs most affected by this set of proposed actions, safe passage, water quality and quantity, and water temperature are expected to function adequately during spawning, rearing, and juvenile and adult migration to serve the intended conservation role for the species.

19.6.3 Snake River Sockeye Salmon

The existence, operation, and maintenance of the FCRPS dams, the mainstem effects of Reclamation's projects in the Columbia River Basin, the operation of Reclamation's Upper Snake River projects, and other mainstem actions have adversely affected some aspects of critical habitat of Snake River Sockeye Salmon in the mainstem migration corridor. However, the FCRPS Proposed RPA and Upper Snake River PA are expected to reduce this negative impact. Snake River Sockeye Salmon exist at low numbers and the ESU is in large part maintained by an artificial propagation program operated by the Idaho Department of Fish and Game. The program is one of the safety-net captive broodstock propagation programs described in the FCRPS BA.

There appears to be substantial mortality of juvenile sockeye salmon outmigrants from Redfish Lake to the point where juveniles enter the FCRPS action area at the mouth of the Salmon River, although FCRPS effects first occur at the confluence of the Snake and Clearwater rivers. Once in the mainstem Snake River, outmigrating sockeye salmon survival is assumed to be similar to that of Snake River Spring/Summer Chinook Salmon. Implementing the proposed configuration and operation changes at FCRPS hydropower projects is expected to improve juvenile sockeye salmon survival 8.2 percent from the current, based on an estimated lifecycle survival improvement (COMPASS modeling results for Snake River spring/summer Chinook salmon, Aug 6, 2007). Reclamation's Upper Snake River PA will result in flow depletions in the Snake River below Hells Canyon Dam; Reclamation's upper Snake River flow augmentation proposed action is expected to offset in part the adverse effect of flow depletions and improve the conservation role of safe passage in the Snake River mainstem. Increased flow is expected to reduce juvenile travel time. The proposed FCRPS Hydro Actions will have no effect on the conservation role of spawning and juvenile rearing areas essential feature of critical habitat for Snake River Sockeye Salmon because, for this ESU, these essential features are found in the tributaries above Redfish Lake and in the lake rather than in the mainstem. Some proportion of returning adults are incorporated into the safety-net captive broodstock propagation program.

The Predation Management Action of continuing the NPMP and implementation of the preferred alternative in the Caspian Tern EIS (affecting predation in the estuary) are expected to improve the essential feature of safe passage. Combined, both programs are expected to reduce predation by 3.1 percent on this ESU from the current (Comprehensive Analysis Chapter 6).

The proposed Estuary Habitat Actions including rehabilitation of off-channel habitat, improved management of riparian habitat, and restored floodplain connectivity, are expected to benefit critical habitat for this ESU by improving and increasing the conservation role of rearing habitat, cover and shelter, riparian conditions, and food availability. The total estuary survival benefit from the numerous estuarine actions is estimated to be a 6 percent improvement in lifecycle survival from the current. From a biological diversity perspective, the availability of diverse and functioning habitat in the estuary is expected to improve the expression of a full range of life history variation.

No FCRPS Actions are proposed in the tributaries above Redfish Lake where sockeye salmon spawn, so freshwater spawning sites are not affected by the FCRPS Proposed RPA. Also, because sockeye salmon rear in the lake, their rearing habitat is not affected. Outmigrating sockeye salmon smolts would benefit from any Federal or non-Federal actions that improve conditions in the migration corridor in the main Salmon River. Juvenile migration corridors will benefit from increased screening of diversions and channel complexity actions.

All of the proposed Actions for ESA-listed species are intended to improve the survival and enhance the recovery potential of listed salmonids. The actions proposed in the biological assessments and discussed here and in Chapter 6, address the following limiting factors for this ESU identified by NMFS (2005i):

- Mainstem lower Snake and Columbia hydropower system mortality,
- Reduced tributary stream flow, and
- Impaired tributary passage and blocks to migration.

Given the range-wide status of critical habitat, the effects of the FCRPS Proposed RPA and Upper Snake River PA, the environmental baseline, and cumulative effects, and considering the fact that this species is maintained in large part by a safety-net captive broodstock propagation program, the essential feature most affected by this suite of proposed actions, safe passage, is expected to function adequately during juvenile and adult migration to serve the intended conservation role for the species.

19.6.4 Snake River Steelhead

The existence, O&M of the FCRPS dams, the mainstem effects of Reclamation's projects in the Columbia River Basin, the operation of Reclamation's Upper Snake River projects, and other mainstem actions have adversely affected some aspects of critical habitat of Snake River Steelhead in the mainstem migration corridor which begins at the confluence of the Snake and Salmon rivers, where these fish first enter the mainstem action area. However, the FCRPS Proposed RPA and Upper Snake River PA are expected to reduce this negative impact.

The estimated change in juvenile steelhead lifecycle survival as a result of implementing the proposed FCRPS Hydro Actions is -11.92 percent from the current (COMPASS modeling results, Aug. 6, 2007). Inriver migrating juvenile steelhead return as adults at low rates. Dam passage survival rates are generally very high for steelhead in comparison to other stocks. Juvenile transport operations also appear to favor steelhead compared to Chinook salmon. It appears that other factors such as Caspian tern predation near Crescent Island as well as possible residualization of the fish and harvest also negatively effect steelhead. Proposed FCRPS Hydro Actions overall are expected to improve safe passage in the migration corridor. Reclamation's Upper Snake River PA will result in flow depletions in the Snake River below Hells Canyon Dam; Snake River Steelhead first enter the FCRPS mainstem action area at the mouth of the Salmon River. FCRPS and upper Snake River flow augmentation are expected to improve the conservation role of safe passage. Increased flow is expected to provide lower water temperatures and reduce juvenile travel time. Water temperature in the Snake River in the action areas remains below 20°C until about the end of June above Lower Granite Reservoir; similar to Snake River Spring/Summer Chinook Salmon, the juvenile steelhead outmigration peaks at Lower Granite Dam about the first week in May and is essentially completed by the middle of June. Therefore, water temperature would remain functional to serve its intended conservation role.

The conservation role of the adult upstream migration corridor is expected to improve due to the hydro configuration and water management components of the proposed FCRPS Hydro Actions. The proposed Hydro Actions will have no effect on the conservation role of freshwater spawning sites and freshwater rearing sites PCEs of critical habitat for Snake River Steelhead because, for this DPS, these PCEs are found in the tributaries rather than the mainstem.

The proposed Predation Management Action of continuing the NPMP and implementation of the preferred alternative in the Caspian Tern EIS (affecting predation in the estuary) are expected to improve the PCE of safe passage. Combined, both programs are expected to reduce predation by 4.4 percent on this DPS from the current (Comprehensive Analysis for Snake River Steelhead, Chapter 7).

The FCRPS proposed Estuary Habitat Actions including rehabilitation of off-channel habitat, improved management of riparian habitat, and restored floodplain connectivity are expected to benefit critical habitat for this DPS by improving and increasing the conservation role of rearing habitat, cover and shelter, riparian conditions, and food availability. The total estuary survival benefit from the numerous estuarine actions is estimated to be a 6 percent improvement in lifecycle survival from the current. From a biological diversity perspective, the availability of diverse and functioning habitat in the estuary is expected to improve the expression of a full range of life history variation.

The proposed FCRPS Tributary Habitat Actions consist of a range of flow, screening diversions, providing access, channel complexity, riparian protection, and enhancement measures that are expected to improve the conservation role of spawning and juvenile rearing areas for Snake River Steelhead by making short- and long-term improvements in water quality and quantity, natural cover, and forage. Estimated lifecycle survival improvements range from < 1 to 17 percent from the current for 18 populations. The conservation role of freshwater migration corridors for juvenile fish will benefit from increased screening of diversions and channel complexity actions. The conservation role of safe passage in tributary migration corridors for adult fish should improve as water quantity and temperature improve and as channel complexity and riparian enhancement actions become established.

The FCRPS Proposed RPA and the Upper Snake River PA are intended to improve the survival and enhance the recovery potential of listed salmonids. The actions proposed in the biological assessments and discussed here and in Chapter 7, address the following limiting factors for this DPS identified by NMFS (2005i):

- Mainstem lower Snake and Columbia river hydropower system mortality,
- Reduced tributary stream flow,
- Altered tributary channel morphology,
- Excessive sediment in tributaries, and
- Degraded tributary water quality.

As discussed in Chapter 17 (Cumulative Effects), Idaho and Oregon report habitat improvement efforts that will improve conditions for Snake River Steelhead. Actions by other Federal agencies (Chapter 18) are also expected to improve habitat conditions for this species.

Given the range-wide status of critical habitat, the effects of the FCRPS Proposed RPA and Upper Snake River PA, the environmental baseline, and cumulative effects, the PCEs most affected by this set of proposed actions, safe passage, water quality, and water quantity are expected to function sufficiently to serve the intended conservation role for the species.

19.6.5 Upper Columbia River Spring Chinook Salmon

The existence, operation, and maintenance of the FCRPS dams combined with the mainstem effects of Reclamation’s projects in the Columbia River Basin the operation of Reclamation’s Upper Snake River projects and other mainstem actions have adversely affected some aspects of critical habitat of Upper Columbia River Spring Chinook Salmon in the mainstem migration corridor. Upper Snake River effects are small compared to those for Snake River ESUs due to the relatively smaller contribution from Snake River flows as larger flows are encountered downstream. However, the FCRPS Proposed RPA and Upper Snake River PA are expected to reduce this negative impact.

The FCRPS Proposed RPA and Upper Snake River PA are expected to have both positive and negative effects on the conservation role of safe passage for outmigrating juvenile fish in the mainstem, the former by improving in-river passage conditions and thus reducing mortality through the hydropower system, based on an estimated 9.42 percent lifecycle survival improvement from the current (COMPASS modeling results, Aug. 6, 2007). The effect of flow depletions for Reclamation’s Upper Snake River PA in the Columbia River is comparatively small, estimated to be about 2 percent of the annual flow at McNary Dam.

FCRPS and Reclamation’s upper Snake River flow augmentation is expected to improve the conservation role of safe passage. The yearling outmigration peaks about the middle of May at McNary Dam and is essentially completed by about the middle of June, prior to when water temperatures approach and exceed 20°C. Therefore, water temperature would remain functional to serve its intended conservation role. The conservation role of the adult upstream migration corridor is expected to improve due to the hydro configuration and water management components of the proposed FCRPS Hydro Action.

The proposed FCRPS Hydro Actions will have no effect on the conservation role of freshwater spawning sites and freshwater rearing sites PCEs of critical habitat for Upper Columbia River Spring Chinook Salmon because, for this ESU, these PCEs are found in the tributaries rather than the mainstem. The proposed Predation Management Action of continuing the NPMP and implementation of the preferred alternative in the Caspian Tern EIS (affecting predation in the estuary) are expected to improve the PCE of safe passage (USFWS 2005). Combined, both programs are expected to reduce predation by 3.1 percent on this ESU from the current (Comprehensive Analysis, Chapter 8).

The FCRPS proposed Estuary Habitat Actions including rehabilitation of off-channel habitat, improved management of riparian habitat, and restored floodplain connectivity are expected to benefit critical habitat for this ESU by improving and increasing the conservation role of rearing habitat, cover and shelter, riparian conditions, and food availability. The total estuary survival benefit from the numerous estuarine actions is estimated to be a 6 percent improvement in lifecycle survival from the current (Comprehensive Analysis, Chapter 8). From a biological diversity perspective, the availability of diverse and functioning habitat in the estuary is expected to improve the expression of a full range of life history variation.

The proposed FCRPS Tributary Habitat Actions consist of a range of flow, screening diversions, providing access, channel complexity, riparian protection, and enhancement measures that are expected to improve freshwater spawning sites and freshwater rearing sites PCEs of critical habitat for Upper Columbia River Spring Chinook Salmon by improving water quality and quantity, natural cover, and forage. Improvements as estimated from the prospective relative lifecycle survival adjustment range from 3 to 22 percent from the current for three populations. Freshwater migration corridors for juvenile fish benefit from increased screening of diversions and channel complexity actions. Safe passage in tributary migration corridors for adult fish should improve as water quantity and temperature improve and as channel complexity and riparian enhancement actions become established.

The FCRPS Proposed RPA and the Upper Snake River PA are intended to improve the survival and enhance the recovery potential of listed salmonids. The actions proposed in the biological assessments and discussed here and Chapter 8, address the following limiting factors for this ESU identified by NMFS (2005i):

- Mainstem Columbia River hydropower system mortality,
- Tributary riparian degradation and loss of in-river wood,
- Altered tributary floodplain and channel morphology, and
- Reduced tributary stream flow and impaired passage.

As discussed in Chapter 17 (Cumulative Effects) Washington reported habitat improvement efforts that will improve conditions for Upper Columbia River Spring Chinook Salmon. Actions by other Federal agencies (Chapter 18) are also expected to improve habitat conditions for this species.

Given the range-wide status of critical habitat, the effects of the FCRPS Proposed RPA and Upper Snake River PA, the environmental baseline, and cumulative effects, the PCEs most affected by this set of proposed actions, safe passage, water quantity, and water quality are expected to function adequately to serve the intended conservation role for the species.

19.6.6 Upper Columbia River Steelhead

The existence, operation, and maintenance of the FCRPS dams, the mainstem effects of Reclamation's projects in the Columbia River Basin, the operation of Reclamation's Upper Snake River projects, and other mainstem actions have adversely affected some aspects of critical habitat of Upper Columbia River Steelhead in the mainstem migration corridor. Upper Snake River effects are small compared to those for Snake River ESUs due to the relatively smaller contribution from Snake River flows as larger flows are encountered downstream. The FCRPS Proposed RPA and Upper Snake River PA are expected to reduce this negative impact.

The FCRPS Proposed RPA and Upper Snake River PA are expected to have both positive and negative effects on the conservation role of safe passage for outmigrating juvenile fish in the mainstem, the former by improving in-river passage conditions and thus reducing mortality through the hydropower system, based on an estimated 12.46 percent lifecycle survival improvement from the current (COMPASS modeling results, Aug. 6, 2007). The effect of flow depletions for Reclamation's Upper Snake River PA in the Columbia River is comparatively small, estimated to be about 2 percent of the annual flow at McNary Dam. FCRPS and Reclamation's upper Snake River flow augmentation are expected to improve the conservation role of safe passage. The juvenile steelhead outmigration peaks about the third week of May at McNary Dam and is essentially completed by about the end of June, prior to when water temperatures approach and exceed 20°C. Therefore, water temperature would remain functional to serve its intended conservation role. The conservation role of the adult upstream migration corridor is expected to improve due to the hydro configuration and water management components of the FCRPS Proposed RPA and Upper Snake River PA.

The FCRPS proposed Hydro Actions will have no effect on the conservation role of freshwater spawning sites and freshwater rearing sites PCEs of critical habitat for Upper Columbia River Steelhead because, for this DPS, these PCEs are found in the tributaries rather than the mainstem.

The FCRPS proposed Predation Management Action of continuing the NPMP and implementation of the preferred alternative in the Caspian Tern EIS (affecting predation in the estuary) are expected to improve the PCE of safe passage. Combined, both programs are expected to reduce predation by 4.4 percent on this DPS from the current (Comprehensive Analysis, Chapter 9).

The FCRPS proposed Estuary Habitat Actions including rehabilitation of off-channel habitat, improved management of riparian habitat, and restored floodplain connectivity are expected to benefit critical habitat for this DPS by improving and increasing the conservation role of rearing habitat, cover and shelter, riparian conditions, and food availability. The total estuary survival benefit from the numerous estuarine actions is estimated to be a 6 percent improvement in lifecycle survival from the current. From a biological diversity perspective, the availability of diverse and functioning habitat in the estuary is expected to improve the expression of a full range of life history variation.

The proposed FCRPS Tributary Habitat Actions consist of a range of flow, screening diversions, providing access, channel complexity, riparian protection, and enhancement measures that are expected to improve spawning and juvenile rearing areas for Upper Columbia River Steelhead by improving water quality and quantity, natural cover, and forage. Improvements as estimated from the prospective relative lifecycle survival adjustment range from 4 to 14 percent from the current for four populations. Freshwater migration corridors for juvenile fish will benefit from increased screening of diversions and channel complexity actions. Safe passage in tributary migration corridors for adult fish should improve as water quantity and temperature improve and as channel complexity and riparian enhancement actions become established.

The FCRPS Proposed RPA and the Upper Snake River PA are intended to improve the survival and enhance the recovery potential of listed salmonids. The actions proposed in the biological assessments and discussed here and in Chapter 9, address the following limiting factors for this DPS identified by NMFS (2005i):

- Mainstem Columbia River hydropower system mortality,
- Reduced tributary stream flow,
- Tributary riparian degradation and loss of in-river wood,

- Altered tributary floodplain and channel morphology,
- Excessive sediment, and
- Degraded tributary water quality.

As discussed in Chapter 17 (Cumulative Effects) Washington reported habitat improvement efforts that will improve conditions for Upper Columbia River Steelhead. Actions by other Federal agencies (Chapter 18) are also expected to improve habitat conditions for this species.

Given the range-wide status of critical habitat, the effects of the FCRPS Proposed RPA and Upper Snake River PA, the environmental baseline, and cumulative effects, the PCEs most affected by this set of proposed actions, safe passage, water quantity, and water quality are expected to function sufficiently to serve the intended conservation role for the species.

19.6.7 Middle Columbia River Steelhead

The existence, operation, and maintenance of the FCRPS dams, the mainstem effects of Reclamation's projects in the Columbia River Basin, the operation of Reclamation's Upper Snake River projects, and other mainstem actions have adversely affected some aspects of critical habitat of Middle Columbia River Steelhead in the mainstem migration corridor. Upper Snake River effects are small compared to those for Snake River ESUs due to the relatively smaller contribution from Snake River flows as larger flows are encountered downstream. The FCRPS Proposed RPA and Upper Snake River PA are expected to reduce this negative impact.

The FCRPS Proposed RPA and Upper Snake River PA are expected to have both positive and negative effects on the conservation role of safe passage for outmigrating juvenile fish in the mainstem, the former by improving in-river passage conditions and thus reducing mortality through the hydropower system. The estimated change in outmigrating Middle Columbia River Steelhead survival as a result of implementing the proposed configuration and operation changes at FCRPS hydropower projects ranges from 5.2 to 12.3 percent from the current, based on an estimated lifecycle survival improvement (COMPASS modeling results, Aug. 6, 2007).

The effect of flow depletions for Reclamation's Upper Snake River PA is comparatively small in the Columbia River, estimated to be about 2 percent of the annual flow at McNary Dam; many populations of Middle Columbia River Steelhead enter the mainstem below McNary Dam where the effect of Upper Snake River projects flow depletions continues to decrease. FCRPS and upper Snake River flow augmentation are expected to improve the conservation role of safe passage. The conservation role of the downstream juvenile and upstream adult migration corridor is expected to improve due to the hydro configuration and water management components of the proposed FCRPS Hydro Action. The proposed FCRPS Hydro Action will have no effect on the conservation role of the freshwater spawning sites and freshwater rearing sites PCEs of critical habitat for Mid-Columbia River Steelhead because, for this DPS, these PCEs are found in the tributaries rather than the mainstem.

The FCRPS proposed Predation Management Action of continuing the NPMP and implementation of the preferred alternative in the Caspian Tern EIS (affecting predation in the estuary) are expected to improve the PCE of safe passage. Combined, both programs are expected to reduce predation by 4.4 percent on this DPS from the current (Comprehensive Analysis, Chapter 10).

The FCRPS proposed Estuary Habitat Actions including rehabilitation of off-channel habitat, improved management of riparian habitat, and restored floodplain connectivity are expected to benefit critical habitat for this ESU by improving and increasing the conservation role of rearing habitat, cover and shelter, riparian conditions, and food availability. The total estuary survival benefit from the numerous estuarine actions is estimated to be a 6 percent improvement in lifecycle survival from the current. From a biological diversity perspective, the availability of diverse and functioning habitat in the estuary is expected to improve the expression of a full range of life history variation.

The proposed FCRPS Tributary Habitat Actions consist of a range of flow, screening diversions, providing access, channel complexity, riparian protection, and enhancement measures that are expected to improve spawning and juvenile rearing areas for Middle Columbia River Steelhead by improving water quality and quantity, natural cover, and forage. Estimated lifecycle survival improvements range from 0.3 to 4 percent from the current for 16 populations (Comprehensive Analysis, Chapter 10). Freshwater migration corridors for juvenile fish will benefit from increased screening of diversions and channel complexity actions. Safe passage in tributary migration corridors for adult fish should improve as water quantity and temperature improve and as channel complexity and riparian enhancement actions become established.

The FCRPS Proposed RPA and the Upper Snake River PA are intended to improved the survival and enhance the recovery potential of listed salmonids. The actions proposed in the biological assessments and discussed here and in Chapter 10, address the following limiting factors for this DPS identified by NMFS (2005i):

- Mainstem lower Columbia River hydropower system mortality,
- Reduced tributary stream flow,
- Impaired passage in tributaries,
- Excessive sediment,
- Degraded tributary quality, and
- Altered channel morphology.

As discussed in Chapter 17 (Cumulative Effects) Washington and Oregon reported habitat improvement efforts that will improve conditions for Middle Columbia River Steelhead. Actions by other Federal agencies (Chapter 18) are also expected to improve habitat conditions for this species.

Given the range-wide status of critical habitat, the effects of the FCRPS Proposed RPA and Upper Snake River PA, the environmental baseline, and cumulative effects, the PCEs most affected by this set of proposed actions, safe passage, water quality and quantity are expected to function adequately to serve the intended conservation role for the species.

19.6.8 Lower Columbia River Chinook Salmon

The existence, operation, and maintenance of the FCRPS dams, the mainstem effects of Reclamation's projects in the Columbia River Basin, the operation of Reclamation's Upper Snake River projects, and other mainstem actions have adversely affected some aspects of critical habitat of Lower Columbia River Chinook Salmon in the mainstem migration corridor. Upper Snake River and other tributary effects are small compared to those for Snake River ESUs due to the relatively smaller contribution from Snake River flows as larger flows are encountered downstream. The juveniles of those fish that spawn above Bonneville Dam pass that dam during their outmigration. The proposed Actions are expected to reduce this negative impact.

The FCRPS Proposed RPA and Upper Snake River PA are expected to have both positive and negative effects on the conservation role of freshwater spawning sites, freshwater rearing sites, and freshwater migration corridor PCEs of critical habitat for Lower Columbia River Chinook Salmon because these PCEs occur in the mainstem. The estimated improvement in lifecycle survival is 5 percent for the ocean-type fall-run Lower Columbia River Chinook Salmon and 1.5 percent for stream-type spring-run fish from the current (Comprehensive Analysis, Chapter12). The negative effect of flow depletions for Reclamation's Upper Snake River PA is nearly immeasurable in the lower Columbia River. The conservation role of both the juvenile downstream and the adult upstream migration corridor is expected to improve due to the water management component of the FCRPS Proposed RPA.

During the juvenile outmigration in the mainstem, the proposed FCRPS Hydro Action of water management is expected to have a positive effect on safe passage by improving flow, and hydropower configurations are expected to have a positive effect on safe passage by improving passage conditions for those populations spawning upstream of Bonneville Dam.

The proposed FCRPS Predation Management Action of continuing the NPMP and implementation of the preferred alternative in the Caspian Tern EIS (affecting predation in the estuary) are expected to improve the PCE of safe passage. Combined, both programs are expected to reduce predation by 1.7 percent for fall-run Chinook salmon and 3 percent for spring-run fish from the current (Comprehensive Analysis, Chapter12).

The FCRPS proposed Estuary Habitat Actions including rehabilitation of off-channel habitat, improved management of riparian habitat, and restored floodplain connectivity are expected to benefit critical habitat for this ESU by improving and increasing the conservation role of rearing habitat, cover and shelter, riparian conditions, and food availability. The total estuary survival benefit from the numerous estuarine actions is estimated to be a 7 and 4 percent improvement in lifecycle survival from the current for fall-run and spring-run fish, respectively. From a biological diversity perspective, the availability of diverse and functioning habitat in the estuary is expected to improve the expression of a full range of life history variation.

A suite of actions is expected to be implemented in lower Columbia River tributaries from 2007 through 2017, the effects of which are expected to accrue over the long term. The magnitude of these effects on the conservation role of PCEs in the lower Columbia River is uncertain at this time. These proposed actions will address the factors that NMFS has identified as limiting this species.

The FCRPS Proposed RPA and the Upper Snake River PA are intended to improve the survival and enhance the recovery potential of listed salmonids. The actions proposed in the biological assessments and discussed here and in Chapter 12, address the following limiting factors for this ESU identified by NMFS (2005b):

- Reduced access to spawning/rearing habitat in tributaries,
- Loss of habitat diversity and channel stability in tributaries,
- Excessive sediment in spawning gravel, and
- Elevated water temperature in tributaries.

As discussed in Chapter 17 (Cumulative Effects) Washington reported habitat improvement efforts that will improve conditions for Lower Columbia River Chinook Salmon. Actions by other Federal agencies (Chapter 18) are also expected to improve habitat conditions for this species.

Given the range-wide status of critical habitat, the effects of the FCRPS Proposed RPA and Upper Snake River PA, the environmental baseline, and cumulative effects, the PCEs most affected by this set of proposed actions, safe passage and juvenile rearing areas, are expected to function adequately to serve the intended conservation role for the species.

19.6.9 Lower Columbia River Steelhead

The existence, operation, and maintenance of the FCRPS dams, the mainstem effects of Reclamation's projects in the Columbia River Basin, the operation of Reclamation's Upper Snake River projects, and other mainstem actions have adversely affected some aspects of critical habitat of Lower Columbia River Steelhead in the mainstem migration corridor. Upper Snake River effects are small compared to those for Snake River ESUs due to the relatively smaller contribution from Snake River flows as larger flows are encountered downstream. However, the FCRPS Proposed RPA is expected to reduce this negative impact.

The FCRPS Proposed RPA and Upper Snake River PA are expected to have both positive and negative effects on the conservation role of safe passage for outmigrating juvenile fish in the mainstem, the former by improving in-river passage conditions and thus reducing mortality at Bonneville Dam for those populations that spawn upstream from the dam. The estimated lifecycle survival improvement as a result of implementing the proposed configuration and operation changes at FCRPS hydropower projects is 2.8 percent from the current (Comprehensive Analysis, Chapter14). The negative effect of flow depletions for Reclamation's Upper Snake River PA is nearly immeasurable in the lower Columbia River. The conservation role of the downstream juvenile and upstream adult migration corridor is expected to improve due to the hydro configuration and water management components of the proposed FCRPS Hydro Action. The Hydro Action will have no effect on the conservation role of freshwater spawning sites and freshwater rearing sites PCEs of critical habitat for Lower Columbia River Steelhead because, for this DPS, this essential feature is found in the tributaries rather than the mainstem.

During the juvenile outmigration the proposed FCRPS Hydro Action is expected to have a positive effect on safe passage by improving passage conditions and thus survival for those populations spawning upstream of Bonneville Dam. Adult upstream migration corridors are expected to improve due to the hydro configuration and water management components of the FCRPS Proposed RPA.

The proposed FCRPS Predation Management Action of continuing the NPMP and implementation of the preferred alternative in the Caspian Tern EIS (affecting predation in the estuary) are expected to improve the PCE of safe passage. Combined, both programs are expected to reduce predation by 4.2 percent from the current (Comprehensive Analysis, Chapter14).

The FCRPS proposed Estuary Habitat Actions including rehabilitation of off-channel habitat, improved management of riparian habitat, and restored floodplain connectivity are expected to benefit critical habitat for this DPS by improving and increasing the conservation role of rearing habitat, cover and shelter, riparian conditions, and food availability. The total estuary survival benefit from the numerous estuarine actions is estimated to be a 3.6 percent improvement in lifecycle survival from the current. From a biological diversity perspective, the availability of diverse and functioning habitat in the estuary is expected to improve the expression of a full range of life history variation.

A suite of actions is expected to be implemented in lower Columbia River tributaries from 2007 through 2017, the effects of which are expected to accrue over the long term. The magnitude of these effects on the conservation role of PCEs in the lower Columbia River is uncertain at this time. These proposed actions will address the factors that NMFS has identified as limiting this species.

The FCRPS Proposed RPA and the Upper Snake River PA are intended to improved the survival and enhance the recovery potential of listed salmonids. The actions proposed in the biological assessments and discussed here address the following limiting factors for this DPS identified by NMFS (2005i):

- Degraded floodplain and stream channel structure and function,
- Reduced access to spawning/rearing habitat,
- Altered streamflow in tributaries, and
- Excessive sediment and elevated water temperatures in tributaries.

As discussed in Chapter 17 (Cumulative Effects) Washington reported habitat improvement efforts that will improve conditions for Lower Columbia River Steelhead. Actions by other Federal agencies (Chapter 18) are also expected to improve habitat conditions for this species.

Given the range-wide status of critical habitat, the effects of the FCRPS Proposed RPA and Upper Snake River PA, the environmental baseline, and cumulative effects, the PCEs most affected by this set of proposed actions, safe passage, water quantity, and water quality are expected to function adequately to serve the intended conservation role for the species.

19.6.10 Columbia River Chum Salmon

The existence, operation, and maintenance of the FCRPS dams, the mainstem effects of Reclamation's projects in the Columbia River Basin, the operation of Reclamation's Upper Snake River projects, and other mainstem actions have adversely affected some aspects of critical habitat of Columbia River chum salmon in the mainstem migration corridor. Upper Snake River effects are small compared to those for Snake River ESUs due to the relatively smaller contribution from Snake River flows as larger flows are encountered downstream. The FCRPS Proposed RPA and Upper Snake River PA are expected to reduce this negative impact.

The FCRPS Proposed RPA and Upper Snake River PA are expected to have both positive and negative effects on the conservation role of freshwater spawning and rearing in the mainstem. The most obvious effect of the FCRPS on chum salmon is that of flow operations on mainstem spawning below Bonneville Dam. The negative effect of flow depletions for Reclamation's Upper Snake River PA is nearly immeasurable in the lower Columbia River. The conservation role of the adult upstream migration corridor is expected to improve due to the water management component of the proposed FCRPS Hydro Action.

The proposed FCRPS Hydro Action in the mainstem will affect the freshwater spawning sites, freshwater rearing sites, and freshwater migration corridor PCEs of critical habitat for Lower Columbia River Chum Salmon because these PCEs occur in the mainstem. The water management component of the proposed FCRPS Hydro Action is expected to improve freshwater spawning, rearing, and migration by maintaining adequate water conditions for spawning and incubation through emergence. The change in chum salmon survival as a result of implementing the proposed configuration and operation changes at Bonneville Dam would be minor, since few adults pass Bonneville Dam each year, and the level of production above the dam is uncertain.

The proposed FCRPS Predation Management Action of continuing the NPMP is expected to improve safe passage and reduce predation by 1 percent from the current (Comprehensive Analysis, Chapter 11). The Caspian Tern Management Plan is not expected to provide a survival benefit to these fish.

The proposed FCRPS Estuary Habitat Actions including rehabilitation of off-channel habitat, improved management of riparian habitat, and restored floodplain connectivity, are expected to benefit critical habitat for this ESU by improving and increasing the conservation role of rearing habitat, cover and shelter, riparian conditions, and food availability. The total estuary survival benefit from the numerous estuarine actions is estimated to be a 7 percent improvement in lifecycle survival from the current (Comprehensive Analysis, Chapter11). This includes restoration of channel structure and function in the Grays River, a tributary to the Columbia River estuary (described in the FCRPS RPA Estuary Habitat Actions, Section 2.2.3, FCRPS BA, B.2.2). From a biological diversity perspective, the availability of diverse and functioning habitat in the estuary is expected to improve the expression of a full range of life history variation.

A suite of actions is expected to be implemented in lower Columbia River tributaries from 2007 through 2017, the effects of which are expected to accrue over the long term. The magnitude of these effects on the conservation role of PCEs in the lower Columbia River is uncertain at this time. These proposed actions will address the factors that NMFS has identified as limiting this species.

The FCRPS Proposed RPA and the Upper Snake River PA are intended to improve the survival and enhance the recovery potential of listed salmonids. The actions proposed in the biological assessments and discussed here and in Chapter 11, address the following limiting factors for this ESU identified by NMFS (2005i):

- Altered channel form and stability in tributaries,
- Excessive sediment in tributary spawning gravels,
- Altered streamflow in tributaries and mainstem Columbia,
- Loss of some tributary habitat types, and
- Harassment of spawners in tributary and mainstem.

As discussed in Chapter 17 (Cumulative Effects) Washington reported habitat improvement efforts that will improve conditions for Columbia River chum salmon. Actions by other Federal agencies (Chapter 18) are also expected to improve habitat conditions for this species.

Given the range-wide status of critical habitat, the effects of the FCRPS Proposed RPA and Upper Snake River PA, the environmental baseline, and cumulative effects, the PCEs most affected by this set of proposed actions, safe passage, water quality and water quantity, spawning, and juvenile rearing areas, are expected to function adequately to serve the intended conservation role for the species.

19.6.11 Upper Willamette River Chinook Salmon

The existence, operation, and maintenance of the FCRPS dams, the mainstem effects of Reclamation's projects in the Columbia River Basin, the operation of Reclamation's Upper Snake River projects, and other mainstem actions have adversely affected some aspects of critical habitat of Upper Willamette River Chinook salmon in the mainstem lower Columbia River migration corridor, although the effects are comparatively minor for this downriver ESU.

The proposed Hydro Actions are expected to have a minor effect on the conservation role of safe passage for outmigrating juvenile fish in the mainstem migration corridor because these fish spawn and rear in the Willamette River, which enters the Columbia River downstream from Bonneville Dam. The benefit of the effects of flow augmentation is much reduced below Bonneville Dam. The conservation role of the adult upstream migration corridor is expected to improve slightly due to the water management component of the proposed FCRPS Hydro Action. The proposed FCRPS Hydro Actions are not expected to have an effect on the conservation role of the freshwater spawning sites and freshwater rearing sites PCEs of critical habitat for Upper Willamette River Chinook Salmon because, for this ESU, these PCEs are found in the Willamette River and its tributaries rather than the Columbia River mainstem.

The proposed FCRPS Predation Management Action of continuing the NPMP and implementation of the preferred alternative in the Caspian Tern EIS (affecting predation in the estuary) are expected to improve the PCE of safe passage to an extent similar to that for Lower Columbia River Chinook Salmon (spring run). Combined, both programs are expected to reduce predation by 3.1 percent from the current (Comprehensive Analysis, Chapter15).

The FCRPS proposed Estuary Habitat Actions including rehabilitation of off-channel habitat, improved management of riparian habitat, and restored floodplain connectivity are expected to benefit critical habitat for this ESU by improving and increasing the conservation role of rearing habitat, cover and shelter, riparian conditions, and food availability. The total estuary survival benefit from the numerous estuarine actions is estimated to be a 4.0 percent improvement in lifecycle survival from the current (Comprehensive Analysis, Chapter15). From a biological diversity perspective, the availability of diverse and functioning habitat in the estuary is expected to improve the expression of a full range of life history variation.

The FCRPS Proposed RPA and the Upper Snake River PA are intended to improved the survival and enhance the recovery potential of listed salmonids. The actions proposed in the biological assessments and discussed here and in Chapter 15, address the following limiting factors for this ESU identified by NMFS (2005i):

- Reduced access to spawning/rearing habitat in tributaries,
- Altered water quality and temperature in tributaries,
- Lost/degraded floodplain connectivity and lowland stream habitat, and
- Altered streamflow in tributaries.

Given the range-wide status of critical habitat, the effects of the FCRPS Proposed RPA and Upper Snake River PA, the environmental baseline, and cumulative effects, the PCEs most affected by this set of proposed actions, safe passage, water quality, and water quantity, are expected to function sufficiently to serve the intended conservation role for the species.

19.6.12 Upper Willamette River Steelhead

The existence, operation, and maintenance of the FCRPS dams, the mainstem effects of Reclamation’s projects in the Columbia River Basin, the operation of Reclamation’s Upper Snake River projects, and other mainstem actions have adversely affected some aspects of critical habitat of Upper Willamette River Steelhead in the mainstem lower Columbia River migration corridor, although the effects are comparatively minor for this downriver DPS.

The proposed Hydro Actions are expected to have a minor effect on the conservation role of safe passage for outmigrating juvenile fish in the mainstem migration corridor. The benefit of flow augmentation is much reduced below Bonneville Dam. The conservation role of the adult upstream migration corridor is expected to improve due to the hydro configuration and water management components of the proposed FCRPS Hydro Action. The Hydro Actions will have no effect on the conservation role of the freshwater spawning sites and freshwater rearing sites PCEs of critical habitat for upper Willamette River Steelhead because, for this DPS, these PCEs are found in the Willamette River tributaries rather than the Columbia River mainstem.

The proposed FCRPS Predation Management Action of continuing the NPMP and implementation of the preferred alternative in the Caspian Tern EIS (affecting predation in the estuary) are expected to improve the PCE of safe passage. Combined, both programs are expected to reduce predation by about 4.4 percent from the current (Comprehensive Analysis, Chapter16).

The FCRPS proposed Estuary Habitat Actions including rehabilitation of off-channel habitat, improved management of riparian habitat, and restored floodplain connectivity are expected to benefit critical habitat for this DPS by improving and increasing the conservation role of rearing habitat, cover and shelter, riparian conditions, and food availability. The total estuary survival benefit from the numerous estuarine actions is estimated to be a 3.6 percent improvement in lifecycle survival from the current (Comprehensive Analysis, Chapter16). From a biological diversity perspective, the availability of diverse and functioning habitat in the estuary is expected to improve the expression of a full range of life history variation.

The FCRPS Proposed RPA and the Upper Snake River PA are intended to improved the survival and enhance the recovery potential of listed salmonids. The actions proposed in the biological assessments and discussed here and in Chapter 16, address the following limiting factors for this DPS identified by NMFS (2005i):

- Reduced access to spawning/rearing habitat in tributaries,
- Altered water quality and temperature in tributaries,
- Lost/degraded floodplain connectivity and lowland stream habitat, and
- Altered streamflow in tributaries.

Given the range-wide status of critical habitat, the effects of the FCRPS Proposed RPA and Upper Snake River PA, the environmental baseline, and cumulative effects, the PCEs most affected by this set of proposed actions, safe passage, water quality, and water quantity, are expected to function adequately to serve the intended conservation role for the species.

Chapter 20
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Appendix A
Analytical Methods

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

BRT	Biological Review Team
ESU	Evolutionarily Significant Unit
FCRPS	Federal Columbia River Power System
ISAB	Independent Scientific Review Board
MPG	Major Population Group
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
QET	quasi-extinction threshold
RFT	reproductive failure threshold
RM&E	research, monitoring, and evaluation
RPA	Reasonable and Prudent Alternative
SE	standard error
SR	spawner-recruit
TRT	Technical Recovery Team

A.1. METHODS FOR CALCULATING EXTINCTION PROBABILITY ESTIMATES USING THE BEVERTON-HOLT AND RICKER PRODUCTION FUNCTIONS

Extinction probability estimates were developed for several stream-type Chinook salmon and steelhead populations in the Columbia River Basin. The approach used the Beverton-Holt production and Ricker functions, which were fit to spawner-recruit (SR) data from brood years 1978 to the present. Because autocorrelation of errors can influence extinction risks, errors were modeled as an autoregressive process of order 1. The estimated Beverton-Holt and Ricker functions were used to project forward populations over a time horizon of 24 years to estimate extinction probability. Alternative quasi-extinction thresholds of 1, 10, 30, and 50 were used. In the projections, extinction was assumed to occur when spawners fall below the quasi-extinction threshold four years running. The following is a summary of the modeling methods.

A.1.1 INTRODUCTION

Population viability analysis is used to gauge the likelihood of extinction of endangered salmon populations in the Columbia River Basin. The 2000 Federal Columbia River Power System (FCRPS) BiOp used the Dennis et al. (1991) model to estimate the probability of absolute extinction (the population falling below 1 individual), with an estimation procedure modified to account for measurement error (Holmes 2001). This method was used as a large-scale, multi-species risk assessment of anadromous salmonids in the Columbia River Basin (McClure et al. 2003).

One important element in the estimation of extinction risks is the production function that is used. The production function is the mathematical rule that describes how spawners in one year are related to spawners in subsequent years (recruits). The models described in Holmes (2001) and McClure et al. (2003), which were used in the 2000 BiOp, were linear. That is, it was assumed that the mean population growth rate was constant regardless of spawner abundance. This assumption is contrary to most fisheries models, such as the Ricker or Beverton-Holt models, which assume that the population growth rate declines as spawner numbers increase (Hilborn and Walters 1992). The most recent estimates used by the National Marine Fisheries Service (NMFS, also called National Oceanic and Atmospheric Administration [NOAA] Fisheries) use nonlinear production functions. The nonlinear models include the assumption that populations cannot grow indefinitely, that is, they must level off as spawner numbers increase. Linear production functions do not include this assumption.

The nonlinear model used by the Interior Columbia Basin Technical Recovery Team (TRT) for estimating extinction risks was the hockey stick model (Barrowman and Myers 2000). The more traditional models, such as Beverton-Holt and Ricker, assume that survival increases with declining population until the last spawner disappears (Hilborn and Walters 1992). For these models, as spawner abundance declines, the number of recruits produced per spawner actually increases. From the perspective of population viability analysis, this assumption of increased survival at low population size may overestimate the resilience of a population and thus lead to underestimates of extinction probability. The hockey stick model addresses this concern by assuming constant recruits produced per spawner when spawner abundance declines below a threshold (Barrowman and Myers 2000). The hockey stick model, however, introduces important estimation issues because the likelihood function includes "kinks" where the derivative is not defined and it often exhibits multiple local maxima.

This appendix details an approach to estimating extinction probabilities using the Beverton-Holt and Ricker production functions. The hockey stick production model was not used because it creates numerical and statistical difficulties for the parameter estimation. Beverton-Holt and Ricker parameter estimates were obtained by maximizing the likelihood function and extinction probabilities were obtained by projecting forward spawner abundances 24 years into the future. The procedure was applied to several salmon populations from the listed Snake River Spring/Summer Chinook and Upper Columbia River Spring/Summer Chinook Salmon ESUs and to the Snake River Steelhead, Upper Columbia River Steelhead, and Mid-Columbia River Steelhead. The time horizon was set at 24 years, and the quasi-extinction threshold (QET) was set at 1, 10, 30, and 50 spawners.

A.1.2 METHODS

A.1.2.1 Data

A.1.2.1.1 Spring/Summer Chinook and Upper Columbia Spring Chinook

The data used were the Snake River and Upper Columbia River stream-type Chinook spawner-recruit data (Interior Columbia Basin TRT 2006), which were updated to include estimates through brood year 1998. Spawner estimates were estimates of annual abundance of salmon arriving at the spawning grounds. Recruitment refers to adult progeny returning to the spawning grounds. A list of populations analyzed is presented in Table A-1.

A.1.2.1.2 Steelhead

Spawner-recruit data developed for steelhead populations from the Snake River, Mid-Columbia, and Upper Columbia River ESUs were also analyzed (Interior Columbia Basin TRT 2006). A list of populations analyzed is presented in Table A-2.

The Model

The underlying production function used in the population projections were the Beverton-Holt and Ricker models (Hilborn and Walters 1992). The Beverton-Holt model was applied to Chinook salmon populations and the Ricker model was applied to steelhead populations. The Beverton-Holt model was used for the spring/summer Chinook salmon populations because preliminary work showed that it yielded extinction probability estimates that were similar to the hockey stick model used by the Interior Columbia Basin TRT. The Beverton-Holt model was not applied to the steelhead populations because valid parameter estimates could not be found from about half of the steelhead populations. Instead, the Ricker model was used because it is guaranteed to yield maximum likelihood estimates. The Beverton-Holt takes the mathematical form:

(1) $$R_t = S_t \exp(a + \phi_t)/(1 + bS_t),$$ (Beverton-Holt)

where R_t is recruitment (the adult progeny of fish spawning in year t), S_t represents the number of spawners in brood year *t*, *a* is the intrinsic productivity which represents the maximum log recruits per spawner, ϕ_t represents a stochastic error term, which follows an autoregressive process of order 1, and *b* is the parameter which describes density dependent growth. The Ricker model takes the mathematical form

(2) $$R_t = S_t \exp(a - bS + \phi_t),$$ (Ricker)

The autoregressive process was used for the error term because extinction probabilities are influenced by autocorrelation (Wichmann et al. 2005). The autoregressive order 1 process is given by

(3) $$\phi_{t+1} = \alpha\phi_t + \varepsilon_{t+1},$$

where α is the autoregressive parameter, which, according to the Yule-Walker equations, is equivalent to the lag-1 autocorrelation coefficient (Box et al. 1994); and the ε_{t+1} are independent and normally distributed random with mean zero and variance σ^2. The ε_t process will be referred to as the white noise process. (The ϕ_t errors represent a red noise process because the errors are positively correlated). The initial production function error, ϕ_1, is set equal to ε_1 (i.e., it is normally distributed with mean zero and variance σ^2).

The parameters were estimated by maximizing the likelihood function. The log likelihood function was formed by taking the log of the joint distribution of the white noise errors, ε_t:

$$l = -\frac{n}{2}\log\left(2\pi\sigma^2\right) - \frac{1}{2\sigma^2}\sum_{t=1}^{n}\varepsilon_t^2 =$$

$$= -\frac{n}{2}\log\left(2\pi\sigma^2\right) - \frac{1}{2\sigma^2}\left\{\left(y_1 - f(a,b,S_1)\right)^2 + \sum_{t=1}^{n-1}\left(y_{t+1} - f(a,b,S_{t+1}) - \alpha\left(y_t - f(a,b,S_t)\right)\right)^2\right\}$$

where n is the number of spawner-recruit observations, y_t represents $\log(R_t / S_t)$, and $f(a,b,S_t)$ is $a - \log(1 + bS_t)$ when the Beverton-Holt production function is used and is equal to $a - bS_t$ when the Ricker production function is used. Notice that when the autoregressive parameter, α, is equal to zero, then the likelihood function is reduced to the usual likelihood function with uncorrelated errors. Altogether, there were four parameters to estimate from this likelihood function: a, b, α, and σ^2. Because the model is nonlinear in the parameters, interior maximum likelihood estimates were not guaranteed to exist.

The nonlinear regression was conducted using the routine *nls* from the R statistical package, which uses a Gauss-Newton algorithm for calculating maximum likelihood estimates (R Development Core Team 2005). Standard errors and *p*-values were calculated for the parameter estimates and correlations between the various estimates were also calculated.

A.1.2.1.3 Extinction Probabilities

Once the Beverton-Holt or Ricker parameters are estimated, it is then possible to use the production function to estimate probabilities of extinction by projecting forward the spawner numbers. In each simulation of a population, $N = 4000$ 24-year sequences of simulated spawners were generated. Once the spawner series was initialized, the stochastic production function was used to build a series of future spawners by allocating recruits to the appropriate spawners in future years. A fixed age structure of recruits was assumed. Age structure was estimated as the average fractions of returns at ages 3, 4 and 5.

The extinction probability was estimated as the fraction of the 4000 24-year sequences in which spawners fell below the quasi-extinction threshold (QET) four years running. Extinction probability estimates were obtained using alternative values of QET (1, 10, 30, and 50), and with a time horizon of 24 years. If, during a population projection, the total number of spawners fell below 10, then number of recruits was set to zero (i.e. the reproductive failure threshold was set at 10 spawners). In the case where QET=1, a reproductive failure threshold of 2 spawners was used. The Action Agencies' estimates of extinction probabilities for selected stocks are presented in Tables A-1 and A-2.

Using the Beverton-Holt production function, the projections took the following mathematical form:

(4) $$R_t^* = S_t^* \exp(\hat{a} + \phi_t^*) / (1 - \hat{b} S_t^*)$$

(5) $$S_t^* = \sum_{\tau=1}^{5} \bar{p}_\tau R_{t-\tau}^*$$

Where R_t^* was the simulated number of recruits generated from spawners in brood year *t*; S_t^* was the simulated number of spawners in brood year *t*; $\hat{a}$ is the maximum likelihood estimate of the Beverton-Holt density-independent parameter a; ϕ_t^* represented a random draw from the autoregressive error model, which represented the estimated residual variance for the Beverton-Holt production function; $\hat{b}$ was the maximum likelihood estimate of the Beverton-Holt density-dependent parameter b; τ represented age of returning adults; and $\bar{p}_\tau$ represented the average fraction of adults returning at age τ. The projections were initialized by setting the first five spawner numbers in the sequence equal to the spawner observations from brood years 1999 to 2003. Autocorrelation in the residual error term was not modeled (i.e., the residuals were treated as independent).

A similar method is used when the Ricker model was employed, but in that case the population projections were accomplished using the function

(6) $$R_t^* = S_t^* \exp(\hat{a} - \hat{b} S_t^* + \phi_t^*)$$

instead of the Beverton-Holt form of the production function.

A.1.2.1.4 Supplementation

In the extinction probability analysis above, it was assumed that the relative reproductive effectiveness of hatchery-born spawners was equal to that of the wild-born spawners and that supplementation would not continue into the future. As an alternative, some extinction runs were conducted under the assumptions that reproductive effectiveness of hatchery-born spawners could differ from that of wild-born spawners and that supplementation would continue at some level into the future.

