Endangered Species Act
Section 7 Consultation

BIOLOGICAL OPINION

On the

Continued Operation and Maintenance of the Willamette River Basin Project and Effects to Oregon Chub, Bull Trout, and Bull Trout Critical Habitat Designated Under the Endangered Species Act.

As Proposed by:

U.S. Army Corps of Engineers (Department of Army)
Bonneville Power Administration (Department of Energy)
Bureau of Reclamation (Department of Interior)

Prepared by:
U.S. Fish and Wildlife Service
Oregon Fish and Wildlife Office

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1. INTRODUCTION

This document constitutes the Fish and Wildlife Service's (FWS) biological opinion (BO) based on our review of the proposed continued operation and maintenance of the Willamette River Basin Project and associated bank protection (Willamette Project). This BO considers the Willamette Project's effects on listed species and critical habitat under the FWS' jurisdiction in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). Your Supplemental Biological Assessment (Supplemental BA) and request for formal consultation were received in our office on June 5, 2007. Additional information was requested by the FWS on June 22, 2007, in order to complete the consultation package. The requested information was transmitted to the FWS on August 20, 2007, via email in the form of an Addendum to the Supplemental BA.

The proposed action, detailed in the above documents, was further modified at the request of the U.S. Army Corps of Engineers (USACE), Bonneville Power Administration (BPA), and Bureau of Reclamation (BOR) (together the Action Agencies) in a January 30, 2008, letter to the FWS that requested we consult on the proposed action as modified by a Reasonable and Prudent Alternative (RPA), developed by the National Marine Fisheries Service (NMFS) in collaboration with the Action Agencies. The reasons for this request are further explained below.

This consultation is subject to recent litigation by Willamette Riverkeeper (WRK) and the Northwest Environmental Defense Center (NEDC) alleging that the FWS (and other involved Federal agencies) violated the Administrative Procedures Act (APA) by unreasonably delaying a BO for the Willamette Project pursuant to the FWS' duties under the ESA. The complaint (Willamette Riverkeeper and Northwest Environmental Defense Center v. U.S. Army Corps of Engineers et al, Civil No. 07-CV- 1399 PK) was filed on September 20, 2007, in the United States District Court for the District of Oregon. A settlement agreement was subsequently reached on February 26, 2008. The settlement agreement stipulated, in part, that the FWS and NMFS (together the Services) shall provide the Action Agencies with final BOs on or before July 11, 2008.

In October and November 2007, the NMFS initiated a series of facilitated meetings with the Action Agencies. The purpose of these meetings was to investigate measures, in addition to those already proposed, that could further minimize the proposed action's effects to listed salmon and steelhead and associated habitat. The FWS participated in the meetings at both the technical and manager level but our role was generally that of observers of the process. Although the negotiations eventually resulted in a refinement of the proposed action that included additional conservation measures, a determination was reached by the NMFS that the action as proposed and refined, implemented over a 15-year timeframe, would likely result in a jeopardy determination for Upper Willamette Chinook and steelhead. As such, the NMFS began development of an RPA, in collaboration with the Action Agencies.

The Action Agencies reached general agreement with NMFS in January 2008 on the actions described in the draft RPA. In order to meet BO completion timelines associated with the settlement agreement, the Action Agencies, in a January 30, 2008, letter requested that the FWS consult on the proposed action as modified by the NMFS draft RPA dated January 24th, 2008.

This BO culminates an ongoing consultation among the FWS, NMFS and the three action agencies (USACE, BPA, and BOR) on the continued operation and maintenance of the Willamette Project, a system of 13 multipurpose dams, reservoirs, and bank protection works operated and maintained by the USACE in the Willamette Basin. The extended timeframes associated with this consultation were agreed to by all involved Federal agencies.

The consultation history below provides a summary of the major events that occurred over the period of consultation. It is important to note that the proposed action in the initial 2000 biological assessment (USACE 2000) submitted to the Services was the continued operation and maintenance of the Willamette Project, as currently operated in 2000, into perpetuity. The proposed action in the 2000 BA generally preserved the way the Willamette Project had been operated in the past, with few exceptions and with limited measures to minimize adverse project effects to listed species and associated habitat.