Within this framework, which recognizes supplementation and differential reproductive effectiveness of hatchery-born spawners, the following model is fit to the retrospective data,

(7) $$R_t = S_t (f_t + (1 - f_t) e_t) \exp(a + \phi_t) / (1 + b S_t)$$

Where f_t represents the fraction of wild-born spawners and e_t represents the relative reproductive success of hatchery-born spawners. In the special case where $e_t = 0$, none of the hatchery-born spawners are contributing to the progeny (recruits) and that is reflected in the above equation. In the case where $e_t = 1$, the model reduces to the model introduced in equation 1, where the fraction of wild-born spawners is irrelevant.

This alternative (supplementation) model will generally produce different estimates of the Beverton-Holt parameters than the model that does not differentiate between hatchery-born and wild-born spawners. Therefore, extinction probability estimates will change. Inclusion of supplementation in the future will also alter extinction probabilities. The population projections with supplementation take the form

(8) $$R_t^* = S_t^* (f_t^* + (1 - f_t^*) e_t^*) \exp(\hat{a} + \phi_t^*) / (1 - \hat{b} S_t^*)$$

(9) $$S_t^* = \left(\sum_{\tau=1}^{5} \overline{p}_\tau R_{t-\tau}^*\right) + H^*{}_t$$

where e_t^* represented the future values of the relative reproductive effectiveness of hatchery-born spawners, f_t^* represented the future fraction of wild-born spawners, and S_t^* represented the total number of (wild + hatchery-born) spawners. ϕ_t^* represented a random draw from the autoregressive error model, which represented the estimated residual variance for the Beverton-Holt production function; $\hat{b}$ was the maximum likelihood estimate of the Beverton-Holt density-dependent parameter b, and H_t^* represents future supplementation in year t. Extinction occurs when the total spawners fall below QET 4 years running. That is, when total spawners falls below QET for four consecutive years within the time horizon of 24 years. A similar methodology was used when the Ricker model was used instead of the Beverton-Holt model.

A.1.2.1.5 Survival Gap Calculations

In the population viability analysis, one may consider extinction probability to be a function of abundance and productivity. Generally, as abundance and productivity (Beverton-Holt *a*) parameters increase, extinction probability decreases. Whenever extinction probability lies above 5 percent, a survival gap is considered to exist. That is, density independent survival must increase in order to reduce extinction risk to 5 percent or less. The density independent survival improvement needed to accomplish this is the “gap.” This gap may be quantified by calculating the increase in productivity necessary to achieve the 5 percent extinction risk target. In this sense, extinction probability is considered as a function of productivity, which may be denoted $P(a)$. $P(a)$ represents the probability of extinction when the Beverton-Holt production parameter is set to a. To achieve a 5 percent extinction probability, one seeks the value of a that makes the value of the function

(10) $$f(a) = P(a) - 0.05$$

equal to zero. This is known as a root finding problem in numerical analysis. The root in this case is the value of the Beverton-Holt *a* parameter that yields an extinction probability of 5 percent. To solve this problem, the bisection method was used, which cannot fail once an interval that contains a root is identified (Press et al. 1992). The bisection algorithm used was *rtbis*, and the bracketing routine used was *zbrac*, which identifies an interval that contains the root (Press et al. 1992).

Once the root a^* was found numerically, it was a simple matter to calculate the survival gap. The survival gap was given by

(11) $$gap = \exp(a^* - \hat{a}),$$

where $\hat{a}$ represents the maximum likelihood estimate of the Beverton-Holt *a* parameter. Based on this definition, the gap represents a multiplier needed for the current survival needed to achieve a 5 percent extinction risk. When the multiplier is at or below one, then no increase in survival is necessary (extinction risk is already at or below 5 percent), but when the multiplier is above one, an increase is necessary to achieve 5 percent risk.

The underlying assumption that allows this gap calculation to work is that the intrinsic productivity, or recruits per spawner at very low abundance given by $\exp(a)$ is proportional to survival. Thus, $\exp(a) = k \cdot s$ where k is a constant and s represents survival. If s_0 represents current survival, and s^* represents the survival necessary to achieve the 5 percent target, then the survival gap is

(12) $$gap = \frac{s^*}{s_0} = \frac{\exp(a^*)/k}{\exp(\hat{a})/k} = \exp(a^* - \hat{a})$$

A.1.3 CHARACTERIZING UNCERTAINTY

The Action Agencies characterized uncertainty in the population viability estimates (extinction probabilities and various estimates of trend) with confidence intervals, and where appropriate, standard errors. The statistical uncertainty for the population viability parameters is generally quite large. Therefore, the trends and extinction probabilities are poorly known. This must be borne in mind whenever making inferences based on these estimates. The methods for estimating confidence intervals are detailed below and the results of the analysis are given in Tables A-1 and A-2.

A.1.3.1 A Note on Confidence Intervals

A confidence interval for a parameter is an interval generated from a random sample, which quantifies the reliability of a parameter estimate. If the random sampling were repeated many times and the confidence interval recalculated from each sample according to the same method, a proportion (e.g., 95 percent) of the confidence intervals would contain the population parameter in question. Usually confidence intervals are constructed in such a way that the parameter will be contained in the interval 95 percent of the time. It is not proper to interpret 95 percent as the probability that the interval contains the parameter, because the parameter is a fixed unknown (e.g., mass of a planet, height of a person), not a random variable.

A confidence interval is not guaranteed to contain the parameter of interest, but we can be reasonably confident that it does. The confidence is based on the fact that if we were to draw many population trajectories from the underlying population growth process and form a confidence interval, then 95 percent of the intervals so constructed would contain the true parameter.

Confidence intervals are a gauge of the reliability of a parameter estimate. When an estimate has high precision (small standard error), confidence intervals will tend to be narrow, and when estimates have low precision (large standard error), confidence intervals will be wide. For example, if a probability of extinction has a 95 percent confidence interval that spans 0 to 1 (0 percent to 100 percent), the confidence interval is as wide as possible. (The fact that an extinction probability is between zero and 1 is known without the use of statistics.) Most of the extinction probabilities developed for this analysis have very wide confidence intervals; some approach 0 to 1, indicating very poor precision. These wide confidence intervals are due to high variability about the underlying spawner-recruit relationship, short data series, and the fact that extinction probability declines sharply with increasing intrinsic productivity (Botsford and Brittnacher 1998).

Confidence intervals were used to assess the Biological Review Team (BRT) trend in natural spawner abundance. To gauge population viability, it is important to know if the population trend is greater or less than one. If the true trend is greater than one, this implies that a population is increasing and if it is less than one, decreasing. Most of the intervals constructed for trend include the value of one, so it is impossible to infer with confidence that a population trend is either increasing or decreasing. This is a common difficulty with salmon populations, which are known to be highly variable (Hinrichsen 2001).

Confidence intervals were also constructed for mean log recruits per spawner, which is an alternative to the BRT trend. The usual approach to estimating standard errors and confidence intervals for a mean did not apply because of serial dependence in the error term. This led to the use of a nonparametric method. The true confidence intervals are generally much wider than those based on the (incorrect) assumption of independent errors.

In all cases, confidence intervals were constructed using bootstrapping because the sampling distributions of the estimators were not known. Bootstrapping involved applying the estimator to many synthetic (numerically generated) data sets then calculating the 0.025 and 0.975 quantiles of the resulting bootstrap replications of the parameter estimates (Efron and Tibshirani 1993). Bootstrap standard errors are calculated as the square root of the sample variance of the bootstrap replications.

A.1.3.2 Use of Confidence Intervals

As noted above, the statistical uncertainty for the metrics used in this analysis is generally quite large. The point estimates of population productivity, growth rate, abundance trend and quasi-extinction probability in this biological analysis are used to roughly size and target the proposed actions to populations that appear to be declining in number or otherwise at risk. In order to address the wide range of uncertainty and manage risks, the Action Agencies' proposal includes performance standards that can be monitored and evaluated on an annual basis. The proposal also includes research, monitoring and evaluation (RM&E), as well as periodic progress reports (and reevaluations) with defined contingency plans, to help ensure accountability for results over the term of the Proposed Reasonable and Prudent Alternative (RPA). Adaptive management and continued collaboration with states and tribes is also a key to managing risk.

The fact is that for the reasons explained in this chapter, confidence intervals for these estimates are so wide in many, if not most, instances that it would simply not be possible (or reasonable) to mitigate for the risk that the actual value of a parameter is at the lower extreme of the range. Consider two example populations from the Snake River Spring/Summer Chinook Salmon ESU: Catherine Creek and the Upper Mainstem Salmon River. The Catherine Creek population is in poor condition with significant survival improvements needed to achieve replacement rate productivity. The Upper Mainstem Salmon River population is in relatively good shape and appears to be replacing itself and increasing over time.

The geometric mean R/S value for the Catherine Creek population is about 0.40[1]. In order to meet the criterion of geomean R/S=>1.0, productivity for this population would need to improve by about 151 percent. This presents a significant mitigation challenge and will likely require decades of sustained effort to achieve. If it is assumed that geometric mean R/S is "truly" 0.16 (at the lower limit of the 95 percent confidence interval), the needed survival improvement to achieve replacement rate productivity (1.0) would be 525 percent. This magnitude of improvement may not be achievable by any combination of means over any period of time.

The geometric mean R/S value for Upper Mainstem Salmon River – a population that appears to be in relatively good condition – is about 1.25 for the 23 years from 1978 to 2000. The population appears to be more than replacing itself over the period in question (this is consistent with abundance estimates, abundance trend estimates and lambda estimates). If it is assumed that geometric mean R/S is "truly" .56 (at the lower limit of the 95 percent confidence interval), a 79 percent survival improvement would be needed to achieve the criterion. Again, this may not be achievable within any reasonable period of time and, given the relative health of this population, does not seem necessary or reasonable.

[1] Time periods used for confidence interval estimation do not necessarily correspond precisely to the time periods used for geomeans R/S estimates used in the Action Agencies' biological analysis so these numbers differ slightly from the estimates in the analysis.

The significant range of uncertainty around the estimates we use in this analysis is explicitly considered. The Action Agencies' response to this uncertainty is to design a robust adaptive management program, with periodic check-ins and re-evaluations of species status.

A.1.3.3 Extinction Probability Confidence Intervals

Extinction probabilities suffer from high uncertainty, especially over long time horizons (e.g., 100 years). Fieberg and Ellner (2000) demonstrate that reliable extinction probability estimates are possible for short-term time horizons (10 percent-20 percent as long as the time series used for model fitting) only. Using 20 percent as a guide, it follows that 24-year extinction probabilities should be estimated using about 100 years of data. Time series of that duration are not available for Columbia River Basin salmonid populations. This analysis and others (the TRT, for example) use much shorter time series of data, generally 20 years. The imprecision of the extinction probability estimates is due, in part, to the lack of data upon which to base the modeling. Thus a 20-year time series is quite short for estimating at 24-year extinction probability.

Bootstrapping was used to estimate confidence intervals for extinction probabilities (Efron and Tibshirani 1993). Bootstrapping proceeded by building an empirical distribution of 1000 bootstrap replications of the extinction probability estimate, then using the 0.025 and 0.975 quantiles of the distribution as the confidence limits. Each of the bootstrap extinction probability estimates was based on a replication of the production function parameter estimates derived from a synthetic data set. If the replicate of the autoregressive parameter exceeded one, it was set to one. Replications giving a negative *b* parameter were ignored. Synthetic data sets were constructed by resampling the original data set with replacement. Maximum likelihood estimates were obtained for each synthetic data set. Replications of extinction probability were then obtained by evaluating the extinction probability at these maximum likelihood estimates.

These methods were applied to both steelhead populations (using the Ricker production function) and spring/summer Chinook salmon populations (using the Beverton-Holt production function).

Confidence intervals that are wide (e.g., spanning 0 to 1), indicate low reliability of an extinction probability estimate. That is, data from the same population process, can yield very different inferences about the extinction probability. This is a common problem with the estimation of extinction probabilities, especially with populations that are highly variable with a nontrivial extinction probability (not zero or one). Furthermore, confidence intervals are wide because extinction probability usually declines sharply with increasing intrinsic productivity (when intrinsic productivity is near its actual estimate) (Botsford and Brittnacher 1998). Therefore any uncertainty in the intrinsic productivity parameter (which depends strongly on the error variance), will be greatly magnified in the estimation of extinction probability. The Action Agencies estimate of extinction probability for selected stocks of salmon and steelhead are presented in Tables A-1 and A-2.

A.1.3.4 BRT Trend Confidence Intervals

Trends in natural spawner abundance were calculated to assess whether population abundance tends to be increasing, decreasing or staying the same. Trend was calculated as the slope of the regression of the abundance index (log transformed) versus time. Two alternative time periods were considered: 1980 to present and 1990 to present. "Present" is considered the most recent annual observation. One was added to the natural spawner abundance before log transforming the data to avoid taking the log of zero, which is undefined. Trend was reported as the exponential function of the estimated slope of the regression line. A trend greater than 1.0 indicates population increase, a trend less than 1.0 indicates population decrease, and a trend of 1.0 indicates that, on average, population numbers are not changing. The regression equation used was

(13) $$\ln(N_t + 1) = \beta_0 + \beta_1 t + \varepsilon_t ,$$

where N_t is the natural spawners in brood year t, β_0 is the intercept regression parameter, β_1 is the slope regression parameter, and ε_t is the random error term of the regression. The regression parameter estimates, $\hat{\beta}_0$ and $\hat{\beta}_1$ are obtained through a least squares fit to the data. The trend estimate is then defined as: $\text{trend estimate} = \exp(\hat{\beta}_1)$.

Developing confidence intervals for $\exp(\beta_1)$ using the usual regression procedures is not possible because the regression residuals are not independent and not identically distributed. This is a drawback for this estimate of trend because the usual desirable statistical properties of maximum likelihood estimators (low bias and relatively high precision) do not apply. Therefore, a bootstrapping approach to estimating confidence intervals for the BRT trend was developed. This involved creating synthetic population data sets and applying the trend estimation procedure to each of these synthetic data sets to obtain a series of trend replications. The confidence intervals were constructed by setting the limits equal to the 0.025 and 0.975 quantiles of the empirical distribution of the trend replications (Efron and Tibshirani 1993).

Assumptions about the relative reproductive success of hatchery-born spawners and the extent of supplementation can influence the synthetic population data. It was assumed that the relative reproductive success of hatchery born spawners equaled one and that the fraction of hatchery-born spawners followed the same trajectory as in the retrospective data.

Because the BRT trend estimator is not based on maximum likelihood theory, but is ad hoc, it is not guaranteed to possess optimal statistical properties (i.e. low bias and relatively high precision). This stems from the fact that the errors in the regression of log(natural spawners+1) against time are serially dependent and are not normally distributed. In some cases the bias of the estimator is quite severe, and in one case, the bootstrap confidence interval does not contain the BRT trend estimate. Therefore, it is important to use this estimate of trend in the context of other estimates, such as log(R/S) and lambda. The Action Agencies estimated of BRT trends are presented for selected salmon and steelhead stocks in Tables A-3 through A-6.

A.1.3.5 Mean Log(R/S) Confidence Intervals

Another useful measure of the productivity of a salmon population is the mean log(R/S). When this estimate is greater than zero, it implies that the population is increasing. When it is below zero, it implies that the population is decreasing. The mean of the log(R/S) was calculated in the usual way,

(14) $$\text{mean}\log(R/S) = \sum_{t=1}^{n} \log(R_t / S_t) ,$$

where *n* represents the total number of log(R/S) observations.

Because there is first-order serial dependence in the time series of log recruits-per-spawner, log(R/S), it is inappropriate to use the usual standard error calculation for mean log(R/S). Instead, a bootstrap technique was used to simulate the times series while respecting autocorrelation in the residuals. A nonparametric approach to bootstrapping the residuals was used to construct confidence intervals and calculate standard errors for the mean of log(R/S).

Synthetic data sets for confidence intervals were generated by using the model

(15) $$y_t^* = \hat{\mu} + \varepsilon_t^*$$

where y_t^* represents a synthetic observation of log(R/S), $\hat{\mu}$ represents the mean log(R/S) calculated from the data set, and ε_t^* is a residual that was resampled from the original model fit (i.e., it is the difference between a log(R/S) value and mean log(R/S)).

The first order serial dependence was incorporated into the bootstrapped residuals by preserving the probability that a sign change occurred between residuals from one brood year to the next. The probability that there was a sign change in the residuals was estimated as

(16) $$\hat{p} = \sum_{t=1}^{n-1} I(\hat{e}_t \hat{e}_{t+1} < 0)/(n-1),$$

where $\hat{e}_t$ is the residuals associated with $\log(R_t / S_t)$, I() is an indicator function that returns a value of one when its argument is true and zero if it is not, and n is the number of observations. When residuals are truly independent, the sign change probability ($\hat{p}$) is 0.5. When there is high (positive) correlation in the residuals, the sign change probability is much less than 0.5.

In the simulations, if e_t^* represents the simulated bootstrap residual in year t, then e_{t+1}^* is selected at random with probability $\hat{p}$ from the residuals that have a sign opposite from e_t^*. With probability $1 - \hat{p}$, e_{t+1}^* is selected from the residuals that have the same sign as e_t^*. In this manner, the synthetic data sets preserve the first-order serial dependence observed in the original log(R/S) data set.

A set of 1000 bootstrap replications of mean log(R/S) were then obtained by taking the mean of each of the 1000 synthetic data sets. Standard error was estimated as the standard deviation of the 1000 replications, and 95 percent confidence limits are estimated as the 0.025 and 0.975 quantiles of the 1000 replications.

Nowhere was an assumption of normality needed in this approach to estimating the standard error and confidence intervals for the mean log(R/S). It was necessary, however, to assume that the error term (representing deviations from the mean log(R/S)) was symmetrically distributed about a mean of zero. The Action Agencies' estimate of mean log(R/S) for selected stocks of salmon and steelhead is presented in Tables A-7 and A-8.

A.1.3.6 Probability That a Trend Estimate is Greater Than 1.0

This section highlights issues regarding estimating a probability that lambda (or other population trend) is greater than one.

One of the difficulties in using lambda to evaluate the status of a population is that it is subject to sampling error. Sampling error is the error that comes from having a finite sample to work with instead of the entire statistical population (an infinite number of population measurements). Treating sampling error in some way recognizes that a different sample of 20 years from the same population process will yield a different estimate of lambda.

With an acknowledgement of uncertainty, one may be tempted to ask a seemingly simple question: what is the probability that lambda is actually greater than one? From a classical statistics viewpoint, this question does not make sense. The actual value of lambda is fixed: not a random quantity subject to probabilities. Considering such a question puts one in the realm of Bayesian statistics.

A Bayesian approach, which reports a probability, differs from the classical approach to quantifying uncertainty. In the classical approach, uncertainty is quantified by calculating a confidence interval. Confidence intervals are constructed so that if the same procedure was used with infinitely many samples, 95 percent of the intervals so constructed would contain the actual value of lambda (Neyman 1937). The fact that Bayesian statistics treats lambda as a random variable makes Bayesian statistics controversial (Dennis 1996), but its use in ecological work increased rapidly in the 1990s. (This discussion names lambda, but applies to other trend estimators as well). Taking a Bayesian approach, and assuming a noninformative (flat) prior distribution, there is a probability of 0.5 that any particular lambda is greater than one. Given the data, this probability will be modified somewhat into what is known as a posterior probability statement, which includes information contained in the sample. The median of the posterior distribution will be fixed at the lambda estimate.

Because of the large process error associated with salmon population dynamics, the data are fairly uninformative, and that the posterior probabilities will remain around 0.5 for many of the stocks. This is more of a statement about the state of our knowledge than the peril of fish populations. When confidence intervals are constructed for these populations, the uncertainty will show up in confidence intervals for lambda that contain one. That is, there will not be enough information in the data to reliably infer that lambda is not one: the confidence intervals will span values that are greater than one and less than one.

Technically, both approaches are possible for an analysis of trend. What is required is some sort of statistical model that describes the population data in terms of parameters and a probability distribution. In the classical statistics approach, one would obtain maximum likelihood estimates of the parameters (one of which is a trend parameter), then report standard confidence intervals. Taking a Bayesian approach, one would specify prior distributions for the parameters (e.g., noninformative priors), calculate a joint probability distribution of the parameters, find the marginal distribution of lambda, then calculate the probability that lambda is greater than one.

More information about the fundamental differences between frequentist (classical) and Bayesian statistical inference in their uses and interpretations of statistical concepts and terms may be found in Ellison (1996). The differences between these approaches are striking, with the frequentists assuming the data are random and parameters are fixed while the Bayesians assuming that the data are fixed and the parameters are random. These are not compatible, but both approaches are now common in the ecological literature.

In this Comprehensive Analysis, the Action Agencies have chosen to report standard errors or confidence intervals for lambdas and other productivity and trend estimates, mainly because they do an adequate job of illustrating the uncertainty in the estimates (see Tables A-1 through A-8 for results). A Bayesian approach will yield a single number representing the Bayesian probability that trends are greater than one. Rather than providing insight into the significant degree of uncertainty in estimates of this kind, it is the Action Agencies' view that Bayesian probabilities tend to mask the uncertainty and provide what is, in effect, a false appearance of precision. If estimates of this kind are intended to inform public policy (and ultimately they are), unintentionally obscuring the uncertainty in the underlying estimating process may not provide the most useful information for policymakers and the public.

Table A-1. Confidence Limits on Extinction Probabilities for Spring/Summer Chinook[1/]

Population	Prob	Lower95	Upper95	QET	RFT	nbadb	nbadalpha	ngood
Tucannon Spring Chinook	0.00	0.00	0.24	1	2	1	184	961
Tucannon Spring Chinook	0.02	0.00	0.47	10	10	1	184	961
Tucannon Spring Chinook	0.06	0.00	0.62	30	10	1	184	961
Tucannon Spring Chinook	0.11	0.00	0.74	50	10	1	184	961
Lostine River Chinook	0.00	0.00	0.44	1	2	43	38	828
Lostine River Chinook	0.03	0.00	0.64	10	10	43	38	828
Lostine River Chinook	0.10	0.00	0.75	30	10	43	38	828
Lostine River Chinook	0.19	0.00	0.81	50	10	43	38	828
Grande Ronde Upper Mainstem Chinook	0.00	0.00	0.14	1	2	9	9	939
Grande Ronde Upper Mainstem Chinook	0.09	0.00	0.57	10	10	9	9	939
Grande Ronde Upper Mainstem Chinook	0.39	0.01	0.88	30	10	9	9	939
Grande Ronde Upper Mainstem Chinook	0.67	0.07	0.97	50	10	9	9	939
Catherine Creek Chinook	0.11	0.00	0.79	1	2	185	120	771
Catherine Creek Chinook	0.28	0.00	0.92	10	10	185	120	771
Catherine Creek Chinook	0.43	0.00	0.97	30	10	185	120	771
Catherine Creek Chinook	0.51	0.02	0.98	50	10	185	120	771
Imnaha River Chinook	0.00	0.00	0.28	1	2	0	25	975
Imnaha River Chinook	0.01	0.00	0.47	10	10	0	25	975
Imnaha River Chinook	0.05	0.00	0.64	30	10	0	25	975
Imnaha River Chinook	0.09	0.00	0.73	50	10	0	25	975
Minam River Chinook	0.00	0.00	0.31	1	2	0	52	933
Minam River Chinook	0.00	0.00	0.41	10	10	0	52	933
Minam River Chinook	0.02	0.00	0.52	30	10	0	52	933
Minam River Chinook	0.06	0.00	0.61	50	10	0	52	933
Wenaha River Chinook	0.00	0.00	0.32	1	2	15	37	970
Wenaha River Chinook	0.05	0.00	0.55	10	10	15	37	970
Wenaha River Chinook	0.16	0.00	0.72	30	10	15	37	970
Wenaha River Chinook	0.26	0.00	0.79	50	10	15	37	970
South Fork Salmon Mainstem	0.00	0.00	0.01	1	2	99	0	741
South Fork Salmon Mainstem	0.00	0.00	0.08	10	10	99	0	741
South Fork Salmon Mainstem	0.00	0.00	0.19	30	10	99	0	741
South Fork Salmon Mainstem	0.00	0.00	0.27	50	10	99	0	741
Secesh River Chinook	0.00	0.00	0.20	1	2	355	30	638
Secesh River Chinook	0.00	0.00	0.29	10	10	355	30	638
Secesh River Chinook	0.01	0.00	0.34	30	10	355	30	638
Secesh River Chinook	0.03	0.00	0.37	50	10	355	30	638
South Fork Salmon East Fork (inc Johnson Cr.)	0.00	0.00	0.03	1	2	390	18	599
South Fork Salmon East Fork (inc Johnson Cr.)	0.00	0.00	0.13	10	10	390	18	599
South Fork Salmon East Fork (inc Johnson Cr.)	0.00	0.00	0.21	30	10	390	18	599
South Fork Salmon East Fork (inc Johnson Cr.)	0.01	0.00	0.28	50	10	390	18	599
Big Creek Chinook	0.00	0.00	0.67	1	2	52	32	896
Big Creek Chinook	0.04	0.00	0.86	10	10	52	32	896
Big Creek Chinook	0.23	0.00	0.95	30	10	52	32	896
Big Creek Chinook	0.43	0.00	0.97	50	10	52	32	896
Bear Valley Creek	0.00	0.00	0.43	1	2	0	57	971
Bear Valley Creek	0.00	0.00	0.55	10	10	0	57	971
Bear Valley Creek	0.03	0.00	0.64	30	10	0	57	971
Bear Valley Creek	0.09	0.00	0.71	50	10	0	57	971
Marsh Creek Chinook	0.02	0.00	0.58	1	2	42	41	871
Marsh Creek Chinook	0.15	0.00	0.77	10	10	42	41	871

Table A-1. Confidence Limits on Extinction Probabilities for Spring/Summer Chinook[1/]

Population	Prob	Lower95	Upper95	QET	RFT	nbadb	nbadalpha	ngood
Marsh Creek Chinook	0.38	0.00	0.89	30	10	42	41	871
Marsh Creek Chinook	0.55	0.00	0.95	50	10	42	41	871
Sulphur Creek	0.00	0.00	0.50	1	2	8	14	892
Sulphur Creek	0.13	0.00	0.75	10	10	8	14	892
Sulphur Creek	0.45	0.00	0.92	30	10	8	14	892
Sulphur Creek	0.66	0.03	0.97	50	10	8	14	892
Valley Creek Chinook	0.03	0.00	0.30	1	2	1	66	726
Valley Creek Chinook	0.28	0.00	0.69	10	10	1	66	726
Valley Creek Chinook	0.60	0.00	0.95	30	10	1	66	726
Valley Creek Chinook	0.74	0.03	0.98	50	10	1	66	726
Lower Mainstem Salmon River (SRLMA)	0.00	0.00	0.18	1	2	1	171	797
Lower Mainstem Salmon River (SRLMA)	0.00	0.00	0.65	10	10	1	171	797
Lower Mainstem Salmon River (SRLMA)	0.05	0.00	0.92	30	10	1	171	797
Lower Mainstem Salmon River (SRLMA)	0.17	0.00	0.98	50	10	1	171	797
Upper Salmon East Fork Chinook	0.00	0.00	0.18	1	2	0	187	905
Upper Salmon East Fork Chinook	0.00	0.00	0.39	10	10	0	187	905
Upper Salmon East Fork Chinook	0.04	0.00	0.62	30	10	0	187	905
Upper Salmon East Fork Chinook	0.13	0.00	0.75	50	10	0	187	905
Upper Mainstem Salmon River (SRUMA)	0.00	0.00	0.36	1	2	19	13	873
Upper Mainstem Salmon River (SRUMA)	0.00	0.00	0.46	10	10	19	13	873
Upper Mainstem Salmon River (SRUMA)	0.00	0.00	0.56	30	10	19	13	873
Upper Mainstem Salmon River (SRUMA)	0.01	0.00	0.62	50	10	19	13	873
Wenatchee River Chinook	0.00	0.00	0.45	1	2	8	174	902
Wenatchee River Chinook	0.01	0.00	0.66	10	10	8	174	902
Wenatchee River Chinook	0.01	0.00	0.75	30	10	8	174	902
Wenatchee River Chinook	0.02	0.00	0.80	50	10	8	174	902
Entiat River Chinook	0.00	0.00	0.17	1	2	2	41	946
Entiat River Chinook	0.00	0.00	0.41	10	10	2	41	946
Entiat River Chinook	0.05	0.00	0.70	30	10	2	41	946
Entiat River Chinook	0.18	0.00	0.85	50	10	2	41	946

[1/] These were based on 1,000 bootstrap replications. The lower confidence bound represents the 0.025 quantile of the 100 extinction probability replications, while the upper limit represents the 0.975 quantile of the 1,000 extinction probability replications. Extinction probabilities were calculated over a time window of 24 years with various levels of quasi-extinction threshold (QET) and reproductive failure threshold (RFT). Note that less than 1,000 replications were actually generated for each of the populations because some bootstrap samples resulted in invalid maximum likelihood estimates of the Beverton-Holt model. The column "ngood" represents the number of valid replications of the parameter estimates, nbadb represents the number of replications with b less than zero, and nbadalpha represents the number of replications with alpha greater than 1.0. Whenever a replication of alpha was greater than one, it was set equal to one. Extinction probabilities were based on 4,000 population trajectories.

Table A-2. Confidence Limits on Extinction Probabilities for Steelhead[1/]

Population	Prob	Lower95	Upper95	QET	RFT	nbadb	nbadalpha	ngood
Average A-run steelhead population	0.00	0.00	0.30	1	2	3	149	937
Average A-run steelhead population	0.01	0.00	0.41	10	10	3	149	937
Average A-run steelhead population	0.06	0.00	0.58	30	10	3	149	937
Average A-run steelhead population	0.10	0.00	0.71	50	10	3	149	937
Grande Ronde Upper Mainstem Steelhead	0.00	0.00	0.00	1	2	0	0	998
Grande Ronde Upper Mainstem Steelhead	0.00	0.00	0.00	10	10	0	0	998
Grande Ronde Upper Mainstem Steelhead	0.00	0.00	0.00	30	10	0	0	998
Grande Ronde Upper Mainstem Steelhead	0.00	0.00	0.00	50	10	0	0	998
Joseph Creek Steelhead	0.00	0.00	0.04	1	2	3	8	981
Joseph Creek Steelhead	0.00	0.00	0.10	10	10	3	8	981
Joseph Creek Steelhead	0.00	0.00	0.15	30	10	3	8	981
Joseph Creek Steelhead	0.00	0.00	0.18	50	10	3	8	981
Imnaha River Steelhead (Camp Creek)	0.00	0.00	0.34	1	2	0	101	992
Imnaha River Steelhead (Camp Creek)	0.00	0.00	0.53	10	10	0	101	992
Imnaha River Steelhead (Camp Creek)	0.13	0.00	0.83	30	10	0	101	992
Imnaha River Steelhead (Camp Creek)	0.51	0.04	0.96	50	10	0	101	992
John Day Lower Mainstem	0.00	0.00	0.20	1	2	0	46	990
John Day Lower Mainstem	0.00	0.00	0.29	10	10	0	46	990
John Day Lower Mainstem	0.00	0.00	0.35	30	10	0	46	990
John Day Lower Mainstem	0.00	0.00	0.38	50	10	0	46	990
John Day North Fork	0.00	0.00	0.01	1	2	0	20	998
John Day North Fork	0.00	0.00	0.03	10	10	0	20	998
John Day North Fork	0.00	0.00	0.06	30	10	0	20	998
John Day North Fork	0.00	0.00	0.08	50	10	0	20	998
John Day Upper Mainstem	0.00	0.00	0.17	1	2	0	120	967
John Day Upper Mainstem	0.00	0.00	0.27	10	10	0	120	967
John Day Upper Mainstem	0.00	0.00	0.34	30	10	0	120	967
John Day Upper Mainstem	0.00	0.00	0.37	50	10	0	120	967
John Day Middle Fork	0.00	0.00	0.12	1	2	0	111	985
John Day Middle Fork	0.00	0.00	0.23	10	10	0	111	985
John Day Middle Fork	0.00	0.00	0.31	30	10	0	111	985
John Day Middle Fork	0.00	0.00	0.35	50	10	0	111	985
John Day South Fork	0.00	0.00	0.50	1	2	0	162	979
John Day South Fork	0.00	0.00	0.68	10	10	0	162	979
John Day South Fork	0.01	0.00	0.77	30	10	0	162	979
John Day South Fork	0.02	0.00	0.82	50	10	0	162	979
Umatilla River Steelhead	0.00	0.00	0.14	1	2	1	28	994
Umatilla River Steelhead	0.00	0.00	0.26	10	10	1	28	994
Umatilla River Steelhead	0.00	0.00	0.33	30	10	1	28	994
Umatilla River Steelhead	0.00	0.00	0.36	50	10	1	28	994
Fifteenmile Steelhead	0.00	0.00	0.25	1	2	1	101	979
Fifteenmile Steelhead	0.00	0.00	0.36	10	10	1	101	979
Fifteenmile Steelhead	0.00	0.00	0.44	30	10	1	101	979
Fifteenmile Steelhead	0.00	0.00	0.49	50	10	1	101	979
Deschutes River Westside from Eric Tinus 11_	0.00	0.00	0.29	1	2	0	157	973
Deschutes River Westside from Eric Tinus 11_	0.00	0.00	0.77	10	10	0	157	973
Deschutes River Westside from Eric Tinus 11_	0.00	0.00	0.90	30	10	0	157	973
Deschutes River Westside from Eric Tinus 11_	0.00	0.00	0.93	50	10	0	157	973
Deschutes Eastside Steelhead	0.42	0.00	1.00	1	2	44	784	690
Deschutes Eastside Steelhead	0.50	0.00	1.00	10	10	44	784	690

Table A-2. Confidence Limits on Extinction Probabilities for Steelhead[1/]

Population	Prob	Lower95	Upper95	QET	RFT	nbadb	nbadalpha	ngood
Deschutes Eastside Steelhead	0.52	0.00	1.00	30	10	44	784	690
Deschutes Eastside Steelhead	0.56	0.00	1.00	50	10	44	784	690
Satus Creek Steelhead	0.00	0.00	0.14	1	2	1	68	977
Satus Creek Steelhead	0.00	0.00	0.24	10	10	1	68	977
Satus Creek Steelhead	0.00	0.00	0.31	30	10	1	68	977
Satus Creek Steelhead	0.00	0.00	0.35	50	10	1	68	977
Toppenish Creek Steelhead	0.00	0.00	0.34	1	2	1	159	982
Toppenish Creek Steelhead	0.02	0.00	0.51	10	10	1	159	982
Toppenish Creek Steelhead	0.13	0.00	0.64	30	10	1	159	982
Toppenish Creek Steelhead	0.31	0.00	0.81	50	10	1	159	982
Naches River Steelhead	0.00	0.00	0.22	1	2	2	65	969
Naches River Steelhead	0.00	0.00	0.35	10	10	2	65	969
Naches River Steelhead	0.00	0.00	0.44	30	10	2	65	969
Naches River Steelhead	0.01	0.00	0.53	50	10	2	65	969
Upper Yakima River Steelhead	0.38	0.00	0.99	1	2	2	615	834
Upper Yakima River Steelhead	0.49	0.00	1.00	10	10	2	615	834
Upper Yakima River Steelhead	0.56	0.00	1.00	30	10	2	615	834
Upper Yakima River Steelhead	0.66	0.03	1.00	50	10	2	615	834
Upper Columbia Steelhead -- Wenatchee River	0.00	0.00	0.54	1	2	0	227	960
Upper Columbia Steelhead -- Wenatchee River	0.07	0.00	0.71	10	10	0	227	960
Upper Columbia Steelhead -- Wenatchee River	0.20	0.00	0.80	30	10	0	227	960
Upper Columbia Steelhead -- Wenatchee River	0.28	0.00	0.83	50	10	0	227	960
Upper Columbia Steelhead -- Methow River	0.04	0.00	0.68	1	2	9	63	984
Upper Columbia Steelhead -- Methow River	0.45	0.00	0.97	10	10	9	63	984
Upper Columbia Steelhead -- Methow River	0.76	0.05	1.00	30	10	9	63	984
Upper Columbia Steelhead -- Methow River	0.87	0.13	1.00	50	10	9	63	984
Upper Columbia Steelhead -- Entiat River	0.08	0.00	0.58	1	2	0	224	943
Upper Columbia Steelhead -- Entiat River	0.45	0.00	0.88	10	10	0	224	943
Upper Columbia Steelhead -- Entiat River	0.69	0.00	0.99	30	10	0	224	943
Upper Columbia Steelhead -- Entiat River	0.83	0.00	1.00	50	10	0	224	943
Upper Columbia Steelhead -- Okanogan River	0.37	0.00	0.95	1	2	2	64	992
Upper Columbia Steelhead -- Okanogan River	0.92	0.24	1.00	10	10	2	64	992
Upper Columbia Steelhead -- Okanogan River	0.99	0.55	1.00	30	10	2	64	992
Upper Columbia Steelhead -- Okanogan River	1.00	0.65	1.00	50	10	2	64	992

[1/] These were based on 1,000 bootstrap replications. The lower confidence bound represents the 0.025 quantile of the 100 extinction probability replications, while the upper limit represents the 0.975 quantile of the 1,000 extinction probability replications. Extinction probabilities were calculated over a time window of 24 years with various levels of quasi-extinction threshold (QET) and reproductive failure threshold (RFT). Note that less than 1,000 replications were actually generated for each of the populations because some bootstrap samples resulted in invalid maximum likelihood estimates of the Ricker model. The column "ngood" represents the number of valid replications of the parameter estimates, nbadb represents the number of replications with b less than zero, and nbadalpha represents the number of replications with alpha greater than 1.0. If a bootstrap replication of alpha (autoregressive parameter) exceeded 1, it was set to 1. Extinction probabilities were based on 4,000 population projections.

Table A-3. Estimates of the Log Biological Review Team Trend for Various Spring/Summer Chinook Populations Using Data from 1980 to Present[1/]

	Trend Estimate	Bootstrap SE	Lower95	Upper95	Nobs
Tucannon Spring Chinook	-0.12	0.23	-0.23	0.67	24
Lostine River Chinook	0.01	0.17	-0.12	0.55	26
Grande Ronde Upper Mainstem Chinook	-0.07	0.12	-0.11	0.38	26
Catherine Creek Chinook	-0.07	0.17	-0.25	0.40	26
Imnaha River Chinook	-0.02	0.15	-0.08	0.49	26
Minam River Chinook	0.02	0.17	-0.16	0.52	26
Wenaha River Chinook	0.04	0.14	-0.14	0.40	26
South Fork Salmon Mainstem	0.05	0.10	-0.07	0.30	24
Secesh River Chinook	0.02	0.12	-0.11	0.36	24
South Fork Salmon East Fork (inc Johnson Cr.)	0.03	0.10	-0.10	0.28	24
Big Creek Chinook	0.02	0.53	-0.31	1.72	25
Bear Valley Creek	0.05	0.16	-0.10	0.52	24
Camas Creek Chinook	-0.02	0.14	-0.21	0.32	24
Loon Creek Chinook	0.06	0.10	0.03	0.39	25
Marsh Creek Chinook	0.00	0.20	-0.18	0.58	24
Sulphur Creek	0.01	0.19	-0.11	0.61	24
Pahsimeroi Chinook	0.32	0.36	-0.19	1.17	20
Lemhi River Chinook	-0.02	0.15	-0.17	0.43	24
Valley Creek Chinook	0.02	0.12	-0.16	0.32	24
Yankee Fork Salmon River	0.03	0.18	-0.27	0.37	23
Lower Mainstem Salmon River (SRLMA)	0.00	0.16	-0.10	0.52	26
Upper Salmon East Fork Chinook	0.01	0.61	-0.31	2.11	26
Upper Mainstem Salmon River (SRUMA)	0.01	0.16	-0.14	0.51	26
Wenatchee River Chinook	-0.12	0.25	-0.27	0.70	24
Methow River Chinook	-0.05	0.32	-0.01	1.27	22

[1/] Estimates of SE were obtained using bootstrapping. Synthetic data sets were generated using run reconstruction information, age structure, and lag-1 autocorrelation in the log(R/S) observations. The log(BRT trend estimate) was generated by regressing log(natural spawners+1) against time and using the slope of the ordinary least squares regression line. "Nobs" represent the number of spawner observations used in the least squares estimation. The SEs were based on 1,000 replications. The confidence intervals were constructed for the log(BRT trend estimate) using bootstrapping.

Table A-4. Estimates of the Log Biological Review Team Trend for Various Spring/Summer Chinook Salmon Populations Using Data from 1990-Present[1/]

Population	Trend Estimate	Bootstrap SE	Lower95	Upper95	Nobs
Tucannon Spring Chinook	-0.04	1.06	-0.41	3.41	14
Lostine River Chinook	0.15	0.35	-0.44	0.94	16
Grande Ronde Upper Mainstem Chinook	-0.01	0.15	-0.09	0.48	16
Catherine Creek Chinook	0.20	0.17	-0.22	0.46	16
Imnaha River Chinook	0.10	0.30	-0.50	0.63	16
Minam River Chinook	0.12	0.28	-0.35	0.78	16
Wenaha River Chinook	0.18	0.34	-0.38	0.94	16
South Fork Salmon Mainstem	0.08	0.24	-0.49	0.41	14
Secesh River Chinook	0.11	0.59	-0.57	1.58	14
South Fork Salmon East Fork (inc Johnson Cr.)	0.03	0.23	-0.47	0.42	14
Big Creek Chinook	0.13	0.42	-0.47	1.06	15
Bear Valley Creek	0.15	0.47	-0.54	1.18	14
Camas Creek Chinook	0.20	0.25	-0.44	0.51	14
Loon Creek Chinook	0.29	0.09	0.24	0.59	15
Marsh Creek Chinook	0.11	0.34	-0.39	1.02	14
Sulphur Creek	0.00	0.20	-0.30	0.52	14
Pahsimeroi Chinook	0.29	0.18	0.05	0.76	16
Lemhi River Chinook	0.12	0.21	-0.28	0.53	14
Valley Creek Chinook	0.19	0.14	-0.38	0.15	14
Yankee Fork Salmon River	0.12	0.63	-0.50	1.94	14
Lower Mainstem Salmon River (SRLMA)	0.10	0.28	-0.45	0.63	16
Upper Salmon East Fork Chinook	0.16	0.45	-0.47	1.28	16
Upper Mainstem Salmon River (SRUMA)	0.10	0.37	-0.52	0.86	16
Wenatchee River Chinook	-0.02	0.52	-0.60	1.25	14
Methow River Chinook	-0.09	0.65	-0.50	2.02	12

[1/] Estimates of SE were obtained using bootstrapping. Synthetic data sets were generated using run reconstruction information, age structure, and lag-1 autocorrelation in the log(R/S) observations. The log (BRT trend estimate) was generated by regressing log(natural spawners+1) against time and using the slope of the ordinary least squares regression line. "Nobs" represent the number of spawner observations used in the least squares estimation. The SEs were based on 1,000 replications. The confidence intervals were constructed for the log(BRT trend estimate) using bootstrapping.

Table A-5. Estimates of the Log Biological Review Team Trend for Various Steelhead Populations Using Data from 1980 to Present[1/]

	Trend Estimate	Bootstrap SE	Lower95	Upper95	Nobs
Average A-run steelhead population	0.01	0.29	-0.39	0.74	19
Average B-run steelhead population	-0.04	NA	NA	NA	19
Grande Ronde Upper Mainstem Steelhead	-0.01	0.06	-0.05	0.21	25
Joseph Creek Steelhead	0.02	0.20	-0.13	0.64	26
Imnaha River Steelhead (Camp Creek)	0.03	0.13	-0.16	0.37	26
John Day Lower Mainstem	-0.02	0.23	-0.31	0.58	26
John Day North Fork	-0.01	0.10	-0.09	0.29	26
John Day Upper Mainstem	-0.05	0.11	-0.13	0.28	26
John Day Middle Fork	-0.03	0.12	-0.10	0.38	26
John Day South Fork	-0.05	0.15	-0.14	0.43	26
Umatilla River Steelhead	0.01	0.07	-0.07	0.20	25
Walla Walla River Steelhead	0.04	0.25	-0.58	0.36	11
Fifteenmile Steelhead	0.04	0.08	-0.08	0.24	21
Deschutes River Westside from Eric Tinus, 11_15_05	-0.01	0.10	-0.10	0.30	26
Deschutes Eastside Steelhead	0.10	0.41	-0.56	0.86	16
Satus Creek Steelhead	0.00	0.14	-0.26	0.26	20
Toppenish Creek Steelhead	0.01	NA	NA	NA	20
Naches River Steelhead	0.00	0.17	-0.35	0.31	20
Upper Yakima River Steelhead	0.00	0.39	-0.30	1.08	20
Upper Columbia River Steelhead -- Wenatchee River	0.02	0.07	-0.05	0.22	25
Upper Columbia River Steelhead -- Methow River	0.06	0.09	0.00	0.37	26
Upper Columbia River Steelhead -- Entiat River	0.02	0.08	-0.06	0.23	25
Upper Columbia River Steelhead -- Okanogan River	0.06	0.09	0.00	0.37	26

[1/] Estimates of SE were obtained using bootstrapping. Synthetic data sets were generated using run reconstruction information, age structure, and lag-1 autocorrelation in the log(R/S) observations. The log(BRT trend estimate) was generated by regressing log(natural spawners+1) against time and using the slope of the ordinary least squares regression line. "Nobs" represent the number of spawner observations used in the least squares estimation. The SEs were based on 1,000 replications. The confidence intervals were constructed for the log(BRT trend estimate) using bootstrapping. NAs were produced for the Average B-run steelhead population because it lacked age structure data. NAs were generated for Toppenish Creek Steelhead because no valid maximum likelihood estimates were found for the spawner-recruit model.

Table A-6. Estimates of the Log Biological Review Team Trend for Various Steelhead Populations Using Data from 1990 to Present[1/]

	Trend Estimate	Bootstrap SE	Lower95	Upper95	Nobs
Average A-run steelhead population	0.07	0.64	-0.59	1.72	15
Average B-run steelhead population	-0.01	NA	NA	NA	15
Grande Ronde Upper Mainstem Steelhead	0.01	0.04	-0.02	0.14	15
Joseph Creek Steelhead	0.04	0.06	-0.06	0.19	16
Imnaha River Steelhead (Camp Creek)	0.05	0.12	-0.17	0.30	16
John Day Lower Mainstem	0.04	0.63	-0.58	1.55	16
John Day North Fork	0.09	0.04	0.09	0.24	16
John Day Upper Mainstem	-0.04	0.11	-0.23	0.20	16
John Day Middle Fork	-0.02	0.16	-0.26	0.38	16
John Day South Fork	0.01	0.28	-0.41	0.68	16
Umatilla River Steelhead	0.07	0.04	0.00	0.16	15
Walla Walla River Steelhead	0.04	0.25	-0.59	0.37	11
Fifteenmile Steelhead	0.11	0.06	0.04	0.28	16
Deschutes River Westside from Eric Tinus, 11_15_05	0.09	0.10	-0.08	0.28	16
Deschutes Eastside Steelhead	0.10	0.44	-0.56	0.97	16
Satus Creek Steelhead	0.08	0.16	-0.17	0.45	15
Toppenish Creek Steelhead	0.08	0.15	-0.17	0.45	15
Naches River Steelhead	0.08	0.16	-0.25	0.38	15
Upper Yakima River Steelhead	0.09	0.39	-0.42	0.96	15
Upper Columbia River Steelhead -- Wenatchee River	0.05	0.11	-0.18	0.26	15
Upper Columbia River Steelhead -- Methow River	0.06	0.18	-0.27	0.43	16
Upper Columbia River Steelhead -- Entiat River	0.05	0.11	-0.18	0.25	15
Upper Columbia River Steelhead -- Okanogan River	0.06	0.17	-0.24	0.42	16

[1/] Estimates of SE were obtained using bootstrapping. Synthetic data sets were generated using run reconstruction information, age structure, and lag-1 autocorrelation in the log(R/S) observations. The log(BRT trend estimate) was generated by regressing log(natural spawners+1) against time and using the slope of the ordinary least squares regression line. "Nobs" represent the number of spawner observations used in the least squares estimation. The SEs were based on 1,000 replications. The confidence intervals are constructed for the log (BRT trend estimate) using bootstrapping. NAs were produced for the Average B-run steelhead population because it lacked age structure data.

Table A-7. Spring/Summer Chinook Estimates of Mean Log (R/S) Using Spawner-Recruit Data Starting in Brood Year 1978

	Estimate	Std. Error	Boot SE	Lower95	Upper95	pswitch
Tucannon Spring Chinook	-0.27	0.23	0.26	-0.76	0.24	0.32
Lostine River Chinook	-0.25	0.29	0.45	-1.12	0.63	0.23
Grande Ronde Upper Mainstem Chinook	-0.78	0.30	0.37	-1.50	-0.11	0.36
Catherine Creek Chinook	-0.92	0.33	0.47	-1.82	-0.07	0.27
Imnaha River Chinook	-0.42	0.21	0.31	-1.05	0.19	0.27
Minam River Chinook	-0.18	0.29	0.54	-1.22	0.82	0.14
Wenaha River Chinook	-0.39	0.25	0.35	-1.05	0.34	0.23
South Fork Salmon Mainstem	-0.15	0.21	0.25	-0.65	0.32	0.35
Secesh River Chinook	0.04	0.20	0.26	-0.44	0.55	0.30
South Fork Salmon East Fork (inc Johnson Cr.)	-0.04	0.22	0.23	-0.49	0.40	0.45
Big Creek Chinook	0.15	0.32	0.62	-1.02	1.33	0.16
Bear Valley Creek	0.21	0.29	0.46	-0.68	1.06	0.25
Camas Creek Chinook	0.03	0.38	0.52	-0.99	1.07	0.26
Loon Creek Chinook	0.48	0.44	0.49	-0.46	1.49	0.40
Marsh Creek Chinook	-0.12	0.34	0.58	-1.20	0.98	0.17
Sulphur Creek	0.10	0.45	0.54	-0.96	1.08	0.35
Pahsimeroi Chinook	-0.94	0.49	1.19	-2.80	0.95	0.07
Lemhi River Chinook	-0.02	0.31	0.60	-1.07	1.13	0.15
Valley Creek Chinook	0.07	0.34	0.61	-1.07	1.20	0.17
Yankee Fork Salmon River	-0.09	0.41	0.76	-1.44	1.30	0.15
Lower Mainstem Salmon River (SRLMA)	0.19	0.26	0.38	-0.59	0.88	0.25
Upper Salmon East Fork Chinook	0.17	0.36	0.73	-1.15	1.57	0.14
Upper Mainstem Salmon River (SRUMA)	0.22	0.31	0.44	-0.58	1.08	0.27
Wenatchee River Chinook	-0.31	0.27	0.50	-1.29	0.65	0.15
Methow River Chinook	0.28	0.52	0.86	-1.33	1.84	0.15
Entiat River Chinook	-0.37	0.21	0.26	-0.85	0.14	0.35

[1/] "Estimate" represents the mean log(R/S), Std. Error represents the usual standard error of the estimate, which ignores serial dependence. "Boot SE" represents the bootstrap standard error, which takes serial dependence into account. The lower and upper limits of the bootstrap confidence interval are given by "Lower95" and "Upper95", respectively. "pswitch" is the probability that a residual switches sign from one year to the next.

Table A-8. Steelhead Estimates of Mean Log(R/S) Using Spawner-Recruit Data Starting in Brood Year 1978[1/]

	Estimate	Std. Error	Boot SE	Lower95	Upper95	pswitch
Average A-run steelhead population	0.23	0.43	0.95	-1.28	1.78	0.08
Average B-run steelhead population	-0.20	0.26	0.36	-0.89	0.50	0.25
Grande Ronde Upper Mainstem Steelhead	0.11	0.23	0.26	-0.39	0.62	0.40
Joseph Creek Steelhead	0.42	0.24	0.48	-0.49	1.31	0.14
Imnaha River Steelhead (Camp Creek)	0.34	0.23	0.34	-0.31	1.01	0.24
John Day Lower Mainstem	0.31	0.29	0.44	-0.53	1.15	0.25
John Day North Fork	0.15	0.22	0.26	-0.35	0.65	0.35
John Day Upper Mainstem	0.05	0.22	0.43	-0.75	0.86	0.15
John Day Middle Fork	0.11	0.21	0.42	-0.69	0.94	0.15
John Day South Fork	0.01	0.25	0.43	-0.83	0.80	0.20
Umatilla River Steelhead	-0.12	0.14	0.21	-0.54	0.27	0.23
Walla Walla River Steelhead	-0.08	0.31	0.45	-0.96	0.70	0.25
Fifteenmile Steelhead	0.19	0.21	0.34	-0.47	0.80	0.21
Deschutes River Westside from Eric Tinus, 11_15_05	-0.07	0.16	0.28	-0.59	0.48	0.19
Deschutes Eastside Steelhead	0.13	0.33	0.66	-0.93	1.19	0.11
Satus Creek Steelhead	-0.01	0.24	0.37	-0.69	0.72	0.21
Toppenish Creek Steelhead	-0.01	0.25	0.40	-0.75	0.76	0.21
Naches River Steelhead	-0.03	0.23	0.37	-0.72	0.68	0.21
Upper Yakima River Steelhead	0.00	0.23	0.56	-0.86	0.86	0.07
Upper Columbia River Steelhead -- Wenatchee River	-1.27	0.15	0.25	-1.76	-0.78	0.20
Upper Columbia River Steelhead -- Methow River	-1.72	0.21	0.41	-2.49	-0.93	0.14
Upper Columbia River Steelhead -- Entiat River	-1.27	0.15	0.25	-1.77	-0.79	0.20
Upper Columbia River Steelhead -- Okanogan River	-2.06	0.21	0.40	-2.84	-1.33	0.14

[1/] "Estimate" represents the mean log(R/S), Std. Error represents the usual standard error of the estimate, which ignores serial dependence. "Boot SE" represents the bootstrap standard error, which takes serial dependence into account. The lower and upper limits of the bootstrap confidence interval are given by "Lower95" and "Upper95", respectively. "pswitch" is the probability that a residual switches sign from one year to the next.

A.1.4 QUASI-EXTINCTION THRESHOLD SENSITIVITIES

NMFS has indicated it will likely consider results from a quasi-extinction modeling exercise with quasi-extinction being defined as fewer than 50 spawners in four consecutive years for any given population. This is the modeling threshold used by the Interior Columbia Technical Recovery Team. One of the Interior Columbia Basin TRT's stated concerns is with "uncertainty regarding low abundance productivity of Interior Columbia ESU populations due to the paucity of escapements less than 50 spawners in the historical record." To support its use of QET=50, the TRT carried out an analysis that showed that the model's proportion of years at low spawning abundance (<50) increases rapidly as the numerical value of QET is adjusted downwards from 100. Building upon this approach, we conducted our own analysis.

First, in the Snake River Spring/Summer Chinook Salmon ESU, we did not find a paucity of escapements below 50 (Table A-9). Model projections were compared with the data, and a QET of 50 or higher resulted in poor agreement with the actual spawner numbers (Figure A-1 and Table A-9).

Here is the overall approach:

1. Generate 20-year trajectories beginning with spawner counts 20 years ago.

2. From these trajectories, create a frequency distribution of the fraction of years resulting in spawners<50.
3. Compare this frequency distribution to the actual fraction of years resulting in spawners < 50.
4. Determine whether the observed fractions are in some sense "unusual" compared to the model-based frequency distribution of fractions. Unusual would mean that the actual fractions would lie in the tail of the frequency distribution (see Figure A-1).

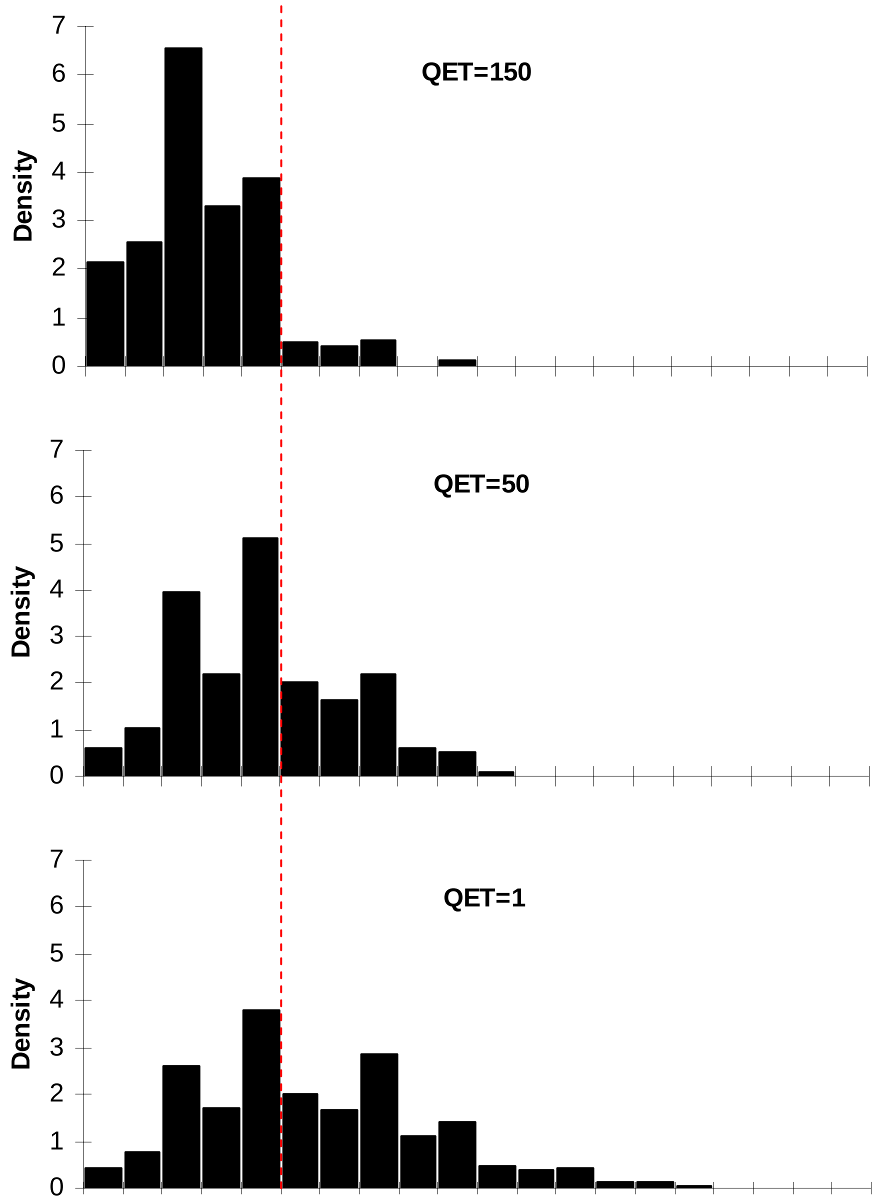
The spawner counts over the last 20 years were used to estimate the observed fraction of years with spawners below 50 because these were the data used to fit the PVA model. If one is checking for consistency between models and data it is most appropriate to use the time period that was used to fit the model. It makes no sense to expect the model, fit to low spawner counts during the last 20 years, to produce the relatively high spawner counts seen before 1975.

It was found that indeed with QET of 50 or higher, the observed fraction of spawners below 50 lay in the tail of the frequency distributions, indicating that the distribution that QET of 50 or higher provides is not consistent with the observed escapements over the last 20 years. The complete results of this analysis are contained in Table A-9.

The Independent Scientific Advisory Board (ISAB) recently completed a review of the Interior Columbia Basin TRT's March 2007 draft Viability Criteria Report (ISAB 2007). In its review, the ISAB noted: "The probabilities of quasi-extinction should not be considered equivalent to the probability of biological extinction. Rather, the former should be interpreted as the probability of entering a state where the risk of extinction cannot be modeled but is considered to be unacceptably high. The true probability of extinction could be bounded by probabilities derived using quasi-extinction thresholds of 1 and 100."

Our analysis indicates that a QET=>50 does not produce model results that are consistent with the data. A review of discussions on this topic from the Interior Columbia Basin TRT and Willamette-Lower Columbia TRT leads us to conclude that there is very little empirical basis for determining the "correct" quasi-extinction threshold for modeling purposes. As noted above, the ISAB states that quasi-extinction can be defined as "entering a state where the risk of extinction…is considered to be unacceptably high." It is precisely that "consideration" that seems to be within the realm of those charged with making public policy. For these reasons we conclude that an appropriate QET is ultimately a policy determination - that the decision about what constitutes an unacceptably high risk level should be made by policymakers, informed by the best scientific and technical information. Therefore, the Action Agencies' biological analysis uses a range of QET sensitivities in order to provide policymakers and others with the full range of information they will need to inform their decisions.

Figure A-1. An Illustration of Histograms of the Fraction of Years with Spawners Falling Below 50 for Upper Grande Ronde Spring/Summer Chinook Salmon Population[1/]



[1/] Notice that with QET at 150, the observed frequency of years with escapements below 50 (dashed red line) lies away from the bulk of the histogram. But, as the QET decreases toward 1, the histogram tends to flatten out and shift the right, bring the histogram to a location centered about the observed frequency. This suggests that that QET<=50 is most consistent with the observed fraction of years with escapement less than or equal to 50.

Table A-9. Spring/Summer Chinook Salmon Quasi-Extinction Threshold (QET)[1/]

Population	Observed Frequency	QET 1	2	5	10	50	100	150
Tucannon River Spring Chinook	0.04	0.90	0.92	0.91	0.90	0.93	0.98	0.99
Lostine River Chinook	0.04	0.64	0.63	0.65	0.64	0.70	0.80	0.88
Grande Ronde Upper Mainstem Chinook	0.25	0.47	0.46	0.49	0.48	0.65	0.86	0.92
Catherine Creek Chinook	0.18	0.69	0.67	0.75	0.74	0.91	0.96	0.99
Imnaha River Chinook	0.00	0.93	0.90	0.91	0.92	0.91	0.94	0.96
Minam River Chinook	0.00	0.59	0.59	0.57	0.60	0.62	0.68	0.80
Wenaha River Chinook	0.04	0.54	0.54	0.53	0.56	0.63	0.73	0.83
South Fork Salmon Mainstem	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Secesh River Chinook	0.00	0.77	0.75	0.76	0.76	0.82	0.90	0.93
South Fork Salmon East Fork (inc Johnson Cr.)	0.00	0.79	0.79	0.78	0.78	0.81	0.88	0.92
Big Creek Chinook	0.22	0.51	0.50	0.52	0.49	0.90	1.00	1.00
Bear Valley Creek	0.12	0.78	0.78	0.75	0.77	0.88	0.97	0.99
Camas Creek Chinook	0.52	NA	NA	NA	NA	NA	NA	NA
Loon Creek Chinook	0.48	NA	NA	NA	NA	NA	NA	NA
Marsh Creek Chinook	0.19	0.28	0.29	0.31	0.30	0.65	0.96	0.98
Sulphur Creek	0.50	0.78	0.78	0.75	0.75	1.00	1.00	1.00
Pahsimeroi Chinook	0.35	NA	NA	NA	NA	NA	NA	NA
Lemhi River Chinook	0.15	NA	NA	NA	NA	NA	NA	NA
Valley Creek Chinook	0.46	0.66	0.62	0.69	0.66	1.00	1.00	1.00
Yankee Fork Salmon River	0.76	NA	NA	NA	NA	NA	NA	NA
Lower Mainstem Salmon River (SRLMA)	0.22	0.85	0.86	0.85	0.85	0.99	1.00	1.00
Upper Salmon East Fork Chinook	0.14	0.90	0.89	0.88	0.89	0.98	1.00	1.00
Upper Mainstem Salmon River (SRUMA)	0.04	0.94	0.94	0.95	0.96	0.94	0.97	0.98
Wenatchee River Chinook	0.00	0.96	0.95	0.95	0.94	0.97	0.98	0.99
Methow River Chinook	0.12	NA	NA	NA	NA	NA	NA	NA
Entiat River Chinook	0.08	0.81	0.81	0.81	0.82	0.89	0.99	0.99

Source: Interior Columbia Basin TRT 2006

[1/] Fraction of model runs having less than (or equal to) the observed frequency of years with less than 50 spawners as a function of QET. "Observed frequency" represents the fraction of years in the historical record (after 1978) that have total spawners less than 50. The "observed frequency" tends to be larger than the bulk of the model-derived frequencies as QET increases. That is, as QET increased, the model yielded fewer years with spawners less than 50 than actually observed. The most extreme discrepancy between observed and modeled frequencies occurred with QET>=50. This suggests that the QET is less than 50. The number of simulated trajectories was equal to 1,000 for each population and value of QET. When QET=1 or 2, RFT=2, when QET>2, RFT=10.

A Note on the Interior Columbia Basin TRT's Mean Recruit-per-Spawner Estimates

This biological analysis relies on estimates of mean recruit-per-spawner productivity developed by the Interior Columbia Basin TRT. The estimates are based on spawner-recruit datasets in Excel spreadsheet format supplied by the Interior Columbia Basin TRT (Cooney and Matheson 2007). The Interior Columbia Basin TRT has not fully documented the methods used to develop the underlying data or the approach taken in translating that data into productivity estimates (ln(R/S)). However, a review of the datasets indicates that data from certain brood years was dropped from the mean R/S calculations. Specifically, it appears that brood years in which parent spawners numbered 5 or fewer were dropped from the estimate. This modification to the underlying datasets obviously affected only small populations, all of which are Chinook salmon populations. Most of these are in the Middle Fork Salmon Major Population Group (MPG) of the Snake River Spring/Summer Chinook Salmon ESU.

The effect of these modifications is in all cases to reduce mean recruit-per-spawner estimates by ignoring brood returns for certain years. For a number of small populations, the number of recruits that were thus eliminated from the calculation is significant. An extreme case is the Loon Creek population, where 429 returning adult salmon were dropped from the productivity estimate. This constitutes about 17 percent of the total brood returns for the 20-year period used for the productivity estimate. The Interior Columbia Basin TRT's updated population status reviews note that years where parent spawners are <=5 are dropped from the mean R/S estimates but do not supply a supporting rationale for this approach (http://www.nwfsc.noaa.gov/trt/trt_current_status_assessments.cfm).

In reviewing and attempting to replicate the Interior Columbia Basin TRT estimates, it was found that the <=5 parent spawner rule was not consistently applied for the Sulphur Creek spring Chinook salmon population. The parent spawner estimate for brood year 1995 is four spawners, yet this brood year is used to calculate mean R/S. If the brood year is removed (per the <=5 parent spawner rule), mean R/S changes from .89 (Interior Columbia Basin TRT estimate) to .97. We have not made this adjustment in our analysis in order to maintain consistency with the Interior Columbia Basin TRT estimates, even where they appear to be flawed or internally inconsistent.

The following populations (Table A-10) appear to be instances where brood years and returns were dropped from the mean R/S estimate. The "alt mean R/S" column shows the mean R/S value if the deleted years are restored to the estimate. However, a few years where parent spawners=0 were not restored. In those few instances, the number of brood returns dropped from the estimate was negligible. It should be noted that the alt mean R/S estimates likely overstate "actual" mean R/S, since in some cases they assign very large numbers of brood returns to very few parent spawners (1 parent spawner in some instances). An alternative approach would be to assign the brood returns in question to an alternative set of parent spawners.

Table A-10. Brood Years and Returns that were Likely Dropped from the Mean R/S Estimate

Chinook Salmon Population	Number of Adult Returns Dropped from Mean R/S Estimate	Interior Columbia Basin TRT Mean R/S	Alt Mean R/S
Upper Grande Ronde River	11	0.32	0.38
Big Creek	83	1.23	1.41
Camas Creek	180	0.88	1.11
Loon Creek	429	1.21	1.73
Sulphur Creek	119	0.89	1.26
Valley Creek	88	1.08	1.23
Yankee Fork	128	0.68	0.95
Methow River	1,410	0.74	1.46

A.1.5 DETAILED ESU/DPS SPREADSHEETS

The following attachments present the spreadsheets used to develop the detailed descriptions for each ESU/DPS that are presented in Chapters 4, 5, and 7 through 10 of this document. These spreadsheets include baseline, current, and prospective model estimates relating to various metrics of status and trends.

Attachment A-1—Snake River Fall Chinook Salmon ESU Spreadsheet
Attachment A-2—Snake River Spring/Summer Chinook Salmon ESU Spreadsheet
Attachment A-3—Snake River Basin Steelhead DPS Spreadsheet
Attachment A-4—Upper Columbia River Spring Chinook Salmon ESU Spreadsheet
Attachment A-5—Upper Columbia River Steelhead DPS Spreadsheet
Attachment A-6—Middle Columbia River Steelhead DPS Spreadsheet

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Appendix B
Analysis of the Effects of Hydro Actions

TABLE OF CONTENTS

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

AFEP	Anadromous Fish Evaluation Program
BA	Biological Assessment
BiOp	biological opinion
BPA	Bonneville Power Administration
BRT	Biological Review Team
COMPASS	Comprehensive Fish Passage Model
Corps	U.S. Army Corps of Engineers
DIS	direct in-river survival
DPS	Distinct Population Segment
DSS	decision support system
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FCRPS	Federal Columbia River Power System
FERC	U.S. Federal Energy Regulatory Commission
IDWR	Idaho Department of Water Resources
ISAB	Independent Scientific Review Board
kcfs	thousand cubic feet per second
MAF	million acre-feet
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
ODS	overall direct survival
OHV	off-highway vehicle
PIT	passive integrated transponder (tag)
PUD	public utility district
PVA	population viability analysis
PWG	Policy Work Group
Reclamation	U.S. Department of the Interior Bureau of Reclamation
RPA	Reasonable and Prudent Alternative
SAR	smolt-to-adult return
TRT	Technical Recovery Team
URC	Upper Rule Curve
USGS	U.S. Geological Survey

B.1. INTRODUCTION

The purpose of this appendix is to explain how the scientific information available, on both hydrology of the system and survival of juvenile salmon past the Federal Columbia River Power System (FCRPS) dams, is integrated into the models and to explain the analysis that support the conclusions of the Comprehensive Analysis. This appendix describes the methods and models used for the 1) hydrologic effects of operations of the FCRPS (e.g., HYDSIM modeling), 2) mainstem Columbia and lower Snake River hydrologic impacts of Reclamation Projects in the Upper Snake River (above Brownlee Reservoir) (e.g., MODSIM modeling), 3) the hydrologic effects in the mainstem Columbia River of Reclamations' Tributary Projects, and 4) the analysis of biological effects of hydro actions (e.g., COMPASS modeling) and it 5) describes the analysis by Evolutionarily Significant Unit (ESU) and 6) a description of the effects.

The survival of juvenile salmon as they migrated downstream to the ocean from the tributaries and through the mainstem Columbia River was not well quantified prior to the construction of the FCRPS and Upper Snake River dams. Clearly there would have been natural mortality associated with this downstream migration. With the FCRPS and Upper Snake River projects in place, mortality levels are assumed to be above levels that would occur if no dams were present. While the Action Agencies have been able to demonstrate causative factors of mortality within the FCRPS and Upper Snake River, the agencies do not believe that it is presently possible to definitely separate the overall differences between natural, hydro related, and other anthropogenic causes of mortality.

In developing the overall analysis of the effects of the proposed hydro action on listed anadromous fish, the Action Agencies relied on both hydrologic and biological model outputs and previous analyses for assessing the effectiveness of the hydro actions. The analysis consists of an ESU-by-ESU analysis for three primary time periods of hydropower system existence, the Base (corresponding to the general conditions that were experienced by juveniles during the 1980-2001 outmigrations), Current, and Prospective conditions, with results reported as an average across all water years.

The analysis began with baseline survival estimates primarily from the Inter Columbia Basin Technical Recovery Team (TRT) or other relevant sources – with consideration of estimates for key parameters (e.g., direct in-river survival, percent transported). Next, we estimated effects that have already occurred (Current) and a range of effects that might occur (Prospective) from operation and configuration changes to the hydropower system. To estimate the hydrologic changes due to operations and existence of the FCRPS and the Upper Snake River projects, the MODSIM model was used to develop hydrologic conditions for Upper Snake River actions above Brownlee Reservoir and the HYDSIM model was used to combine the flow effects of the Upper Snake River actions with those of the FCRPS. Model runs were made to simulate both the Current and Prospective operations.

For the prospective effects, changes provided in the proposed actions were based on best professional judgment. Estimates of survival improvements along with the results from the hydrologic models were then input into the COMPASS model, yielding an output of potential direct in-river survival. Output from COMPASS was used to estimate an overall direct survival to the Bonneville Dam tailrace which included transport survival and Mid-Columbia Public Utility District (PUD) effects for the applicable ESUs.

Finally, smolt-to-adult returns (SARs) were estimated for both in-river and transported juveniles (using the Scheurell and Zabel hypothesis) and an overall SAR was estimated. The COMPASS model results were used to comparatively assess the relative effects of Current operations to Base operations, and Prospective operations to Current operations. For Upper Columbia River ESUs, these effects were combined with the observed (Base-to-Current) or anticipated (Current-to-Prospective) survival changes that are resulting from actions taken to improve juvenile survival through the Mid-Columbia PUD dams as a result of settlement agreements and biological opinions.

B.2. HYDROLOGIC ANALYSIS

B.2.1 HYDROLOGIC MODELING

Both the FCRPS and the upper Snake River reservoirs are operated to meet multiple purposes including operations to benefit Endangered Species Act (ESA)-listed fish, flood control, hydropower operations, irrigation, recreation, navigation and, municipal and industrial water supply. Managing multiple reservoirs to meet multiple needs can be challenging. To aid in making operational decisions, the Action Agencies use computer models to provide valuable information. Models are used for planning purposes as well as real-time operations.

Computer models simulate how the major projects in the different river systems will react to changes in operations and to a wide range of runoff conditions. They help plan how to use the water most efficiently. The different systems are operated to meet multiple purposes both at the individual projects and in the basin as a whole. Operations at each individual project to meet local objectives can result in hydrologic changes that may influence operations on other projects both up and downstream. Models analyze how operational variables interact. The 14 FCRPS dams operate as a single system, where changes in operations at one project can affect the operations of the other projects. In the Upper Snake River above Brownlee, the 12 Reclamation projects operate as nine independent systems (the Snake River above King Hill, Little Wood River system, Owyhee River system, Boise River system, Payette River system, Malheur River system, Mann Creek system, Burnt River system, and the Powder River system). Reclamation developed one model that simulates the operations and the resulting hydrologic changes for all of the Upper Snake River actions.

Two different flow models were used to complete the hydrologic analysis for the comprehensive analysis. One model was used for the Upper Snake River above Brownlee Reservoir, and the other was used for the Snake below Brownlee Reservoir and Columbia River Basin. Reclamation’s MODSIM hydrology model (2007 version) was used to estimate the hydrologic effects and inflows to Brownlee Reservoir resulting from operation and the existence of the Upper Snake River projects and all private diversions and depletions.

The Brownlee Reservoir inflows developed by MODSIM were then incorporated as input into BPA’s HYDSIM model, which is used for the lower Snake and Columbia rivers. Hydro Simulator Program (HYDROSIM, also known as HYDSIM) was developed by BPA in 1990 and 1991, and is used to estimate flows and spills for the various scenarios of flow operations being considered.

Using historical flow data, MODSIM and HYDSIM can be used to project how flow would pass through the Upper Snake River, lower Snake, and Columbia River systems, respectively, if the volume and timing of water available were the same as a specific historical water flow year.

Hydroregulation models can be used to estimate how frequently planned operations will meet desired flows, which are established to protect fish and wildlife habitat and to move young salmon to the sea. On a complex river system, with numerous competing river uses, streamflow routing models help in planning operations that attempt to satisfy a combination of objectives. Flood control is one key objective. Maximum flows, above which flooding will occur, have been established at key points on rivers. Models can help determine how much water must be stored in different reservoirs during flood periods so that rivers will be kept below flood levels.

B.2.1.1 HYDSIM Description

BPA's Hydro Simulator Program (HYDRO-SIM or HYDSIM) was used to conduct analyses. HYDSIM was developed by BPA in 1990 and 1991 and evolved from earlier programs which were written in the 1960's. It was developed to simulate all aspects of the operating characteristics of the Northwest hydro system under varying load and flow conditions.

For its simulations of the operation of the hydroelectric system of the region, the HYDSIM model utilizes flow broken into 14 periods per year, with April and August each divided into two periods. Identified in the model are control points, which are points at which flow or elevation targets or both are measured. All reservoirs are control points as are stream gages where flow or elevation targets have been established. For example, minimum flow requirements have been established for Bonners Ferry on the Kootenai River in Idaho so it is a control point in HYDSIM though no dam exists there. The model considers available water, desired flow at certain times, rule curves for each of the reservoirs, irrigation demands, and projected power demand. In short, HYDSIM analyzes all effects due to the current level of development. It may not be possible to meet all of the targets. Priorities can be set in HYDSIM such that some targets take precedence. For example minimum flow requirements take precedence over desired reservoir refill elevations.

Streamflow records are the backbone of the model. HYDSIM uses historic streamflow measurements which have been adjusted to the 2000 level of development for irrigation diversions and depletions and for other changes in conditions since the measurements were taken. The model has recently been updated to a 70-year record starting in October 1928 and going through September 1998. Streamflows also reflect current operations of tributary reservoirs that are not modeled in HYDSIM, such as the Yakima, Deschutes and Upper Snake River Basins. For example, outflow from Reclamation's MODSIM model provides input to the HYDSIM model for the Upper Snake River in the form of inflow to Brownlee Reservoir.

HYDSIM incorporates the physical characteristics of each project including minimum and maximum reservoir elevations, storage-elevation relationships, tailwater elevation and power plant characteristics. The number of projects HYDSIM generally simulates using these physical characteristics is 75 to 80.

Project operating requirements include maximum and minimum allowable discharge, and maximum and minimum reservoir contents. Many operating requirements, such as flood control operations, are seasonal.

For the purpose of the FCRPS Biological Assessment (BA), the HYDSIM model was used for a 70-year continuous study. That is it simulated the operation of the system for each period from October 1928 through September 1998 in chronological order.

B.2.1.2 MODSIM Description

Reclamation used the Upper Snake River MODSIM model, which represents the major river, reservoir, and water demand features of the Snake River upstream from Brownlee Reservoir, to predict near future operations of the Upper Snake River based on the assumption that current practices will continue. MODSIM is a generalized river basin management decision support system (DSS) designed as a computer-aided tool for water management. The model was designed by Colorado State University. Reclamation then populated the model with the most current available information in the Upper Snake River. The model takes into account all Reclamation operations (storage of water, release from storage, diversion for irrigation or other purposes, delivery for flow augmentation, pumping of ground water, and project return flows), private activities (private storage dams, diversions of private water rights into private canals, and private pumping of ground and surface water, and return flows).

MODSIM uses a series of historic water years starting in October 1928 going through September 2000. This provides a 72-year continuous study period which gives operators an opportunity to look at what would happen with today's number of hydro projects and diversions under a long-term sequence of streamflow conditions. The model begins October 1928 with reservoirs starting at a typical end of irrigation season content levels. The model uses actual runoff, or a "perfect forecast," to set flood control operation simulation parameters. Simulation results are expressed in terms of anticipated monthly volume river flows, irrigation diversions, and end-of-month reservoir contents. The final elevation at the end of September becomes the starting point for the following year. Other output includes reservoir evaporation, seepage, power generation, groundwater pumping, depletion, return flows, and consumptive and nonconsumptive demand shortage.

The MODSIM model network of the Snake River Basin was developed to simulate system operations over a defined historical water supply period of record. After the model had been calibrated to observed data, it was then configured to represent proposed operational conditions for analyses performed in the Upper Snake River BA. Reclamation has continually updated and improved this Upper Snake River Basin MODSIM model since its initial development in 1992. These enhancements to the model are designed to incorporate new information and logic as a means of best representing the physical system or potential operational changes. For example, in 2004, additional years were added to the observed data set to create a 1928 to 2000 period of record, the current level of irrigation diversions were incorporated, and groundwater influences were integrated into the model configuration. In 2007, Reclamation revised the Upper Snake River MODSIM model to capture current groundwater irrigation practices above King Hill and within the Payette River Basin in the model configuration. These revisions do not reflect a material change in Upper Snake River project operations, but rather a better model representation of ground water and surface water interactions based on the current conditions.

For each of the numerous basins comprising the Snake River drainage, various methods and techniques were used to develop the unique scenario configurations presented in the 2007 Upper Snake River BA. Differing levels of data availability, study development and current system knowledge dictated the assumptions used. Sophisticated techniques were used for the Snake River above King Hill to account for aquifer influences and less refined methodologies were used in other reaches to define model configurations.

In the simulations, river reaches, reservoirs, diversion "groups,[1]" and other major features of the Snake River were originally taken from "planning" models from the Idaho Department of Water Resources (IDWR). These models were used to complete analysis for many long-term operation proposals before the Upper Snake River MODSIM model was developed. Data from various sources has since replaced and augmented that obtained from the IDWR model data sets.

[1] Rather than modeling each individual diversion, for convenience of modeling, multiple diversions were grouped by river reach when possible.

B.2.2 HYDROLOGICAL MODELING – CURRENT CONDITION

B.2.2.1 Assumption

MODSIM and HYDSIM were used to model current conditions. The Upper Snake River projects were modeled using MODSIM and represented the current operations described in the 2005 Upper Snake River BiOp. The FCRPS current condition was developed using the 2006 hydropower configuration (i.e., implementation structural measures from the 2000/2004 FCRPS BiOps), and the operation plan in the 2004 FCRPS BiOp.

B.2.2.2 Hydrologic Effects of the FCRPS under Current Conditions

Managing water in the Columbia River system for its many purposes can be challenging particularly given the relatively small portion of the annual runoff volume that can actually be stored in reservoirs. The runoff produces an annual average of about 200 million acre-feet (MAF) of water, but only about 20 percent of it can be impounded for useful purposes. The Columbia River system, with its large annual volume to usable storage ratio, has to evacuate on a yearly basis to accommodate water supply conditions in the Columbia Basin.

The Action Agencies rely on several components of water management in the Columbia River Basin as surrogates or indicators of how well the system is managed for fish. Available “Buckets” of water help shape flows to when they are most effective in enhancing juvenile migration. April 10 and June 30 water surface elevation are indicators of system optimization. The April 10 water surface elevation is an indicator of the Action Agencies’ flexibility to shape spring flows, and the June 30 water surface elevation is an indicator of flexibility to shape summer flows for a particular year. Flow objectives are another indicator of how well the system was optimized. There are four dams that have established flow objectives. They include Lower Granite Dam on the lower Snake River and McNary Dam on the mainstem Columbia River both of which have spring and summer flow objectives. In addition, there are winter flow objectives below Bonneville Dam on the lower Columbia River and a spring flow objective at Priest Rapids Dam in the mid Columbia River. Table B-1 identifies the flow objectives.

Environmental conditions such as precipitation and temperature have the greatest impact in the Action Agencies’ ability to meet flow objectives and fill available buckets. Other factors include the Action Agencies’ ability to forecast what type of environmental conditions are likely to occur in the coming water year which influences such decisions as how the system is operated for flood control, where to set flow objectives at Priest Rapids, how to balance operations for competing species such as chum salmon versus spring migrants and spring versus summer migrants.

Table B-1. Seasonal Flow Objectives and Planning Dates for the Mainstem Columbia and Snake Rivers

	Spring		Summer	
Location	**Dates**	**Objective (kcfs)**	**Dates**	**Objective (kcfs)**
Snake River at Lower Granite Dam	4/03 to 6/20	85 to 100[1/]	6/21 to 8/31	50 to 55[1]
Columbia River at McNary Dam	4/10 to 6/30	220 to 260[1/]	7/01 to 8/31	200
Columbia River at Priest Rapids Dam	4/10 to 6/30	135	N/A	N/A
Columbia River at Bonneville Dam	11/1 – emergence	125 to 160[2/]	N/A	N/A

Notes:
1/ Objective varies according to water volume forecasts.
2/ Objective varies based on actual and forecasted water conditions.
kcfs - thousand cubic feet per second

The model run for the current conditions is based on the 2004 BiOp. Tables B-2 to B-4 provide summary results of how well the system can be managed over a 70-year period of varying water conditions. Table B-2 shows the number of years in a 70-year period that the different flow objectives are expected to be met or exceeded at the different dams.

Table B-2. Current Condition – Number of Years in a 70-year Period That Flow Objectives Are Expected to Be Met or Exceeded

Flow Target Met (within 1 kcfs) or Exceeded							
Lower Granite:							
Apr1-15	Apr16-30	May	June	Apr1 6 -Jun 30	July	August	Jul 1-Aug31
(85-100 kcfs)	(85-100 kcfs)	(85-100 kcfs)	(85-100 kcfs)	(85-100 kcfs)	(50-55 kcfs)	(50-55 kcfs)	(50-55 kcfs)
23	32	44	49	46	36	0	11
Priest Rapids:							
Apr1-15	Apr16-30	May	June	Apr1-Jun 30			
(135 kcfs)	(135 kcfs)	(135 kcfs)	(135 kcfs)	(135 kcfs)			
43	34	53	57	55			
McNary:							
Apr16-30	May	June	Apr16-Jun 30	July	August	Jul1-Aug 31	
(220-260 kcfs)	(220-260 kcfs)	(220-260 kcfs)	(220-260 kcfs)	(200 kcfs)	(200 kcfs)	(200 kcfs)	
26	51	46	48	37	3	23	
Bonneville:							
Nov	December	January	February	March	Oct 1-Mar 31	Nov1 – March 31	
(125 kcfs)	(125 kcfs)	(125 kcfs)	(125 kcfs)	(125 kcfs)	(125 kcfs)	(125 kcfs)	
66	54	61	55	56	57	58	

Table B-3 summarizes the average flow by month or period (April and August are divided into two periods) at the different dams based on four ranges of water year (dry, slightly below average, slightly above average and wet).

Table B-3. Current Condition – Average Flow by Period

Average Flows (kcfs)								
Lower Granite	**April 15**	**April 16 – 30**	**May**	**June**	**April 16 – June 30**	**July**	**August**	**Jul 1 – August 31**
70 yr avg	75	89	107	101	101	54	30	42
Avg. of less than 72 MAF years (8)	38	48	69	59	61	37	25	31
Avg. of 72-100 MAF years (21)	60	77	93	77	84	44	27	35
Avg. of 100-120 MAF years (26)	82	91	111	109	106	57	31	44
Avg. of greater than 120 MAF years (15)	104	125	141	144	139	70	36	53

Priest Rapids	**Apr1-15**	**Apr16-30**	**May**	**June**	**Apri1 6-Jun 30**
70 yr avg	99	131	168	188	169
Avg. of less than 72 MAF years (8)	66	68	80	133	99
Avg. of 72-100 MAF years (21)	79	112	144	151	141
Avg. of 100-120 MAF years (26)	110	142	185	203	184
Avg. of greater than 120 MAF years (15)	126	172	220	243	219

McNary	**Apr16-30**	**May**	**June**	**May1-Jun 30**	**July**	**August**	**Jul 1-Aug 31**	**Sept**
70 yr avg	225	278	294	286	209	153	181	102
Avg. of less than 72 MAF years (8)	117	148	191	169	152	131	141	94
Avg. of 72-100 MAF years (21)	192	239	230	235	183	139	161	94
Avg. of 100-120 MAF years (26)	238	299	318	308	219	154	187	105
Avg. of greater than 120 MAF years (15)	303	367	399	383	261	181	221	114

Bonneville	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**March**	**Oct 1-Mar 31**	**Nov 1-Mar 31**
70 yr avg	109	114	130	146	189	179	175	155	164
Avg. of less than 72 MAF years (8)	100	109	125	124	127	112	114	119	121
Avg. of 72-100 MAF years (21)	100	109	126	129	156	139	139	133	138
Avg. of 100-120 MAF years (26)	112	115	130	147	197	189	180	160	169
Avg. of greater than 120 MAF years (15)	122	122	138	180	253	255	250	199	215

Source: FCRPS and Upper Snake River HYDSIM July 2007

In addition to flow objectives, the buckets of water are an indicator at how well the Action Agencies are able to manage the system under different water conditions. Upper Rule Curves (URC) are used to establish the maximum elevation a storage reservoir can be on a certain date to provide flood control protection both for the local community and the system as a whole. Table B-4 summarizes the number of years out of 70 that a particular reservoir was at its URC on April 10 and June 30.

Table B-4. Current Perspective – Number of Years out of 70 that URCs are Expected to be Met

Reservoir Effects	At URC on April 10 (Tolerance of 5 ksfd[1/])	At URC on June 30 (Tolerance of 5 ksfd[1/])	At Full on August 31 (Tolerance of 1/2 foot)
Libby	28	22	0 times at 2459.0 ft.
Hungry Horse	23	57	0 times at 3560.0 ft.
Albeni Falls	N/A	N/A	70 times at 2062.5 ft.
Grand Coulee	59	70	2 times at 1290 ft.
Dworshak	45	55	0 times at 1600 ft.

1/ ksfd = thousand second-foot days

The hydrologic impacts of the Columbia River Basin and Hungry Horse projects are difficult to separate from the overall FCRPS system operations, particularly because the operations for Grand Coulee and Hungry Horse dams are integrated with operations at other FCRPS facilities. Data describing the Columbia Basin Project's diversions and resulting depletions are presented in Table B-5. The irrigation component of the Hungry Horse Project has not been developed, and subsequently, the project does not have depletionary impacts. These data were incorporated into the HYDSIM model and operations of the Columbia Basin Project are reflected in the summary tables above.

Table B-5. Depletionary impacts of the Columbia Basin Project (in cfs)[1/]

Project	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Columbia Basin Project	-2,779	-293	-548	+48	+201	-1,404	-6,058	-6,971	-7,061	-7,464	-6,039	-6,129
Return Flows at Wanapum	+64	+53	+47	+41	+38	+33	+48	+43	+45	+51	+60	+70
Return Flows at Priest Rapids	+278	+126	+108	+94	+73	+122	+244	+202	+231	+245	+269	+307
Sum of effects at Priest Rapids	-2,437	-114	-393	+183	+312	-1,249	-5,766	-6,726	-6,785	-7,168	-5,710	-5,752
Return Flows at McNary	+534	+386	+312	+236	+228	+309	+432	+432	+475	+470	+512	+550
Blocks 2 and 3	-25	0	0	0	0	-9	-38	-50	-62	-70	-63	-25
Sum of effects at McNary and Bonneville	-1,928	+272	-81	+419	+540	-949	-5,372	-6,344	-6,372	-6,768	-5,261	-5,227

[1/]Negative values imply a flow reduction due to Reclamation activities.
Source: BPA 2000.

B.2.2.3 Hydrologic Effects of the Upper Snake River under Current Conditions

The Upper Snake River projects and the FCRPS are operated independent of each other. However, both operations hydrologically influence flows in the Snake and Columbia Rivers. Any flow-related effects to listed salmon and steelhead due to operation of Reclamation's Upper Snake River projects occur well downstream of these projects, because no listed salmon or steelhead occur in the vicinity of Reclamation's Upper Snake River storage reservoirs or diversion structures. The Upper Snake River actions directly affect inflows to Brownlee Reservoir. From here, Idaho Power Company re-regulates flows through the Hells Canyon Complex.

Inflows to Brownlee Reservoir are the downstream point for the MODSIM model. Inflows to Brownlee Reservoir are the upstream point on the mainstem Snake River for the HYDSIM model. Summarized in this comprehensive analysis are the average inflows to Brownlee and the average flow augmentation water provided from the Upper Snake River based on water year conditions (wet, average, dry) resulting under Reclamation's current Upper Snake River operations.

Reclamation's current Upper Snake River operations include delivery of salmon flow augmentation water that balances benefiting ESA-listed salmon and steelhead downstream of the Hells Canyon Complex while not jeopardizing listed snail species in the Snake River or bull trout in the Boise and Payette River systems. In 1991, Reclamation committed to providing water to augment flows below the Hells Canyon Hydropower Complex in the lower Snake and Columbia Rivers. Reclamation has continued to work to improve the reliability and amount of water available to augment flows, operating within applicable institutional and legal constraints. The modeled current operations data presented below reflect delivery of up to 487 KAF of flow augmentation consistent with the 2004 Nez Perce Water Rights Settlement and as described in Reclamation's 2004 Upper Snake River BA in Chapter 2 and Appendix B.

Under the current and historical patterns of releases, Reclamation has generally provided flow augmentation water beginning after the spring freshet when maximum storage has been achieved (which typically occurs in June) and continuing through August 31, the end of the juvenile migration season at Lower Granite Dam (April 3 through August 31). Table B-6 shows modeled inflows to Brownlee during the juvenile migration period under the current conditions for wet, average and dry water years. These inflows represent the hydrologic conditions that will result under current operations of the Upper Snake River projects and also incorporates hydrologic influences of private water development in the Upper Snake River Basin. The table also indicates the component of inflows comprising flow augmentation under Reclamation's current delivery of flow augmentation, emphasizing summer season delivery.

Table B-6. Modeled Total Brownlee Reservoir Inflows and Upper Snake River Flow Augmentation Component for the Current Condition using a 1928 to 2000 Period of Record

Month	Average of Wet Years (at or below 10 Percent exceedance)			Average of Average Years (between 10 percent and 90 percent exceedance)			Average of Dry Years (at or above 90 percent exceedance)		
	Total Brownlee Reservoir Inflows (cfs)	Flow Augmentation Component cfs	Flow Augmentation Component percent	Total Brownlee Reservoir Inflows cfs	Flow Augmentation Component cfs	Flow Augmentation Component percent	Total Brownlee Reservoir Inflows (cfs)	Flow Augmentation Component cfs	Flow Augmentation Component percent
April	58,139	261	0.45	28,667	261	0.91	11,652	261	2.24
May	56,701	261	0.46	30,841	261	0.85	11,239	261	2.32
June	41,452	261	0.63	25,716	518	2.01	9,514	1,253	13.17
July	21,497	3,869	18.00	13,519	3,533	26.13	8,316	1,464	17.61
August	143,532	3,532	23.98	11,834	2,873	24.28	6,990	1,464	20.95

Source: Upper Snake River MODSIM – May 2007

Average depletions into Brownlee Reservoir attributed to Reclamation's Upper Snake River proposed actions total 2.3 MAF annually for the 1928 to 2000 period of record (Reclamation 2007). MODSIM was used to calculate depletive effects from the Upper Snake River operations by developing a "Without Reclamation" scenario that removed Reclamation's Upper Snake River project operations from the model. The development of the "Without Reclamation" scenario made no other assumptions as to how water users would have reacted had Reclamation not built storage and conveyance projects. This modeled analysis allows a determination of the hydrologic change attributed to Reclamation's operations. Table B-7 presents model output for wet, average and dry water year types based on total annual volume into Brownlee Reservoir.

Table B-7. Modeled Changes in Flow into Brownlee Reservoir Comparing Current Condition to a Without Reclamation[1] Modeled Scenario for Dry, Average and Wet Water Year Types[2]

	Wet Years			Average Years			Dry Years		
Month	Current Condition (cfs)	Without Reclamation (cfs)	Hydrologic Change (cfs)	Current Condition (cfs)	Without Reclamation (cfs)	Hydrologic Change (cfs)	Current Condition (cfs)	Without Reclamation (cfs)	Hydrologic Change (cfs)
Oct	17,726	17,331	396	13,905	14,166	-262	12,247	12,661	-414
Nov	19,903	24,161	-4,258	15,735	20,629	-4,894	14,053	18,045	-3,992
Dec	19,259	24,354	-5,095	15,431	20,678	-5,247	12,700	17,247	-4547
Jan	34,405	28,772	5,634	17,472	20,153	-2,681	12,174	17,152	-4,977
Feb	34,295	28,548	5,747	18,586	22,328	-3,742	12,091	17,588	-5,497
Mar	46,161	44,065	2,097	20,712	26,218	-5,506	11,957	18,538	-6,581
Apr	54,281	56,760	-2,479	28,842	35,502	-6,661	11,652	14,767	-3,115
May	55,860	75,034	-19,173	31,306	43,349	-12,043	12,122	15,076	-2,954
Jun	44,760	66,988	-22,227	26,899	36,088	-9,189	9,358	9,464	-106
Jul	17,607	17,248	359	11,798	9,740	2,058	6,981	4,915	2,065
Aug	12,386	7,412	4,974	9,840	5,996	3,844	6,736	4,261	2,475
Sep	14,433	10,331	4,102	11,888	8,477	3,411	8,446	6,419	2,028

[1] "Without Reclamation" represents a modeled simulation without Reclamation's Upper Snake River projects operating.
[2] Period of Record: 1928 to 1998 - Conditions based on water year flows
Wet Conditions: Average of years at or below 10 percent exceedance
Average Conditions: Average of years between 10 percent and 90 percent exceedance
Dry Conditions: Average of years at or above 90 percent exceedance
Source: Upper Snake River MODSIM, May 2007 run.

B.2.2.4 Hydrologic Effects of Reclamation Projects

The following sections include irrigated acres and acre-foot diversions associated with Reclamation Projects in the Columbia River Basin. The HYDSIM model incorporates the hydrological impacts of irrigation diversions, and therefore, the flow impacts of the projects listed in Tables B-3 are factored into all analyses.

B.2.2.4.1 Irrigated Acres and Diversions - Reclamation's Upper Snake River and other Tributary Projects

The Columbia River drains about 219,000 square miles in the United States and 39,500 square miles in Canada. Observed outflow of the Columbia River averages about 198 MAF per year. Irrigation accounts for most surface water withdrawals in the Columbia River Basin. Total irrigation withdrawals for the Columbia River Basin in the U.S. are about 33 MAF of water each year; about 19 MAF of this withdrawn water return to the river as return flows and are available for reuse (BPA et al. 1995). Irrigation depletions are less than 7 percent of the Columbia River's observed outflow.

Total irrigated acreage in the United States portion of the basin in 1990 was between 6.9 and 7.1 million acres (BPA et al. 1995). Table B-8 shows the number of irrigated acres and the volume of water diverted. The area of land irrigated in any single year varies from 10 to 20 percent with water supply and the general economy, and different methods are used to estimate nonfederal irrigated acreage; therefore, these data are only intended to be a general guide.