In contrast, the revised proposed action contained in the May 31, 2007, Supplemental BA, and the associated Addendum provided on August 20, 2007, provides a number of conservation and restoration actions, and proposed studies aimed at minimizing future adverse effects to listed species and their habitat and designated critical habitat from continued operation and maintenance of the Willamette Project.

The Supplemental BA provided an update on the biological information for listed species, the environmental baseline condition, and analysis of the effects of the revised proposed action. The intent of the Supplemental BA was not to replace the 2000 BA, but to provide information on the changes in operation of the Willamette Project since the 2000 BA was completed and to propose measures to minimize the proposed actions effects to ESA listed species and critical habitat. The Supplemental BA was therefore not intended as a stand-alone document. The base operations to meet authorized purposes for the Willamette Project, as described in the 2000 BA, remain in place.

1.1 Consultation History

Formal ESA Section 7 consultation on continued operation and maintenance of the Willamette Project was initiated in April 2000 with completion of the BA (USACE 2000). The 2000 BA concluded that the proposed action was “likely to adversely affect” several fish species and one plant species. On the basis of this finding, the USACE requested formal consultation with the FWS and NMFS. The BPA and BOR joined the USACE as Action Agencies for the Section 7 consultation shortly after issuance of the April 2000 BA.

The initial formal consultation meeting was held on August 1, 2000. In September 2000, the Services provided a preliminary joint federal review draft BO. In November 2000, the FWS sent a letter to USACE documenting mutual agreement that consultation would not be completed within the usual timeframes for a formal consultation. The Action Agencies provided to the Services a consolidated written response to the federal review draft BO in January 2001.

On March 3, 2001, the Services transmitted a joint draft RPA and Incidental Take Statement (ITS) to the Action Agencies. The draft RPA and ITS were based on the federal review draft BO. On April 25, 2001, the Action Agencies provided consolidated comments back to the Services on the draft RPA/ITS. The Action Agencies expressed concerns about the approach taken by the Services to define baseline conditions and the effects of the proposed action, as well as a number of other considerations. The Action Agencies also expressed concern that they did not have the authority to implement many of the actions specified in the draft RPA/ITS.

From March 2001 through February 2002, the Action Agencies and the Services worked collaboratively to refine the draft RPA and ITS. A key element of this process was development of mainstem and tributary flow management protocols developed specifically to address flow management operations in extremely dry years, such as those experienced in 2001 in the Willamette Basin. The flow management protocols were implemented beginning in water year 2002 and have been used to guide flow management in the Willamette Basin since that time.

On November 13, 2001, the Action Agencies and the Services met jointly with representatives of the Grand Ronde, Siletz, and Warm Springs tribes for informal coordination regarding the scope and content of the Willamette Project ESA consultation.

In May 2002, the Action Agencies submitted an amendment to the 2000 BA (USACE 2000) raising a potential release of 95,000 acre-feet of water contracted through BOR for irrigation. Also, in September 2002, the Action Agencies and the Services agreed to a Management Forum to provide management level oversight to the continuing Willamette Project ESA consultation. The participating federal agencies agreed to the following principles:

- Collaborate to develop mutually agreeable outcomes.
- Avoid jeopardy if possible based on best available scientific and commercial information.
- Commit to an All-H strategy and prioritization and allocation of resources Willamette as an integral part of the Federal Columbia River Power System (FCRPS) and Columbia Basin fish recovery efforts.
- Seek consistency with other BOs and policy documents within the region, including approaches and policies already addressed by the federal agencies.
- Development of an acceptable RPA (if necessary) has a higher priority than completing the consultation by an unreasonable deadline.

In July 2002, the Services presented a revised draft joint RPA to managers from the Action Agencies.

In February 2003, the Services notified the Action Agencies that, due to differences in internal agency policies and procedures for processing ESA Section 7 consultations, they would no longer attempt to provide a single joint BO. The Services would provide separate BOs specific to the species for which they were responsible under ESA. The Services remained committed to a joint consultation process and would work closely to ensure that the RPA (if necessary) contained in their respective BOs would be consistent and compatible.