Table B-8. Irrigated Acres and Diversions in the Columbia River Basin[1/]

Location and Type	Acres	Acre-Feet
Upper Columbia River (Upstream from the Snake River Confluence)		
Reclamation	1,170,690	4,844,000
Non-Reclamation	926,000	2,576,000
Total	**2,096,690**	**7,420,000**
Lower Columbia River (Downstream from the Snake River Confluence)		
Reclamation	171,700	764,000
Non-Reclamation	915,900	2,186,000
Total	**1,087,600**	**2,950,000**
Snake River		
Reclamation	1,703,900	9,136,000[2/]
Non-Reclamation	2,202,800	13,346,000[2/]
Total	3,906,700	22,482,000[2/]
Total Columbia River Basin		
Total Reclamation	3,046,290	14,744,000
Total Non-Reclamation	4,044,700	18,108,,000
Grand Total within Basin	**7,090,990**	**32,852,000**

[1/] These numbers represent diversions from the river, not hydrologic depletions, and include small Reclamation projects that are not included in either the FCRPS or Upper Snake River Consultation. Sources: Reclamation 1990 and 1992 with 2006 updates as contained in their respective descriptions; non-Reclamation diversions use 1990 USGS data and BPA 2004.
[2/] Water is diverted and returned to the river multiple times. Sources: Reclamation 2000 and 2004

Nearly 33 MAF are diverted from streams and pumped from groundwater for irrigation (BPA et al. 1995). Of this total, about 13.7 MAF are consumptively used and lost from the system; the remaining 18.9 MAF return to surface and ground water systems. Irrigation diversions are more susceptible to annual variation than the amount of irrigated land. During drought years, irrigation diversions from a storage reservoir may be much greater than in wet years, whereas those dependent entirely on natural flow rights will likely be less as the streamflow falls. Because the methods of determining diversions for Reclamation and non-Reclamation projects differ, irrigation diversions are only intended to be a general guide (Reclamation data use actual diversions, while U.S. Geological Survey (USGS) data are generally an estimate based on irrigated acres, climate, crops needs, and expected conveyance and other losses).

Table B-9 provides a breakdown of irrigated acres and diversions by project to show which projects account for the bulk of irrigation associated with Reclamation's operations in the Geographic Scope.

This appendix does not present specific information on return flows for individual Reclamation projects. Based on the data for the total Columbia River Basin, slightly more than 40 percent of irrigation diversions could be expected to be consumptively used, and therefore, approximately 60 percent returns to the system. However, data on some Reclamation projects indicate that the volume of return flow versus total diversion is highly variable and depends on many factors including the available water supply, type of application, application rate, and efficiency of the carriage system.

Table B-9. Irrigated Acres and Diversions for Reclamation Projects[1/]

Project	Acres	Acre-Feet
Upper Columbia River (Upstream from the Snake River Confluence)		
Avondale[2/]	240	1,000
Chief Joseph Dam [2/]	19,300 [3/]	69,000
Columbia Basin	671,500	2,700,000
Dalton Gardens[2/]	700	2,000
Frenchtown[2/]	3,800	29,000
Hungry Horse	0	0
Missoula Valley[2/]	150	3,000
Okanogan	5,000	14,000
Rathdrum Prairie[2/]	4,000	10,000
Spokane Valley[2/]	4,000	16,000
Yakima [4/]	462,000	2,000,000
Lower Columbia (Downstream from the Snake River Confluence)		
Crooked River	20,000	50,000
Deschutes	85,000	500,000
The Dalles	5,600	11,000
Tualatin	15,800	37,000
Umatilla	43,300	161,000
Wapinitia	2,000	5,000
Snake River (with the exception of the Lewiston Orchards project, the other Reclamation projects are above Brownlee Dam)		
Baker	26,300	78,000
Boise and Lucky Peak [5/]	390,000	1,808,000
Burnt River	15,600	50,000
Lewiston Orchards[2/]	3,900	6,000
Little Wood	10,000	60,000
Mann Creek	5,085	8,000
Minidoka, Palisades and Ririe Projects [6/]	1,100,000	6,526,000
Owyhee	118,000	530,000
Vale	35,000	70,000
Reclamation Total	3,046,275	14,750,000

[1/] These numbers represent diversions from the river, not hydrologic depletions, and include small Reclamation projects that are not included in either the FCRPS or the Upper Snake River Consultations. Source: Reclamation 1990 and 1992, with 2006 updates as contained in their respective descriptions. The diversion data include both storage and natural flows.
[2/] Projects not included in either the FCRPS or Upper Snake River Consultation—they had minimal effect on the mainstem Columbia River.
[3/] Includes irrigable lands, not only irrigated lands.
[4/] Includes the U.S. Bureau of Indian Affairs Wapato Irrigation Project.
[5/] Both projects irrigate the same lands.
[6/] Information available for above Milner Dam and not separated by project.

B.2.2.4.2 Mainstem Columbia and Lower Snake River Hydrologic Impacts of Reclamation Projects

The future operations of Reclamation projects in the Columbia River Basin are expected to cause some hydrologic depletions to Snake and Columbia River flows. The average impacts of Reclamation projects, excluding the FCRPS Projects (Hungry Horse and Columbia Basin), on Columbia and lower Snake River flows at key points are summarized in Table B-10. (Hungry Horse and Columbia Basin Projects are shown in Table B-5). These data include the effects of storage (and the subsequent alteration of the natural hydrograph) and depletions that occur with water use. A single set of data using a consistent period of record is not available for all the non-FCRPS projects, and therefore, the average hydrologic effects shown in Table B-10 are the best information available.

Table B-10. Mainstem Impacts of Reclamation Projects, Excluding Hungry Horse and Columbia Basin Projects (in cfs) [1/]

Project [2/]	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Upper Columbia River												
Chief Joseph Dam Project	-2	0	0	0	0	0	-10	-64	-138	-190	-112	-22
Okanogan Project	-4	-6	-8	-7	-8	-11	-43	-87	-65	-15	10	10
Sum of effects at Priest Rapids	-6	-6	-8	-7	-8	-11	-53	-151	-203	-205	-102	-12
Percent of Columbia River Flows [3/]	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Yakima Project	-300	-800	-750	-650	-700	-1,100	-2,900	-4,300	-2,600	-200	1,550	1,600
Umatilla Phase II Pump Exchange	-62	0	0	0	0	0	-2	-8	-47	-137	-146	-96
Snake River												
Upper Snake River above Brownlee Reservoir [4/]	-329	-4,805	-5,174	-2,033	-2,910	-4,793	-5,794	-11,972	-9,523	1,922	3,822	3,352
Sum of effects at Lower Granite	-329	-4,805	-5,174	-2,031	-2,910	-4,793	-5,794	-11,972	-9,523	1,922	3,822	3,352
Percent of Snake River Flows [3/]	1.6	20	16	5.6	7	10	7	11	9.2	4	12	12.6
Lower Columbia River												
Sum of effects at McNary	-697	-5,611	-5,932	-2,690	-3,618	-5,904	-8,749	-16,431	-12,293	1,380	5,134	4,846
Percent of Columbia River Flows [4/]	<1	4.7	4.4	1.6	2.3	3.9	4.4	6	4	<1	3.3	4.7
Umatilla Phase I Pump Exchange	-32	0	0	0	0	+5	+10	+2	-52	-19	-138	-50
Umatilla Project	+196	-5	-186	-244	-314	+91	-27	+51	+129	-26	+36	+135
Deschutes, Crooked River, and Wapinitia Projects	-413	-450	-434	-410	-212	-757	-514	-166	-57	+31	+144	-53
The Dalles Project	-4	0	0	0	0	0	-7	-27	-37	-47	-38	-22
Sum of effects at Bonneville	-950	-6,066	-6,552	-3,344	-4,144	-6,565	-9,287	-16,571	-12,390	1,219	5,140	4,862
Percent of Columbia River Flows [3/]	<1	4.6	4.3	1.7	2.4	3.9	4.2	5.8	3.7	<1	3.2	4.4
Tualatin Project	-24	-103	-58	-170	-178	-75	-40	-13	+14	+68	+94	+97

[1/] Negative values imply a flow reduction due to Reclamation activities. Natural flow diversions would still occur without Reclamation.
[2/] Sources: Chief Joseph Dam—Postlethwait 2004, in litt.; Okanogan—Postlethwait 2006a, in litt.; Lewiston Orchards - NMFS 2006, Reclamation 1998, 2001a, 2006; Yakima—Postlethwait 2006b, in litt.; Umatilla—Reclamation 2003c; Deschutes River projects—Stillwater 2006, in litt.; The Dalles—Peterson 2000, in litt.; Tualatin—Stillwater 2006, in litt.
[3/] Source: Modeled flows for the selected alternative.
[4/] Source: 2007 Upper Snake River BA

Reclamation conducted modeled analyses of its Upper Snake River projects using MODSIM to describe the hydrologic effects attributed to its Upper Snake River Proposed Actions. The MODSIM modeling generates monthly inflows to Brownlee Reservoir for the 1928 to 2000 period of record. The modeled Brownlee Reservoir inflows were incorporated into the HYDSIM model to analyze hydrologic effects to the lower Snake and Columbia Rivers associated with FCRPS and Upper Snake River operations.

B.2.3 HYDROLOGICAL MODELING – PROSPECTIVE CONDITION

B.2.3.1 Assumption

The FCRPS Proposed RPA and the Upper Snake River Proposed Actions (PA) were modeled as the prospective condition. Emerging juvenile Snake River fall Chinook salmon migration data and continued analysis of temperature data may indicate that a change in timing of Upper Snake River flow augmentation releases would be desirable. Accordingly, Reclamation is proposing to provide water earlier in the spring season, during the May to early July period, inasmuch as possible.

National Marine Fisheries Service (NMFS, also called National Oceanic and Atmospheric Administration [NOAA] Fisheries) staff has recommended that the regional priority on flow augmentation for the summer period be relaxed, with flow augmentation water from the Upper Snake River best delivered by July 31. Since the 1990s, Upper Snake River flow augmentation was managed to benefit juvenile Snake River Fall Chinook Salmon migrating during the July and August period. At that time, the ESU was at an extremely depressed level. However, data now indicate that the majority of the Snake River Fall Chinook ESU are actively migrating primarily in June and early July rather than in July and August in the Snake River, with 95 percent of the juveniles migrating past Lower Granite Dam by mid-July in recent years (2004-to-2006) (Cook et al. 2007). Population metrics for Snake River fall Chinook salmon indicate that they are much stronger than most of the spring migrating ESUs in the interior Columbia River Basin (Good et al. 2005). Accordingly, NMFS is recommending that Upper Snake River flow augmentation delivery be shifted to an earlier release.

For the prospective condition, information developed in the FCRPS Remand Collaboration Process was considered when developing the FCRPS Proposed RPA for both operation and configuration changes. Changes to the operational scenarios for transportation were also considered and the Action Agencies included these in the FCRPS Proposed RPA and the Upper Snake River PA. For more information on hydrologic assumptions, see the FCRPS BA Appendix B and the 2007 Upper Snake River BA.

B.2.3.2 Hydrologic Effects of FCRPS under the Prospective Condition

The model run for the prospective conditions is based on the FCRPS Proposed RPA and the Upper Snake River PA. Tables B-11 through B-13 provide summary results of how well the system can be managed over a 70-year period of varying water conditions.

Table B-11 shows the number of years in a 70-year period that the different flow objectives were met or exceeded at the different dams.

Table B-11. Prospective Condition – Number of Years in a 70-year Period That Flow Objectives Are Expected to Be Met or Exceeded

Flow Target Met (within 1 kcfs) or Exceeded							
Lower Granite							
Apr1-15	Apr16-30	May	June	Apr16-Jun 30	July	August	Jul1-Aug31
(85-100 kcfs)	(85-100 kcfs)	(85-100 kcfs)	(85-100 kcfs)	(85-100 kcfs)	(50-55 kcfs)	(50-55 kcfs)	(50-55 kcfs)
23	32	42	49	46	24	0	8
Priest Rapids							
Apr1-15	Apr16-30	May	June	Apr1-Jun 30			
(135 kcfs)	(135 kcfs)	(135 kcfs)	(135 kcfs)	(135 kcfs)			
43	35	51	61	56			
McNary							
Apr16-30	May	June	Apr16-Jun30	July	August	Jul1-Aug31	
(220-260 kcfs)	(220-260 kcfs)	(220-260 kcfs)	(220-260 kcfs)	(200 kcfs)	(200 kcfs)	(200 kcfs)	
28	49	47	48	34	3	18	
Bonneville							
Nov	December	January	February	March	Oct1-Mar31	Nov1 - March31	
(125 kcfs)	(125 kcfs)	(125 kcfs)	(125 kcfs)	(125 kcfs)	(125 kcfs)	(125 kcfs)	
70	61	62	52	57	56	58	
Source FCRPS and Upper Snake River HYDSIM July2007							

Table B-12 summarizes the average flow by month or period (April and August are divided into two periods) at the different dams based on four ranges of water year (dry, slightly below average, slightly above average and wet).

Table B-12. Prospective Condition – Average Flow by Period

Average Flows (kcfs)

Lower Granite	Apr1-15	Apr16-30	May	June	Apr16-Jun 30	July	August	Jul1-Aug31
70 yr avg	76	90	107	102	102	48	32	40
Avg. of less than 72 MAF years (8)	40	48	67	59	60	32	26	29
Avg. of 72-100 MAF years (21)	62	79	91	77	83	38	29	34
Avg. of 100-120 MAF years (26)	83	92	112	109	107	52	32	42
Avg. of greater than 120 MAF years (15)	103	125	143	145	140	65	38	52

Priest Rapids	Apr1-15	Apr16-30	May	June	Apr16-Jun 30
70 yr avg	99	133	167	192	170
Avg. of less than 72 MAF years (8)	64	66	77	141	100
Avg. of 72-100 MAF years (21)	78	117	142	155	142
Avg. of 100-120 MAF years (26)	109	143	184	206	185
Avg. of greater than 120 MAF years (15)	128	173	220	244	220

McNary	Apr16-30	May	June	May1-Jun30	July	August	Jul1-Aug31	September
70 yr avg	227	276	299	287	201	149	175	100
Avg. of less than 72 MAF years (8)	116	143	198	170	145	130	137	95
Avg. of 72-100 MAF years (21)	199	234	235	235	174	135	154	92
Avg. of 100-120 MAF years (26)	240	298	321	309	211	149	180	102
Avg. of greater than 120 MAF years (15)	305	368	402	385	254	176	215	109

Bonneville	Sept	Oct	Nov	December	January	February	March	Oct1-Mar31	Nov1 – March31
70 yr avg	106	116	132	150	192	178	176	157	166
Avg. of less than 72 MAF years (8)	100	109	125	129	131	112	114	120	123
Avg. of 72-100 MAF years (21)	98	110	127	133	161	138	138	135	139
Avg. of 100-120 MAF years (26)	108	117	132	151	200	188	182	162	171
Avg. of greater than 120 MAF years (15)	117	124	142	185	253	254	252	201	217

Source: FCRPS and Upper Snake River HYDSIM July 2007

Table B-13 shows the number of years out of 70 that the different storage projects are expected to be at URC on April 10 and June 30.

Table B-13. Prospective Perspective – Number of Years out of 70 that URCs are Expected to be Met

	Reservoir Effects		
	At URC on April 10	At URC on June 30	At Full on August 31
	(Tolerance of 5 ksfd)		(Tolerance of 1/2 foot)
Libby	28	22	0 times at 2459.0 ft.
Hungry Horse	31	62	0 times at 3560.0 ft.
Albeni Falls	N/A	N/A	70 times at 2062.5 ft.
Grand Coulee	60	0[1/]	0 times at 1290 ft.
Dworshak	45	55	0 times at 1600 ft.

1/Operations to show that implementation of *Washington State's Columbia River Water Management Program (CRWMP): Early Actions-Lake Roosevelt drawdown* would not reduce flows during the juvenile fish migration season can result in water surface elevations at Lake Roosevelt that are slightly below the URC on June 30.
Source FCRPS and Upper Snake River HYDSIM July 2007

B.2.3.3 Hydrologic Effects of Upper Snake River under the Prospective Condition

The Upper Snake River operations remain similar to the operations incorporated into the current conditions analysis. However, Reclamation is proposing to make adjustments in the timing of flow augmentation water delivery, if NMFS deems the changes will benefit the listed Snake and Columbia River salmon and steelhead and their designated critical habitat. NMFS staff has recommended that the regional priority on flow augmentation for the summer period be relaxed, with flow augmentation water from the Upper Snake River best delivered by July 31. Accordingly, Reclamation's Proposed Actions include a shift in reservoir releases for flow augmentation to earlier in the spring. This shift in timing is anticipated to benefit Snake River and Columbia River ESUs/DPSs. NMFS' staff recommendation is currently undergoing formal review by its Northwest Fisheries Science Center. Changing the release timing would also avoid increasing summer releases from Hells Canyon Dam when water temperatures are warmer than desired. In addition, providing water earlier may conserve Dworshak Reservoir storage and may improve the efficacy of Dworshak Reservoir releases.

Reclamation reviewed system operational flexibility to come up with a proposed shift of the timing of flow augmentation to shape more water into the spring, which will more closely mimic the shape of the natural spring freshet. Modeled analyses using MODSIM incorporated this shift in timing to determine the resulting hydrologic conditions. Table B-14 presents the modeled inflows to Brownlee Reservoir under the prospective condition, reflecting resulting flows from Upper Snake River operations and other upstream water development activity under dry, average and wet water year types. The table also identifies the proportion of inflows that are comprised of flow augmentation water reflecting a shift to a spring delivery. Some storage releases will remain in August because of either operational constraints or water year type. Flow augmentation provided through natural flow rights continue to be provided in the April 3 through August 31 period.

Table B-14. Modeled total Brownlee Reservoir Inflows and Upper Snake River Flow Augmentation Component under the Prospective Condition using a 1928 to 2000 Period of Record

	Average of Wet Years (at or Below 10 Percent Exceedance)			Average of Average Years (between 10 percent and 90 percent exceedance)			Average of Dry Years (at or above 90 percent Exceedance)		
	Total Brownlee Reservoir Inflows (cfs)	Flow Augmentation Component		Total Brownlee Reservoir Inflows (cfs)	Flow Augmentation Component		Total Brownlee Reservoir Inflows (cfs)	Flow Augmentation Component	
Month		**cfs**	**percent**		**cfs**	**percent**		**cfs**	**percent**
April	58,139	261	0.45	28,667	261	0.91	11,652	261	2.24
May	57,995	1,505	2.59	32,663	2,016	6.17	12,526	1,498	11.96
June	42,746	1,555	3.64	27,203	2,005	7.37	9,358	1,098	11.73
July	20,704	2,977	14.38	11,873	1,826	15.38	7,213	350	4.85
August	12,935	1,682	13.00	10,171	1,171	11.52	6,961	350	5.03

Source: Upper Snake River MODSIM – May 2007

Flow augmentation largely relies on willing sellers offering water to Reclamation for lease. The availability of water for lease from Idaho's rental pool for flow augmentation varies with runoff volume, carryover storage, general rental pool conditions, and legal and institutional constraints. Many of these factors are outside of Reclamation's control. The best currently available estimate of Reclamation's ability to acquire water for this purpose under the proposed action is that the future rental water availability will closely mimic recent conditions. Reclamation conducted a modeled analysis using the experience it has gained from past flow augmentation activities to identify flow augmentation volume goals by water year type

Table B-15 is a matrix that represents the modeled range of potential augmentation water delivery to Brownlee Reservoir under various water year forecast and reservoir storage carryover conditions. April through September runoff forecast is the driving component for determining the potential volume available for flow augmentation each year. In general, the greater the runoff forecast volume, the greater the amount of augmentation water delivered. Similarly, the greater the volume of water in storage at the end of the previous irrigation season (carryover), the greater the amount of flow augmentation potential for the succeeding year. The values in Table B-15 represent the flow augmentation volumes contained in the MODSIM model and that were later input to HYDSIM when conducting hydro effects analysis of Prospective Conditions in this comprehensive analysis. They represent a reasonable estimate of targeted flow augmentation volumes for delivery based on recently experienced operating conditions and assumptions.

Table B-15. Matrix of Modeled Upper Snake River Flow Augmentation Volume by Water Year Type and Reservoir Carryover under the Prospective Condition[1]

	Total April 1 Forecast [2]		
Total November 1 Carryover Volume[3]	**Less than 5,400,000 acre-feet** ***(represents dry years)***	**5,400,000 – 8,699,999 acre-feet** ***(represents average years)***	**More than 8,700,000 acre-feet** ***(represents wet years)***
Less than 2,400,000 acre-feet *(represents dry years)*	average: 198,000 minimum: 146,000 maximum: 254,000	average: 391,000 minimum: 277,000 maximum: 428,000	average: 452,000 minimum: 427,000 maximum: 477,000
2,400,000 – 3,599,999 acre-feet *(represents average years)*	average: 360,000 minimum: 191,000 maximum: 487,000	average: 475,000 minimum: 396,000 maximum: 487,000	487,000
More than 3,600,000 acre-feet *(represents wet years)*	average: 370,000 minimum: 204,000 maximum: 464,000	487,000	487,000

[1] Assumptions: (1) The modeled period of record is from water years 1928 through 2000; (2) The calculated unregulated runoff volumes were sorted and divided into fourths, based on modeled output, to represent dry (bottom fourth), average (two middle fourths), and wet (top fourth) water years; and (3) The carryover volumes were similarly divided, based on modeled output, to represent dry, average, and wet water years.
[2] Combined April 1 through September 30 total unregulated runoff forecast for Snake River at Heise, Payette River at Horseshoe Bend, and Boise River at Lucky Peak.
[3] Combined November 1 contents (active storage) at Grassy Lake, Jackson, Palisades, Ririe, American Falls, Walcott, Island Park, Anderson Ranch, Arrowrock, Lucky Peak, Deadwood, and Cascade Reservoirs.
Source: Snake River MODSIM, May 2007

Chapter 3 of the 2007 Upper Snake River BA (Reclamation 2007) provides additional information specific to Upper Snake River operations and flow effects.

B.3. BIOLOGICAL ANALYSIS

The Action Agencies used the Comprehensive Passage (COMPASS) model to estimate the changes in relative survival for five interior ESUs. This model was developed over a two year period by the NMFS (Northwest Fisheries Science Center and Northwest Regional Office) in cooperation with scientists and managers representing other Federal agencies (Corps, BPA, Reclamation, and U.S. Fish and Wildlife Service), States (Washington Department of Fish and Wildlife, Oregon Department of Fish and Wildlife), Tribes (Columbia River Inter-Tribal Fish Commission), the Fish Passage Center, and the University of Washington. The purpose of the model is to predict the effects of alternative operations of Snake and Columbia River dams and reservoirs on salmon survival rates, expressed both as direct effects within the hydropower system and as latent effects that may occur outside the hydropower system. Thus, the model attempts to simulate all mortality (direct, indirect, and delayed) associated with passage through the hydropower system.

COMPASS has been extensively reviewed by the Independent Scientific Advisory Board (ISAB). Concerns raised in the review have been addressed and have strengthened the model. A paper describing COMPASS has been provisionally accepted in the peer-reviewed journal *Hydrobiologia* (Zabel et al. 2007). See Zabel et al. 2007 for more information about the model.

The model is composed of five modules:

- *Reservoir Survival*. Survival through a reservoir is potentially related to the following factors: travel time, distance traveled, river flow, temperature, and proportion of fish passing through the spillway. Reservoir survival relationships were calibrated using passive integrated transponder (PIT)-tag data for four river segments beginning at Lower Granite and extending to Bonneville.

- *Dam Passage and Survival*. Fish passing dams are assigned to alternative passage routes (spillway, removable spillway weir, bypass system, turbine, or sluiceway) according to dam- and species-specific passage probabilities. Each passage route has an associated survival. In addition, fish entering a bypass system may be transported to below Bonneville Dam. Dam passage survival and passage probabilities are based on studies using radio and acoustic tagged fish.
- *Fish Travel Time*. Cohorts of fish move downstream based on migration rates related to water flow and date in the season. In addition, cohorts spread out as they move downstream. Fish travel times were based on a model developed by Zabel and Anderson (1997) that is governed by two parameters: fish velocity and population spread rate. Models are based on PIT-tag data.
- *Hydrology*. River flow, water velocity, and water temperature are specified for each river segment on a daily basis. The hydrology module keeps track of flow and temperature gains and losses in successive river segments. In addition, river flow is assigned to dam passage route (e.g., spillway versus powerhouse) on a daily basis at each dam. The hydrology module is based on either historical river conditions or HYDSIM output.
- *Post-Bonneville Survival*. Post-Bonneville Dam survival is modeled by several alternative hypotheses. For the current modeling, survival from Bonneville Dam to adult return to Lower Granite Dam is based on arrival timing at Bonneville Dam for both transported and in-river fish. The return rate versus arrival timing relationships are derived from PIT-tag data, and represent average return rates over at least five years.

Retrospective modeling was used for calibration (estimating parameters) of the survival and travel time functions based on historical PIT-tag data (1995 to 2005). In this type of modeling, historical dam conditions were recreated using year-specific dam survival and passage route parameters to reflect that dam configurations and operations have varied from year to year.

When COMPASS was calibrated, the unit of comparison is project survival, which incorporates both dam survival and reservoir survival.

$$S_{PROJ} = S_{RES} \cdot S_{DAM}$$

The COMPASS model produces predictions of project survival that combine dam survival predictions and reservoir survival predictions. Model-predicted project survival was compared to project survival estimated from PIT-tag data. COMPASS is capable of representing any salmonid population that migrates through the Snake and Columbia rivers, including the upper Columbia River. The model is currently calibrated for the Snake River Spring/Summer Chinook Salmon and Steelhead ESUs/ DPSs.

As stated above, the primary function of the model is to compare prospective hydrosystem survival across management scenarios. The three main operations that vary among management scenarios are flow (based on releases from storage reservoirs), proportion of river flow passed through the spillway, and transportation scheduling. Changes in these operations can change in-river survival and adult return rate through a variety of mechanisms. Also, dam configurations have changed across years, notably the addition of spillway weirs, and certain management scenarios may involve further dam configurations. To run the model prospectively, data files of river conditions (primarily flow and temperature) were assembled that reasonably reflect the variability in future conditions. As has been implemented in past modeling efforts, HYDSIM was used to model river conditions in the hydrosystem based on historical outflows from headwaters during the years 1929-1998 (October, 1928 to September, 1998 – a 70 year record). The HYDROSIM model also takes into account current storage reservoirs and scheduled water releases. Because temperature is an important factor in some reservoir survival relationships, water temperatures was also simulated during these years based on flow-temperature relationships.

For each of the “water years” described above, key information was produced on juvenile fish migration through the hydrosystem. This includes annual survival through the entire hydrosystem, percentage of fish transported, and arrival timing below Bonneville (along with other diagnostic information). For some post-Bonneville survival, information from the downstream migration module – arrival timing and percent fish transported – are incorporated into predictions of post-Bonneville survival.

For each of the ESUs, there is a COMPASS table showing relative change in survival for the different 70-year hydro-regulations and a spreadsheet calculation of relative improvements from base-to-current, and current-to-prospective for average system survival and average smolt-to-adult survival (see Tables B-16 to B-25).

Table B-16. Snake River Spring/Summer Chinook Salmon Relative Change in Survival for Different 70-Year Hydro-Regulations

				Median day of arrival		Proportion of population below Bonneville		FCRPS Survival			Composite Bon-LGR SAR Estimate		
		In-River Survival	"destined" for transport	In-River Migrants	Transported	In-River Migrants	Transported	Survival without "D"	"D" estimate	Survival with "D"	In-River Migrants	Transported	Whole population LGR-LGR SAR
Base Case	70 year Average	0.485	0.781	136.8	128.3	0.145	0.855	0.882	0.586	0.555	0.01594	0.00934	0.00934
Proposed Action		0.557	0.587	138.9	131.8	0.327	0.673	0.827	0.653	0.605	0.01555	0.01015	0.01011
Absolute Change		0.071	-0.195	2.1	3.5	0.181	-0.181	-0.055	0.067	0.050	-0.00039	0.00080	0.00076
Relative Change		14.7%	-24.9%	0.02	0.03	125.1%	-21.2%	-6.2%	11.4%	9.1%	-2.5%	8.6%	8.2%
Base Case	<65 KCFS n = 13	0.351	0.989	147.6	132.3	0.005	0.995	0.974	0.703	0.685	0.01403	0.00985	0.00931
Proposed Action		0.331	0.927	167.7	132.5	0.040	0.960	0.940	1.345	1.246	0.00739	0.00994	0.00913
Absolute Change		-0.020	-0.062	20.1	0.2	0.035	-0.035	-0.033	0.643	0.562	-0.00664	0.00008	-0.00018
Relative Change		-5.7%	-6.3%	0.14	0.00	688.7%	-3.5%	-3.4%	91.5%	82.0%	-47.3%	0.8%	-1.9%
Base Case	65-80 KCFS n=13	0.471	0.879	144.3	130.0	0.071	0.929	0.923	0.681	0.644	0.01462	0.00996	0.00921
Proposed Action		0.565	0.694	141.7	132.5	0.222	0.778	0.859	0.650	0.615	0.01562	0.01015	0.00971
Absolute Change		0.094	-0.184	-2.6	2.5	0.151	-0.151	-0.063	-0.031	-0.029	0.00100	0.00019	0.00050
Relative Change		19.8%	-21.0%	-0.02	0.02	211.6%	-16.2%	-6.9%	-4.6%	-4.5%	6.8%	1.9%	5.4%
Base Case	80-130 KCFS n=36	0.528	0.733	133.4	127.0	0.174	0.826	0.861	0.597	0.570	0.01676	0.01000	0.00938
Proposed Action		0.622	0.485	130.8	131.5	0.410	0.590	0.796	0.568	0.591	0.01794	0.01020	0.01048
Absolute Change		0.095	-0.248	-2.6	4.4	0.236	-0.236	-0.065	-0.028	0.021	0.00118	0.00019	0.00110
Relative Change		17.9%	-33.8%	-0.02	0.03	136.0%	-28.6%	-7.6%	-4.8%	3.7%	7.0%	1.9%	11.7%
Base Case	>130 KCFS n=8	0.536	0.502	122.7	124.8	0.363	0.637	0.759	0.571	0.548	0.01753	0.01001	0.00943
Proposed Action		0.615	0.315	124.3	131.1	0.586	0.414	0.730	0.571	0.597	0.01796	0.01026	0.01065
Absolute Change		0.079	-0.188	1.6	6.3	0.223	-0.223	-0.030	0.000	0.050	0.00043	0.00025	0.00123
Relative Change		14.7%	-37.4%	0.01	0.05	61.5%	-35.0%	-3.9%	0.1%	9.1%	2.5%	2.5%	13.0%

Notes:
1/ Average estimates for analysis parameters
Source: August 2007 COMPASS model runs

Table B-17. Snake River Spring/Summer Chinook Salmon Relative Improvements from "Base" to "Current" to "Prospective" Hydro Survival Improvements[1/]

Population	Average System Survival Estimates [1]			Average Smolt to Adult Survival Estimates (Scheurell-Zabel Hypothesis) [2]			Source
	Base	Current	Prospective	Base	Current	Prospective	
Populations Upstream of LGR	0.722			0.00762			Rich Zabel: pers. comm. Mar 26, 2007 e-mail providing TRT "Base" parameters used for life-cycle modeling.
		0.882	0.827		0.00934	0.01011	August 1, 2007 COMPASS model estimates: in-river survival and LGR to LGR SARs
	0.722	**0.882**	**0.827**	**0.00762**	**0.00934**	**0.01011**	**Best Estimate (LGR to BON in-river survival & LGR to LGR SARs)**
		1.222	**0.938**		**1.225**	**1.082**	**Relative Adjustment**

Notes:
[1] When Hydro and other Prospective Actions are added to a lifecycle model, the populations may grow to a point where density dependent effects occur; which would be equivalent to reducing the survival improvements.
[2] Average "Base" (1980 to 2001 migration years) system survival (i.e., estimated number of fish surviving via in-river or transport to below BON) was estimated assuming: In-river survival = 0.334; Proportion transported = 0.600; and % transport survival = 0.98; average "Current" and "Prospective" system survival was estimated using COMPASS.
[3] The average "Base" (1980 to 2001 migration years) LGR to LGR SAR is estimated by applying the Current average in-river ((0.01594) and transport ((0.00934)) SAR estimates generated by the COMPASS model to the Base in-river and transport system survival estimates: 0.00762 = (0.6*0.98*0.00934)+((1-0.6)*0.334*0.01594)

Table B-18. Snake River Steelhead Salmon Relative Change in Survival for Different 70-Year Hydro-Regulations

		In-River Survival	"destined" for transport	Median day of arrival		Proportion of population below Bonneville		FCRPS Survival			Composite Bon-LGR SAR Estimate		Whole population LGR-LGR SAR
				In-River Migrants	Transported	In-River Migrants	Transported	Survival without "D"	"D" estimate	Survival with "D"	In-River Migrants	Transported	
Base Case	70 year Average	0.407	0.883	139.0	133.6	0.068	0.932	0.923	1.419	1.276	0.01472	0.02088	0.01821
Proposed Action		0.465	0.693	142.0	135.1	0.213	0.787	0.846	1.381	1.080	0.01466	0.02024	0.01604
Absolute Change		0.059	-0.191	3.0	1.6	0.145	-0.145	-0.077	-0.038	-0.195	-0.00006	-0.00064	-0.00217
Relative Change		14.4%	-21.6%	2.1%	1.2%	211.8%	-15.5%	-8.4%	-2.7%	-15.3%	-0.42%	-3.08%	-11.92%
Base Case	<65 KCFS n=13	0.185	0.997	153.4	137.4	0.001	0.999	0.978	1.582	1.546	0.01202	0.01902	0.01831
Proposed Action		0.197	0.950	172.1	137.2	0.015	0.985	0.942	4.736	4.418	0.00403	0.01906	0.01741
Absolute Change		0.011	-0.047	18.8	-0.1	0.014	-0.014	-0.036	3.154	2.872	-0.00800	0.00005	-0.00090
Relative Change		6.0%	-4.8%	12.2%	-0.1%	2146.1%	-1.4%	-3.7%	199.4%	185.7%	-66.52%	0.24%	-4.94%
Base Case	65-80 KCFS n=13	0.353	0.934	144.8	135.5	0.028	0.972	0.940	1.497	1.394	0.01335	0.01998	0.01792
Proposed Action		0.396	0.785	144.2	136.5	0.114	0.886	0.855	1.297	1.082	0.01505	0.01951	0.01582
Absolute Change		0.043	-0.150	-0.5	1.0	0.086	-0.086	-0.085	-0.200	-0.312	0.00170	-0.00047	-0.00210
Relative Change		12.0%	-16.0%	-0.4%	0.7%	306.6%	-8.8%	-9.1%	-13.4%	-22.4%	12.73%	-2.35%	-11.70%
Base Case	80-130 KCFS n=36	0.470	0.862	135.1	132.5	0.078	0.922	0.911	1.356	1.210	0.01579	0.02141	0.01832
Proposed Action		0.546	0.619	134.0	134.5	0.266	0.734	0.818	1.165	0.915	0.01767	0.02058	0.01568
Absolute Change		0.075	-0.242	-1.2	2.0	0.188	-0.188	-0.094	-0.192	-0.296	0.00188	-0.00083	-0.00264
Relative Change		16.0%	-28.1%	-0.9%	1.5%	241.8%	-20.4%	-10.3%	-14.1%	-24.4%	11.92%	-3.89%	-14.41%
Base Case	>130 KCFS n=8	0.568	0.711	123.7	129.0	0.201	0.799	0.862	1.394	1.136	0.01649	0.02298	0.01799
Proposed Action		0.654	0.454	125.3	132.2	0.456	0.544	0.803	1.230	0.904	0.01772	0.02179	0.01576
Absolute Change		0.086	-0.257	1.6	3.2	0.255	-0.255	-0.059	-0.164	-0.231	0.00123	-0.00119	-0.00224
Relative Change		15.1%	-36.1%	1.3%	2.5%	127.2%	-31.9%	-6.8%	-11.8%	-20.4%	7.47%	-5.18%	-12.42%

Notes:
1 Average estimates for analysis parameters
Source: August 2007 COMPASS model runs

Table B-19. Snake River Steelhead Relative Improvements from "Base" to "Current" to "Prospective" Hydro Survival Improvements

Population	Avg System Survival Estimates [1]			Avg Smolt to Adult Survival Estimates (Scheurell-Zabel Hypothesis) [2]			Source
	Base	**Current**	**Prospective**	**Base**	**Current**	**Prospective**	
Populations Upstream of LGR	0.899			0.01859			Rich Zabel: pers. comm. Mar 20, 2007 e-mail providing TRT "Base" parameters used for life-cycle modeling.
		0.923	0.846		0.01821	0.01604	August 1, 2007 COMPASS model estimates: in-river survival and LGR to LGR SARs
	0.899	**0.923**	**0.846**	**0.01859**	**0.01821**	**0.01604**	**Best Estimate (LGR to BON in-river survival & LGR to LGR SARs)**
		1.027	**0.916**		**0.979**	**0.881**	**Relative Adjustment**

Notes:

1 When Hydro and other Prospective Actions are added to a lifecycle model, the populations may grow to a point where density dependent effects occur; which would be equivalent to reducing the survival improvements.

2 Average "Base" (1980 to 2001 migration years) system survival (i.e., estimated number of fish surviving via in-river or transport to below BON) was estimated assuming: In-river survival = 0.265; Proportion transported = 0.887; and % transport survival = 0.98; average "Current" and "Prospective" system survival was estimated using COMPASS.

3 The average "Base" (1980 to 2001 migration years) LGR to LGR SAR is estimated by applying the Current average in-river ((0.01472) and transport ((0.02088)) SAR estimates generated by the COMPASS model to the Base in-river and transport system survival estimates: 0.01859 = (0.887*0.98*0.02088)+((1-0.887)*0.265*0.01472)

Table B-20. Upper Columbia River Spring Chinook Salmon Relative Change in Survival for Different 70-Year Hydro-Regulations

		In-River Survival	Median day of arrival	Estimated SAR BON-Rock Island	Estimated Rock Island to Rock Island SAR
Base Case	70 year Average	0.646	147.3	0.01432	0.00926
Proposed Action		0.707	147.3	0.01431	0.01013
Absolute Change		0.061	0.1	-0.00001	0.00087
Relative Change		9.51%	0.000	-0.10%	9.42%
Base Case	<200,000 n=17	0.602	149.0	0.01375	0.00829
Proposed Action		0.652	149.5	0.01360	0.00888
Absolute Change		0.050	0.5	-0.00015	0.00059
Relative Change		8.38%	0.004	-1.09%	7.18%
Base Case	200,000-325,000 n=46	0.656	146.9	0.01446	0.00949
Proposed Action		0.720	146.9	0.01447	0.01042
Absolute Change		0.064	0.0	0.00002	0.00093
Relative Change		9.70%	0.000	0.11%	9.80%
Base Case	>325,000 n=7	0.683	145.5	0.01482	0.01013
Proposed Action		0.756	145.0	0.01493	0.01129
Absolute Change		0.073	-0.4	0.00011	0.00116
Relative Change		10.69%	-0.003	0.74%	11.48%

Note:
[1] Average estimates for analysis parameters
Source: August 2007 COMPASS model runs

Table B-21. Upper Columbia River Spring Chinook Salmon Relative Improvements from "Base" to "Current" to "Prospective" Hydro Survival Improvements[1/]

	Avg System Survival Estimates [2]			Avg Smolt to Adult Survival Estimates (Scheurell-Zabel Hypothesis) [3]			
Population	**Base**	**Current**	**Prospective**	**Base**	**Current**	**Prospective**	**Source**
Wenatchee River (7 dams)	0.441						Rich Zabel: pers. comm. Mar 26, 2007 e-mail providing TRT "Base" parameters (RIS to BON) used for life-cycle modeling.
		0.646	0.707	0.01432	0.01432	0.01431	August 1, 2007 COMPASS model estimates: in-river survival and BON to RIS SARs
	0.662	0.823	0.823				Survival Estimates through Mid-Columbia River projects from 2002 Final Draft QAR Report and NMFS' Hydro Module. [4]
	0.441	**0.531**	**0.582**	**0.00632**	**0.00761**	**0.00832**	**Best Estimate (RIS to BON in-river survival & RIS to RIS SARs)**
		1.205	**1.095**		**1.205**	**1.094**	**Relative Adjustment**
Entiat River (8 dams)	0.666						Estimated MCN to BON survival of 66.6% (RIS to BON = 0.441 / RIS to MCN = 0.662)
		0.646	0.707	0.01432	0.01432	0.01431	August 1, 2007 COMPASS model estimates: in-river survival and BON to RIS SARs
	0.573	0.757	0.765				Survival Estimates through Mid-Columbia River projects from 2002 Final Draft QAR Report and NMFS' Hydro Module. [4]
	0.382	**0.489**	**0.541**	**0.00547**	**0.00700**	**0.00774**	**Best Estimate (RRE to BON in-river survival & RRE to RIS SARs)**
		1.281	**1.107**		**1.281**	**1.106**	**Relative Adjustment**
Methow and Okanogan Rivers (9 dams)	0.666						Estimated MCN to BON survival of 66.6% (RIS to BON = 0.441 / RIS to MCN = 0.662)
		0.646	0.707	0.01432	0.01432	0.01431	August 1, 2007 COMPASS model estimates: in-river survival and BON to RIS SARs
	0.511	0.728	0.736				Survival Estimates through Mid-Columbia River projects from 2002 Final Draft QAR Report and NMFS' Hydro Module. [4]
	0.340	**0.470**	**0.520**	**0.00487**	**0.00673**	**0.00744**	**Best Estimate (WEL to BON in-river survival & WEL to RIS SARs)**
		1.381	**1.107**		**1.381**	**1.106**	**Relative Adjustment**

[1] When Hydro and other Prospective Actions are added to a life-cycle model, the populations may grow to a point where density dependent effects occur, which would be equivalent to reducing the survival improvements.
[2] Average "Base" (1980 to 2001 migration years) system survival was estimated as 0.441 from Rock Island to Bonneville Dams (7 dams).
[3] Average "Base" (1980 to 2001 migration years) system survival was estimated assuming average system survival parameters; estimated SARs from COMPASS: average BON to RIS SAR of 0.01432 for Base and Current and 0.01431 for Prospective.
[4] Final Draft QAR Report (Sept 2002): Avg survival estimates (1982-1996) through Mid-Columbia River Dams (Table 18); NMFS Hydro Module - Mid-Columbia River Projects (2004-2009) - Table 4.1a; and (2010-2013) Table 4.1.b.

Table B-22. Upper Columbia River Steelhead Salmon Relative Change in Survival for Different 70-Year Hydro-Regulations

		In-River Survival	Median day of arrival	Estimated SAR BON-Rock Island	Estimated Rock Island to Rock Island SAR
Base Case	70 year Average	0.588	150.2	0.01354	0.00789
Proposed Action		0.661	150.2	0.01353	0.00888
Absolute Change		0.0724	0.0057	-0.00001	0.00098
Relative Change		12.31%	0.004%	-0.09%	12.46%
Base Case	<200,000 n=17	0.431	149.3	0.01393	0.00598
Proposed Action		0.481	148.8	0.01416	0.00686
Absolute Change		0.0494	-0.4500	0.00022	0.00087
Relative Change		11.46%	-0.301%	1.61%	14.57%
Base Case	200,000-325,000 n=46	0.629	150.1	0.01359	0.00850
Proposed Action		0.706	150.0	0.01363	0.00961
Absolute Change		0.0772	-0.1322	0.00004	0.00110
Relative Change		12.27%	-0.088%	0.30%	12.98%
Base Case	>325,000 n=7	0.701	153.0	0.01224	0.00854
Proposed Action		0.797	155.0	0.01130	0.00900
Absolute Change		0.0967	2.0186	-0.00094	0.00047
Relative Change		13.80%	1.319%	-7.64%	5.48%

Notes:
[1] Average estimates for analysis parameters.
Source: August 2007 COMPASS model runs

Table B-23. Upper Columbia River Steelhead Relative Improvements from "Base" to "Current" to "Prospective" Hydro Survival Improvements[1/]

Population	Avg System Survival Estimates [2/]			Avg Smolt to Adult Survival Estimates (Scheurell-Zabel Hypothesis) [3/]			Source
	Base	**Current**	**Prospective**	**Base**	**Current**	**Prospective**	
Wenatchee River (7 dams)	0.515						Estimated as TRT "Base" in-river survival estimate (0.265) from LGR to BON (.847 per project survival). [4/]
		0.588	0.661	0.01354	0.01354	0.01353	August 1, 2007 COMPASS model estimates: in-river survival and BON to RIS SARs
	0.690	0.727	0.814				Survival Estimates through Mid-Columbia River projects from 2002 Final Draft QAR Report and NMFS' Hydro Module. [4/]
	0.355	**0.428**	**0.538**	**0.00481**	**0.00579**	**0.00727**	**Best Estimate (RIS to BON in-river survival & RIS to RIS SARs)**
		1.204	**1.257**		**1.204**	**1.256**	**Relative Adjustment**
Entiat River (8 dams)	0.515						Estimated as TRT "Base" in-river survival estimate (0.265) from LGR to BON (.847 per project survival). [4/]
		0.588	0.661	0.01354	0.01354	0.01353	August 1, 2007 COMPASS model estimates: in-river survival and BON to RIS SARs
	0.633	0.696	0.780				Survival Estimates through Mid-Columbia River projects from 2002 Final Draft QAR Report and NMFS' Hydro Module. [4/]
	0.326	**0.409**	**0.515**	**0.00441**	**0.00554**	**0.00697**	**Best Estimate (RRE to BON in-river survival & RRE to RIS SARs)**
		1.257	**1.259**		**1.257**	**1.257**	**Relative Adjustment**
Methow and Okanogan Rivers (9 dams)	0.515						Estimated as TRT "Base" in-river survival estimate (0.265) from LGR to BON (.847 per project survival). [4/]
		0.588	0.661	0.01354	0.01354	0.01353	August 1, 2007 COMPASS model estimates: in-river survival and BON to RIS SARs
	0.549	0.670	0.750				Survival Estimates through Mid-Columbia River projects from 2002 Final Draft QAR Report and NMFS' Hydro Module. [4/]
	0.283	**0.394**	**0.495**	**0.00383**	**0.00534**	**0.00670**	**Best Estimate (WEL to BON in-river survival & WEL to RIS SARs)**
		1.395	**1.257**		**1.395**	**1.256**	**Relative Adjustment**

[1/] When Hydro and other Prospective Actions are added to a life-cycle model, the populations may grow to a point where density dependent effects occur, which would be equivalent to reducing the survival improvements.

[2/] Average "Base" (1980 to 2001 migration years) Snake River steelhead in-river survival estimate (0.265) through 8 dams system equals an average pre project survival of 0.847. 0.847^4 = 0.515 (and estimate of the average survival through the 4 lower Columbia River projects.

[3/] Average "Base" (1980 to 2001 migration years) system survival was estimated assuming average system survival parameters; estimated SARs from COMPASS: average BON to RIS SAR of 0.01354 for Base and Current and 0.01353 for Prospective.

[4/] Final Draft QAR Report (Sept 2002): Avg survival estimates (1982-1996) through Mid-Columbia River Dams (Table 18); NMFS Hydro Module - Mid-Columbia River Projects (2004-2009) - Table 4.1a; and (2010-2013) Table 4.1.b.

Table B-24. Mid Columbia Steelhead Relative Change in Survival for Different 70-Year Hydro-Regulations[1/]

		Project Survival				Stock survivals			
		Bonneville	**The Dalles**	**John Day**	**McNary**	**Yakima Walla Walla**	**Umatilla, John Day**	**Deschutes**	**Bonneville Pool**
Base Case	70 year Average	0.943	0.855	0.795	0.908	0.588	0.645	0.806	0.943
Proposed Action		0.946	0.896	0.833	0.926	0.661	0.710	0.848	0.946
Absolute Change		0.003	0.041	0.038	0.018	0.072	0.065	0.042	0.003
Relative Change		0.34%	4.80%	4.73%	1.99%	12.31%	10.12%	5.16%	0.34%
Base Case	<200,000 n=17	0.906	0.829	0.654	0.867	0.431	0.494	0.752	0.906
Proposed Action		0.909	0.868	0.682	0.883	0.481	0.541	0.790	0.909
Absolute Change		0.002	0.039	0.028	0.016	0.049	0.047	0.038	0.002
Relative Change		0.27%	4.74%	4.35%	1.80%	11.46%	9.53%	5.01%	0.27%
Base Case	200,000-325,000 n=46	0.953	0.862	0.832	0.919	0.629	0.684	0.821	0.953
Proposed Action		0.956	0.903	0.871	0.939	0.706	0.752	0.863	0.956
Absolute Change		0.003	0.041	0.039	0.019	0.077	0.068	0.042	0.003
Relative Change		0.36%	4.74%	4.67%	2.10%	12.27%	9.99%	5.11%	0.36%
Base Case	>325,000 n=7	0.964	0.869	0.899	0.930	0.701	0.753	0.838	0.964
Proposed Action		0.968	0.916	0.951	0.946	0.797	0.843	0.886	0.968
Absolute Change		0.004	0.046	0.052	0.016	0.097	0.089	0.048	0.004
Relative Change		0.41%	5.31%	5.80%	1.75%	13.80%	11.86%	5.74%	0.41%

[1] Average estimates for analysis parameters
Source: August 2007 COMPASS Model Runs

Table B-25. Middle Columbia River Steelhead Relative Improvements from "Base" to "Current" to "Prospective" Hydro Survival Improvements[1/,2/]

Population	Avg System Survival Estimates [3/]			Source
	Base	Current	Prospective	
Bonneville Pool Tributaries (1 dam)	0.847			Estimated as TRT "Base" in-river survival estimate (0.265) from LGR to BON (.847 per project survival^1).
		0.943	0.946	August 1, 2007 COMPASS model estimates: in-river survival.
	0.847	**0.943**	**0.946**	**Best Estimate**
		1.113	**1.003**	**Relative Adjustment**
Deschutes River (2 dams)	0.717			Estimated as TRT "Base" in-river survival estimate (0.265) from LGR to BON (.847 per project survival^2).
		0.806	0.848	August 1, 2007 COMPASS model estimates: in-river survival.
	0.717	**0.806**	**0.848**	**Best Estimate**
		1.123	**1.052**	**Relative Adjustment**
Umatilla and John Day Rivers (3 dams)	0.608			Estimated as TRT "Base" in-river survival estimate (0.265) from LGR to BON (.847 per project survival^3).
		0.645	0.710	August 1, 2007 COMPASS model estimates: in-river survival.
	0.608	**0.645**	**0.710**	**Best Estimate**
		1.061	**1.101**	**Relative Adjustment**
Yakima and Walla Walla Rivers (4 dams)	0.515			Estimated as TRT "Base" in-river survival estimate (0.265) from LGR to BON (.847 per project survival^4).
		0.588	0.661	August 1, 2007 COMPASS model estimates: in-river survival.
	0.515	**0.588**	**0.661**	**Best Estimate**
		1.143	**1.123**	**Relative Adjustment**

[1/] When Hydro and other Prospective Actions are added to a life-cycle model, the populations may grow to a point where density dependent effects occur, which would be equivalent to reducing survival improvements.
[2/] For MCR steelhead, no assumption is made regarding changes in SARs between the Base, Current, and Prospective periods. It seems likely that improving passage conditions (Current and Prospective model output compared to estimated Base conditions) has reduced sub-lethal effects to some extent, which would, in turn, be likely to increase, by some unquantifiable amount, the average SARs of these fish compared to SARs during the average Base period. This analysis is therefore conservative in that it only estimates direct survival improvements and does not presume any positive adjustment related to likely increased SARs (reduced latent mortality) for populations in this DPS.
[3/] Average "Base" (1980 to 2001 migration years) Snake River steelhead in-river survival estimate (0.265) through 8 dams system equals an average pre project survival of 0.847. 0.847^(# of dams) = the estimated average survival through the corresponding number of lower Columbia River projects.

Table B-26 is a summary of the dam passage survival estimates generated by COMPASS for the current and prospective conditions. COMPASS model project survival estimates were derived based on best professional judgment. Data used as input to the model were developed from means of relative project survival estimates collected over multiple years at each project and over a range of project operations; which may be different than the proposed operations. Further uncertainty in the data was introduced by different experimental designs between years and projects. In the case where survival data was limited for a species at a project, the data was derived from survival estimates for a similar species or from a different project. The dam survival estimates may change as new information becomes available and updates are made to the COMPASS model.

Table B-26. Summary of Dam Passage Survival Estimates Generated by COMPASS Model

Current Dam Passage Survival Estimates

Yearling Chinook	LGR	LGS	LMN	IHR	MCN	JDA	TDA	BON
Average	**0.963**	**0.950**	**0.932**	**0.966**	**0.937**	**0.939**	**0.915**	**0.971**
Max value	0.970	0.964	0.957	0.967	0.949	0.953	0.919	0.971
75%	0.968	0.960	0.952	0.966	0.942	0.940	0.915	0.971
50%	***0.967***	***0.959***	***0.950***	***0.966***	***0.935***	***0.937***	***0.914***	***0.971***
25%	0.956	0.941	0.903	0.966	0.932	0.936	0.914	0.971
Min value	0.950	0.923	0.884	0.966	0.928	0.936	0.913	0.970

Steelhead	LGR	LGS	LMN	IHR	MCN	JDA	TDA	BON
Average	**0.962**	**0.956**	**0.934**	**0.989**	**0.950**	**0.917**	**0.923**	**0.986**
Max value	0.972	0.968	0.957	0.990	0.954	0.942	0.924	0.990
75%	0.971	0.964	0.953	0.989	0.951	0.920	0.923	0.987
50%	***0.966***	***0.963***	***0.951***	***0.989***	***0.950***	***0.914***	***0.923***	***0.986***
25%	0.956	0.947	0.909	0.989	0.949	0.912	0.923	0.984
Min value	0.945	0.930	0.881	0.988	0.947	0.911	0.923	0.983

Proposed Action Dam Passage Survival Estimates

Yearling Chinook	LGR	LGS	LMN	IHR	MCN	JDA	TDA	BON
Average	**0.973**	**0.969**	**0.953**	**0.971**	**0.963**	**0.952**	**0.943**	**0.975**
Max value	0.975	0.974	0.964	0.978	0.965	0.970	0.951	0.976
75%	0.974	0.973	0.958	0.972	0.964	0.953	0.944	0.975
50%	***0.973***	***0.973***	***0.956***	***0.971***	***0.962***	***0.950***	***0.943***	***0.975***
25%	0.972	0.965	0.951	0.970	0.962	0.949	0.942	0.974
Min value	0.969	0.955	0.932	0.967	0.961	0.948	0.939	0.973

Steelhead	LGR	LGS	LMN	IHR	MCN	JDA	TDA	BON
Average	**0.971**	**0.973**	**0.962**	**0.994**	**0.969**	**0.961**	**0.953**	**0.989**
Max	0.974	0.978	0.972	0.995	0.972	0.979	0.956	0.992
75%	0.973	0.976	0.966	0.994	0.971	0.964	0.953	0.990
50%	***0.971***	***0.975***	***0.964***	***0.994***	***0.969***	***0.960***	***0.953***	***0.989***
25%	0.969	0.974	0.962	0.993	0.967	0.956	0.953	0.989
Min	0.962	0.957	0.938	0.992	0.965	0.955	0.951	0.987

Table B-27 is COMPASS Estimates of Juvenile In-River System Survival for Current and Prospective Conditions Using the 70-Year (1929-1998) Hydrologic Record.

Table B-27. COMPASS Estimates of Juvenile In-River Survival for Current and Prospective Conditions Using the 70-Year (1929 to 1998) Hydrologic Record

ESU/DPS	Seasonal River Discharge	In-River Juvenile Survival mean (min/max)	In-River Juvenile Survival mean (min/max)
Snake River Spring/Summer Chinook		**Current**	**Prospective**
	70-year Hydrologic Record Average	0.485 (.281 - .551)	0.557 (.229 - .637)
	<65 kcfs (13 of 70 years)	0.351 (.281 - .503)	0.331 (.229 - .527)
	65-80 kcfs (13 of 70 years)	0.471 (.358 - .536)	0.565 (.407 - .613)
	80-130 kcfs (36 of 70 years)	0.528 (.432 - .551)	0.622 (.588 - .637)
	>130 kcfs (8 of 70 years)	0.536 (.521 - .546)	0.615 (.605 - .622)
Snake River Steelhead		**Current**	**Prospective**
	70-year Hydrologic Record Average	0.407 (.111 - .593)	0.465 (.108 - .684)
	<65 kcfs (13 of 70 years)	0.185 (.167 - .593)	0.197 (.131 - .684)
	65-80 kcfs (13 of 70 years)	0.353 (.131 - .593)	0.396 (.159 - .684)
	80-130 kcfs (36 of 70 years)	0.470 (.038 - .593)	0.546 (.064 - .684)
	>130 kcfs (8 of 70 years)	0.568 (.038 - .593)	0.654 (.046 - .684)
Upper Columbia River Spring Chinook		**Current**	**Prospective**
	70-year Hydrologic Record Average	0.646 (.565 - .704)	0.707 (.613 - .771)
	<200 kcfs (17 of 70 years)	0.602 (.565 - .656)	0.652 (.613 - .708)
	200-325 kcfs (46 of 70 years)	0.656 (.034 - .696)	0.720 (.038 - .751)
	>325 kcfs (7 of 70 years)	0.683 (.663 - .704)	0.756 (.741 - .771)
Upper Columbia River Steelhead		**Current**	**Prospective**
	70-year Hydrologic Record Average	0.588 (.325 - .730)	0.661 (.363 – 807)
	<200 kcfs (17 of 70 years)	0.431 (.325 - .626)	0.481 (.363 - .649)
	200-325 kcfs (46 of 70 years)	0.629 (.113 - .728)	0.706 (.125 - .791)
	>325 kcfs (7 of 70 years)	0.701 (.658 - .730)	0.797 (.774 - .807)
Middle Columbia River Steelhead		**Current**	**Prospective**
Stocks Entering Columbia River Above McNary Dam			
	70-year Hydrologic Record Average	0.588 (.325 - .730)	0.661 (.363 - .807)
	<200 kcfs (17 of 70 years)	0.431 (.325 - .626)	0.481 (.363 - .649)
	200-325 kcfs (46 of 70 years)	0.629 (.113 - .728)	0.706 (.125 - .791)
	>325 kcfs (7 of 70 years)	0.701 (.658 - .730)	0.797 (.774 - .807)
Stocks Entering Columbia River in The John Day Pool			
	70-year Hydrologic Record Average	0.645 (.389 - .783)	0.710 (.427 - .853)
	<200 kcfs (17 of 70 years)	0.494 (.389 - .679)	0.541 (.427 - .700)
	200-325 kcfs (46 of 70 years)	0.684 (.108 - .781)	0.752 (.117 - .833)
	>325 kcfs (7 of 70 years)	0.753 (.710 - .783)	0.843 (.815 - .853)
Stocks Entering Columbia River in The Dalles Pool			
	70-year Hydrologic Record Average	0.806 (.704 - .843)	0.848 (.739 - .888)
	<200 kcfs (17 of 70 years)	0.752 (.704 - .816)	0.790 (.739 - .849)
	200-325 kcfs (46 of 70 years)	0.821 (.038 - .844)	0.863 (.039 - .886)
	>325 kcfs (7 of 70 years)	0.838 (.831 - .844)	0.886 (.883 - .888)

Table B-27. COMPASS Estimates of Juvenile In-River Survival for Current and Prospective Conditions Using the 70-Year (1929 to 1998) Hydrologic Record

ESU/DPS	Seasonal River Discharge	In-River Juvenile Survival mean (min/max)	In-River Juvenile Survival mean (min/max)
Stocks Entering Columbia River in The Bonneville Pool			
	70-year Hydrologic Record Average	0.943 (.875 - .968)	0.946 (.876 - .901)
	<200 kcfs (17 of 70 years)	0.906 (.875 - .947)	0.909 (.876 - .947)
	200-325 kcfs (46 of 70 years)	0.953 (.025 - .968)	0.956 (.255 - .971)
	>325 kcfs (7 of 70 years)	0.964 (.959 - .968)	0.968 (.964 - .969)

B.4. ANALYSIS BY ESU

Table B-28 identifies the aggregation of the five interior Columbia ESUs for the hydro effects analysis based on river passage conditions experienced by the populations Snake River steelhead and spring/summer Chinook were aggregated across the entire ESU because in-river hydro improvements were expected to affect populations similarly. Although upper Columbia Chinook salmon and steelhead are assumed to experience similar conditions passing through the FCRPS dams, different conditions are experienced upstream (as they migrate past a different number of dams and reservoirs), therefore they are reported on separately as three primary populations. The Mid-Columbia Steelhead DPS inhabits tributaries and enter the Columbia River at different locations between Bonneville Dam and McNary reservoir, therefore, the populations experience different passage conditions at the FCRPS facilities. These populations were aggregated according to the pool initially entered on their downstream migration; the analysis for Mid-Columbia steelhead examined the Yakima/Walla Walla aggregate, Umatilla /John Day aggregate, Deschutes River aggregate, and Bonneville pool tributaries aggregate as distinct groups.

Table B-28. ESU-by-ESU Analysis Matrix

ESU	Hydro Analysis	Rationale
Snake Spring/Summer Chinook Salmon	Aggregated for ESU	Similar FCRPS experience
Snake River Steelhead	Aggregated for ESU	Similar FCRPS experience
Upper Columbia River Chinook Salmon	Independent by population	Different downstream migration experience
Upper Columbia River Steelhead	Independent by population	Different downstream migration experience
Mid-Columbia River Steelhead	Aggregated by entry point into FCRPS	Notably different FCRPS experience

Because the data used in the analysis was more robust for Snake River migrants traveling through the lower Columbia River, the assumption was made that the effects of hydro actions in the lower Columbia River would be consistent for both upper Columbia and Snake River ESUs. However, empirical data was used to provide separate estimates of passage timing at McNary Dam as upper Columbia River fish generally arrive at this project many days later than Snake River fish.

B.4.1 BASE CONDITION

For the five interior ESUs of Chinook salmon and steelhead, base conditions for direct in-river survival (DIS) were taken from TRT estimates (largely for average survival rates and transport rates) for the 1980 to 2001 juvenile migrations which used both empirical and interpolated information. For the Mid-Columbia Steelhead DPS, the Base condition for DIS was empirically derived by calculating in-river survival from Lower Granite to Bonneville, which was 26.5 percent. From this estimate, a per-project survival estimate of 84.7 percent was derived. This was then applied on a project-by-project basis to determine the survival of fish encountering from one to four projects.

B.4.2 CURRENT CONDITION

The Current condition was developed via the MODSIM, HYDSIM and COMPASS modeling using the 2006 hydropower configuration (i.e., implementation of structural measures from the 2000/2004 FCRPS Biological Opinions to date), and the operation plan that was laid out in the 2004 FCRPS and 2005 Upper Snake River Biological Opinions.

B.4.3 PROSPECTIVE CONDITION

For the Prospective condition, information developed in the FCRPS remand collaboration process was considered when developing the proposed action for both FCRPS operation and configuration changes. The Upper Snake River Proposed Actions include shifting the delivery of flow augmentation earlier in the migration season as recommended by NMFS staff.

Changes to the *operational* scenarios for water management and transportation were considered and the Action Agencies included these in the FCRPS Proposed RPA and the Upper Snake River Proposed Actions. Several scenarios evaluating different water management actions were modeled using MODSIM and HYDSIM. The changes in operations as reflected in MODSIM and HYDSIM and other changes including level of spill, initiation of transport, etc., were analyzed in COMPASS and subsequent survival changes were calculated.

With respect to *configuration* changes, the FCRPS Proposed RPA included the prospective construction and operation of surface passage, spillway improvements and other changes. The ranges of potential effects for each of these changes were estimated by the Action Agencies, and discussed and modified with input from NMFS technical staff. This information was then shared with the State and Tribal co-managers that work in the AFEP process as provided in the December 20, 2006 FCRPS proposed action draft to the Policy Work Group.

The best professional judgment of the effects for route specific survivals were included in the prospective COMPASS model (often including the upper end of the range), with the assumption that all of the configuration elements would be in place by 2017. Changes associated with structural configuration actions (e.g., surface passage) were reflected as an improvement in the timing of the arrival of fish arrive in the estuary (consistent with the estuary arrival time hypothesis).

After the potential operation and configuration survival changes were input into the model, the analysis was run with both the Current condition (2006 configuration/2004 FCRPS operations and 2005 Upper Snake River operations) and the full complement of proposed actions (2017) in place for the 50-year water record (1929 to 1978). This analysis was completed for each of the five interior Columbia ESUs as summarized in the matrix described above (Table B-28).

B.5. EFFECTS DESCRIPTION

The effects examined are reported stepwise here to provide a thorough explanation of how the analysis was conducted.

<u>Direct In-river Survival (DIS)</u> – This analysis used the calculations of the anticipated direct in-river survival changes to juvenile migrants resulting from proposed operation and configuration actions. For this analysis, neither transportation effects nor the effects of the Mid Columbia PUD actions are included.

With the proposed actions (FCRPS Proposed RPA and Upper Snake River Proposed Actions), mean DIS effects ranged from improvements of 5.9 to 7.2 percent for the Upper Snake River ESUs with a relative difference ranging from 14.4 to 14.8 percent improvements. For the upper Columbia ESUs, the relative change in mean DIS ranged from improvements of 6.1 to 7.2 percent with a relative difference ranging from 9.5 to 12.3 percent improvement (Table B-29).

Table B-29. Direct In-River Survival Changes for Upper River Chinook Salmon and Steelhead ESUs

Direct In-river Survival Effects		COMPASS Analysis			
ESUs	TRT Base Case	2004/2006 Current	2007 BiOp Prospective	Absolute Difference Prospective/ Current	Relative Difference Prospective/ Current
Snake River Sp/Su Chinook	33.4%	48.5%	55.7%	7.2%	14.8%
Snake River Steelhead	26.5%	40.7%	46.5%	5.9%	14.4%
Upper Columbia Sp. Chinook	44.1%	64.6%	70.7%	6.1%	9.5%
Upper Columbia Steelhead	51.5%	58.8%	66.1%	7.2%	12.3%

For mid-Columbia River steelhead the relative change in mean DIS ranged from 0.3 percent improvement for the populations that entered in the Bonneville pool to 12.4 percent improvement for those fish entering via the McNary pool (Table B-30).

Table B-30. Direct In-River Survival Changes for Mid-Columbia Steelhead Populations

Direct In-river Survival		COMPASS Analysis			
Mid Columbia Steelhead Populations	TRT Base Case	2004/2006 Current	2007 BiOp Prospective	Absolute Difference	Relative Difference Prospective/ Current
Yakima/Walla Walla Rivers	51.5%	58.8%	66.1%	7.2%	12.4%
Umatilla/John Day Rivers	60.8%	64.5%	71.0%	6.5%	10.1%
Deschutes River	71.7%	80.6%	84.8%	4.2%	5.16%
Bonneville Pool Tributaries	84.7%	94.3%	94.6%	0.3%	0.3%

Overall Direct Survival (ODS) – This analysis uses the effects incorporated in the DIS in concert with the aggregated effects of downstream passage. This is considered as an interim step between the DIS and the SAR estimates.

For the Snake River ESUs, ODS incorporates the downstream survival of transported fish. Note that when comparing the value of overall direct survival effects for in-river and transported fish, the number will be lower when the number of fish transported is decreased. This is due to the assumption of 98 percent survival of transported fish and because the relative SARs of transported vs. in-river fish or “D” has not yet been applied.

For the upper Columbia River ESUs, the estimates provided in this table incorporate the effects of passage improvements at the Grant, Douglas, and Chelan County PUD projects. The improvement estimates for those projects come from the NMFS Qualitative Analysis Report as developed under the HCP process and the NMFS Hydro Module for recovery planning. The final estimate incorporates the changes at the lower river FCRPS projects as estimated by the COMPASS model.

With the proposed actions, ODS effects ranged from absolute decreases of -5.5 to -7.7 percent for the Upper Snake River ESUs with a relative difference ranging from decrements of -6.2 to -8.4 percent. For the upper Columbia populations, the relative change in ODS ranged from improvements of 5.0 to 11.0 percent with a relative difference ranging from 9.5 to 25.9 percent improvement (Table B-31).

Table B-31. Overall Direct Survival Changes for Upper River Chinook Salmon and Steelhead ESUs and Populations

Overall Direct Survival Changes	TRT Base Case	COMPASS for FCRPS and Reclamations Upper Snake River Projects and QAR for Upper Columbia River			
ESU/Population		**2004/2006 Current**	**2007 BiOp Prospective**	**Absolute Difference**	**Relative Difference Prospective/Current**
Snake River Spring/Summer Chinook Salmon	72.2%	88.2%	82.7%	-5.5%	-6.2%
Snake River Steelhead	89.9%	92.3%	84.6%	-7.7%	-8.4%
Upper Columbia River Spring Chinook Salmon (Wenatchee)	44.1%	53.1%	58.2%	5.1%	9.5%
Upper Columbia River Spring Chinook Salmon (Entiat)	38.2%	48.9%	54.1%	5.2%	10.7%
Upper Columbia River Spring Chinook Salmon (Methow)	34.0%	47.0%	52.0%	5.0%	10.7%
Upper Columbia River Steelhead (Wenatchee)	35.5%	42.8%	53.8%	11.0%	25.7%
Upper Columbia River Steelhead (Entiat)	32.6%	40.9%	51.5%	10.6%	25.9%
Upper Columbia River Steelhead (Methow)	28.3%	39.4%	49.5%	10.1%	25.7%

For mid-Columbia steelhead, the ODS is expected to be the same as the DIS. No additional analysis was performed for this ESU for transport scenarios, because only in the very lowest of low flow years in the lower Columbia River would transport occur from McNary Dam.

Estimated Smolt-to-Adult Returns (SARs) – Estimates of SARs incorporates ODS results as well as the Scheuerell and Zabel hypothesis on delayed timing to the estuary for both upper Snake River and upper Columbia River ESUs. For modeling purposes, estimates of "D" were based on the Scheuerell and Zabel hypothesis being applied to both in-river and transported fish. For the Snake River ESUs, these numbers were very sensitive to the "D" component in that Chinook had a lower "D" and steelhead had a higher "D". Therefore, the more steelhead that are left in river, the lower the estimated adult returns (Table B-32).

Table B-32. Lifecycle Effects for Upper River Chinook Salmon and Steelhead ESUs and Populations

SAR Effects	Relative Change with only FCRPS and Upper Snake River Projects	Relative Change Including PUD Improvements
ESU/Population	**Prospective**	**Prospective**
Snake River Spring/Summer Chinook Salmon	8.2%	NA
Snake River Steelhead	-11.9%	NA
Upper Columbia River Spring Chinook Salmon(Wenatchee)	9.4%	9.4%
Upper Columbia River Spring Chinook Salmon (Entiat)	9.4%	10.6%
Upper Columbia River Spring Chinook Salmon (Methow)	9.4%	10.6%
Upper Columbia River Steelhead (Wenatchee)	12.5%	25.6%
Upper Columbia River Steelhead (Entiat)	12.5%	25.7%
Upper Columbia River Steelhead (Methow)	12.5%	25.6%

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Appendix C
Analysis of the Effects of Tributary Habitat Actions

TABLE OF CONTENTS

LIST OF ATTACHMENTS

C.1. INTRODUCTION

This appendix addresses the effects of the tributary habitat actions that are included as part of the Federal Columbia River Power System (FCRPS) Proposed Reasonable and Prudent Alternative (RPA). The appendix consists of the following attachments:

Attachment C-1 - Tributary Habitat Benefits

This attachment is briefly described below.

Attachment C-1 describes the specific approach used to determine the potential benefits for each Evolutionarily Significant Unit (ESU). The analysis is based on two time periods: a base-to-current period and a current-to-prospective period. Attachment C-1 includes three annexes that provide additional details about the specific approach. These annexes are:

Annex 1 - Tributary Habitat Benefits and Methods
Annex 2 - Approach to Estimating Survival Benefits of Habitat Actions
Annex 3 - Understanding the Habitat Workgroup Approach to Estimating Habitat Quality and Freshwater Survival Benefits

Appendix C—Analysis of the Effects of Tributary Habitat Actions

Attachment C-1
Tributary Habitat Benefits

TABLE OF CONTENTS

LIST OF TABLES

ANNEXES

ACRONYMS AND ABBREVIATIONS

BiOp	biological opinion
BPA	Bonneville Power Administration
CHW	Collaboration Habitat Workgroup
CRITFC	Columbia River Inter-Tribal Fish Commission
DPS	Distinct Population Segment
EDT	Ecosystem Diagnosis and Treatment
ESU	Evolutionarily Significant Unit
FCRPS	Federal Columbia River Power System
HEP	Habitat Evaluation Procedure
HQI	Habitat Quality Index
ISAB	Independent Scientific Advisory Board
MPG	Major Population Group
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
PHABSIM	Physical Habitat Simulation Model
PFC	properly functioning condition
PWG	Policy Work Group
RHW	Remand Habitat Workgroup
RPA	Reasonable and Prudent Alternative
TRT	Technical Recovery Team
WDFW	Washington Department of Fish and Wild

1. ESTIMATING POPULATION SURVIVAL ASSOCIATED WITH COMPLETED AND PLANNED TRIBUTARY HABITAT ACTIONS

1.1 SUMMARY

This paper describes the specific approach used and results for estimating tributary habitat survival improvement benefits for each Evolutionarily Significant Unit (ESU)/Distinct Population Segment (DPS). These tributary action benefits fall into the two time periods that were used for the base-to-current and current-to-prospective biological analysis (Chapters 5 and 7 through 10 of this Comprehensive Analysis document):

1. **2000 to 2006**: survival estimates for completed actions adjusted for accrued future benefits through 2017
2. **2007 to 2017**: survival estimates attributable to the specific Tributary Habitat Actions for 2007 to 2009 (an expanded level of effort compared to 2000 to 2006) plus additional 2008 and 2009 actions described in the Tributary Habitat Action.

1.2 SUMMARY OF METHODOLOGY

The Action Agencies estimated survival benefits attributable to tributary habitat actions that are implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies. These actions were described in the draft Tributary Habitat Action. Survival improvement estimates were made for actions completed from 2000 to 2006 and planned for 2007 to 2009. Survival improvement estimates described in this report correspond with values for the base-to-current (2000 to 2006) and the current- to- prospective periods represented in the biological analysis.

To compile these estimates, the Action Agencies used information and methods produced in conjunction with the tributary Remand Collaboration Habitat Workgroup process. The Remand Collaboration Habitat Workgroup was charged by the Policy Work Group to evaluate the method used in Appendix E of the 2004 Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp) (NMFS 2004) and decided to update the method used in Appendix E of the 2004 FCRPS BiOp (see Annex 1 to this attachment). The Action Agencies applied two main approaches to use data and information from the Remand Collaboration Habitat Workgroup to produce survival estimates for salmon and steelhead populations. Further detail on the procedures and components utilized are available in Annex 2 to this attachment.

In the first approach, called the Hybrid Method, Remand Collaboration Habitat Workgroup products were supplemented with information obtained in meetings with local biologists (Federal, State, and Tribal) and tributary habitat project sponsors. Local biologists have the most knowledge about local watershed processes, habitat conditions, and fish populations in their respective areas. For a number of populations, local biologists helped define:

1. reference habitat functions:
   (a) current, existing habitat function and
   (b) habitat functions associated with implementing all planned tributary habitat actions by 2017;
2. habitat functions associated with tributary habitat actions implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies.

Habitat functions were expressed with numerical values. The Action Agencies used this information and calculated survival estimates from them using the method developed in conjunction with the Remand Collaboration Habitat Workgroup.

In the second approach, referred to as the Appendix E method, the Action Agencies used base information from Appendix E of the 2004 FCRPS BiOp, the tables of limiting factor information provided to the Remand Collaboration Habitat Workgroup, and best professional judgment to estimate survival estimates for another set of salmon and steelhead populations. The second approach is likely to be conservative (low) in estimating habitat benefits compared to the first method.

Both of these approaches are based on the linkages between improvements to limiting factors, improvements to habitat quality and survival improvements. The logic path that demonstrates this determination of biological effectiveness is shown below:

$$$ → **Specific Projects** → **Address Limiting Factors at Programmatic Scale** → **Improvement in Habitat Function** → **ΔS Change in Survival**

This methodology utilizes the best available information regarding key limiting factors, habitat improvement potential, habitat action effectiveness, and the expert views of local biologists. The particular component of this method used by the Action Agencies to quantify habitat changes and to calculate survival estimates was not formally endorsed by the Remand Collaboration Habitat Workgroup. Some critics did not endorse a numerical approach to expressing habitat functionality and potential improvements.

1.3 SUMMARY OF RESULTS

The following tables (Tables 1 through 5) display estimated survival improvement percentages by population for each ESU that are used in the biological analysis. The percentages indicate the incremental survival improvement estimated to accrue by 2017 for actions implemented for each time period shown. These time periods correspond to the base-to current (2000 to 2006) and current- to-prospective (2007 to 2017) periods represented in the biological analysis. The actions identified represent an increase in Action Agency tributary habitat effort compared to efforts for the 2000 and 2004 FCRPS BiOps. Shaded populations were estimated using the Hybrid method; unshaded populations were estimated using the Appendix E method.

Table 1. Upper Columbia River Spring Chinook Salmon Estimated Survival Improvement Percentages for Action Agencies Actions

		Estimated Percentage Survival Improvement		
MPG[1/]	**Population**[2/]	**By 2017 for Actions Completed from 2000 to 2006 (Base-to-current)**	**By 2017 for Actions Completed from 2007-2017 (Prospective)**	**After 2017 for Actions Completed from 2007-2009 (within 25 years)**
Upper Columbia - Below Chief Joseph	Entiat River	2	22	2
	Methow River	2	6	1
	Wenatchee River	2	3	

Notes:
1/ MPG—Major Population Group
2/ All populations were estimated using the Hybrid method.

Table 2. Upper Columbia River Steelhead Estimated Survival Improvement Percentages for Action Agencies Actions

		Estimated Percentage Survival Improvement		
MPG[1/]	**Population**[2/]	**By 2017 for Actions Completed from 2000 to 2006 (Base-to-current)**	**By 2017 for Actions Completed from 2007-2017 (Prospective)**	**After 2017 for Actions Completed from 2007-2009 (within 25 years)**
Upper Columbia River - Below Chief Joseph	Entiat River	2	8	3
	Methow River	2	4	1
	Okanogan River	6	14	3
	Wenatchee River	2	4	1

Notes:
1/ MPG—Major Population Group
2/All populations were estimated using the Hybrid method.

Table 3. Mid-Columbia River Steelhead Estimated Survival Improvement Percentages for Action Agencies Actions

MPG[1/]	Population[2/]	Estimated Percentage Survival Improvement: By 2017 for Actions Completed from 2000 to 2006 (Base-to-current)	By 2017 for Actions Completed from 2007-2017 (Prospective)	After 2017 for Actions Completed from 2007-2009 (within 25 years)
Cascades Eastern Slope Tributaries	Deschutes River - eastside	**1**	**1**	
	Deschutes River - westside	**0.2**	**<1**	
	Fifteenmile Creek (winter run)	**0.1**	**<1**	
	Klickitat River	**4**	**4**	
	Rock Creek			
John Day River	John Day River lower mainstem tributaries	**0.2**	**<1**	
	John Day River upper mainstem	**0.2**	**<1**	
	Middle Fork John Day River	**0.2**	**<1**	
	North Fork John Day River	**0.3**	**<1**	
	South Fork John Day River	**0.7**	**1**	
Umatilla and Walla Walla River	Touchet River	**4**	**4**	
	Umatilla River	**4**	**4**	
	Walla Walla River	**4**	**4**	
Yakima River Group	Naches River	**4**	**4**	
	Satus Creek	**4**	**4**	
	Toppenish	**4**	**4**	
	Yakima River upper mainstem	**4**	**4**	

Notes:
[1/] MPG—Major Population Group
[2/] All populations were estimated using the Appendix E method.

Table 4. Snake River Spring/Summer Chinook Salmon Action Agencies Actions

MPG[1/]	Population[2/]	Estimated Percentage Survival Improvement: By 2017 for Actions Completed from 2000 to 2006 (Base-to-current)	By 2017 for Actions Completed from 2007-2017 (Prospective)	After 2017for Actions Completed from 2007-2009 (within 25 years)
Grande Ronde / Imnaha	Catherine Creek	4	23	10
	Lostine/Wallowa River	1	2	1
	Minam River			
	Grande Ronde River upper mainstem	4	23	2
	Wenaha River			
	Big Sheep Creek			
	Imnaha River mainstem	1	1	2
Middle Fork Salmon River	Bear Valley Creek			
	Big Creek		1	1
	Camas Creek			
	Loon Creek			
	Marsh Creek			
	Sulphur Creek			
	Middle Fork Salmon River above Indian Creek			
	Chamberlain Creek			
	Middle Fork Salmon River below Indian Creek			
South Fork Salmon River	East Fork South Fork Salmon River			
	Little Salmon River			
	Secesh River		1	1
	South Fork Salmon River mainstem		<1	<1
Lower Snake	Tucannon River	3.5	17	13
Upper Salmon River	East Fork Salmon River	0.5	1	
	Lemhi River	0.5	7	
	North Fork Salmon River			
	Pahsimeroi River	0.5	41	

Table 4. Snake River Spring/Summer Chinook Salmon Action Agencies Actions

MPG[1/]	Population[2/]	Estimated Percentage Survival Improvement: By 2017 for Actions Completed from 2000 to 2006 (Base-to-current)	By 2017 for Actions Completed from 2007-2017 (Prospective)	After 2017for Actions Completed from 2007-2009 (within 25 years)
	Salmon River lower mainstem below Redfish Lake	0.5	1	
	Salmon River upper mainstem above Redfish Lake	0.5	14	
	Valley Creek	0.5	1	
	Yankee Fork	0	30	32

Notes:
1/ MPG—Major Population Group
2/ Shaded populations were estimated using the Hybrid method; unshaded populations were estimated using the Appendix E method.

Table 5. Snake River Steelhead Estimated Survival Improvement Percentages for Action Agencies Actions

MPG[1/]	Population[2/]	Estimated Percentage Survival Improvement: By 2017 for Actions Completed from 2000 to 2006 (Base-to-current)	By 2017 for Actions Completed from 2007-2017 (Prospective)	After 2017 for Actions Completed from 2007-2009 (within 25 years)
Clearwater River	Clearwater River lower mainstem			
	Lochsa River	0.5	17	5
	Lolo Creek	0.5	8	2
	Selway River	0.7	<1	<1
	South Fork Clearwater River	1.5	14	3
Grande Ronde River	Grande Ronde River lower mainstem tributaries	0.1	<1	
	Grande Ronde River upper mainstem	2	4	5
	Joseph Creek (Oregon)	0.1	<1	
	Joseph Creek (Washington)	4	4	
	Wallowa River	2	<1	<1

Table 5. Snake River Steelhead Estimated Survival Improvement Percentages for Action Agencies Actions

MPG[1/]	Population[2/]	Estimated Percentage Survival Improvement: By 2017 for Actions Completed from 2000 to 2006 (Base-to-current)	By 2017 for Actions Completed from 2007-2017 (Prospective)	After 2017 for Actions Completed from 2007-2009 (within 25 years)
Hells Canyon	Hells Canyon	0		
Imnaha River	Imnaha River	0.1	1	1
Lower Snake	Asotin Creek	8.5	4	8
	Tucannon River	6.5	5	8
Salmon River	Lower Middle Fork mainstem and tribs (Big, Camas, and Loon Creeks)		1	1
	Chamberlain Creek			
	East Fork Salmon River	0.5	2	1
	Lemhi River	0.5	3	
	Little Salmon and Rapid River			
	Upper Middle Fork mainstem and tribs			
	North Fork Salmon River			
	Pahsimeroi River	6.5	9	
	Panther Creek			
	Salmon River upper mainstem	0.5	6	15
	Secesh River		1	1
	South Fork Salmon River		<1	<1

Notes:
[1/] MPG—Major Population Group
[2/] Shaded populations were estimated using the Hybrid method; unshaded populations were estimated using the Appendix E method.

ANNEX 1: TRIBUTARY HABITAT BENEFITS AND METHODS

1. INTRODUCTION

This report describes the methods used to calculated benefits associated with implementing habitat projects as proposed by the Action Agencies. The report describes the nature of the collaboration on habitat benefits, the two separate methods used (hybrid and Appendix E), and the actual application of these methods. The actual application of the methods is detailed, but is presented here for transparency.

The National Marine Fisheries Service (NMFS, also known as the National Oceanic and Atmospheric Administration [NOAA] Fisheries) described a method to identify the status and potential to improve survival and recovery of listed salmon and steelhead through improvement of tributary habitat conditions (Appendix E of the 2004 FCRPS BiOp [NMFS 2004]). This method identified qualitative very high (VH), high (H), medium (M), low (L), and very low (VL) estimates for status and potential for improvement. This method is hereafter referred to as the "Appendix E method." The Action Agencies utilized the Appendix E framework to implement their tributary habitat proposed action in 2004 (Updated Proposed Action 2004) and continue to rely heavily on the biological rationale articulated in Appendix E.

The Appendix E method employed by NMFS in 2004 used the best available information at the time to estimate effects of the tributary habitat proposed action for the 2004 FCRPS BiOp. However, additional information has become available from recovery planning and other efforts that have occurred since the 2004 FCRPS BiOp was issued.

The Remand Collaboration Habitat Workgroup (CHW) convened at the request of the Policy Work Group (PWG). The PWG tasked the CHW to review the Appendix E method and (1) decide whether the method needed to be updated, and (2) if that were the case, describe an approach to update Appendix E. The CHW met regularly during the spring and summer of 2006. CHW members included representatives from the sovereign States and Tribes and Federal Agencies involved in the Collaboration process. Meeting schedules, agendas, notes, and products are available at the "step 5 habitat" webpage on the secure Collaboration website maintained by BPA. The CHW determined that Appendix E needed to be updated. Furthermore, the group developed a process and provided information that could be used to update the Appendix E method.

The CHW explored possible approaches to update the qualitative estimates in Appendix E such as using the best available data since 2004 to update Appendix E, conduct Ecosystem Diagnosis and Treatment (EDT) or other modeling, or seek more recent estimates from field biologists. The CHW determined that the Appendix E method could be updated by taking a series of steps:

1. Identify the primary factors limiting the recovery of salmon and steelhead populations,
2. Identify the tributary habitat actions (or types of actions) that could be implemented to address those limiting factors,
3. Estimate the current habitat function,
4. Estimate the habitat function that could be obtained by 2017 (within 10 years) by implementing all tributary habitat restoration actions that were identified as planned by 2017,
5. Estimate the habitat function that could be obtained after 2017 (within 25 years) by implementing all tributary habitat restoration actions that were identified as planned by 2017, and
6. Convert estimated overall habitat functions to survival estimates.

CHW sought assistance from local biologists on steps 1-5, and reviewed methods, which the Action Agencies used to complete step 6.

The CHW determined it would be beneficial to create a logical path to obtain estimates of the habitat condition and survival improvement potential from habitat actions. After several meetings and revisions, the CHW settled on developing tables that included columns to consider the population, assessment unit, limiting factors, potential actions that could be implemented to address primary limiting factors, and the current and potential future habitat function.

The CHW developed a template and instructions to obtain the data and information that were provided by each State from field biologists. This table template provided the basis for estimating changes in habitat function for salmon and steelhead populations, which Remand Collaboration Habitat Workgroup members solicited from local field biologists and recovery planners.

Although data and information obtained by CHW participants varied by location, they represented the following general conditions. Local biologists[2] and recovery planning processes were enlisted by CHW members to identify primary limiting factors, tributary habitat actions needed to address those limiting factors, and to estimate habitat functions. Local biologists identified limiting factors and actions needed to reach recovery.

Information used to determine habitat functions varied by location. Local biologists determined habitat function utilizing their professional judgment and any other data and information at their disposal, including EDT or any other data- analysis tools. Most CHW participants recognized that empirical data and information provides the best insight for determining habitat function. However, most CHW participants acknowledged that the extent of readily- available empirical data and information was not adequate at the time to make a precise determination of habitat function uniformly throughout the Columbia River Basin. Most CHW participants acknowledged that regardless of the amount of empirical data and information available, professional judgment by expert scientists provided a large part of the determination of habitat function in all locations simply because of the limited extent of readily-available empirical data and information.

The States of Washington, Idaho, and Oregon each provided tables of information in slightly different formats from the original template. Tables received from Washington were reformatted by the Action Agencies to conform to the original template.

The Action Agencies used base information from Appendix E, limiting factors, actions, and habitat functions provided by the CHW in the tables described above, and professional judgment to develop survival estimates attributable to tributary habitat actions to be implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies. Specific tributary habitat actions are described in the Tributary Habitat Action. The following sections describe the methods the Action Agencies used to convert this information to survival improvement estimates.

2. METHODS

Two methods were used to estimate survival improvements— the Appendix E method and the Hybrid method. These methods were used to estimate survival improvements for actions completed from 2000 to

[2] Local biologists enlisted in these efforts were employed by sovereign tribes and State and Federal agencies and were intimately familiar with the biological and physical status and needs of anadromous fish as well as the salient details entailed in subbasin and recovery planning and project funding processes for the salmon and steelhead populations they addressed. In Washington, these specialists were sponsored by experts and persons responsible for developing regional recovery plans

2006, and actions to be implemented from 2007-2017. The following sections generally describe these methods.

2.1 Appendix E Method

To estimate survival estimates based on Appendix E, the following steps were involved:

1a) Assembling lists of completed projects with habitat work element actions for the 2000 to 2006 timeframe for the respective ESU populations.

1b) Assembling lists of proposed projects that will be funded for 2007 to 2009 with habitat work element actions for the respective ESU populations.

2) Linking the projects to the populations to the extent enabled by database information.

3) Considering the project work elements linkage to beneficial on-the-ground habitat work to address important limiting factors for a population.

4) If habitat work element actions that help address limiting factors to benefit the population occur in the population area, then Appendix E estimate is possible. If no habitat work element actions that benefit the population occur in the population area, then no estimate of benefit is made.

5) Appendix E used a qualitative system of benefits associated with a quantitative range to estimate "adjusted improvement potential based on practical constraints" (Very Low: 0; Low: > 0 > 2; Medium: 2-24; High: 25 < 100; Very High: 100). This estimate that considers practical constraints is a conservative Appendix E estimate (Very low=0; Low=1; Medium=4; High=25; Very High=100).

Using Low-end Appendix E Ranges in each timeframe, and develop rationale for supporting higher estimates for populations with gaps: This approach uses the low end of Appendix E ranges as the total survival estimate possible from implementing tributary habitat actions in each of the three timeframes (2000 to 2006; 2007 to 2009; 2010 to 2017), with the total capped by the maximum potential from recovery actions calculated by states for the Remand Workgroup Process.

6) In using Appendix E for estimating population survival, a low end (conservative estimate) was initially used as follows: Very low=0; Low=1; Medium=4; High=25; Very High=100. Thus, if a population area had beneficial habitat work elements from projects in 2000 to 2006 or 2007 to 2009 and the Appendix E improvement potential was Medium, then a survival estimate of 4 percent was used in the tables. This survival estimate was expressed as a 1.04 survival multiplier in each of the first two timeframes of 2000 to 2006 and 2007 to 2009 if there were beneficial work element habitat actions for the respective time period. The total from multiplying the values from each of the timeframes should not exceed the "survival improvement (juvenile) potential from current condition (recovery plan actions estimated by remand habitat workgroup (25 yrs)" (see numbers in Draft NMFS staff product: Possible recovery scenarios based on Interior Columbia Basin Technical Recovery Team [TRT] criteria).

7) Use only if maximum potential is exceeded: If the Appendix E estimate results from combining the low end estimates in each timeframe results in a value that exceeds the maximum potential, then the Appendix E estimate was adjusted downward to not exceed the maximum survival improvement potential from the remand habitat workgroup process. A number of maximum potential values were provided by the CHW and were used in the following order: 10-

year maximum potential, 25-year maximum potential, and "survival improvement (juvenile) potential from current condition (recovery plan actions estimated by remand habitat workgroup (25 years)" (see numbers in Draft NMFS staff product: Possible recovery scenarios based on Interior Columbia Basin TRT criteria).

8) Potential to increase estimates may exist based on any additional actions and input from local biologists, project sponsors, and recovery planners: The estimates using the Appendix E based approach could potentially be increased after additional input from local biologists and project sponsors. If more information about the limiting factors and the actions to be implemented for specific populations is added and the Habitat Workgroup estimate is used with a potential to recalculate the maximum potential for a population, many estimates would be expected to increase.

2.2 Hybrid Method

A number of methods to convert habitat function to survival estimates were discussed by the CHW. These methods included habitat models and a simplified general approach. The habitat models included EDT (Independent Scientific Advisory Board [ISAB] 2001), Shiraz (Scheuerell and others 2006), McHugh (McHugh and others 2004), and an approach presented by one of the members of the HWC. Although each of these models have strong and weak points, most, but not all, HWC participants concluded that each model required a significant amount of empirical data and information that was not consistently and readily available for all salmon and steelhead populations throughout the Columbia River Basin.

A simplified general approach (Remand Collaboration Habitat Workgroup 2006) was developed by the HWC (Attachment 1).[3] This method uses the habitat functions provided in the CHW tables and averages available, generalized, empirically-derived egg-smolt survival relations to produce linear relations between overall habitat function and egg-smolt survival for salmon and steelhead. This method is certainly not precise; however, it provides a method that:

1. uses habitat function information provided in the CHW tables,
2. is derived from the egg-smolt survival literature and
3. can be applied for all salmon and steelhead populations in the Columbia River Basin. This method is referred to as the Hybrid Method in the remainder of this report.

Survival estimates by 2017 and 25 years after 2017 calculated using the Hybrid Method for all planned tributary habitat restoration actions that could be implemented by 2017 were provided to the HWC for salmon and steelhead populations in Washington**.** Survival estimates 25 years after 2017 calculated using this approach for all planned tributary habitat restoration actions that could be implemented by 2017 were provided to the HWC for salmon and steelhead populations in Idaho.

The Action Agencies used the Hybrid Method to calculate survival estimates by 2017 and 25 years after 2017 for tributary habitat actions implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies from 2000 to 2006 and tributary habitat actions expected to be implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies from 2007 to 2009 with information provided by local biologists and project sponsors described below.

[3] Note that not all participants in the CHW fully agreed to the methods develop by the Workgroup.

Action Agency representatives met with local biologists, project sponsors, and other CHW members in October and November, 2006, and in May, 2007, to obtain input about the effects on habitat function by 2017 and continuing effects after 2017 resulting from tributary habitat actions implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies from 2000 to 2006 and habitat actions expected to be implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies from 2007 to 2009.

In some cases the effects of tributary habitat actions completed from 2000 to 2006 were already included in the estimate of current habitat function. However, in some cases (most notably riparian protection and enhancement actions) habitat function could continue to improve for decades as a consequence of actions already completed. The objective of identifying habitat function associated with actions completed from 2000 to 2006 was to capture the continuing effects associated with those completed actions that continue to improve habitat function after completion. For example, riparian planting actions that occurred in 2002 may have small survival improvement benefits the first few years after planting, but shading, cooling, and habitat benefits accrue as the vegetation grows and matures in later years, sometimes continuing to accumulate additional survival improvement benefits for several decades.

Actions expected to be implemented from 2007 to 2009 are those that 1) have been identified for funding by BPA based on biological priorities and recommendations from the Northwest Power and Conservation Council, and 2) are already “in the pipeline” for implementation in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies by the Action Agencies. Specific actions are described in the Tributary Habitat Action.

Identifying effects by 2017 of both actions completed from 2000 to 2006 and actions expected to be implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies from 2007 to 2009 quantifies those effects within the 10 year time frame of a Biological Opinion. Identifying effects after 2017 of both actions completed from 2000 to 2006 and expected to be implemented from 2007 to 2009 quantifies the continuing effects that some actions (most notably riparian protection and enhancement actions) could continue to provide after the initial 10-year time frame.

2.2.1 Meetings

2.2.1.1 Walla Walla Meeting

Tributary habitat actions for Tucannon and Asotin spring Chinook salmon and steelhead were discussed at a meeting held in Walla Walla, Washington on October 18, 2006. Meeting participants provided habitat function estimates and comments associated with tributary habitat actions implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies. Estimates were reviewed and updated by biologists at the Lower Snake River Salmon Recovery Technical Team meeting on October 24.

2.2.1.2 Wenatchee Meetings

Actions for Methow, Wenatchee, and Entiat spring Chinook salmon and steelhead and Okanogan steelhead were discussed at an initial meeting in Wenatchee, Washington on October 19, 2006. Follow-up meetings for Upper Columbia populations of spring Chinook salmon and steelhead populations were held in Wenatchee for Entiat populations on November 7, 2006, Methow populations on November 13, 2006, and Wenatchee populations on November 14, 2006. Participants at the initial October 19 meeting had questions about derivation of the original current and resulting 10- and 25-year habitat functions. Working tables produced at this meeting included comments and indicated relative changes in habitat function that fell between the original references of current and resulting 10- and 25-year habitat functions. Some of the original reference current and resulting 10- and 25-year habitat functions were revised and absolute habitat functions were provided at follow-up meetings.

2.2.1.3 Boise Meetings

Actions for Snake River steelhead in the Clearwater and Little Salmon subbasins were discussed at a meeting held in Boise, Idaho on November 16, 2006. Actions for Snake River spring Chinook salmon and steelhead in the Salmon River Basin were discussed at a meeting held in Boise, Idaho on November 17, 2006. Meeting participants provided habitat function estimates and comments associated with tributary habitat actions implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies in the Clearwater subbasin and the Salmon basin.

2.2.1.4 La Grande Meeting

Actions for Upper Grande Ronde and Catherine Creek Chinook salmon and Upper Grande Ronde steelhead were discussed at a meeting in La Grande, Oregon, on May 2 and 3, 2007. Meeting participants provided habitat function estimates for 2007 to 2009 tributary habitat actions funded through the Northwest Power and Conservation Council (Council) 2007 to 2009 solicitation, which were implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies in the Grande Ronde subbasin.

2.2.1.5 Spokane Meeting

Additional actions for Okanogan steelhead were discussed at a meeting in Spokane, Washington, on May 4, 2007. Participants identified additional 2007 to 2017 actions and associated changes in habitat function for Okanogan steelhead for Action Agency consideration.

2.2.2 Survival Improvement Estimates for Actions Completed from 2000 to 2006 and Actions to be Implemented from 2007 to 2009

Survival improvement estimates were calculated with the Hybrid Method in a series of steps by applying information obtained from the original habitat tables and from information obtained at field verification meetings held with local biologists and project sponsors in October and November, 2006, and May, 2007. Information used from the original habitat tables included population name, assessment unit weight, assessment unit area, limiting factor, and reference habitat functions (current habitat function and the resulting habitat functions that could be obtained by 2017 and after 2031 by implementing all planned actions identified to address limiting factors by 2017). Information used from the field verification meetings included any revised reference habitat functions and estimated habitat function by 2017 and after 2017 associated with tributary habitat actions implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies from 2000 to 2006 and actions expected to be implemented from 2007 to 2009.