In July 2003, NMFS submitted a revised Willamette Project draft BO, Chapters 1-8, to the Action Agencies for review and comment. This was followed in April 2004, by the FWS draft BO, Chapters 1-8, submitted to the Action Agencies for review. On April 26, 2004, the NMFS provided a preliminary revised draft RPA. The revised RPA was not for review and comment at that time; it was provided to establish a basis for understanding the effects assessment in Chapters 1-8.

On December 28, 2004, the Action Agencies provided consolidated comments to the NMFS on the revised draft BO, Chapters 1-8, identifying a number of key areas of concern that the Action Agencies believed should be resolved before the BO is finalized.

In August 2005, the Action Agencies provided consolidated comments to the FWS on the draft BO previously submitted in April 2004.

In October 2005, Judge Redden remanded the 2004 FCRPS BO. The Willamette Project consultation experienced some delays due to the uncertainties associated with ESA consultations on operations of existing federal reservoir systems stemming from the ongoing FCRPS consultation.

On January 3, 2006, the USACE notified the Services by letter of the Action Agencies' decision to prepare a revised proposed action and supplement to the 2000 BA. The Supplemental BA would include a revised proposed action that would more accurately reflect current operations of the Willamette Project, particularly with regard to mainstem and tributary flow modifications implemented subsequent to 1999. Also, the Supplemental BA would identify new measures to address ESA-listed species requirements that the Action Agencies have the authority to implement including:

- Changes to reservoir management implemented subsequent to the 2000 BA, including mainstem and tributary minimum flow objectives.
- Completion of the selective withdrawal tower at Cougar Dam and actions underway to address fish passage and related issues at Cougar and Blue River dams under the Willamette Temperature Control Project.
- Strategies for reform of fish hatchery operations and associated mitigation.
- Habitat restoration actions undertaken on project lands through the Action Agencies' natural resources stewardship responsibilities, as well as off site under the USACE General Investigation (GI) and Continuing Authorities Program (CAP).
- Evaluation of the potential feasibility and effectiveness of proposed major structural modifications at the dams to address ESA issues, including improved fish passage and handling, temperature control and hatchery facilities at projects other than Blue River and Cougar dams.
- Strategies for integrating the various operational, structural, habitat, and hatchery measures across the basin that enhance their effectiveness and take advantage of synergies that may exist.
- The water marketing program, including water service supply contracts from the reservoirs.
- Update and accurately describe ongoing research, monitoring, and evaluation (RM&E) program in the Willamette Basin and develop a comprehensive RM&E plan that better meets ESA requirements.

On June 1, 2007, the Action Agencies provided a final Supplemental BA to FWS and NMFS.

On June 4, 2007, the FWS received a Freedom of Information Act (FOIA) request from the Northwest Environmental Defense Center. The request, dated June 1, asked for information from three major areas of the Willamette Project consultation: 1) information related to the duration and extension of consultation; 2) documents related to request for additional information to better formulate a biological opinion; and, 3) documents related to irreversible or irretrievable commitments of resources pursuant to Section 7(d) of the ESA.

On June 15, 2007, the FWS (and separately NMFS, BOR and USACE) received a sixty-day Notice of Intent to Sue (NOI) for unreasonable delay in completing a BO for the Action Agencies Willamette Project. The NOI, dated June 6, was submitted by Willamette Riverkeeper and the Northwest Environmental Defense Center under grounds that the FWS (and other involved Federal agencies) violated the Administrative Procedures Act (APA) by unreasonably delaying a BO for the Willamette Project pursuant to the FWS' duties under the ESA.

On June 22, 2007, the FWS determined the Supplemental BA was deficient with regard to baseline information on, and description of effects of the action to, listed species and critical habitat in the action area and under the jurisdiction of the FWS. The FWS requested additional information from the Action Agencies in order to proceed with developing a BO. Subsequently via email on June 27, 2007, the USACE agreed to provide the additional information requested.

On July 13, 2007, a draft Addendum to the Supplemental BA was provided to the FWS for review. FWS comments were subsequently provided back to the USACE on July 16, 2007.