Numerical survival estimates were calculated using the method described by the Remand Collaboration Habitat Workgroup (2006) as follows:

1) For each assessment unit in a population:

   a) The average habitat function was calculated as the sum of the habitat functions for each limiting factor in the assessment unit and dividing by the number of limiting factors

   b) Survival within an assessment unit was calculated by multiplying the average habitat function determined in step 1a by the assessment unit weight and by the slope of the egg-smolt survival function (0.0018 for Chinook salmon; 0.0004 for steelhead, Remand Collaboration Habitat Workgroup [2006]).

2) For each population:

The resulting assessment unit survival estimates calculated in step 1b were summed to obtain the population survival estimate.

The calculation of habitat function described in step 1a is the same approach used by state and tribal participants in the CHW who provided the original tables that included limiting factors, actions to address those limiting factors, and calculation of current and resulting habitat functions from implementing all planned actions by 2017.

Numerical survival estimates were calculated in this fashion for six different representations of habitat function:

1. current habitat function;
2. habitat function by 2017 resulting from implementing all tributary habitat restoration actions that were identified as planned by 2017;
3. resulting habitat function by 2017 associated with tributary habitat actions implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies from 2000 to 2006;
4. resulting habitat function by 2017 associated with tributary habitat actions expected to be implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies from 2007 to 2009;
5. resulting habitat function after 2017 (within 25 years) associated with tributary habitat actions implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies from 2000 to 2006 and actions expected to be implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies from 2007 to 2009; and
6. habitat function after 2017 (within 25 years) resulting from implementing all tributary habitat restoration actions that were identified as planned by 2017.

Numerical changes in estimated survival were calculated for each of the six different representations of habitat function described above by dividing the resulting population survival estimate by the numerical survival estimate for current habitat function.

3. APPLICATION OF METHODS AND RESULTS

The methods described above were applied to obtain survival improvement estimates for three sets of actions completed or to be implemented from: 2000 to 2006, 2007 to 2009, and 2010 to 2017. Furthermore, survival improvement estimates were obtained for these three sets of actions by 2017 (the term of the BiOp) and after 2017 (to account for survival improvement benefits that accrue in the long term, such as riparian actions).

During development of these documents, the Action Agencies decided to report 2007 to 2017 tributary habitat results simply as the combination of the 2007 to 2009 and 2010 to 2017 results to be consistent with reporting for the other components described in the Action and biological analysis. Follow-up meetings identified additional 2008 and 2009 actions for some populations. Survival improvement by 2017 (within 10 years) and after 2017 (within 25 years) estimated for these populations using the Hybrid Method were combined with survival estimates obtained for the other 2007 to 2017 actions described above. In some cases a combination of both methods was used to estimate survival improvements as described below. Survival improvement estimates described in this annex are presented in Attachment 2.2-1, Table 1 of the Biological Assessment and were used in the biological analysis described in separate reports.

3.1 Survival Improvement Estimates Through 2017 for Actions Completed from 2000 to 2006

The Appendix E method described in an earlier section of this annex was used to estimate survival improvement associated with actions completed from 2000 to 2006 for the unshaded salmon and steelhead populations in Attachment 2.2-1, Table 1 of the Biological Assessment and for upper Grande Ronde and Catherine Creek Chinook salmon and upper Grande Ronde steelhead populations.

The following method was used to estimate survival improvement associated with actions completed from 2000 to 2006 for salmon and steelhead populations which are shaded in Attachment 2.2-1, Table 1 of the Biological Assessment except for upper Grande Ronde and Catherine Creek Chinook salmon and upper Grande Ronde steelhead populations for which the Appendix E method was used. A combination of the Appendix E and Hybrid method was used to calculate these estimates as follows.

1. Referred to qualitative biological benefits identified in the 2004 Updated Proposed Action (UPA) for "Tributary Habitat Actions Implemented under the 2000 RPA." This indicated the survival improvement benefits expected by the Action Agencies for <u>2000-2003</u> actions.
2. Referred to qualitative biological benefits identified in the 2004 UPA for "Tributary Habitat Actions" associated with the UPA. This indicated the survival improvement benefits expected by the Action Agencies for actions <u>after 2004.</u>
3. Referred to the qualitative determination of benefits associated with tributary habitat actions for each ESU contained in the "Conclusion" section of the 2004 FCRPS BiOp. This indicated the survival improvement benefits NMFS associated with tributary habitat actions to be implemented <u>after 2004.</u>
4. Referred to tables of metrics for 2000 to 2006 completed actions associated with the 2000 and 2004 BiOps compiled by BPA and Reclamation.
5. Referred to the Appendix E qualitative potential values (VL to VH) and associated numerical ranges.
6. Converted the qualitative Appendix E values to the following numeric values:

Appendix E Qualitative Value	Appendix E Numeric Range	Representative Numeric Value (RNV)
Very Low	0	0
Low	0-2	1
Low end of Medium	N/A	4
Medium	2-24	N/A
High	25-100	N/A
Very High	100	N/A

Single numeric values were assigned to represent each numeric ranges cited in Appendix E. The qualitative value "Low" was assigned a midpoint value of 1 and "Low end of Medium" was assigned a value of 4.

Information from step 4 was reviewed to validate metrics associated with completed 2000 to 2006 actions for respective ESUs. The survival estimate for 2000 to 2006 completed actions was calculated by averaging the representative numeric values associated with step 1 and for step 5 for each ESU. This approach incorporates available information about expected biological benefits before 2004 (step 1) and after 2003 (step 5). The resulting value represented survival improvement associated with the 2000 to 2006 time period and was added to the survival improvement value obtained from the Hybrid Method for 2000 to 2006 completed actions, which represented survival improvement benefits accrued from 2007 to 2017.

3.2 Survival Improvement Estimates After 2017 for Actions Completed from 2000 to 2006 Funded for 2008 and 2009

Survival improvements after 2017 (within 25 years) were not estimated for populations for which the Appendix E method was used. The Hybrid method described in an earlier section of this annex was used to estimate survival improvement after 2017 associated with actions completed from 2000 to 2006, actions to be implemented from 2007 to 2009, and additional actions funded for 2008 and 2009 (for populations for which follow-up meetings were held) for the shaded salmon and steelhead populations in Tables 1 through 5 of Attachment C-1.

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ANNEX 2
APPROACH TO ESTIMATING SURVIVAL BENEFITS OF HABITAT ACTIONS

1. INTRODUCTION

Over the decade, many books on salmon conservation have emerged (e.g., National Research Council (NRC) 1996; Stouder et al. 1997; Lichatowich 1999; Knudsen et al. 2000; Lynch et al. 2002; Montgomery et al. 2003; Wissmar and Bisson 2003), and all agree that habitat restoration should be a cornerstone of any recovery program. As such, it is important to identify locations where current habitat conditions would benefit from protection or restoration. In addition, it is also important to assess the potential benefits of habitat actions to target fish populations and Evolutionarily Significant Units (ESUs).

Estimating potential biological benefits (e.g., increased survival or productivity) is a difficult task because most habitat actions do not affect biological parameters directly. The usual approach is to manipulate the environment (e.g., add wood, rock, vegetation, nutrients, passage) in the hope that the change in the environment will result in a desired change in the population (biological parameters). For example, one may add woody debris to a stream to increase the abundance and survival (productivity) of juvenile Chinook salmon in a stream reach. In the chain-of-causation, the “cause” is the addition of wood (treatment), which directly “affects” the stream environment (presence of woody debris is the first link in the chain). The presence of woody debris should then “affect” the abundance and survival of juvenile Chinook salmon (biological response is the second link). Note that abundance and survival of Chinook salmon (biological response) is more than one link from the treatment (Figure 1).

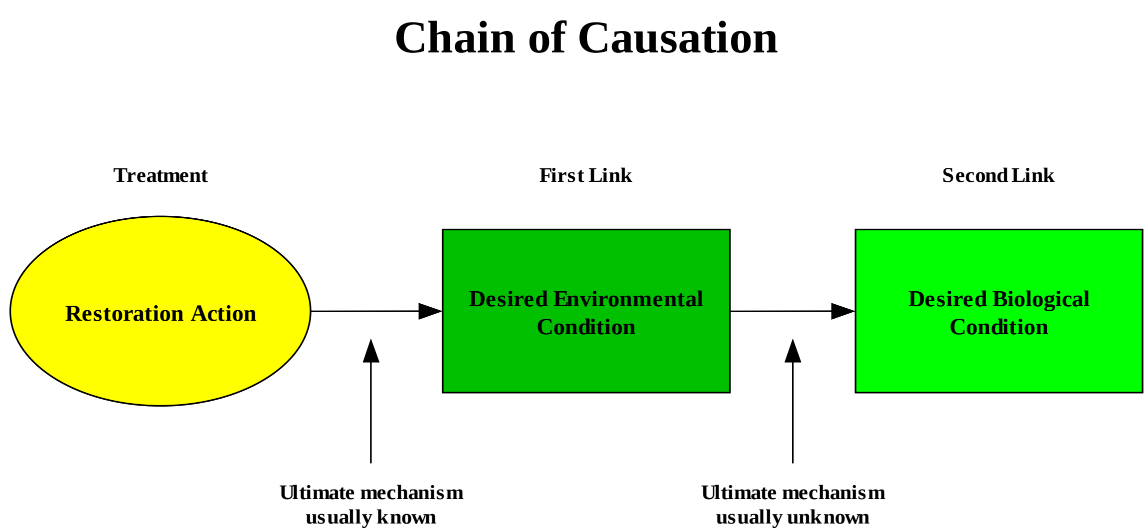

Figure 1. Conceptual Model Showing the Chain-of-Causation from the Restoration Action (treatment) to the Environmental and Biological Responses

Note: The mechanism(s) resulting in a biological change is (are) less well understood as more links are added to the chain.

As a general rule, the more links there are between the treatment and desired effect, the more difficult it will be to detect or predict a treatment effect. Stated another way, the more links between the treatment and the desired effect, the less confidence one has that the treatment will actually result in a desired effect. This is because several other factors (extraneous or nuisance factors) may have a greater effect on the desired outcome than the treatment. For example, it is unlikely that one can predict with any confidence what affect rock weirs will have on the abundance and productivity of adult Chinook salmon within a stream. Not only is adult abundance several links removed from the treatment, Chinook salmon, like other anadromous species, use multiple ecosystems (tributary, mainstem, estuary, ocean systems) that are each replete with extraneous factors acting upon the survival of the fish (Figure 2). As the number of links between the action and the desired response increase, the number of extraneous factors increases making predictions about biological responses uncertain.

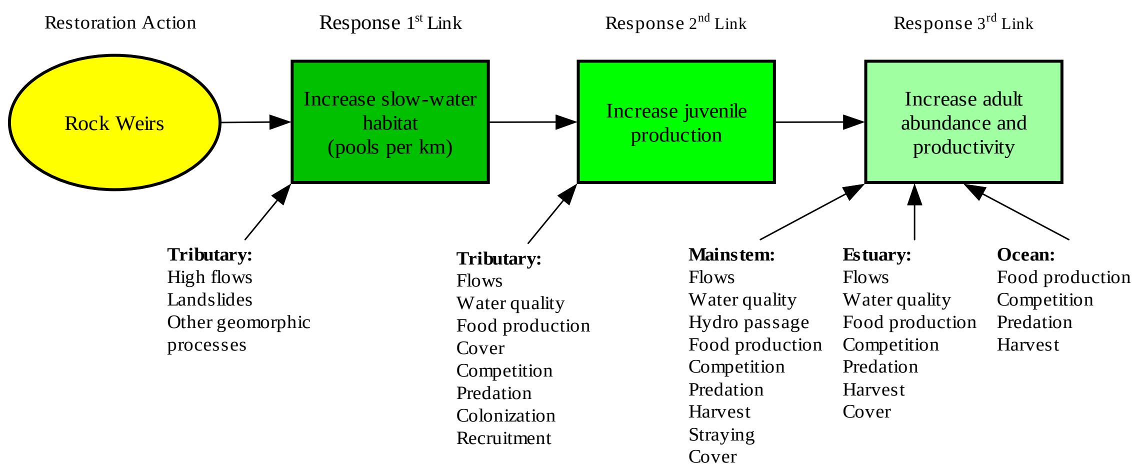

Figure 2. Relationship between a Restoration Action (rock weirs) and Physical and Biological Responses

Note: As the number of links increase, the number of extraneous factors (those listed below the causal chain) increase, making it more difficult to identify a treatment effect. The ability to predict desired outcomes decreases as more links are added to the chain (reflected in the decreasing shades of green).

For these reasons, it is very difficult to estimate with any certainty the potential benefits of habitat actions on adult abundance or productivity. Therefore, the Habitat Workgroup estimated survival benefits for only two life-stages, juvenile and pre-spawning adult.

There were two general approaches that the Habitat Workgroup explored: (1) lifecycle models and (2) professional judgment (similar to the Appendix E approach used in the 2004 BiOp [see Annex 1 to this attachment]). The workgroup considered models such as Ecosystem Diagnosis and Treatment (EDT), Habitat Quality Index (HQI), Habitat Evaluation Procedures (HEP), Physical Habitat Simulation Model (PHABSIM), Shiraz, and a simple model developed by the Columbia River Inter-Tribal Fish Commission (CRITFC). One model, EDT, has been used by some recovery planning groups to estimate survival benefits associated with recovery actions. Although the model was used to generate hypotheses in draft recovery plans, it is very complex, relies on many assumptions, and requires considerable input based on empirical data, derived data, and/or professional judgment. In addition, outputs lack confidence limits and therefore sensitivity analysis is needed to estimate certainty. Populating and running the model is time-consuming. Other models (e.g., HQI, HEP, PHABSIM, and Shiraz) can be used to generate hypotheses about potential benefits, but, like EDT, these tools require significant input and time to run. Given the lack of time and information or data, such analytical tools or models were not an option in the Remand Process. The workgroup did use results from models used in other forums (e.g., recovery plans and subbasin plans).

The second approach relied on professional judgment. This method was deemed the most reasonable approach given the lack of time and information available. This approach relied heavily upon the expertise of local biologists. Local biologists with the most knowledge about local watershed processes, habitat conditions, and fish populations in their respective areas provided the workgroup with estimates of current habitat conditions, primary limiting factors, restoration actions needed to fix limiting factors, and potential habitat conditions that would result if the primary limiting factors were addressed.

In an attempt to standardize the habitat assessment process, the Habitat Workgroup provided local biologists with a guidance document and standardized matrices to aid in estimating current conditions, limiting factors, restoration actions, and potential habitat conditions. Local biologists, with guidance from the Habitat Workgroup, populated the habitat matrices. Data within these matrices were used by the Habitat Workgroup to estimate overall habitat quality and potential survival benefits associated with implementing proposed tributary habitat actions.

2. ESTIMATING HABITAT QUALITY

Habitat quality is dependent on more than one habitat variable (e.g., stream flows, temperature, water quality, fine sediments, pools, woody debris, and off-channel habitat). Local biologists provided the Habitat Workgroup with estimates of current and potential conditions[3] for each habitat variable that was currently limiting fish productivity. The workgroup then combined the condition scores for each individual variable into a composite habitat quality score. The workgroup evaluated several different methods for combining conditions of individual habitat variables to obtain a composite score.

1. The first method was multiplication (i.e., multiply the individual habitat scores to obtain a composite score). This method assumes that fish select each particular habitat variable independently of other variables (assumes no interaction or compensation). One problem with this method is that the product equation yields zero habitat quality for any given habitat variable of unsuitable condition. For example, a stream reach with no woody debris (0 percent function) would result in a composite habitat quality score of 0 percent.
2. The second approach used the lowest condition habitat variable as the composite habitat quality score. This assumes that the most limiting factor (habitat variable with the lowest condition score) determines the upper limit of habitat quality and the fact that variables with high condition cannot compensate for low condition variables.
3. The third approach was the geometric mean of individual habitat scores. This method provides some compensation, but like the product equation, it yields zero habitat quality for any zero-valued habitat variable.
4. The final approach was the arithmetic mean of individual habitat scores. This approach assumes that good habitat conditions on one variable can compensate for poor conditions on other variables.

[3] Current and potential conditions were given as percentages of optimal conditions. NMFS definition of properly functioning condition (PFC) was used to help local biologist understand what was meant by optimal condition (see NMFS 1996).

After evaluating these methods, the Habitat Workgroup concluded that a combination of the second and fourth approaches was reasonable. The second method was used when a limiting habitat variable was considered a lethal factor. Lethal factors included variables that at certain concentrations or levels kill fish (e.g., temperature and other water quality parameters, fine sediment, and flows).[4] Thus, overall habitat quality was based only on the condition of the lethal factor if its concentration was at a level that would kill fish. The arithmetic mean (fourth approach) was used if no lethal factors were identified by the local biologists.

Following this exercise, the Habitat Workgroup then identified "functional relationships" that would aid in estimating potential survival benefits corresponding to projected changes in habitat quality. The intent was to find a simple function or functions that would allow the workgroup to estimate how much juvenile or pre-spawning adult survival would increase if habitat quality improved from, say, 35 percent to 45 percent of optimal condition. The functional relationships were only used to guide professional judgment in estimating potential survival increases. They were not developed to estimate "absolute" survival rates.

3. IDENTIFICATION OF FUNCTIONAL RELATIONSHIPS

Not knowing if the "shape" of the relationship between habitat quality (as a percent of optimal condition) and survival was linear or non-linear, the Habitat Workgroup began by exploring existing lifecycle models in search of common relationships that could be used to guide professional judgment. Examination of relationships in EDT was difficult, because of the complexities of the model. The workgroup found no simple functions in EDT that could be used to guide professional judgment. On the other hand, the Shiraz model (Scheuerell et al. 2006) and work by McHugh et al. (2004) were more transparent and provided analytical relationships between habitat attributes and survival. These models included relationships for temperature, fine sediment (embeddedness), flows, and cover (cobbles and wood) for different juvenile life stages and for pre-spawning adults. Listed below are relationships between survival and habitat attributes for different life stages.

3.1 LIFESTAGE HABITAT/SURVIVAL RELATIONSHIP

3.1.1 Incubation

Scheuerell et al. (2006) described the following hockey-stick relationship between temperature and egg-fry survival based on data in Tappel and Bjornn (1983):

$$p_{1,2} = \begin{cases} 0.95 & \text{if } f < 0.268 \\ -3.32f + 1.81 & \text{if } 0.268 \le f < 0.544 \\ 0.06 & \text{if } f \ge 0.544 \end{cases}$$

This function relates survival ($p_{1,2}$) to the percentage of fine sediment (f < 6.35 mm) within spawning and incubation habitat. If fines less than 1.7 mm are used, the following relationship applies:

$$p_{1,2} = \begin{cases} 0.93 & \text{if } f < 0.116 \\ -5.21f + 1.54 & \text{if } 0.116 \le f < 0.283 \\ 0.06 & \text{if } f \ge 0.283 \end{cases}$$

[4] In contrast, controlling factors include variables that do not directly kill fish but can affect their abundance and distribution (e.g., number of pools, off-channel habitat, woody debris, etc.). These variables were averaged to estimate overall habitat quality.

McHugh et al. (2006) provided an alternative survival function based on data in Stowell et al. (1983) and Tappel and Bjornn (1983).

$$p_{1,2} = [92.95 / (1 + e^{-3.994+0.1067*\text{fines}})]/100$$

This relationship is based on fine sediments in spawning gravels less than 6.35 mm in diameter. Scheuerell et al. (2006) described the following relationship between water temperature (T_{inc}) and egg-fry survival ($p_{1,2}$):

$$p_{2,1} = \begin{cases} 0.273T_{inc} - 0.342 & \text{if } 1.3 \le T_{inc} < 4.7 \\ 0.94 & \text{if } 4.7 \le T_{inc} < 14.3 \\ -0.245T_{inc} + 4.44 & \text{if } 14.3 \le T_{inc} < 18.1 \\ 0.01 & \text{if } T_{inc} \ge 18.1 \end{cases}$$

McHugh et al. (2004) described an alternative survival rate function for egg-fry survival.

$$p_{1,2} = -0.26 + 0.27(T_{inc}) - 0.02(T_{inc})^2$$

Scheuerell et al. (2006) described the following relationship between normalized flow (Q*) and egg-fry survival ($p_{1,2}$):

$$p_{2,2} = \begin{cases} 0.58 - 0.844Q^* & \text{if } Q^* < 0.675 \\ 0.01 & \text{if } Q^* \ge 0.675 \end{cases}$$

3.1.2 Summer Rearing

McHugh et al. (2006) provided the following functional relationship using a polynomial function reported in Stowell et al. (1983) based on the work of Bjornn et al. (1977).

$$S = [100 - 1.79(\text{Emb}) + 0.0081(\text{Emb})^2]/100$$

The function relates percentage summer stream capacity to the degree (percent) that cobbles are embedded in riffle/run habitat.

McHugh et al. (2004) described the following relationship between water temperature and survival of Chinook salmon parr during summer rearing:

$$S = \exp\left\{-\left[\left(\frac{sumT}{27.0271}\right)^{10.74}\right]\right\}$$

This function was computed using a Weibull function that related daily survival (*S*) to mean daily stream temperature (*sumT*) for any given day of the summer rearing period. Using this function, the daily survival rate decreases whenever the average daily temperature exceeds an upper temperature threshold of 17.8 °C.

3.1.3 Winter Rearing

McHugh et al. (2006) provided the following relationship using a function reported in Stowell et al. (1983) based on the work of Bjornn et al. (1977).

$$S = 1.001e^{-0.013(\text{Emb})}$$

This exponential function relates overwinter capacity for Chinook salmon parr to percent pool embeddedness (Emb).

Cramer (2001) described the following relationship between percentage of cobbles and wood in pools (<15 percent) and overwinter survival of Chinook salmon parr:

$$S = 20 + [80(\text{Cob})/15]/100$$

3.1.4 Pre-Spawning Adult

Cramer (2001) provided the following relationship for pre-spawner adult Chinook salmon:

$$p_1 = \begin{cases} 1 & \text{if } T_{pre} < 16 \\ 1 - 0.15(T_{pre} - 16) & \text{if } 16 \le T_{pre} < 22.6 \\ 0.01 & \text{if } T_{pre} \ge 22.6 \end{cases}$$

This function relates adult survival (p_1) to mean maximum temperatures (T_{pre}) during migration and pre-spawning.

These functions describe relationships between specific habitat attributes (e.g., temperature, fine sediment, etc.) and survival. However, local biologists provided habitat quality data scaled from 0 percent to 100 percent of optimal condition. Therefore, it was necessary to transform the habitat attributes into a common habitat quality index that ranged from 0-100 percent; where 0 percent habitat quality represented the worst habitat condition (lethal sediment levels and temperatures) and 100 percent habitat quality represented the best habitat condition (optimal temperature and sediment levels). These habitat quality ratings of 0-100 percent equated to survival indices that ranged from 0.0 to 1.0, respectively. In this case the survival index has no connection with “absolute” survival rate. That is, one cannot determine the absolute egg-smolt survival rate from these relationships. In contrast, the functions can be used to estimate possible survival increases associated with habitat actions if the ratio of the survival index under improved habitat conditions (potential survival index; S_{rp}) to the survival index under current conditions (S_{rc}) equals the ratio of potential absolute survival (S_{ap}) to current absolute survival (S_{ac}).

$$S_{rp} / S_{rc} \approx S_{ap} / S_{ac}$$

Thus, an estimated survival index ratio of 1.2, calculated as the ratio of the potential survival index of 0.30 to the current survival index of 0.25, implies that the absolute survival rate would increase approximately 20 percent if habitat restoration actions were implemented. If the current absolute survival rate is 0.08[5], the expected potential survival rate would increase about 20 percent to 0.10. In this exercise the workgroup is more concerned with the ratio than with the absolute survival values.

The workgroup plotted the relationships in an effort to find a common "shape" among the functions (Figure 3). It was clear that no "common" functional relationship existed within or among life stages. Therefore, the workgroup tried to combine relationships in an attempt to find a shape of central tendency.[6] The workgroup explored several different approaches: (1) average across all survival functions, (2) average survival functions within a life stage and multiply the mean functions across life stages, (3) multiply across all survival functions, and (4) use a simple linear function. These relationships are shown in Figure 4.

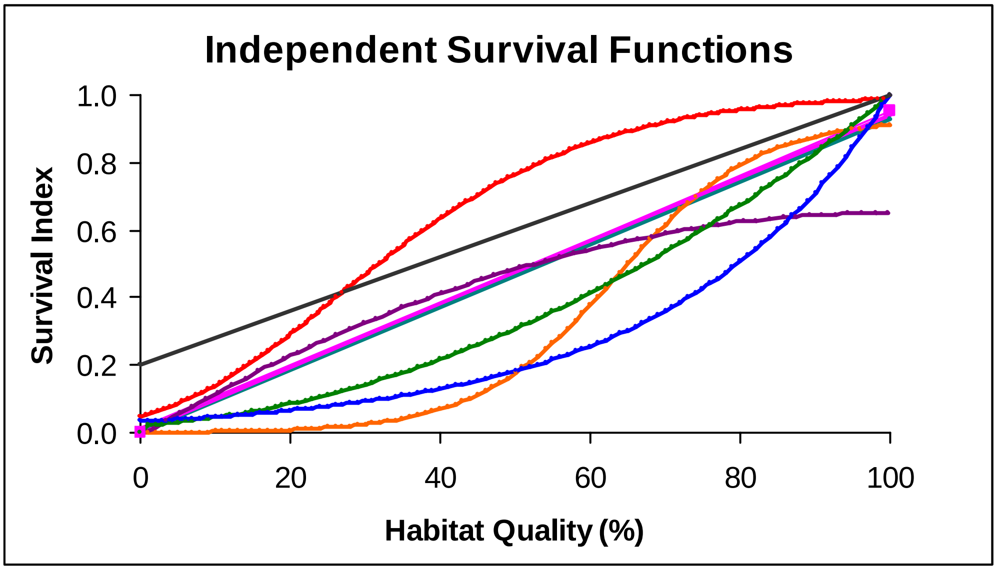

Figure 3. Various Shapes of Functional Relationships between Habitat Quality and Survival Index

[5] For many populations, absolute survival rates for juvenile Chinook salmon are unknown. Calculating ratios of survival indices appears to be a useful alternative in the absence of absolute survival rates. This is based on the assumption that ratios of survival indices represent ratios of absolute survival rates.

[6] It is important to note that there are several problems with generating functions of central tendency. For example, absolute survival rates cannot be estimated, information is lost by converting habitat attributes into habitat quality ratings, and combining functions provides false precision and accuracy. However, the intent was simply to identify a functional shape that would guide professional judgment. The function was not developed to estimate absolute survival rates.

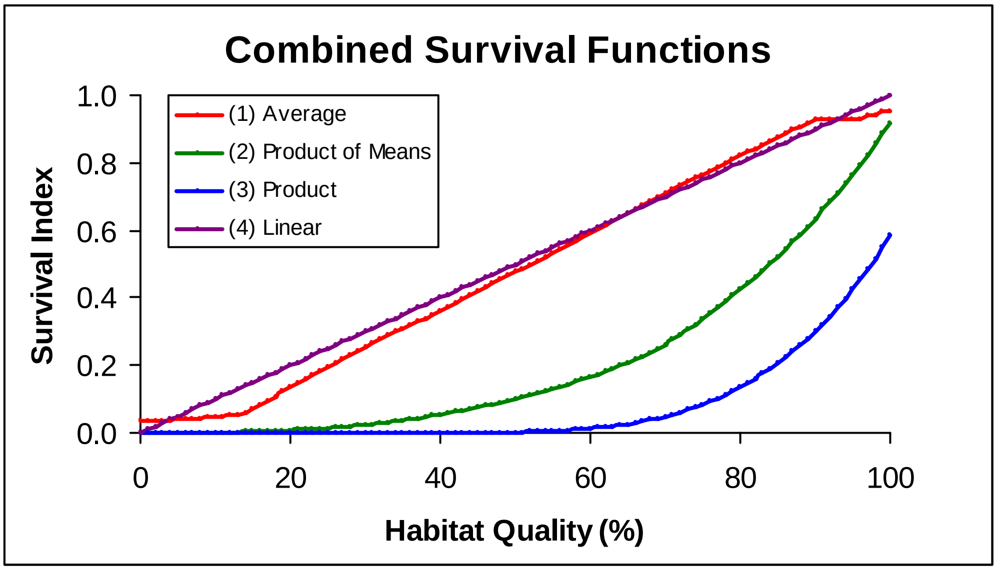

Figure 4. Comparison of Shapes of Functions Generated by Seeking Relationships of Central Tendency

Each of the "combined" functions was then evaluated by calculating potential survival gains associated with habitat quality data provided by local biologists. Where possible, estimated survival increases were compared with EDT results, historic redd counts, and/or survival benefits identified in the Human Impacts Report (from the Framework Workgroup). Both the linear function and the average function (based on median scores) provided estimates closest to EDT results and estimates contained in the Human Impacts Report. The exponential functions grossly overestimated survival benefits (in some cases they estimated well over 10,000 fold increases in juvenile survival).

The workgroup found no biological reason why the average function was the most appropriate relationship. There is no justification why there would be little survival increase associated with habitat quality increases from 0-10 percent and 90-100 percent. The workgroup collectively agreed, given the current data, that the linear function was the most realistic and should be used to guide professional judgment. This relationship also fits well with published literature that indicates that more intensive and extensive restoration actions result in greater survival benefits (e.g., see Paulsen and Fisher 2001).

To avoid the misconception that juvenile survival could be near 100 percent (survival index of 1.0) at high habitat quality, the Habitat Workgroup converted the survival indices into survival rates that represented actual juvenile and adult survivals measured in natural environments. The workgroup then developed different linear functions for Chinook salmon, steelhead, and chum salmon based on these actual survival rates. The goal was to identify what egg-smolt survivals for naturally produced Chinook salmon and steelhead and egg-fry survivals of chum salmon corresponded to optimal habitat conditions (100 percent habitat quality under natural conditions). The following is a brief summary of egg-smolt and egg-fry survival estimates that were readily available.

3.2 SPECIFIC HABITAT/SURVIVAL RELATIONSHIPS

3.2.1 Chinook Salmon

Some of the highest Chinook salmon survival rates were reported by Bugert and Seidel (1988) in the Tucannon River. Using a migrant trap on the lower Tucannon River, Bugert and Seidel (1988) estimated an egg-smolt survival that ranged from 13-22 percent between 1985 and 1987. In the Yakima River, Major and Mighell (1969) estimated that 5.4-16.4 percent of the potential spring Chinook salmon egg deposition survived to migrate as yearling smolts. Later work by Fast et al. (1989) indicated that, on average, 4.94 percent (range, 4.2-6.5 percent) of the eggs survived to migrate as smolts in the Yakima River. In the John Day River, egg-smolt survivals of spring Chinook salmon were estimated as 3.6-8.6 percent (Knox et al. 1984), while Lindsay et al. (1989) reported spring Chinook salmon survivals of 2.1-8.7 percent in the Deschutes River.

In the Methow, Wenatchee, and Entiat systems, Mullan et al. (1992) estimated egg-smolt survivals of 1.35-2.15 percent, 1.55-2.35 percent, and 2.90-6.65 percent, respectively, for spring Chinook salmon. Mullan et al. (1992) calculated these survivals by extrapolating rearing densities for the total basin rearing areas by habitat quality index ranking with an assumed 40 percent overwinter survival. In the Chiwawa Basin, the Washington Department of Fish and Wildlife (WDFW) (unpublished data) has estimated egg-smolt survivals for spring Chinook salmon brood years 1991-2003. WDFW estimated an average egg-smolt survival of 8.6 percent (range, 3.7-16.9 percent). Quinn (2005) recently reviewed published and unpublished estimates for wild or naturally produced Chinook salmon populations and reported a mean egg-smolt survival of 10.4 percent.

3.2.2 Steelhead

Ward and Slaney (1993) conducted a thorough study of steelhead egg-smolt survival for seven years in the Keogh River, B.C. and estimated a mean survival of 0.51 percent (range, 0.28-1.30 percent). Bley and Moring (1988) described a study that was conducted by the Washington Department of Wildlife (WDW – now WDFW) Snow Creek Research Station in Washington. Using winter steelhead, WDW estimated an egg-smolt survival of 1.6 percent. Bjornn (1978) reported that survival of steelhead from egg-smolt in the Lemhi River ranged from 0.16-3.61 percent. WDF et al. (1990) estimated an egg-smolt survival of 1.7 percent for steelhead in the Wenatchee River. In contrast, Peven (1992) reported a survival of 0.4 percent. Peven’s estimate included the entire mid-Columbia Basin.

Thurow (1987) reviewed egg-smolt survival rates for wild steelhead. He found that rates ranged from 0.5-2.5 percent. Most of the work reported for seven river systems indicated survivals from 1-2 percent (Bjornn 1978; Phillips et al. 1981; Washington Department of Game [WDG] 1983). Thurow (1987) assumed survival of 1 percent under poor spawning conditions (e.g., poor quality spawning habitat, abnormal flows, abnormal temperature regimes, and redd superimposition), 1.5 percent under average conditions, and 2 percent under optimal conditions in the South Fork Salmon River. Quinn’s (2005) review of published and unpublished estimates for wild or naturally produced steelhead populations indicated a mean egg-smolt survival of 1.4 percent.

3.2.3 Chum Salmon

Salo (1991) summarized egg-fry survival rates of chum salmon in his Tables 10 and 11. His summary indicates that egg-fry survivals of naturally produced chum salmon in natural environments can range from 0.1 to 85.9 percent. The latter is an estimate of survival of chum in the Iski River (tributary to the Amur River in Russia). This estimate appears to be an outlier when compared to estimates from other systems. Most survival estimates were less than 35 percent. Quinn’s (2005) review indicated a mean egg-fry survival of 12.9 percent for chum salmon.

Based on this review of readily available literature, the following egg-smolt and egg-fry survival estimates appear reasonable if one assumes optimal (100 percent habitat quality) spawning and rearing conditions:

Chinook Salmon:	18 percent egg-smolt survival
Steelhead:	4 percent egg-smolt survival

Chum Salmon: 35 percent egg-fry survival

These estimates represent the highest survivals that could be achieved under optimal habitat conditions. The workgroup also assumed that the maximum pre-spawning adult survival would be 100 percent at optimal conditions. It is important to note that some systems may never achieve these life-stage survivals, because the systems are naturally unable to establish conditions that would be "optimal," even if all anthropogenic effects could be removed.

Applying these maximum survival rates to optimal habitat conditions resulted in linear functions with different slopes (rates of change) for each species and life stage (Figure 5). The Habitat Workgroup used the following linear functions to guide professional judgment in estimating survival improvements associated with habitat quality improvements:

Chinook salmon egg-smolt survival = 0.0018*(Habitat Quality)
Steelhead egg-smolt survival = 0.0004*(Habitat Quality)
Chum salmon egg-fry survival = 0.0035*(Habitat Quality)
Adult pre-spawning survival = 1.0*(Habitat Quality)

These functions provided a conservative approach to estimating survival gains and resulted in estimates that were generally less than those calculated with the Ecosystem Diagnosis and Treatment (EDT) model.

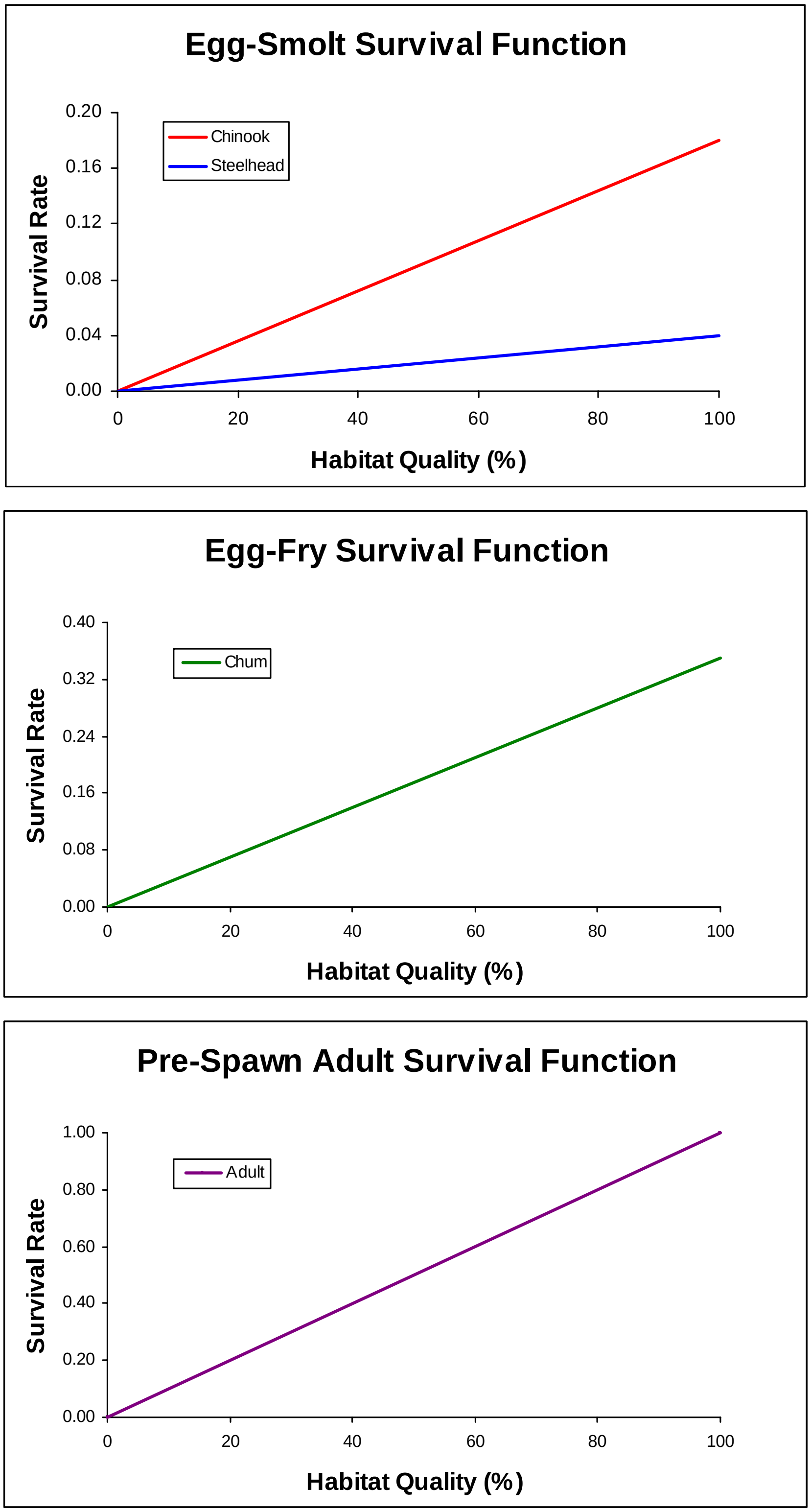

Figure 5. Linear Functions for Egg-smolt, Egg-fry, and Pre-spawning Adult Survival of Chinook Salmon, Chum Salmon, and Steelhead

4. ESTIMATING SURVIVAL CHANGES WITHIN ASSESSMENT UNITS

Local biologists have subdivided the geographic areas of some populations into smaller assessment units or watersheds. Within these smaller units, they described current habitat conditions (as a percent of optimal conditions), identified primary limiting factors, proposed restoration actions that would address limiting factors, and estimated the potential habitat condition (as a percent of optimal condition) that would result if restoration actions were implemented. These habitat conditions within assessment units were translated into relative survival estimates using the linear relationships described above. Current and potential survival rates were estimated based on current and potential habitat conditions. Potential survival rates were based on habitat conditions that could be achieved if actions were implemented within each assessment unit.

Because different assessment units within a population have different capacities and/or production potentials, survival estimates for those assessment units were weighted according to their capacities or production potentials. Weightings were based on the fraction of the population that spawns within each assessment unit or on the fraction of the total geographic area of the population that was contained in each assessment unit. For example, if a given population had three assessment units and one unit supported 65 percent of the spawners, another supported 10 percent, and the last supported 25 percent of the spawners, then Assessment Unit 1 was given a weight of 0.65, 2 a weight of 0.10, and Assessment Unit 3 a weight of 0.25. Survival estimates for each assessment unit were then multiplied by their respective weights to estimate a weighted survival rate. These weighted rates were added together to estimate the overall survival rate for the juvenile (tributary) life-stage of the population.

Overall current and potential survival estimates for the population were calculated separately. That is, current and potential survival estimates for each assessment unit were multiplied by their respective weights and summed independently of each other. Once the workgroup had calculated the current and potential survival estimates for the population, the survival increase associated with habitat restoration actions was calculated simply as the ratio of the potential survival estimate for the population (S_p) to the current survival estimate for the population (S_c). That is,

$$S = Sp/Sc$$

The Habitat Workgroup reported these ratios as the survival improvements associated with habitat restoration actions.

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ANNEX 3
UNDERSTANDING THE HABITAT WORKGROUP APPROACH TO ESTIMATING HABITAT QUALITY AND FRESHWATER SURVIVAL BENEFITS

The Remand Habitat Workgroup (RHW) developed a simple approach for estimating overall habitat quality and freshwater (egg-to-smolt) survival benefits. The approach relied primarily on the professional judgment of local biologists, who had the most knowledge about local watershed processes, habitat conditions, and fish populations within their respective areas. Information from the local biologists provided the raw materials used by the RHW and Action Agencies to estimate overall habitat quality and population survival benefits. This paper describes how the information provided by the local biologists was used to derive overall habitat quality and survival benefits.

<u>Logic Path and Assumptions</u>

In the absence of life-cycle models (because of a lack of time, resources, and data to populate and run the models), the RHW developed the following general logic path for estimating overall habitat quality and freshwater survival benefits.

Habitat Action → Limiting Factors (Habitat Variables) → Local Habitat Conditions → Overall Habitat Quality (at the population scale) → Freshwater Survival

In words, the implementation of habitat actions should reduce the detrimental effects of factors currently limiting the productivity of a population or portion of a population. Thus, these habitat actions directly affect specific habitat variables (flow, temperature, fine sediments, woody debris, pools, etc.) that are thought to limit the freshwater survival or productivity of the population. As the negative effects of the limiting factors are reduced (the quality of habitat variables beneficial to fish survival increase), local habitat conditions should improve. These local conditions represent the amalgamation of habitat variables that affect the freshwater survival of fish in specific locations (e.g., in streams or watersheds). Because limiting factors and habitat conditions vary across the distribution of the population, improvements in local habitat conditions across the distribution of the population should improve the overall habitat quality for the population.[7] That is, the combination of improvements in local habitat conditions should result in population-level habitat quality improvements. Finally, improvement to population-level habitat quality correlates to a change in population survival for the egg-to-smolt life history stage.

There are several assumptions associated with this logic path:

1. Limiting factors are known for each population.
2. Habitat actions directly affect habitat variables that limit the population.
3. Habitat variables can be combined to describe local habitat conditions.
4. Local habitat conditions can be combined to describe overall habitat quality for the entire population.
5. Changes in overall habitat quality are directly linked to changes in freshwater survival.

[7] The difference between "local habitat condition" and "overall habitat quality" is based on spatial scale. Although both represent composite habitat scores, "local habitat condition" refers to the composite score at a scale smaller than the distribution of the population (i.e., at the assessment unit or watershed scale). The "overall habitat quality" score refers to the composite score at the scale of the population, which may consist of several assessment units or watersheds. Therefore, the overall habitat quality score can be estimated as the composite (weighted average) of local habitat condition scores.

Local Biologist Input
The RHW relied on local biologists to provide the following:

1. A list of primary limiting factors for each population or assessment unit[8].
2. The current status of each limiting habitat variables.
3. Habitat actions that would address the primary limiting factors or habitat variables.[9]
4. An estimate of the potential status of limiting habitat variables if those variables were treated with the habitat actions.

Local biologists described the "status" of limiting factors (habitat variables) as a percent of optimal condition. As a guide, local biologists used the definition of properly functioning condition (PFC) developed by NMFS to estimate the status of habitat variables.[10]

For those populations that local biologists divided into assessment units, they also provide weights for each assessment unit. The weights were needed because different watersheds or assessment units within a population have different habitat capacities and productivities.

Assessment units were assigned weights according to the proportion of the total population area that each assessment unit made up. For example, if a given population consisted of three assessment units and one unit made up 65 percent of the total area, another made up 10 percent, and the last made up 25 percent of the total area, then Unit 1 was given a weight of 0.65, Unit 2 a weight of 0.10, and Unit 3 a weight of 0.25. The weights were scaled from 0.00-1.00 and their sums equaled 1.00. These weights represented the importance of each assessment unit in contributing to overall habitat quality for the population.

Some biologists also provided weights for each habitat variable. These weights indicated the importance of each habitat variable to the freshwater survival or productivity of fish. For example, if a given assessment unit or population was limited by three primary factors, high levels of fine sediments, lack of woody debris, and a lack of off-channel habitat, the biologist weighted each habitat variable by its relative importance to fish survival. In this case, the biologist may weight fine sediment the highest, because it has a relatively larger effect on fish survival than the other two factors. The resulting weights may be 0.75 for fine sediment, 0.15 for off-channel habitat, and 0.10 for woody debris. These weights were scaled from 0.00-1.00 and their sums equaled 1.00. The idea was to make sure that some factors or habitat variables (those that had a relatively greater detrimental effect on fish survival or productivity) had a greater influence on overall local habitat condition.

Not all biologists assigned weights to each habitat variable that limited freshwater fish production. Biologists in Washington, for example, assumed equal weights among habitat variables, unless the concentration or level of a given factor was considered lethal to fish (< 20 percent of optimal condition). In this case, the lethal factor was assigned a weight of 1.00 and all other limiting variables were assigned a weight of 0.00. Once the lethal factor is addressed through habitat actions, the remaining, non-lethal factors would be assigned equal weights.

Derivation of Local Habitat Conditions
With information from local biologists on limiting factors, current and potential status of habitat variables, habitat actions, and weightings, the RHW and Action Agencies estimated local habitat

[8] Some biologists divided the spatial distribution of populations into smaller streams or watersheds. These smaller areas were referred to as "assessment units." Thus, a population may consist of one or more assessment units.
[9] Biologists relied on draft recovery plans and subbasin plans to identify primary limiting factors and tributary habitat actions.
[10] PFC was used to help standardize optimal conditions across the Columbia River Basin.

conditions for each assessment unit (e.g., see Table 1 in this annex, below). The first step was to estimate the weighted status for each limiting habitat variable. This was calculated as the status of the habitat variable (as a percent of optimal condition) times its associated weight (relative weight of the variable on fish survival). In Table 1, the weighted current and potential status of habitat variables are shown in columns F and K, respectively.

The second step was to combine the weighted status scores into a composite local habitat condition score for each assessment unit. This was accomplished by simply adding together the weighted habitat status scores. For example, for the O'Hara Creek assessment unit in Table 1, the current weighted status scores of 35 percent for fine sediment and 18 percent for temperature/riparian vegetation were added together to estimate a current local habitat condition score of 53 percent (column G in Table 1). This score represents the current average habitat condition for the O'Hara Creek assessment unit. If the negative effects of the limiting factors are reduced with the implementation of the proposed actions (identified in column I in Table 1), the average habitat condition for the assessment unit should increase to 67 percent. This represents a 1.26 fold (67 percent ÷ 53 percent = 1.26, or 26 percent) increase in average habitat condition for the assessment unit.

In those cases where biologists assumed equal weights among limiting factors, the local habitat condition score for an assessment unit was estimated as the arithmetic mean of the status of habitat variables. In Table 1, for example, if the biologists had assumed equal weights for the two limiting factors (fine sediment and temperature/riparian habitat) in the O'Hara Creek assessment unit, the current local habitat condition would have been 55 percent (mean of the current status of habitat variables in column E; (50 percent + 60 percent)/2 = 55 percent)) rather than 53 percent, which was based on unequal weightings.

Table 1. Example of Limiting Habitat Variables (factors), Habitat Weights, Current and Potential Status of Habitat Variables, Current and Potential Local Habitat Condition, and Overall Habitat Quality Scores for the Selway Steelhead Population within the Clearwater MPG of the Snake River Steelhead DPS[1/2/]

				Current Conditions				Resulting Potential Conditions				
[A] Assessment unit	[B] AU weight (proportion of population area)	[C] Limiting habitat variables	[D] Relative weight of variable on survival	[E] Current status of habitat variable (% of optimum)	[F] Current weighted status of habitat variable (D x E)	[G] Current local habitat condition (sum of F)	[H] Current overall habitat quality score (sum of G x B)	[I] Proposed habitat actions	[J] Potential status of habitat variable (% of optimum)	[K] Potential weighted status of habitat variable (J x D)	[L] Potential local habitat condition (sum of K)	[M] Potential overall habitat quality score (sum of L x B)
O'Hara Creek	0.015	Fine sediment	0.70	50	35.0	53%	83%	Road decommission and improvements	65	45.5	67%	86%
		Temperature and riparian vegetation	0.30	60	18.0			Riparian restoration and woody debris treatments	70	21.0		
Lower Selway River	0.035	Fine sediment	0.70	55	38.5	61%		Riparian restoration and sediment filters	65	45.5	73%	
		Connectivity	0.30	75	22.5			Culvert replacement	90	27.0		
Meadow Creek	0.165	Fine sediment	1.00	78	78.0	78%		Trail improvements	80	80.0	80%	
Wilderness Area	0.785	Fine sediment	1.00	85	85.0	85%		Trail improvements	88	88.0	88%	

Notes:
1/ Data are from the Nez Perce Tribe DFRM Watershed Division
2/ The numbers in black were provided by the local biologists; numbers in red are derived values.

Derivation of Overall Habitat Quality

With the estimation of local habitat condition scores for each assessment unit within a population, one can calculate overall habitat quality scores for the entire population.[11] This is accomplished by multiplying the local habitat condition scores for each assessment unit by their respective assessment unit weights. These products (weighted habitat condition scores) are then added together to estimate the overall habitat quality score for the population. For example, in Table 1, the current local habitat condition score of 53 percent in column G) for the O'Hara Creek assessment unit is multiplied by its assessment unit weight of 0.015 (in column B). This results in a weighted local habitat condition score of 0.79. The sum of these weighted local habitat condition scores results in a current overall habitat quality score of 83 percent (column H in Table 1), which represents the current average habitat quality for the Selway steelhead population.

The same approach is used to estimate the potential overall habitat quality score that would result if the proposed actions were implemented. In the example above, the resulting overall habitat quality score is 86 percent (column M in Table 1). Thus, the implementation of actions identified in Table 1 would result in a 1.04 fold (86 percent ÷ 83 percent = 1.04, or 4 percent) increase in overall average habitat quality for the Selway steelhead population. Note that the 1.26 fold increase in local habitat condition in the O'Hara Creek assessment unit had little effect on the overall habitat quality score for the population. This is because the O'Hara Creek assessment unit made up a very small portion (1.5 percent) of the overall spatial distribution of the population.

The largest assessment unit was in wilderness and its projected improvement in local habitat condition was relatively small (wilderness areas have relatively high quality habitat and little room for improvement). Therefore, the increase in overall habitat quality for the population was low because of the influence of the higher quality habitat in the larger assessment units.

Derivation of Survival Benefits

The RHW spent a large amount of time trying to identify common relationships between habitat quality and freshwater survival (see Annex 2 - *Approach to Estimating Survival Benefits of Habitat Actions* for a complete discussion). After considerable discussion, the RHW decided that a simple linear relationship between habitat quality and egg-smolt survival was the most appropriate relationship and should be used to guide professional judgment. For each species, survival was scaled from 0.00 to the maximum egg-smolt survival reported in the literature. Habitat quality was scaled from 0 to 100 percent of optimal condition. This resulted in the following linear functions:

Chinook salmon egg-smolt survival = 0.0018 x (habitat quality score)

Steelhead egg-smolt survival = 0.0004 x (habitat quality score)

Chum salmon egg-fry survival = 0.0035 x (habitat quality score)

There are several assumptions associated with this approach.

1. Egg-smolt survival is the lowest when habitat quality is the lowest and survival is the highest when habitat quality is the highest.

[11] Although overall habitat quality for the entire population can be calculated with the information provided by the local biologists, the RHW and Action Agencies did not calculate these scores for all populations. This is because survival changes, which were the focus of the RHW and Action Agencies at the time proposed RPA were being identified, can be estimated using local habitat condition scores (see later section). Recently, however, overall habitat quality was identified as a performance metric that needs to be identified in the RPA.

2. Egg-smolt survival is directly proportional to habitat quality.
3. Density dependence is not considered.[12]
4. Any effect of hatchery programs on egg-smolt survival of naturally produced fish is not considered.

Although some of these assumptions are extremely generalized considering natural biological variability, the overall approach is useful in describing potential changes in survival associated with habitat quality improvements.

It is important to note that the estimated egg-smolt survival for a given habitat quality is less important than the change in survival that is expected to occur with habitat quality improvements. That is, for the purposes of the BiOp, it is more appropriate to report that a 25 percent increase in juvenile steelhead survival is expected from increasing habitat quality from 53 percent to 66 percent than it is to report absolute survivals of 0.0212 and 0.0264 for the respective habitat quality scores. The absolute survival values are not precise estimates, even though they appear precise.[13]

The RHW and Action Agencies used the habitat information provided by the local biologists to translate habitat quality changes into egg-smolt survival benefits. The process began by converting the local habitat condition scores for each assessment unit into survival estimates. This was done by multiplying the local habitat condition score by their respective assessment unit weights. This product was then multiplied by the appropriate habitat/survival function (0.0018 for Chinook, 0.0004 for steelhead, and 0.0035 for chum; from the above linear equations). The result was a fish survival estimate for each assessment unit. The survival estimates for each assessment unit were then added together to derive an overall survival estimate for the population.

An example of this approach is shown in Table 2 for the Selway steelhead population. The current and potential local habitat conditions for each assessment unit shown in Table 2 were carried over from columns G and L in Table 1. These local habitat conditions were multiplied by their respective assessment unit weights (column B in Table 2) to estimate the weighted local habitat conditions (shown in columns E and I in Table 2). These scores were then multiplied by 0.0004, the steelhead habitat/survival function, which resulted in weighted survival scores for each assessment unit. Adding these survival scores together resulted in a current steelhead survival value of 0.0330 (column G) and a potential survival value of 0.0343 (column K). The ratio of the potential survival to current survival indicates that steelhead egg-smolt survival could increase 4 percent (0.0343 ÷ 0.0330 = 1.04 or 4 percent) if the habitat actions proposed in Table 1 increase overall habitat quality from 83 percent to 86 percent.

[12] This means that survival is not regulated by mechanisms controlled by the size of the population.
[13] The appearance of precision is shown in the number of decimal places. The more decimal places, the more precise an estimate appears to be.

Table 2. Example of Limiting Habitat Variables, Current and Potential Local Habitat Conditions, and Current and Potential Egg-Smolt Survivals for the Selway Steelhead Population within the Clearwater MPG of the Snake River Steelhead DPS[1/]

			Current Condition				Resulting Potential Condition			
[A] Assessment unit	**[B]** AU weight (proportion of population area)	**[C]** Limiting habitat variables	**[D]** Current local habitat condition (from column G in Table 1)	**[E]** Current weighted local habitat condition (D x B)	**[F]** Current survival estimate for each AU (E x 0.0004)	**[G]** Current survival estimate for entire population (sum of F)	**[H]** Potential local habitat condition (from column L in Table 1)	**[I]** Potential weighted local habitat condition (H x B)	**[J]** Potential survival estimate for each AU (I x 0.0004)	**[K]** Potential survival estimate for entire population (sum of J)
O'Hara Creek	0.015	Fine sediment	53%	0.795	0.00032	0.0330	67%	1.005	0.00040	0.0343
		Temperature and riparian vegetation								
Lower Selway River	0.035	Fine sediment	61%	2.135	0.00085		73%	2.555	0.00102	
		Connectivity								
Meadow Creek	0.165	Fine sediment	78%	12.870	0.00515		80%	13.200	0.00528	
Wilderness Area	0.785	Fine sediment	85%	66.725	0.02669		88%	69.080	0.02763	

Note:
1/ Data from the Nez Perce Tribe DFRM Watershed Division

Notice that one could translate the overall habitat quality scores into survival values by simply multiplying 83 percent and 86 percent (from Table 1, columns H and M) by 0.0004 to obtain the same survival estimates obtained in Table 2, columns G and K (ignoring rounding errors). Thus, both ways of estimating survival values result in the same survival estimates.

Because the method used to estimate survival benefits assumes that survival change is directly proportional to habitat quality change, the change in survival equals the change in overall habitat quality. That is, the ratio of potential survival to current survival equals the ratio of potential overall habitat quality to current overall habitat quality. In the Selway steelhead example, the 1.04 fold increase in overall habitat quality (86 percent ÷ 83 percent = 1.04) equals the 1.04 fold increase in egg-smolt survival (0.0343 ÷ 0.0330 = 1.04). This equality only applies to the ratios. Differences in overall habitat quality scores and survival values are not equal (i.e., 86 percent - 83 percent ≠ 0.0343 – 0.0330) and differences in habitat quality scores are not equal to the ratio of the survival estimates (86 percent - 83 percent ≠ 0.0343 ÷ 0.0330).

Estimating Benefits from Non-Specific Proposed Actions

For some populations, the Action Agencies were unable to identify specific habitat actions for the period 2010-2017. This is because recovery plan implementation teams and local biologists have not had a chance to work with local landowners to determine the feasibility of implementing specific habitat actions in the long term. Therefore, the Action Agencies proposed identifying specific habitat projects in 3-year cycles from 2010-2017 and identified suites of actions that could be implemented, projecting a linear increase in habitat quality and survival improvement from 2007-2009 to 2010-2017 (not to exceed the potential habitat quality status) to obtain a target value for change in fish survival and overall habitat quality. For example, the Action Agencies identified different suites of habitat actions that should result in a 1.04 fold increase in overall habitat quality and juvenile steelhead survival in the Wenatchee Basin for the period 2010 to 2017.[15] Each suite of actions proposed by the Action Agencies addresses the primary limiting factors with different intensities of implementation but yielding the same projected overall habitat quality improvement.

As specific actions are identified but before those actions are implemented during the 2010-2017 period, the projected change in overall habitat quality will be determined for priority populations by using the analytical approach described earlier for estimating overall habitat quality. This means that local biologist will have to estimate the resulting status of limiting habitat variables, which are then weighted according to their influence on fish survival. The sum of the weighted habitat variables will then be multiplied by the weight of the assessment unit in which the action was implemented. This product, which represents the local habitat condition for a given assessment unit, will be added to the other assessment unit habitat condition scores to estimate the overall habitat quality for the population. This score will be compared to the target value to determine how much the proposed actions closed the gap between current overall habitat quality and the overall habitat quality target. This process is important to properly represent the effects of habitat actions in attaining the habitat quality target because the same magnitude of a given action implemented within different assessment units will have different effects on local habitat conditions and overall habitat quality scores.

[15] Because changes in survival are directly proportional to changes in overall habitat quality, the target of a 4 percent (or 1.04 fold) change in survival also means a 4 percent change in overall habitat quality for the Wenatchee steelhead population. This is useful because local biologists are better able to estimate a 4 percent change in habitat than a 4 percent change in egg-smolt survival.

Appendix D
Analysis of the Effects of Estuary Habitat Actions

TABLE OF CONTENTS

LIST OF ATTACHMENTS

D.1. INTRODUCTION

This appendix addresses the effects of the estuary habitat actions that are included as part of the proposed Federal Columbia River Power System (FCRPS) Reasonable and Prudent Alternative (RPA). The proposed estuary habitat actions included as part of the Proposed RPA are discussed in detail in Appendix B.2.2 of the FCRPS Biological Analysis (BA). This appendix consists of the following attachments:

Attachment D-1 - Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary
Attachment D-2 – Federal Columbia River Power System Estuary Workgroup Table

These attachments are briefly described in the following paragraphs.

Attachment D-1 is the *Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary* paper prepared by PC Trask & Associates in 2007. This paper explains the process used to evaluate federally funded habitat projects in the Columbia River estuary for their potential to improve the survival of salmon and steelhead in the estuary, which extends from Bonneville Dam at River Mile 146 to the mouth of the Columbia and includes the river's plume.

The workgroup table presented in Attachment D-2 summarizes the estimated percent of ocean type survival improvement targets and the estimated percent of stream type survival improvement targets by reach assessment unit for each action. The table also identifies the primary limiting factors, spatial structure, life history diversity, and estimated implementation benefits by action and reach assessment unit.

Appendix E
Analysis of the Effects of Hatchery Actions

TABLE OF CONTENTS

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

BiOp	Biological Opinion
FCRPS	Federal Columbia River Power System
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
R/S	recruits-per-spawner
RPA	Reasonable and Prudent Alternative
TRT	Technical Recovery Team
VSP	Viable Salmonid Population

1. HATCHERY BENEFITS ESTIMATION METHOD

For populations where relatively accurate spawner counts and run reconstruction information are available, salmonid productivity can be measured as the number of adult progeny returning for each adult in the previous generation. As noted previously, progeny are referred to as recruits; parents, as spawners. The relationship is expressed in mathematical terms as recruits-per-spawner, or recruits-per-spawner (R/S). An average recruit-per-spawner value greater than 1.0 indicates a growing population over the time period used for the analysis; a value less than 1.0 indicates a population declining in size.

Also, in calculating R/S productivity, it is conventional to count both natural-origin and hatchery-origin fish spawning naturally as spawners whenever hatchery-origin fish are present on the spawning grounds (this is the approach used by the Interior Columbia Basin Technical Recovery Team [TRT]). However, only natural-origin fish returning to the spawning grounds are counted as recruits. If hatchery-origin spawners are as productive as the natural-origin spawners (hatchery effectiveness = 1.0), then R/S will accurately reflect the productivity of both the natural-origin and hatchery-origin components of the spawning population. However, if hatchery-origin spawners are less productive than the natural-origin fish in the spawning population (hatchery effectiveness < 1.0), then R/S will understate the productivity of the natural-origin fish in the spawning population.

The emerging scientific consensus is that hatchery-origin fish are generally not as productive as natural-origin fish and that the difference in productivities is greatest when the hatchery broodstock used is derived from non-local, domesticated sources. Research into this issue is limited. Very little is known of the relative reproductive effectiveness of hatchery-origin and natural-origin stream-type Chinook salmon, for instance. The relatively few existing studies on the subject are dominated by steelhead, coho salmon and Atlantic salmon.

However, Berejikian and Ford's review of the research literature advises that "to the extent that the general loss of fitness increases with the duration of the lifecycle spent in captivity, we believe that is it reasonable to extrapolate the results from steelhead, coho, and Atlantic salmon to hatchery propagation of other species that have an extensive freshwater life history phase" (Berejikian and Ford 2004). For Pacific salmon in the Pacific Northwest, these species include stream-type Chinook salmon, which spend approximately 1 year in fresh water (Healey 1991), sockeye salmon, and anadromous cutthroat trout. Therefore, based on available information and for the purposes of this analysis, the relative fitness values for steelhead and coho salmon presented in Berejikian and Ford's review are being applied to these species until data on their relative fitness become available.

The fact is, R/S productivity, as it is estimated by the Interior Columbia Basin TRT for recovery planning and for this analysis, is a measure of the productivity of the entire naturally spawning population. In the 2000 Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp), National Marine Fisheries Service (NMFS, also known as National Oceanic and Atmospheric Administration [NOAA] Fisheries) attempted to tease out the productivity of the natural-origin spawners in the spawning population by estimating lambda assuming two alternative values of hatchery effectiveness: .20 and .80. However, in this Comprehensive Analysis, we treat these populations as integrated wholes and attempt to estimate the effects of changes in the relative reproductive effectiveness of the hatchery-origin fish in the spawning population resulting from significant improvements in hatchery practices. This is not to suggest that longer-term supplementation does not carry risks. Supplementation must remain a strategy to support, not substitute for, self-sustaining natural populations.

Average R/S productivity values are reported by the Interior Columbia Basin TRT as the geometric mean of productivity estimates for an historical period. This biological analysis primarily used 20-year and 10-

year geomeans. These historical averages fail to represent current productivities, in part because changes may have taken place as a result of hatchery reforms implemented in recent times. Reforms that will have the greatest impact on mean R/S include significant improvements in broodstock management protocols and curtailment of significant straying of hatchery-origin fish into native populations being managed as wild-only populations.

By estimating the relative reproductive effectiveness of hatchery-origin spawners before and after a hatchery reform action, and making a reasonable forecast of the future percentage of natural- and hatchery-origin fish in the spawning population, it is possible to calculate the improvement in population productivity resulting from a hatchery reform action whose effect would be to increase relative reproductive success of hatchery-origin fish.

However, this is not intended to suggest that the only negative effect that hatchery fish can have on population productivity and/or other viable salmonid population (VSP) parameters results from the lower reproductive effectiveness of hatchery-origin fish. Hazards associated with artificial production can be classified into four major categories – genetic, ecological, demographic, and facility (Busack et al 2004).

Genetic hazards associated with artificial propagation may include loss of genetic variability within and among populations; domestication; and extinction (Busack and Currens 1995). Within-population diversity loss caused by hatchery practices may potentially lead to a loss in fitness of the supplemented or natural population (inbreeding depression) and changes in gene frequencies (genetic drift). Loss of diversity within a population may also occur when the population is reared in the hatchery, causing selection for hatchery production traits that reduce the fitness of the population for the natural environment (domestication selection) (Busack and Currens 1995; Waples 1999). Loss of genetic variability among populations resulting from mating of unrelated populations (e.g., non-indigenous origin hatchery fish spawning in the wild with natural origin fish) may lead to decreased fitness, limiting the potential of the species to adapt to new environmental conditions, thereby reducing its capacity to buffer the total productivity of the resource against periodic or unpredictable changes (Cuenco et al. 1993 quoting Riggs 1990).

Other potentially negative effects include ecological effects, as a result of disease transfer and other facility failures, as well as hazards associated with adverse competitive effects of hatchery-origin salmonids on listed wild fish.

The Action Agencies expect that implementation of the FCRPS hatchery program reform actions in the Proposed Reasonable and Prudent Alternative (RPA), particularly improved broodstock management, will reduce fitness loss in the hatchery. Consequently, the hatcheries will be able to produce supplementation fish with much improved reproductive success relative to natural-origin fish.

The method described in this appendix estimates only the expected effects on population productivity resulting from improvements to the relative reproductive effectiveness of hatchery-origin spawners. It is acknowledged that improved hatchery practices could lead to other fitness and survival improvements in the natural-origin component of the population. It is also acknowledged that adverse effects on the fitness of the natural-origin component of the spawning population could complicate the comparison of the relative reproductive effectiveness of hatchery-origin spawners to a hypothesized natural-origin fish (this would more likely be an issue for populations with extremely high historical hatchery influence). However, any reduction in the estimated survival improvements that might result from genetic fitness loss in natural-origin spawners could very well be negated by a long-term improvement in natural-origin spawner fitness as a result of the hatchery reforms considered in this analysis. In any case, this analysis does not attempt to *quantitatively* estimate genetic and other changes resulting from hatchery actions.

These considerations are treated qualitatively. The following diagram illustrates the concept being described here.

In the table on the left in Figure E-1, productivity of the naturally-spawning population is 0.5; 50 hatchery-origin and 50 natural-origin spawners produced 50 recruits (50/100=0.5). For the purposes of this example, the hatchery-origin fish are assumed to be derived from non-native, domesticated broodstock and have relative reproductive effectiveness of 0.[1] In the table to the right in Figure E-1, broodstock management protocols have been significantly improved and the hatchery-origin fish in the spawning population are now thought to have relative reproductive effectiveness of 1.0 (i.e., they are producing an equal number of progeny as the natural-origin spawners). All other things being equal, it is expected that the same numbers of hatchery-origin and natural-origin spawners to produce twice as many recruits, an overall productivity improvement of 100 percent (100/100=1.0).

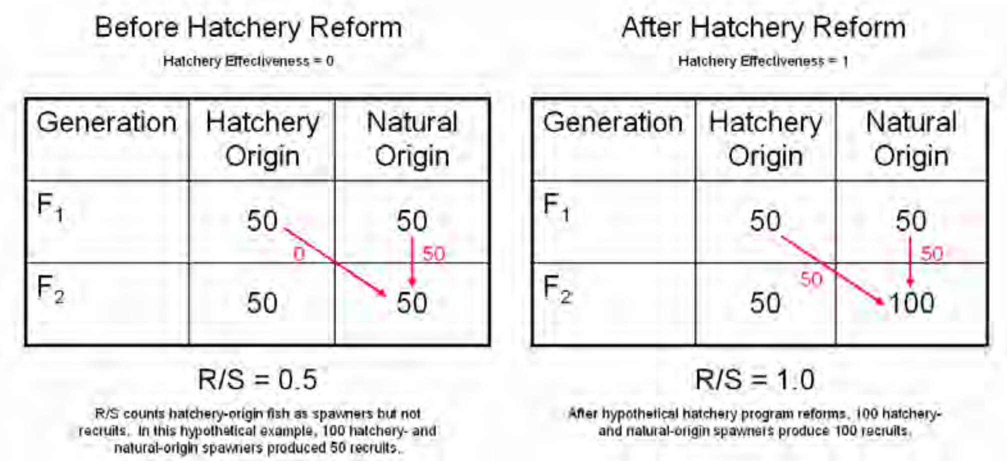

Figure E-1. Simplified Illustration of Hatchery Reform Benefits to Productivity of the Naturally Spawning Population

This phenomenon is even more pronounced in a case where significant straying of relatively unfit, non-native hatchery fish is curtailed. In the example above, it would be as though the hatchery-origin component of the naturally-spawning population was simply eliminated, again resulting in a productivity improvement of 100 percent, relative to the log(R/S) estimated for the historical period during which straying occurred.

Preliminary and draft guidance from NMFS provides the basis for the hatchery effectiveness and future hatchery/wild fraction estimates used in this analysis (NMFS 2007). The draft NMFS memo bases its conclusions on works by Berejikian and Ford (2004) and Araki et al. (2006). Briefly, four categories of hatchery programs are identified, distinguished primarily on the basis of broodstock management protocols.

> Category 1, includes non-local domesticated broodstock, hatchery-origin fish (hatchery-origin fish)<30 percent as reproductively effective as natural-origin fish (natural-origin fish);

[1] This example is intended to simplify the concept. It is not intended to imply that pre-reform hatchery-origin spawners would be likely to have relative reproductive effectiveness of 0, nor that post-reform hatchery-origin fish would be likely to be as productive as wild fish.

> Category 2, includes local-origin natural-origin fish broodstock (the broodstock consists entirely or primarily of natural-origin fish each generation), hatchery-origin fish are 90 to 100 percent as reproductively effective as natural-origin fish;
>
> Category 3, includes local-origin natural-origin fish and hatchery-origin fish broodstock (includes varying mixtures of hatchery and natural-origin fish in the broodstock each generation), hatchery-origin fish are 6-45 percent as reproductively effective as natural-origin fish (Araki et al. 2006); and
>
> Category 4 includes captive and farmed broodstocks.

Hatchery programs affecting certain populations in the interior Columbia River Basin were assessed according to these categories, both historically and prospectively. Estimates were made of past, present and likely future hatchery-origin fish/natural-origin fish fractions in the spawning populations. The equations that follow were then used to estimate changes in productivity expected to result from past and prospective hatchery reforms.

1.1 EQUATIONS DESCRIBING IMPROVEMENTS IN PRODUCTIVITY

The equations that follow describe a method of estimating the changes in the productivity of the naturally spawning population as hatchery effectiveness improves. In the analysis that follows, assume that $S_{h,t}$ represents hatchery-origin spawners in the naturally spawning population, $S_{w,t}$ represents the number of natural-origin spawners in that population, and e_t represents the relative reproductive success of hatchery-origin spawners. The goal is to find an expression for the productivity of the natural spawners, regardless of their origin. To do this, assume that the number of recruits from the natural-origin spawners is given by $R_{w,t}$ and that the number of recruits for the hatchery-origin spawners is given by $R_{h,t}$. Further assume that the proportion of natural-origin spawners is f_t and that $P_{w,t}$ represents the productivity of the natural-origin spawners, and $P_{h,t}$ represents the productivity of the hatchery-origin spawners.

The productivity of all natural spawners is equal to:

$$P(e_t) = \frac{R_{w,t} + R_{h,t}}{S_{w,t} + S_{h,t}} = \frac{P_{w,t}S_{w,t} + P_{h,t}S_{h,t}}{S_{w,t} + S_{h,t}} = \frac{P_{w,t}S_{w,t} + e_t P_{w,t}S_{h,t}}{S_{w,t} + S_{h,t}} = P_{w,t}(f_t + (1 - f_t)e_t)$$

Let's assume we are interested in how the geomean of natural spawner productivity changes over time, and we are interested in the change at time t_s and assume the final time in the series is t_f. The change in productivity can then be described by:

$$\delta = \sum_{t=t_s+1}^{t_f} \log\left\{P_{w,t}(f_t + (1-f_t)e_t)\right\} / \left(t_f - t_s\right) - \sum_{t=1}^{t_s} \log\left\{P_{w,t}(f_t + (1-f_t)e_t)\right\} / t_s$$

One of the difficulties in applying this equation directly is that $P_{w,t}$ is not known. However, if it is assumed that the average productivity of natural-origin spawners does not change after time t_s then we can write:

$$\delta = \sum_{t=t_s+1}^{t_f} \log\left\{(f_t + (1 - f_t)e_t)\right\} / \left(t_f - t_s\right) - \sum_{t=1}^{t_s} \log\left\{(f_t + (1 - f_t)e_t)\right\} / t_s$$

If it is further assumed that the fraction of natural-origin spawners and relative reproductive success of hatchery-origin spawners do not change after time t_s (assume they are fixed at f^* and e^*, respectively) then we can write:

$$\delta = \log\left\{(f^* + (1 - f^*)e^*)\right\} - \sum_{t=1}^{t_s} \log\left\{(f_t + (1 - f_t)e_t)\right\} / t_s$$

The fixed fraction of natural-origin spawners, f^*, could be set to the average over a subset of the data (e.g., the last 10 years) or to some assumed value. The current method fixes t_s at the most recently available year of spawner values and f^* and e^* represent assumed future values.

In order to place this result in terms of productivity ratios, the ratio of productivities is given as $\exp(\delta)$.

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Appendix F
Analysis of the Effects of Predation Management Actions

TABLE OF CONTENTS

LIST OF ATTACHMENTS

F.1 INTRODUCTION

This appendix addresses the effects of the predation management actions that are included as part of the Federal Columbia River Power System (FCRPS) Proposed Reasonable and Prudent Alternative (RPA). The appendix consists of two attachments:

Attachment F-1 – Benefits of Predation Management on Northern Pikeminnow
Attachment F-2 – Effects of Action to Reduce Tern Predation

These attachments are briefly described in the following paragraphs.

Attachment F-1 describes Predation Management Action 1 and continued adjustments to the base Northern Pikeminnow Management Program, which comprises this action. The attachment discusses methodology, specific actions, and estimated benefits.

Attachment F-2 addresses Caspian tern predation on fish species in the lower Columbia River. The attachment discusses tern consumption of juvenile salmonids, juvenile salmonid survival, and baseline to current and prospective survival changes.

Attachment F-1
Benefits of Predation Management on Northern Pikeminnow

TABLE OF CONTENTS

1. ACTION SUMMARY

The following predation management action (Predation Management Action 1) will be implemented to reduce mortality and improve survival of juvenile salmonids migrating through the Federal Columbia River Power System (FCRPS) projects on the Snake and Columbia rivers, and in the Columbia River downstream of Bonneville Dam.

- Implement the base Northern Pikeminnow Management Program (NPMP) and continue the general increase in the reward structure in the sport reward fishery similar to that of 2001 and 2004 through 2006. This includes increasing the budget for monetary rewards for harvesting northern pikeminnow structured in a tiered fashion to increase the reward as anglers increase total seasonal catch.
- Evaluate the benefit of additional removals and resultant increase in exploitation rate's effect on reduction in predator mortality since the 2004 program incentive increase.
- Continue to evaluate if inter- and intra-species compensation is occurring on surviving northern pikeminnow and other piscivorous species.

2. METHODOLOGY

The juvenile salmon survival benefits associated with an increased incentive program can be estimated by modeling the additional removals consistent with the general assumptions and model parameters used in evaluating and estimating the cumulative benefits of the NPMP to date. The general approach employed by NPMP analysts involves applying an appropriate northern pikeminnow consumption rate on juvenile salmonids (temporally and spatially) to the number of additional northern pikeminnow removed (temporally and spatially) to determine "number of smolts" not eaten. This provides an indication of potential incremental benefit of increased removals, assuming no significant inter-or intra-specific compensation.

3. SPECIFIC ACTIONS AND ESTIMATED BENEFITS

In 2006, the Action Agencies continued implementing a general increase in the reward structure started in the summer of 2004. Average exploitation rates (the percentage of the targeted size fish annually removed) in the NPMP, notwithstanding the increased reward structure in 2001 and 2004 through 2006, have averaged approximately 11 percent for the last 16 years. The observed exploitation rate on pikeminnow since increasing the monetary incentives has averaged 18 percent, an improvement of more than 50 percent.

Program evaluators are modeling the estimates of the increased exploitation rate's additional effect on reduction in predator mortality during the 2006-2007 off-season. This increase above the baseline, once estimated and quantified, is above and beyond the base benefits assumed in the analytical analyses at present. Therefore, the marginal benefit of any increase in exploitation rate resulting from increases in program incentives should be separate and above base-period benefits.

Preliminary results from the Oregon Department of Fish and Wildlife (ODFW) evaluation indicate an increase in the reduction in northern pikeminnow predation resulting from the observed increase in annual exploitation since 2004 and improved estimates of pikeminnow over-wintering mortality on the order of 42 percent (ODFW, Tucker Jones, personal communication). This represents a 60 percent increase in the benefits compared to previous benefit estimates.

For the 2004 Summer Spill Offset Process, the Action Agencies developed a model to quantify the marginal impact of the additional harvest and resultant change in the exploitation rate of pikeminnows. The model was developed for juvenile fall Chinook salmon as the focal species, because impacts from elimination of spill in August primarily affected that stock. This model could be modified to consider other salmonid stocks. The model and analysis assumes average consumption rates and geographical distribution of pikeminnow removals within the Snake and Columbia rivers based on historical data. The model accounts for juvenile fish transportation and timing of juvenile runs, and for the gradual within-season removal of northern pikeminnow. It also accounts for the abundance of smolts entering the FCRPS or below Bonneville Dam, and assumes that northern pikeminnow feed only to satiation.

The Action Agencies determined that a 1 to 2 percent increase in the exploitation rate (20,000 to 40,000 increase in catch) would result in an additional savings of approximately 1,400,000 to 2,800,000 smolts across the lifespan of the northern pikeminnow caught. This equated at the time to a 0.6 percent increase in the juvenile survival of migrating salmonids. Currently, the NPMP is observing closer to 90,000 additional pikeminnow catch since 2004 relative to the average pikeminnow catch for the previous 16 years.

It appears reasonable, based mainly on the preliminary ODFW evaluation and the 2004 Summer Spill Offset Analysis, to conclude that increasing the incentive in the pikeminnow removal program and resultant marginal increase in observed exploitation rate has a positive benefit in reduction in pikeminnow mortality. Pre-program estimates of the northern pikeminnow predation rate on juvenile salmonid migrants in the Columbia River basin are 8 percent (NMFS 2000, FCRPS BiOp at 9-106). Before implementation of the additional incentive program in 2004, the cumulative benefit has reduced the pikeminnow related mortality rate to 6 percent (25 percent reduction, Friesen and Ward 1999). Preliminary estimates of reduction in predator mortality are now 42 percent, or an additional 1.4 percent reduction. Therefore, it is reasonable to assess the marginal benefit to outmigrating salmonids as at least 1 percent increase relative to the baseline.

4. SPECIES AFFECTED

Juvenile salmonids are the major dietary component of northern pikeminnow greater than 250 millimeter (mm) fork length. The importance of salmonids in the diet of northern pikeminnow does vary seasonally; however, all migrating salmonids receive benefit from the NPMP.

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Attachment F-2
Effects of Action to Reduce Tern Predation

TABLE OF CONTENTS

LIST OF TABLES

1. BACKGROUND

Caspian tern predation on fish species in the lower Columbia River is a major source of mortality for Endangered Species Act (ESA)-listed Snake River and Columbia River juvenile salmonids. The tern population has changed substantially over the base period (1980 to 2001). The year of first occurrence of Caspian terns in the Columbia River Estuary is known to be 1984 when they first used East Sand Island. By 1986, the bulk of the tern population was at Rice Island with a remnant colony (numbers unknown) at East Sand Island. Caspian terns nested exclusively at Rice Island from 1987 to 1998.

Management efforts were implemented in 1999 to shift the Caspian tern colony back to East Sand Island. The split in the nesting colony for 1999 and 2000 can be seen in Table 1. Data are reported separately for the islands in those years to facilitate further analysis.

2. TERN CONSUMPTION OF JUVENILE SALMONIDS

Caspian tern population estimates were derived and where necessary, interpolated, from known data. Research data collected by D. Roby (U.S. Geological Survey/Oregon State University) and associates formed the basis for these analyses. Collis et al. (1998) had documented population estimates for the Columbia River Estuary Caspian tern colony for 1984, 1986, 1987, and 1991 from U.S. Army Corps of Engineers (Corps) and U.S. Fish and Wildlife Service (USFWS) biologists. Research data for 1997 to 2006 (Collis 2007) provided Caspian tern population estimates for that time period. Population estimates for the years when data were unavailable were interpolated from estimates for the years that encompassed the time period.

Total estimated juvenile salmonid consumption by Caspian terns is based upon research results for the period 1997 to 2006. Estimates of annual smolt consumption were calculated using a bioenergetics modeling approach (see Roby et al. 2003 for a detailed description of model construction and input variables). The annual consumption estimates from 1997 to 2006 were compiled by the researchers and forwarded to Portland District, Corps for utilization in preparation of these estimates. These data were derived from a (Lyons 2007) and populate Table 1 for the years research occurred.

To calculate total juvenile salmonid consumption for years prior to 1997, these data were separated by island (e.g., Rice Island and East Sand Island). For each island, the number of juvenile salmonids consumed per tern per year was determined. Thus, for East Sand Island, data from 1999 to 2006 were evaluated to determine the average number of juvenile salmonids consumed per tern per year. For Rice Island, the average was calculated for 1997 to 2000. These averages were then multiplied by the estimated tern population at Rice Island or East Sand Island for the years prior to 1997 to generate total juvenile salmonids consumed for this period.

Table 1. Caspian Tern Population Estimates and Estimated Consumption of Juvenile Salmonids at Rice Island and East Sand Island from 1980 to 2006

	Breeding Pairs		Estimated Consumption			
Year	**East Sand**	**Rice**	**Yearling Chinook**	**Sub-Yearling Chinook**	**Steelhead**	**Coho**
1980	0	0	0	0	0	0
1981	0	0	0	0	0	0
1982	0	0	0	0	0	0
1983	0	0	0	0	0	0
1984	**1,000**	0	130,126	92,529	78,179	273,167
1985	1,000	0	130,126	92,529	78,179	273,167
1986		**1000**	92,392	667,590	162,506	505,512
1987	0	**1350**	124,729	901,247	219,384	682,441
1988	0	2563	236,800	1,711,033	416,504	1,295,627
1989	0	3776	348,871	2,520,820	613,624	1,908,813
1990	0	4989	460,942	3,330,607	810,744	2,521,999
1991	0	**6200**	572,828	4,139,058	1,007,540	3,134,174
1992	0	6356	587,241	4,243,202	1,032,891	3,213,034
1993	0	6512	601,654	4,347,346	1,058,242	3,291,894
1994	0	6668	616,067	4,451,490	1,083,593	3,370,754
1995	0	6824	630,480	4,555,634	1,108,944	3,449,614
1996	0	6980	644,893	4,659,778	1,134,295	3,528,474
1997	0	**7134**	**280,000**	**2,875,000**	**1,030,000**	**3,965,000**
1998	0	**8766**	**700,000**	**5,460,000**	**1,370,000**	**4,860,000**
1999		**8328**	**1,120,000**	**7,520,000**	**1,340,000**	**3,080,000**
1999	**588**		**70,000**	**440,000**	**70,000**	**150,000**
2000		**547**	**130,000**	**260,000**	**180,000**	**4,010,000**
2000	**8,513**		**1,480,000**	**1,010,000**	**840,000**	**300,000**
2001	**8,982**	**0**	**1,170,000**	**1,000,000**	**570,000**	**3,090,000**
2002	**9,933**	**0**	**1,350,000**	**960,000**	**740,000**	**3,480,000**
2003	**8,325**	**0**	**1,100,000**	**700,000**	**560,000**	**1,800,000**
2004	**9,502**	**0**	**840,000**	**630,000**	**530,000**	**1,460,000**
2005	**8,822**	**0**	**970,000**	**370,000**	**730,000**	**1,490,000**
2006	**9,201**	**0**	**1,380,000**	**830,000**	**980,000**	**2,060,000**

Notes:
Bolded numbers based on research data from Dan Roby (U.S. Geological Survey/Oregon State University).

A similar process to juvenile salmonid consumption estimates for years prior to 1997 was used to calculate the number of sub-yearling Chinook salmon, yearling Chinook salmon, steelhead, and coho consumed by terns per year at either East Sand Island or Rice Island. Juvenile salmonid consumption data, broken into the four "species" categories (Lyons 2007) was grouped by island and the average percent composition for each island was then multiplied by the estimated juvenile salmonid composition (total) for the respective islands to provide a "species" breakdown.

3. JUVENILE SALMONID SURVIVAL

The analysis of tern predation on juvenile salmon and steelhead survival in the estuary divides the tern predation effects into three time periods: 1) baseline covers 1980 to 2001; 2) current condition includes 2002 to 2006; and 3) prospective [a future tern population level which is based on the 'Future 2' population objective or 3,125 breeding pairs established in the 2005 *Caspian Tern Management to Reduce Predation of Juvenile Salmonids in the Columbia River Estuary FEIS* (USFWS 2005)].

To estimate the effects of tern predation on juvenile salmonid survival, estimates of the number of juvenile salmonids consumed (Table 1) were divided by the number of juvenile salmonids estimated to arrive at Tongue Point [Fish Passage Center (FPC) hatchery release, transportation, and in-river migrant estimates for 1987 to 1999; National Marine Fisheries Service (NMFS, also known as National Oceanic and Atmospheric Administration [NOAA]) Estimation Memos, 2000-2006; Table 2]. No estimates were available prior to 1987. Therefore, the 1987 to 1999 smolt numbers for each species were averaged and then extrapolated to those years.

Table 2. Estimated Number of Smolts Arriving at Tongue Point from 1980 to 2006

Year[1/]	Scenario[2/]	Yearling Chinook	Sub-Yearling Chinook	Steelhead	Coho	Total
1980		12,798,976	69,429,653	11,301,436	27,187,701	120,756,907
1981		12,798,976	69,429,653	11,301,436	27,187,701	120,756,907
1982		12,798,976	69,429,653	11,301,436	27,187,701	120,756,907
1983		12,798,976	69,429,653	11,301,436	27,187,701	120,756,907
1984		12, 798,976	69,429,653	11,301,436	27,187,701	120,756,907
1985		12,798,976	69,429,653	11,301,436	27,187,701	120,756,907
1986		12,798,976	69,429,653	11,301,436	27,187,701	120,756,907
1987		10,457,444	74,372,997	8,738,765	27,187,701	120,756,907
1988		15,710,187	89,231,869	9,978,598	34,614,359	149,535,013
1989		11,083,229	90,629,260	10,979,152	29,653,583	142,345,224
1990		14,459,431	81,363,074	12,279,275	38,356,235	146,458,015
1991		11,726,399	84,080,243	13,266,512	36,080,187	145,153,341
1992		14,601,665	67,780,287	10,228,875	32,143,160	124,753,987
1993		12,320,315	73,934,735	13,084,545	30,724,931	130,064,526
1994		13,030,326	60,043,148	10,831,845	22,931,208	106,836,527
1995		14,383,917	81,437,342	11,669,565	25,577,140	133,067,964
1996		9,777,921	66,457,615	12,028,607	21,630,781	109,894,924
1997		10,676,760	56,810,074	10,320,437	18,498,204	96,305,475
1998		12,956,348	41,692,702	11,009,686	16,731,779	82,390,515
1999	T & S	15,202,744	34,752,149	12,502,812	21,035,814	83,493,519
2000	T & S	30,565,835	47,345,104	13,981,625	26,194,669	118,087,233
2001	Full T	23,704,323	38,571,680	14,923,748	22,573,035	99,772,786
2002	T & S	35,891,234	52,830,287	14,875,230	16,429,704	120,026,455
2003	T & S	38,662,026	59,463,290	15,767,097	21,258,982	135,151,395
2004	T & S	33,826,302	60,475,322	13,639,272	15,023,348	122,964,244
2005	T & S	37,104,975	81,247,508	13,692,298	25,950,135	157,994,916
2006	T & S	38,832,655	89,791,172	14,963,344	22,613,494	166,200,665

Notes:
1/ Smolt numbers for 1987 to 1999 are estimates of transported, in-river migrants, and hatchery releases from the Fish Passage Center. Smolt estimates from 1980 to 1986 are extrapolated using 1987 to 1999 averages. Data for 2000 to 2006 are from NMFS estimation memorandums 2000 to 2006.
2/ T&S refers to transport with spill. Full T refers to full transport scenarios.

Estimated consumption rates for the baseline, current condition, and prospective tern population scenarios are presented in Table 3. The average consumption rates per breeding pair were estimated and then extrapolated that rate to the future estimates of the tern population. For the baseline, we used the average tern numbers and consumption rates from 1980 to 2001. For the current condition, we used the average tern numbers and consumption rate from 2002 to 2006. To estimate the consumption rates for the prospective condition, we calculated the 2002 to 2006 average proportion of smolts consumed per breeding pair, and expanded it to the future tern population objective of 3,125 breeding pairs.

Table 3. Estimated Consumption Rate of Juvenile Salmonids by Lower Columbia River Terns for the Baseline, the Current Condition, and the Action

Timeframe	Number of Tern Pairs	Yearling Chinook	Subyearling Chinook	Steelhead	Coho
Baseline (1980-01)	4,458	0.027	0.031	0.046	0.066
1999 Alone	*8,916*	*0.078*	*0.229*	*0.113*	0.119
Current (2002-06)	9,157	0.030	0.011	0.049	*0.154*
Prospective	3,125	0.010	0.004	0.017	0.036

Note:
1/ Based on USFWS 2005, 'Future 2'

4. BASELINE TO CURRENT AND PROSPECTIVE SURVIVAL CHANGES

Relative survival changes resulting from the relocation of terns to East Sand Island (baseline to current) and additional benefits that would be expected for the future reduced tern population objective in the Tern Environmental Impact Statement (EIS) (prospective) (USFWS 2005) are presented in Table 4.

Relative survival changes for the baseline to current condition are calculated by dividing the estimated absolute survival of the current condition by the estimated absolute survival of the baseline condition. For example, the baseline to current relative survival change for yearling Chinook salmon would be calculated as (1-current consumption)/(1- baseline consumption) = (1-0.030)/(1-0.027) = 0.996. It is assumed that these relative survival rates, which are based on the entire Columbia Basin run for each species and rearing type, are the same as they would be for the respective Evolutionarily Significant Units (ESUs). For example, the 1.007 relative survival rate for all subyearling Chinook salmon under the prospective scenario would be same as that for the Snake River Fall Chinook Salmon ESU.

Estimates of juvenile salmonids at Tongue Point prior to the year 2000 assume that there is no mortality between Bonneville Dam and Tongue Point. The analysis also assumes that juvenile chum salmon and Snake River Sockeye Salmon consumption by terns is not substantial enough for there to be a survival benefit from the proposed tern population reduction (Collis et al. 2002).

Table 4. Relative Juvenile Salmonid Survival Changes Attributed to Tern Relocation Actions

Timeframe	Yearling Chinook	Sub-Yearling Chinook	Steelhead	Coho
Current 2 S/ Baseline 2 S	0.996	1.021	0.997	0.957
Prospective 2 S / Current 2 S	1.021	1.007	1.034	1.078

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Appendix G
Analysis of the Effects of Harvest Actions

TABLE OF CONTENTS

LIST OF TABLES

1. INTRODUCTION

This appendix presents the estimates of survival changes associated with past changes in harvest management that were supplied by Anthony Nigro of the Oregon Department of Fish and Wildlife on behalf of an ad hoc technical workgroup representing certain of the parties in the *U.S. v. Oregon* process. These estimates were used in the base-to-current adjustment of the biological analyses for Snake River Spring/Summer Chinook Salmon, Upper Columbia River Spring Chinook Salmon, Snake River Steelhead, Upper Columbia River Steelhead, and Mid-Columbia River Steelhead populations presented in this document.

The appendix consists of four tables:

Table G-1—Estimated Survival Changes for Spring Chinook Salmon
Table G-2—Estimated Survival Changes for Summer Steelhead A-Run (excludes Skamania Stock)
Table G-3—Estimated Survival Changes for Summer Steelhead B-Run
Table G-4-- Estimated Survival Changes for URB Chinook Salmon

Table G-1. Estimated Survival Changes for Spring Chinook Salmon

Spring Chinook

Harvest Rate (%)

	Under the Columbia River Fish Management Plan (CRFMP)	Under an Adjusted CRFMP (Rates in 2000-2004 equal "05-07 Bridge" Rates for those years multiplied by the the average "CRFMP" rate for 1996-1999 divided by the average "05-07 Bridge" rate for 1996-1999)	05-07 Bridge
1983	12.00%	12.00%	8.50%
1984	12.00%	12.00%	7.00%
1985	12.00%	12.00%	9.00%
1986	12.00%	12.00%	10.00%
1987	12.00%	12.00%	10.00%
1988	12.00%	12.00%	9.00%
1989	12.00%	12.00%	9.00%
1990	12.00%	12.00%	9.00%
1991	12.00%	12.00%	8.50%
1992	12.00%	12.00%	9.00%
1993	12.00%	12.00%	10.00%
1994	10.00%	10.00%	5.50%
1995	10.00%	10.00%	5.50%
1996	12.00%	12.00%	8.50%
1997	12.00%	12.00%	10.00%
1998	10.00%	10.00%	6.00%
1999	10.00%	10.00%	6.00%
2000	41.90%	15.87%	11.00%
2001	81.70%	23.08%	16.00%
2002	72.20%	20.20%	14.00%
2003	58.00%	17.31%	12.00%
2004	53.00%	17.31%	12.00%
2005	12.00%	12.00%	9.00%
2006	13.60%	13.60%	10.00%
Average Harvest Rate (1983-2006)	22.02%	13.14%	9.35%
Base Period Average Harvest Rate (CRFMP:1983-2003)	21.42%	12.97%	
Current Period Average Harvest Rate (05-07 Bridge:1983-2006)			9.35%

	Survivals (Using CRFMP Rates for 2000-2003)	**Survivals (Using Adjusted CRFMP Rates for 2000-2003)**
Base	Base (CRFMP:1983-2003) 0.79	Base (Adjusted CRFMP:1983-2003) 0.87
Current	Current (05-07 Bridge:1983-2006) 0.91	Current (05-07 Bridge:1983-2006) 0.91
Lifecycle Adjustment	Lifecycle Adjustment (Base-to-Current) 1.15	Lifecycle Adjustment (Base-to-Current) 1.04

Survival improvements are of adult fish returning to the mouth of the Columbia River, not smolts arriving at Bonneville Dam

Table G-2. Estimated Survival Changes for Summer Steelhead A-Run (excludes Skamania Stock)

Summer Steelhead A's (excludes Skamania stock)

Return Year	Number of Adults Returning to Bonneville Dam	Estimated Number of Adults Returning to the River Mouth/1	Non-Indian Harvest Rates (%)	Treaty-Indian Harvest Rates (%) /2,3	Total Harvest Rates (%)
1985	51,922	52,960	2.00	20.49	22.49
1986	56,570	57,701	2.00	13.66	15.66
1987	106,690	108,824	2.00	15.48	17.48
1988	64,331	65,617	2.00	16.96	18.96
1989	57,513	58,663	2.00	19.78	21.78
1990	27,102	27,644	2.00	20.04	22.04
1991	60,264	61,470	2.00	16.42	18.42
1992	44,294	45,179	2.00	18.42	20.42
1993	28,650	29,223	2.00	16.55	18.55
1994	21,212	21,636	2.00	11.37	13.37
1995	25,997	26,517	2.00	12.48	14.48
1996	25,721	26,235	2.00	11.72	13.72
1997	30,852	31,469	2.00	12.95	14.95
1998	34,836	35,532	2.00	12.67	14.67
1999	56,626	57,192	1.00	7.52	8.52
2000	63,628	64,519	1.40	5.44	6.84
2001	137,230	139,138	1.39	6.23	7.62
2002	87,276	88,410	1.30	5.10	6.40
2003	67,049	67,994	1.41	5.41	6.82
2004	60,421	61,206	1.30	7.48	8.78
2005	58,917	59,742	1.40	6.13	7.53
2006	63,734	64,626	1.40	5.70	7.10
		Average Harvest Rate (1985-2006)	1.75	12.18	13.94
		Base Period Average Harvest Rate (1991-2003) /4	1.73	10.94	12.67
		Current Period Average Harvest Rate (1997-2006)	1.46	7.46	8.92

Survivals
Base (1991-2003) 0.87
Current (1997-2006) 0.91
Lifecycle Adjustment (Base-to-Current) 1.04

Survival improvements are of adult fish returning to the mouth of the Columbia River, not smolts arriving at Bonneville Dam

/1 = Number of Wild A-Run Steelhead Returning to Bonneville X (1 + Non-Indian Harvest Rate)

/2 = Catch of Wild A-Run Steelhead in Tribal Fisheries / Estimated Number of Adults Returning to the River Mouth

/3 Treaty catch of Wild A-Run Steelhead in all fishing seasons.

/4 Average return age 4-5 years; first harvest impact to brood year 1996 (used in Interior Columbia Technical Recovery Team analysis) would occur in return year 1991.