On July 17, 2007, the NMFS sent a letter to the Action Agencies requesting further information to use in determining how and to what extent the operation and maintenance of the Willamette Project may affect listed species and their critical habitat.

On August 20, 2007, a final Addendum to the Supplemental BA was provided to the FWS via email (hard copy and formal transmittal letter received September 18, 2007).

On August 23, 2007, letters were sent by the FWS to the Action Agencies acknowledging the receipt of a complete BA package and stating our intent to complete consultation within 135 days (by early January, 2008).

On September 11, 2007, letters were sent by the FWS to Willamette Riverkeeper and the Northwest Environmental Defense Center, acknowledging our receipt of a complete BA package from the Action Agencies.

On September 20, 2007, the FWS (and separately NMFS, BOR and USACE) received a complaint by Willamette Riverkeeper and the Northwest Environmental Defense Center under grounds that the FWS (and other involved Federal agencies) violated the Administrative Procedures Act (APA) by unreasonably delaying a BO for the Willamette Project pursuant to the FWS' duties under the ESA. The complaint (Willamette Riverkeeper and Northwest Environmental Defense Center v. U.S. Army Corps of Engineers et al, Civil No. 07-CV- 1399

PK) was filed on September 20, 2007, in the United States District Court for the District of Oregon.

From September through November 2007, the NMFS initiated and coordinated a series of facilitated meetings with the Action Agencies to investigate measures, in addition to those in the proposed action, that could be implemented to minimize the proposed action's effects to listed salmon and steelhead and associated habitat.

On December 14, 2007, the FWS (and separately NMFS) were sent a letter from the Action Agencies that (1) provided clarification of information and agreements resulting from the October and November 2007 facilitated consultation meetings; and (2) addressed the July 17, 2007, information request from the NMFS. More specifically, the letter: identified anticipated milestones in the process of planning, designing and implementing ESA-related actions and clarified the purpose and intent of related decision points; clarified the schedule for modification of existing fish collection, handling and transportation facilities; and, clarified the longer term post-2014 actions that may result from the Willamette System Review studies.

On January 30, 2008, the USACE submitted a letter to the FWS clarifying the action under consideration for consultation. The letter stated that the Action Agencies had been collaborating with the NMFS in developing a draft RPA. In order to meet timelines associated with the draft settlement agreement between the Federal government and the plaintiffs (Willamette Riverkeeper and Northwest Environmental Defense Center), the Action Agencies requested the FWS consult on the proposed action as modified by the NMFS draft RPA dated January 24, 2008.

On February 4, 2008, the FWS received a copy of a letter sent to NMFS by the Action Agencies. The purpose of the letter was to provide a final version of draft attachments that were enclosed with the December 14, 2007, letter to the Services. In addition, the attachments were modified to reflect changes in various project completion dates as agreed to in meetings held since December 14, 2007, between the Action Agencies, FWS and NMFS.

On February 26, 2008, a settlement agreement between the plaintiffs and the Federal government was reached. The settlement agreement stipulated, in part, that the Services shall provide the Action Agencies with final BOs on or before July 11, 2008.

On March 10, 2008, the Services jointly issued a letter to the plaintiffs that provided an update on the development of the BOs. Both the FWS and NMFS stated that the BOs were on track for completion by the July 11, 2008, date in the settlement agreement.

On April 28, 2008, The FWS issued a draft BO to the Action Agencies for review. The NMFS issued their draft BO to the Action Agencies on May 1, 2008. Written and verbal comments from the Action Agencies on the draft BOs were received by the FWS and NMFS throughout May and early June leading up to finalization of the BOs in early July 2008.

2. RELATED BIOLOGICAL OPINIONS

2.1 Willamette Project Consultation on Effects to Oregon Chub

In 1993, the Oregon chub was the first fish species in the Willamette River Basin to be listed under the ESA. In 1996, the USACE formally consulted with the FWS to address the effects of 13 multipurpose dams in the Willamette Basin on the Oregon chub. The FWS issued a no-jeopardy BO on August 21, 1996. Terms and conditions included in the ITS accompanying the BO directed the USACE to fund an active research program to study the effects of reservoir operations on Oregon chub survival and recovery, and to implement a variety of actions to improve the status of the Oregon chub in the Willamette Basin. The 2000 BA and 2007 Supplemental BA and Addendum constitute a new "federal action" for the Willamette Project thus the effects to Oregon chub will be considered in this BO; its accompanying ITS will supercede the 1996 BO and ITS.