Table G-3. Estimated Survival Changes for Summer Steelhead B-Run

Summer Steelhead B's

Return Year	Number of Adults Returning to Bonneville Dam	Estimated Number of Adults Returning to the River Mouth/1	Non-Indian Harvest Rates (%)	Treaty-Indian Harvest Rates (%) /2,3	Total Harvest Rates (%)
1985	12,986	13,245	2.00	30.43	32.43
1986	9,984	10,184	2.00	26.22	28.22
1987	13,990	14,270	2.00	36.52	38.52
1988	17,742	18,097	2.00	22.99	24.99
1989	12,367	12,615	2.00	34.32	36.32
1990	8,811	8,987	2.00	21.13	23.13
1991	6,207	6,331	2.00	29.36	31.36
1992	12,715	12,969	2.00	25.81	27.81
1993	4,378	4,465	2.00	18.72	20.72
1994	5,152	5,255	2.00	18.23	20.23
1995	1,847	1,884	2.00	18.25	20.25
1996	3,912	3,990	2.00	33.94	35.94
1997	3,913	3,991	2.00	13.98	15.98
1998	3,415	3,483	2.00	15.30	17.30
1999	3,740	3,798	1.56	12.37	13.93
2000	8,368	8,525	1.87	14.08	15.95
2001	12,047	12,236	1.57	11.34	12.91
2002	32,333	32,828	1.53	3.34	4.87
2003	6,418	6,588	2.65	14.56	17.21
2004	9,202	9,371	1.84	11.10	12.94
2005	9,619	9,802	1.90	12.05	13.95
2006	8,465	8,634	2.00	15.65	17.65
		Average Harvest Rate (1985-2006)	1.95	19.99	21.94
		Base Period Average Harvest Rate (1990-2003) /4	1.94	17.89	19.83
		Current Period Average Harvest Rate (1997-2006)	1.89	12.38	14.27

Survivals
Base (1990-2003) 0.80
Current (1997-2006) 0.86
Lifecycle Adjustment (Base-to-Current) 1.07

Survival improvements are of adult fish returning to the mouth of the Columbia River, not smolts arriving at Bonneville Dam

/1 = Number of Wild B-Run Steelhead Returning to Bonneville X (1 + Non-Indian Harvest Rate)

/2 = Catch of Wild B-Run Steelhead in Tribal Fisheries / Estimated Number of Adults Returning to the River Mouth

/3 Treaty catch of Wild B-Run Steelhead in all fishing seasons.

/4 Average return age 5 years; first harvest impact to brood year 1996 (used in Interior Columbia Technical Recovery Team analysis) would occur in return year 1990.

Table G-4. Estimated Survival Changes for URB Chinook

URB Chinook

Return Year	Non-Indian Harvest Rates (%)	Treaty-Indian Harvest Rates (%)	Total Harvest Rates (%)
1983	5.53	14.17	19.70
1984	20.02	22.10	42.12
1985	18.73	27.68	46.41
1986	23.61	33.18	56.79
1987	27.74	29.31	57.05
1988	26.82	36.90	63.72
1989	19.34	37.81	57.15
1990	14.38	38.71	53.09
1991	16.02	24.13	40.15
1992	9.18	17.14	26.32
1993	8.01	19.76	27.77
1994	0.12	18.06	18.18
1995	1.43	17.52	18.95
1996	5.54	20.83	26.37
1997	5.80	26.37	32.17
1998	3.41	23.19	26.60
1999	7.29	23.05	30.34
2000	7.27	21.51	28.78
2001	5.94	15.11	21.05
2002	7.34	20.95	28.29
2003	8.67	12.88	21.55
2004	8.97	11.58	20.55
2005	8.64	16.96	25.60
2006	8.13	18.95	27.08
Average Harvest Rate (1983-2006)	11.16	22.83	33.99
Base Period Average Harvest Rate (1983-2003)	11.53	23.83	35.36
Current Period Average Harvest Rate (1994-2006)	6.04	19.00	25.04

Survivals
Base (1983-2003)
0.65
Current (1994-2006)
0.75
Lifecycle Adjustment (Base-to-Current)
1.16

Survival improvements are of adult fish returning to the mouth of the Columbia River, not smolts arriving at Bonneville Dam

Appendix H
Consideration of Climate Change

TABLE OF CONTENTS

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

All-H	hydro, habitat, hatchery, and harvest
BA	Biological Assessment
BiOp	biological opinion
ENSO	El Niño Southern Oscillation
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FCRPS	Federal Columbia River Power System
GHG	greenhouse gases
ICBTRT	Interior Columbia Basin Technical Recovery Team
IPCC	4^{th} Intergovernmental Panel on Climate Change
ISAB	Independent Science Advisory Board
lambda	population growth rate
MPG	major population group
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPMP	Northern Pikeminnow Management Program
PDO	Pacific Decadal Oscillation
R/S	recruits-per-spawner
RM&E	research, monitoring, and evaluation
RPA	Reasonable and Prudent Alternative
RSW	removable spillway weir
SRBA	Snake River Basin Adjudication
TMT	Technical Management Team
URC	upper rule curve
USFWS	U.S. Fish and Wildlife Service

H.1. INTRODUCTION

A number of reports have recently addressed the prospects and implications for climate change in the Pacific Northwest and the Columbia River Basin. The Action Agencies recognize that climate change could pose an additional threat to the survival and recovery of Endangered Species Act (ESA) listed species during the term of the Federal Columbia River Power System (FCRPS) and the Upper Snake River Biological Opinion (BiOp), and consequently steps have been undertaken to ensure that the implications these potential changes could have on ESA-listed salmon and steelhead have been considered. To a significant extent, the existing proposed Reasonable and Prudent Alternative (RPA) already addresses potential impacts of climate change in its provisions for dry year strategies, predator management, and habitat protection and improvements. In addition, under the adaptive management approach, the Action Agencies will continue to monitor and assess potential climate change impacts on hydrological and fish conditions, and provide a mechanism to implement additional actions if appropriate.

This appendix discusses the general temperature and hydrologic trends expected in the future, the effects these trends might have on ESA-listed salmon and steelhead, and how the Action Agencies took these effects into consideration in developing the Proposed RPA.

H.2. POTENTIAL IMPACTS TO TEMPERATURE AND HYDROLOGY

The Columbia River Basin is primarily a snowmelt driven system, relying heavily on the spring freshet to maintain river levels and water quality through the majority of the spring and summer. Snowpack accumulation and the timing of the runoff are critical to supplying streamflows during the April through August period, a key period for agriculture, recreation, hydropower, and fish. Runoff volume and timing are also important for the drafting and refilling of the system for flood control protection. The two main drivers to the hydrology of the Columbia River Basin are air temperature and precipitation.

Temperature and precipitation regimes during the last century have primarily been dominated by natural variations and known climate cycles such as the El Niño Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO). Distinguishing between short climate cycles and long term climate trends is not easy. Precipitation over the last century has displayed several wet and dry periods, with no clear “trend”. In fact, the climate models used in the 4th Intergovernmental Panel on Climate Change (IPCC) Assessment Report provide for a modest range of projected precipitation scenarios which all fall within the natural variability that occurred over the last century. It is not until late in the 21st century that most models project long-term increases in winter precipitation and decreases in summer precipitation. The historic precipitation record captures the range of projected climate change scenarios for the Columbia River Basin.

Air temperatures are a different matter. Although temperature variability over the last century has occurred, there is still a distinguishable warming trend. For the Pacific Northwest this trend has been a 1.0˚C increase since 1900 or about 50 percent more than the global average warming over the same period. In fact, the latest climate models project a warming of 0.1 to 0.6˚C per decade over the next century. This rate of warming has the potential in itself to alter the hydrology and water conditions of the Columbia River Basin. In a basin reliant on cooler winter temperatures to store much of the impending water supply in the snowpack, warmer temperatures could have the following impacts:

- Warmer temperatures will result in a shift to more winter/spring rain and runoff, rather than snow that is stored until the spring/summer melt season.
- With a shift to more rain and less snow, the snowpacks will diminish in those areas that typically accumulate and store water until the spring freshet. With a smaller snowpack, these watersheds

will see their runoff diminished and exhausted earlier in the season, resulting in lower streamflows in the June through September period.

- River flows in general and peak river flows are likely to increase during the winter due to more precipitation falling as rain rather than snow.
- Water temperatures will continue to rise, especially during the summer months when lower streamflows and warmer air temperatures will contribute to the problem.

Sensitivity to warming temperatures may not be as obvious across the Columbia River Basin over the next few decades due to the fact that many of the watersheds in the basin are at elevations high enough to still maintain temperatures below freezing for most of the winter and early spring. The most noticeable changes will occur in the “transient snow” watersheds or low elevation basins where the threshold between freezing and non-freezing temperatures will be much more sensitive to warming.

At this time, changes to water supply or runoff volumes for the key Columbia River Basin drainages appear to be more susceptible to shorter climatic cycles, such as El Niño and the PDO, than a perceptible longer term trend. The variability experienced in the last 10-15 years falls within the variability seen in the Columbia River Basin over the last 80 years.

H.2.1 POTENTIAL IMPACTS TO OCEAN CONDITIONS

Global climate changes are also projected to impact ocean conditions. It is known that current ocean conditions in the northeast Pacific Ocean are dictated by three key factors; the Aleutian Low variability, El Niño/La Niña events, and PDO phases. Shifting of the strength, phases, or positioning of these factors can impact the conditions of the ocean in important areas for various ecosystems. How these factors will be altered in future due to global warming is still unsure, however, potential impacts are as follows:

- Increases in ocean surface temperatures;
- Increased stratification of the water column;
- Changes in the intensity and timing of coastal upwelling; and
- Increases in CO_2 in the ocean, lowering the pH.

There is still a broad range of uncertainty surrounding the potential impacts to the ocean. A key uncertainty is how global warming will influence the characteristics of atmospheric surface pressure and wind fields over the North Pacific because of the prominent role that wind forcing plays in structuring the upper ocean. As with the overall hydrology of the Columbia River Basin, the ocean impacts from global warming are also difficult to separate from the natural variability which occurs from such cycles as El Niño and the PDO.

H.3. POTENTIAL EFFECTS ON ESA-LISTED SALMON AND STEELHEAD

H.3.1 POTENTIAL BIOLOGICAL EFFECTS ON THE MAINSTEM RIVER

The Independent Science Advisory Board (ISAB) prepared the report *Climate Change Impacts on Columbia River Basin Fish and Wildlife* (May 11, 2007) that identified the following key findings regarding potential effects on salmonids in the mainstem Snake and Columbia rivers:

- Fall Chinook salmon spawn in the mainstem of the Snake and Columbia rivers. Increases in water temperature will accelerate the rate of egg development and lead to earlier emergence, most likely at a smaller average size than historically. Smaller-sized fry may have lower survival due to increased vulnerability to predators.
- Predation on salmonids may be increased by elevated water temperatures. Northern pikeminnow generally select smaller fish when feeding on juvenile salmonids. Warmer temperatures may reduce the size of smolts. Elevated water temperatures also will increase consumption rates and growth rates of predators.
- Warmer water temperatures may exclude salmonids from reaches with temperatures that are already close to their upper thermal limit. Even where water temperatures do not exclude use by salmonids, metabolic rates will increase, leading to reduced growth rates where food is limited and smaller size at the end of the summer. Smaller fish typically suffer higher mortality rates during winter than do larger fish.
- Many fish pathogens and parasites common in the environment and their salmon hosts may become more injurious when smolts become thermally stressed. Future increasing water temperatures may therefore increase the frequency of occurrence and severity of bacterial gill and bacterial kidney disease infections in salmonids throughout the Columbia River Basin.
- Potential impacts of increased water temperatures on adult salmon include delay in dam passage, failure to enter fish ladders, and loss of energy reserves due to increased metabolic demand. Increases in mortality also may be caused by fish pathogens and parasites as these organisms often do not become injurious until their host is thermally stressed.
- Numerous warm-water adapted fish, including several non-indigenous species, normally found in freshwater may expand their populations with the warmer water and seasonal expansion of freshwater habitats. The potential impacts on salmon are not understood.

H.3.2 POTENTIAL BIOLOGICAL EFFECTS IN TRIBUTARY AREAS

The potential effects of climate change on the Columbia River Basin salmonid freshwater lifecycle stage is significant, according to the ISAB Report and a recent study by Battin, et al. (2007).

The ISAB Report notes that there is uncertainty about how severe or widespread the loss of cool-water fish habitat will be in the Columbia River Basin, but there is compelling and growing evidence to indicate that significant changes in the quality and quantity of habitat suitable for salmon and other cool-water species will occur. Sites most susceptible to effects from higher summer water temperatures would include those locations that currently experience high summer air temperatures. Lower elevation areas, locations east of the Cascade Mountain crest and in the southern portions of the Columbia River Basin would be expected to be most affected.

Changes in hydrology will affect tributary habitats in those watersheds where snow levels are impacted. Watersheds that are just above the current snow line currently may experience a change from a snow melt dominated hydrologic regime to one that is driven primarily by rainfall or rain on transient snow pack. Even those watersheds that remain above the snow line will experience earlier snow-melt runoff. These changes in hydrology all may have associated impacts on salmonid productivity.

The effects of climate change on terrestrial ecosystems may increase the severity and frequency of both fires and insect infestation that may indirectly impact aquatic habitats important to salmon and other cold-water species. Loss of tree cover will lead, until tree re-growth occurs, to an increase in solar radiation reaching the water surface, which would exacerbate water temperature. Reduction in tree cover may also lead to increased snow accumulation and earlier and more rapid melting. This development would contribute to an earlier period of high flows, increasing the risk of mass soil movements such as landslides and debris torrents. Some of the highest quality aquatic habitat remaining in the Columbia River Basin is found in forested areas. Loss of forests due to fire and insect outbreaks will disproportionately impact key habitats for fish and wildlife.

The projected changes in temperature and hydrologic conditions have the potential to affect salmonid fishes during all their freshwater life history stages. Climate change has the potential to fundamentally alter the capacity of the Columbia River Basin to produce salmon.

Potential effects on egg incubation and fry emergence can include:

- Increased maintenance metabolism will produce a smaller fry
- Lower disease resistance may lead to lower survival
- Faster embryonic development will lead to earlier hatching
- Increased mortality due to more frequent flood flows as snow level rises

Increased frequency and severity of flood flows during winter can affect over wintering juvenile fish and eggs incubating in the streambed and elsewhere. Eggs of fall and winter spawning fish, including Chinook, coho, chum, and sockeye salmon and bull trout, may suffer higher levels of mortality when exposed to increased flood flows. Scouring of the streambed can dislodge the eggs and elevated sediment transport caused by high flow can increase sediment deposition in redds, suffocating eggs.

Spring spawning fish, such as steelhead and cutthroat trout, also may suffer increased egg mortality due to dewatering of redds caused by earlier snow melt runoff. Shifts in the timing and magnitude of natural runoff will likely introduce new selection pressures that may cause changes in the most productive timing or areas for spawning.

Potential effects on spring/summer rearing can include:

- Lower summer/early autumn flow will reduce habitat area,
- Cold-water species may be excluded from areas currently occupied,
- Lower growth due to increased metabolic rate (if food limiting),
- Competitive advantage from non-native and warm-water species,
- Increased predation mortality if temperatures exceed optimal levels, and
- Fish in streams with very cold water may benefit (high elevations).

Reduction in spring and summer stream flow in watersheds where snow pack has been reduced and snow melt timing advanced may impact the quality of rearing habitat. Reduction in summer and early autumn flows will, at a minimum, reduce the area of wetted stream channel, thereby reducing available habitat for rearing fish. In addition, susceptibility to predation may be increased due to shallower water or stranding of fish in isolated pools.

Warmer water temperatures during summer can have a variety of effects. Salmonids may be excluded from reaches with temperatures that are already close to their upper thermal limit. Even in systems where water temperatures do not exclude use by salmonids, metabolic rates will increase. In systems where food is limited, the increased energy required for metabolic maintenance will reduce growth rates leading to smaller size at the end of the summer. Smaller fish typically suffer higher mortality rates during winter than larger fish.

Potential effects on overwinter survival can include*:*

- Potential for positive and negative effects;
- Higher water temperature increases metabolic rate and activity:
  - Higher growth rate with sufficient food
  - Lower growth rate if food is limiting;
- Higher predation rates; and
- Increased frequency and severity of winter high flow will have detrimental effects: Fish displaced downstream if sufficient off-channel, refuge habitat not available.

Increased winter water temperatures may have both positive and negative impacts on fish. Higher winter temperatures may enable fish to feed more actively during the winter, potentially increasing growth rates if sufficient food is available. If food is in limited supply, the elevated metabolic demands created by elevated winter temperatures could reduce winter growth rates and contribute to reduced smolt size the following spring. Higher winter temperatures also would increase the activity of predators, possibly increasing fish mortality.

Climate change effects experienced by fish during the spring and summer also can affect their ability to survive through the winter. Generally, higher summer temperatures will reduce the growth rates of juvenile fish, reducing average size entering winter. Body size at the end of summer has been shown to be positively related to overwinter survival. In certain circumstances higher water temperatures during spring and summer may accelerate growth, if sufficient food is available to offset the higher metabolic cost associated with elevated temperature. This effect is likely to occur most frequently in cold, high-elevation streams.

Where the hydrologic regime changes from snow melt dominated to rain dominated, more frequent high flows could occur. These circumstances are likely to cause increased mortality if winter habitat that provides refuge from floods is not available. This type of habitat is often located on floodplains in the form of low-gradient tributaries or ponds. As floodplain habitat along many of the major rivers in the Columbia River Basin has been modified or isolated from the channel, refuge habitat is likely to be very limited. Therefore, the hydrologic changes during winter associated with climate change would be likely to elevate mortality.

H.3.3 POTENTIAL BIOLOGICAL EFFECTS IN THE ESTUARY AND OCEAN

Climate change could have the following potential biological effects on the Columbia River Estuary and the Pacific Ocean:

- For immigrating adults, an increase in ocean temperatures could lead to a loss in energy reserves because of increasing metabolic demand. Pre-spawn mortality of Chinook salmon in the Yukon River, Alaska has been linked to rising average water temperatures in the last thirty years.
- Information on the effects of climate change on the Columbia River estuary is limited, but includes both marine and freshwater changes resulting in a complex interaction of influences in this transition zone. Forecasts suggest higher average Columbia River flows in winter and early spring flows, and less snowmelt in summer in future years. It is reasonable to expect that any increase in freshwater temperatures will result in warming in the estuary.
- A change in species composition in the estuary could increase predation on salmon by Caspian terns. An increase in non-native species including shad could both directly compete with salmon for forage and habitat, and increase predation.
- Factors that are known to affect the North Pacific climate include the Aleutian Low variability, El Niño events, and PDO phases. These are all well described and may demonstrate future impacts of climate change.
- If the climate change is expressed in the North Pacific, El Niño or PDO warmer waters would promote increased production in Alaskan waters and lower production in the Pacific Northwest region influenced by the California Current System. However, it is not known how global warming would influence the upper ocean via wind and surface pressure, and if higher temperatures would lead to increased surface stratification thereby reducing the availability of nutrients.
- On a global scale increased upper ocean temperatures have been documented to reduce primary productivity since 1997.
- A growing mismatch of coastal upwelling and smolt migrations would likely have significant negative impacts on marine survival rates. Warmer sea temperatures require increased prey consumption to maintain a given growth rate. This could delay the time when populations return to fresh water to spawn.

In summary, it is not known if increased ocean surface temperatures will have similar or possibly more severe impacts than seen in recent El Niño events and warm phases of the PDO. A lack of certainty exists on the effects of wind on stratification and availability of nutrients. A change in the timing of upwelling is likely as are changes in prey availability and timing of physical and biological forcing mechanisms affecting salmon survival.

Evolutionary change is possible and this has been observed in salmon introduced to New Zealand and the artificial selecting for early spawning times of hatchery-reared salmon in the Pacific Northwest. This could partially ameliorate climate changes.

H.3.4 SENSITIVITY ANALYSIS FOR A RANGE OF FUTURE OCEAN PRODUCTIVITY CONDITIONS

The Action Agencies' biological analysis assumes that future ocean and climate conditions will approximate the average conditions that prevailed during the 20-year base period used for the analytic assessments (approximately 1980 to 2000). This period fell almost entirely within a warm PDO phase, which has been shown to be strongly correlated with poor ocean productivity and Columbia River Basin salmon returns (Mantua et al 1997; Peterson et al. 2006). Thus, the analysis takes a precautionary approach to future ocean conditions.

The Interior Columbia Basin Technical Recovery Team (TRT) has modeled the effects on population status for two Interior Columbia River Basin Evolutionarily Significant Units (ESUs) under alternative early ocean climate regimes (Interior Columbia Basin TRT and Zabel 2006). The modeling exercise produced survival multipliers associated with three ocean condition scenarios representing the observed ocean conditions roughly corresponding to the base period used in the Action Agencies' Comprehensive Analysis (1980 to 2001), a period of relatively poor ocean conditions (1975 to 1998) and a relatively good set of conditions from a 100-year historical period.

The following tables (Tables H-1 and H-2) display the results of the Action Agencies' biological analysis for Upper Columbia Spring Chinook Salmon and Snake River Spring/Summer Chinook Salmon under these three future climate assumptions. The results are expressed in terms of estimated future recruit-per-spawner productivity. The observed condition corresponds to the climate assumptions used in the Action Agencies biological analysis. The sensitivities for "poor" and "historical" ocean conditions represent estimated future recruits-per-spawner (R/S) productivities that might be expected under those future climate and ocean productivity conditions.

Table H-1. Upper Columbia River Spring Chinook Salmon Climate Scenarios

Major Population Group (MPG)	Observed Ocean Future R/S	Poor Ocean Future R/S	Historical Ocean Future R/S
Wenatchee River	1.16	0.74	1.61
Methow River	1.41	0.90	1.96
Entiat River	1.45	0.93	2.02

Table H-2. Snake River Spring/Summer Chinook Salmon Climate Scenarios

	Observed Ocean Future R/S	Poor Ocean Future R/S	Historical Ocean Future R/S
Lower Snake MPG			
Tucannon River	1.31	1.11	1.81
Grande Ronde/Imnaha MPG			
Catherine Creek	0.88	0.75	1.23
Lostine River	1.12	0.96	1.56
Minam River	1.38	1.18	1.92
Imnaha River	0.86	0.73	1.19
Wenaha River	1.30	1.11	1.81
Upper Grande Ronde River	0.77	0.65	1.07
S. Fork Salmon MPG			
South Fork	1.25	1.06	1.73
Secesh River	1.49	1.27	2.07
East Fork South Fork	1.39	1.18	1.93

Table H-2. Snake River Spring/Summer Chinook Salmon Climate Scenarios (continued)

Middle Fork Salmon MPG			
Big Creek	1.76	1.50	2.45
Bear Valley Creek	1.93	1.64	2.68
Marsh Creek	1.39	1.18	1.93
Sulphur Creek	1.26	1.07	1.75
Camas Creek	1.26	1.07	1.75
Loon Creek	1.72	1.46	2.39
Chamberlain Creek			
Lower Middle Fork			
Upper Salmon MPG			
Lemhi River	1.66	1.41	2.31
Valley Creek	1.55	1.32	2.16
Yankee Fork	1.25	1.07	1.74
Upper Salmon	2.44	2.07	3.39
N. Fork Salmon			
Lower Salmon	1.77	1.51	2.46
East Fork Salmon	1.68	1.43	2.34
Pahsimeroi	1.81	1.54	2.51

H.4. POTENTIAL MITIGATION ACTIONS TO REDUCE CLIMATE CHANGE IMPACTS

If predictions of climate change do occur, and fall outside the range of historical conditions, the distribution of fish and wildlife populations in the Columbia River Basin will change and many currently suitable habitats will not be suitable in the future, regardless of efforts at the local watershed level. The ISAB suggested the following actions to minimize these effects:

- Hydro Passage and Operations
  - Provide additional flow augmentation in summer to reduce water temperature
  - Use removable spillway weirs (RSWs) to reduce time spent by juvenile salmon in warm water dam forebays
  - Reduce water temperature in fish ladders during adult salmon migration
  - Establish thermal criteria for initiation of full transportation for juvenile fall Chinook salmon

- Tributary Habitat
  - Protect or restore riparian buffers along streams to provide/restore summer shade cover for lower water temperatures
  - Remove stream barriers to fish passage into thermal refugia
  - Maintain high summer stream flows by managing water withdrawals to help alleviate both elevated temperatures and low stream flows during the summer and autumn
  - Buy or lease water rights to dedicate to instream flows
  - Improve efficiencies of diversions and irrigation systems to reduce water loss
  - Protect and restore wetlands, floodplains, and other landscape features that store water for use in summer and autumn
  - Protect and restore cool-water refugia along and within tributaries of the Columbia for migrating adult salmon and steelhead and young of the year

- Predator Management

  - Reduce predation by liberalizing harvest of introduced predatory fish (e.g., walleye and bass)

- Hatchery Management
  - Reduce release of hatchery fish during poor ocean conditions to enhance wild fish survival

- Harvest Management
  - Modify fish management practices in the ocean to address impacts of climate change
  - Develop mechanisms to incorporate climate change, PDO, or ENSO cycles into run size predictions and harvest management

H.4.1 HOW THE FCRPS PROPOSED RPA AND UPPER SNAKE PROPOSED ACTIONS ADDRESS CLIMATE CHANGE

Humans contribute to global climate change through their production of "greenhouse gases" (GHGs), such as carbon dioxide. The FCRPS dams and generators subject to this consultation produce only insignificant amounts of these gases (e.g., possibly some methane). Indeed, the FCRPS has allowed the region to avoid the construction of significant amounts of fossil-fuel fired generation – the type of generation that gives the rest of the electric utility industry such a high "carbon footprint."

If the FCRPS dams were removed, or their power production more tightly restrained, greenhouse gas emissions in the Northwest would likely be exacerbated by the consequent switch to higher impact fuels (e.g., coal and natural gas). Thus, the FCRPS helps to prevent green house gases from being produced, and ameliorates the causes of climate change. Therefore, production of greenhouse gases should not be considered to be either a direct or indirect effect of the Proposed RPA.

Even though the FCRPS helps to reduce greenhouse gas emissions within the region, the Action Agencies' Proposed RPA includes strategies that implement many of the ISAB's suggested actions.

H.4.1.1 Dry Year Strategies

The Proposed RPA includes a "dry year" strategy to exercise flexibility to distribute available water across the expected migration season to optimize biological benefits and anadromous fish survival. The Action Agencies will coordinate use of this flexibility in the Regional Forum to ensure that the limited water available is distributed in a manner that will maximize water quality and benefits to migrating juvenile and adult fish.

In addition, consistent with operating plans developed under the Canadian Treaty, in dry water years Treaty reservoirs will be operated below their normal refill levels in the late spring and summer, therefore increasing flows during that period relative to a standard refill operation. Annual agreements between the U.S. and Canadian Entities to provide flow augmentation storage in Canada for U.S. fisheries needs will include provisions that allow flexibility for the release of any stored water to provide U.S. fisheries benefits in dry water years, to the extent possible.

BPA will continue to pursue opportunities in future long-term non-Treaty storage agreements to develop mutually beneficial in-season agreements with Canada to shape water releases using non-Treaty storage space within the year and between years to improve flows in the lowest 20th percentile water years to the benefit of ESA-listed ESUs, considering ESU status. Upon issuance of the FCRPS BiOp, the Action Agencies will convene a technical workgroup to scope and initiate investigations of alternative dry water year flow strategies to enhance flows in dry years for the benefit of ESA-listed ESUs.

Another dry year strategy is to maximize transport for Snake River migrants in early spring through May 31. During low water years, the environmental conditions for migrating fish deteriorate in-river, and increased transportation leads to higher survival of both juveniles and returning adults. BPA will implement as appropriate its *Guide to Tools and Principles for a Dry Year Strategy* to reduce the effect energy needs may pose to fish operations and other project purposes. These strategies are intended to reduce the extent that power needs have to rely upon hydrogeneration, and have the effect of reducing the likelihood that emergency power operations might occur (as in 2001), and increases the availability of in-stream water for use by fish.

H.4.1.2 Use of RSWs and Transportation

The Proposed RPA includes firm commitments to installation of surface bypass systems such as RSWs, which are recommended by the ISAB, along with performance standards to guide their operation. In addition, in dry years, when the projected amount of spring seasonal average flow below 65,000 cfs (lowest 15 percent), transportation will be initiated April 3 at the Snake River collector projects. Transportation from Snake River projects will be maximized (i.e., no voluntary spill or bypass provided) until May 31. Beginning June 1, to spread-the-risk for migrating subyearling Chinook salmon, spill and transportation would be adaptively managed, such that when subyearling Chinook salmon exceeded 50 percent of the collection for a 3-day period, a spill and transportation operation would be initiated at each dam. Transportation is maximized during these dry year scenarios because in-river conditions, such as temperature and predation, significantly deteriorate for migrating fish. As the projected amount of spring runoff increases, the initiation of transportation is delayed and amount of in-river migration increases.

H.4.1.3 Flow Variation and Refill

Under the Proposed RPA, a change in precipitation (such as more rain and less snow in winter) is addressed in large part by current flood control operation strategies. Storage Reservation Diagrams are used to establish flood control rule curves [also called Upper Rule Curves (URC)] that direct the amount of storage that must be evacuated throughout the year to provide flood protection to points downstream. The amount of storage to be evacuated is dependent on the magnitude of the volume of water forecast to run off in the spring. The volume forecasts are updated on a monthly basis. So, in the case of more snow pack and cooler temperatures (leading to the expectation of higher runoff volume in the spring), the flood control requirement is that more flood storage space be evacuated. On the other hand, if global warming causes less snow and a shift to more rain in the winter (reducing the expected spring runoff due to snow melt), then the flood control requirement is for less space to be evacuated in the winter. Thus, the current flood control rule criteria allows for flexibility and mid season corrections to adjust for variations in weather patterns. However, if the peak snowmelt hydrograph moves earlier in the season, it may be necessary to shift the timing of flood control draft to accommodate refill of some reservoirs or to maintain the current level of flood protection.

H.4.1.4 Temperature Control

Beginning in 1992, Dworshak Reservoir water as cool as 6°C has been released during July and August to decrease water temperatures in the Snake River. This action is done in an attempt to provide benefits to summer migrating juvenile and adult salmonids in the lower Snake River system. The Corps operates Dworshak Dam and implements this strategy on an annual basis at the request of the National Marine Fisheries Service (NMFS, also called National Oceanic and Atmospheric Administration [NOAA] Fisheries). This operation has proven to be an effective tool to cool the temperature at the tailwater of the Lower Granite Dam. The Action Agencies coordinate through Technical Management Team (TMT) and the Nez Perce Tribe [for Snake River Basin Adjudication (SRBA) actions] to determine water temperature releases from Dworshak during late June through September to make best use of the cool water at depth in the reservoir. In addition, the Action Agencies will complete studies to evaluate temperature effects on adult Snake River Steelhead and Fall Chinook Salmon of drafting Dworshak Reservoir to 1520 feet elevation and extending the draft period into September.

Reclamation's Upper Snake River Proposed Actions include provision to shift some flow augmentation delivery earlier in the migrating season, if or when needed, for the purpose of improving temperature management in the lower Snake River below Hells Canyon Dam. Reclamation will continue to work with the NMFS to determine the most favorable timing for Upper Snake River flow augmentation for listed fish.

H.4.1.5 Predator Management

The Proposed RPA includes a number of actions to control predators of salmon and steelhead. These actions provide tools to manage increases in predation that could result from warmer temperatures. The Action Agencies propose to manage predators of salmonids through the following actions and programs:

Northern Pikeminnow Management Program (NPMP) – Provides monetary rewards for the harvesting of this native predator of juvenile salmon and steelhead. This program has been implemented for the past 16 years. Studies indicate that as a result of this program, cumulative removal of pikeminnow has resulted in a 25 percent reduction in predation by the pikeminnow. The RPA proposes to continue this effective predation control program.

Non-indigenous fish – While they do not have management authority over non-indigenous fish such as American shad or smallmouth bass, the Action Agencies will collaborate with the States and Tribes with management authority to review, evaluate, and develop strategies to reduce non-indigenous piscivorous predation.

Avian predators in the estuary –Redistribute Caspian terns from the Columbia River estuary to alternative habitats consistent with a management plan. The Action Agencies are also conducting additional research of Double-crested cormorants in the estuary, and will develop and, if warranted, implement a management plan to reduce impacts to juvenile salmonids. Research, monitoring, and evaluation (RM&E) will also continue.

Avian predators in the Mid-Columbia – Develop and implement a plan to manage the colonies of double-crested cormorants and Caspian-terns on the Corps-managed Crescent Island and Foundations Island. The management plans will be preceded by a thorough analysis of avian predator diets, predation rates, and overall effects of current avian predation on various salmonid ESUs. This will be a comprehensive plan developed in collaborative discussion with the U.S. Fish and Wildlife Service (USFWS).

H.4.1.6 Habitat Protection and Improvement

The FCRPS Proposed RPA includes commitments to fund extensive habitat actions in the estuary and tributaries, an area of potential climate change response identified by the ISAB. In the tributaries, these actions include:

- Increasing streamflows through water acquisition,
- Addressing entrainment through screening,
- Providing fish passage and access,
- Improving mainstem and side channel habitat conditions,

- Protecting and enhancing riparian conditions, and
- Improving water quality.

In the estuary, the Actions Agencies will:

- Acquire, protect and restore off-channel habitat;
- Restore tidal influence and improve hydrologic flushing;
- Restore floodplain reconnection by removing or breaching dikes or installing fish friendly tide gates;
- Remove invasive plants and weeds; replant native vegetation;
- Protect and restore emergent wetland habitat and riparian forest habitat; and
- Restore channel structure and function.

H.4.1.7 Adaptive Management Process

The Action Agencies have used the best available scientific information within the Biological Assessment (BA)/Comprehensive Analysis. However, as with any analysis for a species with a complex lifecycle, there is uncertainty associated with the evaluation of survival, recovery, and biological benefits. To address this uncertainty, the Action Agencies proposal incorporates an adaptive management structure of checks and balances that include monitoring to performance standards and targets, continued collaboration and oversight, adaptive actions and contingencies (see Adaptive Management, Contingencies and Oversight Section in Chapter 2, FCRPS BA, Upper Snake River Flow Augmentation Delivered, Section 3.2.1.1, Upper Snake River BA).

Within the adaptive management process, there is an All-H (i.e., hydro, habitat, hatchery, and harvest) diagnosis framework that tracks the population abundance and trends of each population (Tier 1 technical assessment). If a significant number of an ESU's populations have decreasing trends in abundance, R/S, or lambda (population growth rate), then a more specific diagnosis is triggered. This Tier 2 component of the All-H diagnosis, which investigates the reasons for these decreasing trends, includes evaluation of the impact of climate and environmental conditions on the status of the populations that are not performing as expected. If this evaluation shows adverse conditions outside of the historic range of conditions considered in the biological analysis (i.e., climate change effects, unexpected adverse ocean conditions, or other unpredictable climate or environmental impacts), the Action Agencies will use adaptive management or contingencies--or reconsult--to address additional needed survival improvements and associated actions to address these adverse conditions. As described above we have identified the range of potential actions that would be undertaken depending on the specific impacts that are observed.

The Action Agencies are pursuing various activities and building partnerships with others to better understand and incorporate climate change information into future water resources management and project operations. On the local scale, Reclamation participates on the Climate Impacts Subcommittee of the Idaho Water Supply Committee in an effort to better understand and address the issue of climate change in southern Idaho. Reclamation's Pacific Northwest Region is developing "climate changes" water supply data sets in partnership with other entities for various watersheds in the Columbia River basin to improve modeled operational analyses. The Bonneville Power Administration is working with the University of Washington Climate Impacts Group and other entities to develop "climate changed" streamflows in order to improve the modeling of the FCRPS under potential climate change scenarios. Results from these studies will help to better understand the impacts of climate change to the hydrology of the Basin. In addition, the Action Agencies continue to be actively involved in workshops, studies, and research partnerships with universities and research organizations to better understand climate change impacts.

At a larger scale, encompassing the western United States, the Secretary of the Interior has convened a Climate Change Task Force which will evaluate information needs and identifying strategies for managing lands and waters, protecting fish and wildlife, and minimizing the Department's environmental footprint. Information from these efforts will be incorporated as available and appropriate to operationally respond to changing climate trends while meeting ESA obligations.

H.4.2 THE FCRPS AND UPPER SNAKE RIVER PROJECTS ARE BENEFICIAL TO THE ATMOSPHERE FROM A CARBON STANDPOINT

Previous sections in this appendix focused on how global climate change may affect salmon recovery and FCRPS and Upper Snake River operations. Humans contribute to global climate change through their production of "greenhouse gases" (GHGs), such as carbon dioxide. The FCRPS dams and generators subject to the FCRPS consultation produce insignificant amounts of these gases (e.g., possibly some methane). The existence of FCRPS, and to a lesser extent the dams in the upper Snake River, have likely resulted in a lower "carbon footprint" than use of fossil fuel alternatives.

H.5. CONCLUSIONS

As noted above, the biological analysis in the BA/Comprehensive Analysis already contains a relatively pessimistic view of ocean conditions within the timeframe of the FCRPS Proposed RPA. Thus, the Action Agencies believe the amount of "additional" impacts that may occur as a result of global warming is likely already more than accounted for in the current biological analysis. Moreover, the Action Agencies believe the FCRPS Proposed RPA and Upper Snake River Proposed Action appropriately considered the potential impacts of climate change, consistent with the recommendations made by the ISAB. As described above, the FCRPS Proposed RPA and Upper Snake River Proposed Action includes a multitude of measures that will actually improve climate sensitive habitat conditions for fish throughout the course of these consultations. Besides these specific actions, the adaptive management program, by committing to achieving specific biological performance standards, provides additional assurances that potential climate change will be more than adequately addressed by the FCRPS Proposed RPA and the Upper Snake River Proposed Action.

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Appendix I
Consideration of Human Population Growth

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

FCRPS	Federal Columbia River Power System
ISAB	Independent Science Advisory Board
PBDE	polybrominated diphenyl ether
PCB	polychlorinated biphenyl
PNW	Pacific Northwest
Report	"Human Population Impacts on Columbia River Basin Fish and Wildlife." ISAB 2007-3.
RPA	Reasonable and Prudent Alternative

I.1. INTRODUCTION

The Independent Scientific Advisory Board (ISAB) produced a report entitled, “Human Population Impacts on Columbia River Basin Fish and Wildlife “ (Report), in June 2007 (Independent Scientific Advisory Board, ISAB 2007-3). The central point of the Report is that human population and its pattern on the landscape significantly impact fish and wildlife. While the cause of population change within the Columbia River Basin takes place against a large background of changes in population worldwide, nationally, and in the West, the action agencies have considered this potential impact, and are addressing the issue to a degree in our proposed Reasonable and Prudent Alternative (RPA).

I.2. POPULATION PATTERNS AND PROJECTIONS FOR GROWTH

The Pacific Northwestern portion of the United States and Canada, which encompasses the Columbia River Basin, has a current population of 15 million people. The population of the Pacific Northwest (PNW) is expected to grow to 50 to 100 million people by the end of the century (330% to 667% increase). Global population is expected to increase from the present 6 billion to 8 to 12 billion people (33% to 100% increase) by the end of the century. While it is difficult to accurately predict population growth, as a “fill-in region,” it is clear the PNW will be much more densely populated in the future. The impact on fish and wildlife, especially salmon, in the PNW will be significant, as many of the most populous countries lie on the Pacific Rim. Worldwide declines in mid-latitude salmon abundance closely follow human population growth and the additional stresses of increasing water temperatures possibly linked to global warming. The mid-latitude salmon populations are on the threshold of optimum water temperatures and, therefore, most vulnerable to any additional environmental impacts that an increasing population will bring.

I.3. LINKING POPULATION TO THE NATURAL ENVIRONMENT

Using the “I = PAT” equation: “Environmental Impact = Population x Affluence/Consumption x Technology,” the Report details how population growth affects the environment. Environmental impact represents how “species, natural resources, and whole ecosystems are affected or impacted by humans.” Population is the total number of people (this also includes growth indicators, distribution and composition). Affluence/consumption is how much each person consumes and how much waste each person generates. Finally, technology represents how a resource is used and how much “waste and pollution is created by the production and consumption of the resource.”

I.4. POPULATION EFFECTS IN THE COLUMBIA RIVER BASIN

The Report cites a National Research Council review of PNW salmon management, which stated (among other things) the following, “As long as human populations and economic activities continue to increase, so will the challenge of successfully solving the salmon problem.” Changes in both the size and distribution of the Columbia River Basin population will be influenced by “climate, vegetation, and the availability of water. Human population will in turn affect ecological processes.”

Increasing water demand will be “exacerbated by climate change effects on the quantity and temperature of summer stream flows in many subbasins.” As rural development increases, the demand for water will grow, affecting water quantity and quality. In most rural areas, people draw their water from subsurface groundwater sources. Such withdrawals can induce movement of water from streams into aquifers, depleting stream flows. The Report notes some of the effects of pumping, including, “lowered surface flows, reductions in spring flows, higher stream temperatures, lower oxygen levels, and dewatering of streams." Such water reductions can affect flows in the "hyporheic zone in the shallow subsurface of the streambed." Adequate water flow is necessary in the hyporheic zone because it brings cool, oxygenated water into contact with eggs left by spawning salmon. Water quality is affected by rural development, due to the widespread use of septic tanks, and the resulting discharge of nutrients and bacteria into the ecosystem.

The Report next examines the conversion levels of forests and agricultural lands. In the United States, 10.3 million acres of non-federal forest land was converted to non-forest use between 1982 and 1997. The number of farms in the United States has declined significantly since 1950, from 5 million to 2 million. In Oregon, approximately 870 acres of agricultural land are lost each year to urban expansion, 700 acres are lost to rural development of rezoned lands, and 15,000 acres are converted to "ranchette, rural homes and vacation homes." Efforts to conserve agricultural land are threatened by state laws that significantly deregulate land use and biofuel production. Preservation of forest and farm lands is important for maintaining biodiversity, wildlife habitat, and water quality.

Significant mining operations in the Columbia River Basin have also impacted water quality and stream flows. Sand and gravel mining, if unchecked, could disrupt continuity of sediment transport down the streams and rivers, resulting in "channel and bed erosion, channel incision, and low availability of spawning gravels for salmon." Demand for energy is also expected to rise by approximately 5,000 average megawatts by 2025, creating a challenging balance between societal values of an adequate power supply and preserving environmental values.

De-forestation , agriculture, mining, urbanization, and sprawl all combine to cause changes in the "physical, chemical and ecological characteristics of stream ecosystems." Often, such changes are "detrimental to native aquatic biota, including salmon." One physical effect of increasing urbanization is the expanding area of impervious surfaces in a watershed. As a result, precipitation cannot penetrate the soil, which causes more runoff. Increased surface runoff causes higher peak flows of shorter duration, reducing groundwater recharge and base flow discharge in urban streams. Additionally, urbanization alters channel networks, changes channel width and depth, and can change water temperatures because of removal of riparian vegetation and reduced groundwater input.

Urbanization has increased amounts of chemicals in urban streams. "Effluent from industrial facilities, discharge from wastewater treatment plants, runoff from paved surfaces, and pesticides and fertilizers from lawns all find their way into urban streams." Some chemicals cause increased growth of algae and other plant life. When the organic material decomposes in water with higher temperatures, low levels of dissolved oxygen are recorded. Scientists have also documented rising levels of various other elements, chemicals, pharmaceuticals, hormones and personal care products in water including: mercury, polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), antibiotics, steroids, antidepressants, caffeine, insect repellant and fragrances.

The physical and chemical changes of streams and rivers due to urbanization combine to alter the ecology of critical fish and wildlife habitats. Invertebrates have also been affected by urbanization, as most studies have found declining levels in urban streams and rivers.

The physical, chemical and ecological changes have negatively affected fish communities, resulting in declining diversity and abundance. Studies conducted in various parts of the country found salmon populations, such as the coho salmon, especially sensitive to urbanization. In some streams where the coho salmon had been dominant, urbanization was found to directly correlate with the ascendance of invasive species that overtook the native coho salmon population. Exurban development ("low density, semi-rural residential lands that are intermediate between urban and rural in population or housing density") represents the dominant trend in human settlement in the Western U.S. since 1970. In addition, much exurban development occurs near wetlands, riparian zones and valley bottoms, thus accentuating their effects upon fish and wildlife. The Report concludes that exurban development has led to "decreased species diversity, decreased abundance, and local extirpation of some species...and increases in species associated with people...."

I.5. POPULATION AND OUTSIDE-BASIN EFFECTS

The Report identifies five "population-driven" factors external to the Columbia River Basin affecting fish and wildlife: international trade, shipping, dredging, hazardous material transport and airborne pollution. Ports along the Columbia River are expected to keep getting busier, resulting in more ship traffic. Ship traffic and trade affect fish communities along the river by introducing aquatic invasive species, by making waves that strand fish, and by eliminating fish habitat as ports expand. To support increased ship traffic, the river must be continually dredged to maintain channel depth and width, affecting sediment supply. Hazardous material transportation is increasing in the region to support the growing population, putting streams and rivers at risk of spills. Lastly, airborne pollution, especially from overseas, has increased the levels of dust and chemical particles in the air and has likely reduced the quality of ocean water.

I.6. INCORPORATING HUMAN POPULATION INTO FISH AND WILDLIFE RESTORATION PLANNING

Four elements are outlined for incorporating changes in human population into land use planning:

- Stakeholder involvement
  - Landowners must regard the management process as fair and predictable
  - Monitoring should inform habitat-enhancing housing and development design
  - The Report cites the Deschutes River Basin Water Management Convning Assessment Process, as an example

- Explicit spatial modeling of critical resources (habitat, species, water quality and quantity, etc.) and development patterns to provide a scientific basis for decision-making
  - Subbasin plans need to incorporate human population growth more explicitly. Currently, very few do.
  - The Report cites as an example the Coastal Landscape Analysis and modeling Study, an "integrated ecological-socioeconomic" approach, which attempts to understand consequences of forest policies on different ecological outputs.

- Investigation of alternative development scenarios
  - The Willamette Partnership created the Willamette Ecosystem Marketplace, a mechanism where "regulated industries, developers, and other investors can pay land managers to manage for ecosystem services such as clean abundant water, healthy populations of fish and wildlife, and a stable environment.

- Evaluation and monitoring to enable adaptive management

Other strategies the Report recommends are: to build from strength; to create wild salmon refuges; and to protect habitat that supports diverse fish and wildlife populations. Some of the tools to protect desirable habitat include: fee simple acquisitions; conservation easements; settlement and land management agreements; habitat conservation plans; water and land leases; purchase of development rights; transfer of development rights; tradable environmental credits (market-based approach allowing private parties to pay for ecological restoration); certification programs such as “Salmon Safe”; and salmon strongholds (protect remaining healthy wild stocks before they are threatened).

The proposed Federal Columbia River Power System (FCRPS) RPA includes commitments to fund extensive habitat actions, many of which are consistent with the recommendations listed above. For example, the RPA will call for land acquisitions, conservation easements, acquisition of development rights, water acquisitions, and water leases, among other actions. Specifically, the proposed RPA will: increase streamflow through water acquisition; provide fish passage and access to rearing and spawning habitat by removing or improving man-made barriers; protect and restore mainstem, side channel, floodplain, riparian and tidal habitat; improve water quality; remove invasive plants and weeds and replant with native vegetation; and restore emergent wetland habitat, forest habitat, and channel structure and function.

I.7. FINDINGS AND RECOMMENDATIONS

The Report describes four areas related to protections for fish and wildlife and recommendations for changing planning processes, adding new conservation tools and coordinating efforts with appropriate authorities.

- Protections for Fish and Wildlife
  - Impacts of population growth were not adequately incorporated in many subbasin plans
  - There is a wide range of innovative natural resource planning processes that effectively incorporate consideration of human population growth
  - Urban containment can be effective in limiting exurban sprawl
  - Incorporating human population growth into fish and wildlife planning requires stakeholder involvement, spatial modeling of critical resources and development patterns, investigation of alternative development scenarios, and evaluation and monitoring to enable adaptive management.

- Planning Processes
  - Explicitly address population growth in planning and prioritization of projects at the subbasin scale (plans should be flexible and adaptable to population growth)
  - Create dialogue among ranchers, environmentalists, and policy-makers to increase understanding of the economic and ecological value of ranchlands and the economic costs of rural sprawl
  - Focus actions on “protecting the best” in areas of rapid population growth
  - Increase monitoring and curb movement of aquatic invasive species

- Tools
  - Establish permanent refugia “strongholds” to minimize interactions between salmon and human activities
  - Avoid habitat fragmentation
  - Protect areas that will restore headwater sources of cool water in warm streams
  - Provide incentives to private landowners to protect fish and wildlife habitat
  - Provide incentives for water conservation
  - Provide incentives to modify the timing and quantity of irrigation withdrawals
  - Provide incentives to purchase or lease water rights and eliminate withdrawls of shallow groundwater in the vicinity of salmon bearing streams
  - Utilize emerging markets for ecosystem services

- Coordination with other Authorities
  - Encourage more regulation of development in prime habitat areas
  - Encourage water and land use plans that promote sustainable surface and groundwater use in the face of population growth
  - Encourage the strengthening of water quality regulations
  - Avoid barriers to wildlife movement across good habitat
  - Coordinate with environmental agencies outside the Columbia River Basin if their mandates affect Basin habitat

I.8. CONCLUSION

Although an increase in the human population is not a direct or indirect effect of the proposed action, an increase in the human population in the PNW is reasonably certain to occur. The precise locations and degree of increases that will occur are not known, but there is little doubt that increases in population will continue in general within the Basin until at least 2030. Moreover, the types of impacts attributable to population growth, and their deleterious effects to salmon are well understood. While the action agencies do not regulate or control human population growth, they are committed to implement habitat actions that will protect and improve land and water resources that are important to listed salmon and steelhead. Through the implementation of the proposed RPA, some land and water areas that might otherwise be developed or degraded will be acquired or otherwise protected, for the benefit of listed salmon and steelhead.