2.2 Cougar Dam Water Temperature Control Construction

On March 8, 2000, the Services completed a joint BO on the effects of the USACE's construction of the proposed water temperature control project at Cougar Dam (Cougar WTC) on the South Fork McKenzie River. The BO addressed effects of the Cougar WTC project on listed Upper Willamette River Chinook salmon, bull trout, and the northern spotted owl. The purpose of the Cougar WTC project was to retrofit Cougar Dam with a water temperature control tower to allow the USACE to better control the temperature of water released from the dam. The construction of the water temperature control tower occurred from 2002 through 2004, and operation began in 2005. The project benefited bull trout and Chinook salmon in the project area, as well as other native fish, by ameliorating adverse water temperature effects of Cougar Dam downstream in the South Fork and mainstem McKenzie rivers.

The joint BO for the Cougar WTC project required the following measures during the construction phase of the proposed project: (1) monitoring of water quality conditions; (2) monitoring of fish movements and populations; (3) provision of temporary fish passage around the dam; and (4) development and implementation of protective measures on an as-needed basis as determined by a multi-agency Environmental Coordination Task Force.

In the spring of 2003, the USACE determined they were unable to carry out measure number (3) (above) due to cost over-runs associated with the Cougar WTC project as a whole, and cost over-runs associated with biological monitoring associated with project construction. The USACE provided a letter to the FWS in June, 2003, clarifying reasons for not building the interim fish trap facility and requesting reinitiation of formal consultation due to their failure to comply with the term and condition in the BO. The FWS responded in June 2003, stating that due to the disclosure of USACE's current budget, the reasonable and prudent measure addressing interim fish passage in the BO was deemed no longer "reasonable" and thus the USACE's obligation to implement the measure was removed. Although the original budget for the Cougar WTC would not provide for the development of a permanent fish trap, the long-term operation of the Cougar WTC justified the need for a more permanent fish trapping facility. Post-project authorization

funding is being pursued and is part of the revised proposed action in the 2007 Supplemental BA (described in more detail in this BO).

2.3 Cougar Dam Fish Collection Facility

On February 15, 2007, the FWS completed a BO on the effects to bull trout and northern spotted owl from the USACE's proposed construction, initial operation, and monitoring and evaluation program for a trap and haul fish facility at Cougar Dam, South Fork McKenzie River (USFWS 2007). Construction of the facility is anticipated to occur during 2009, with the Monitoring and Evaluation Program scheduled to run through 2010.

The trap and haul facility and post-construction monitoring and evaluation program are components of a Post-Authorization Change (PAC) report that was initiated in 2003, to evaluate the biological response (i.e., operational effectiveness) associated with WTC implementation and resulting adjustments in McKenzie River fisheries management necessitated by WTC implementation. Of particular interest was the disposition of spring Chinook salmon and bull trout that may accumulate below Cougar Dam in response to discharge through the WTC feature and improved water temperature conditions below the dam, as well as the disposition of bull trout and juvenile Chinook salmon that may be entrained through the WTC feature.

The USACE obtained funding for development of the PAC report in 2005. It initiated work on conceptual design of a fish collection and transport facility to be located below Cougar Dam, and an alternatives evaluation report was completed in December 2005. A Detailed Design Report was prepared during 2006, based upon the recommended alternative. The project is expected to benefit bull trout, Chinook salmon and other native fish by providing habitat and population connectivity for fish populations above and below Cougar Dam.

2.4 Carmen Smith Hydroelectric Project Interim Biological Opinion

On June 26, 2003, the FWS completed a non-jeopardy BO on Trail Bridge Dam Spillway Modification, and existing operation of the Carmen Smith Hydroelectric Project, owned and operated by the Eugene Water and Electric Board (EWEB), and licensed by the Federal Energy Regulatory Commission (FERC). The BO assessed effects to bull trout, bald eagle, and the Northern spotted owl. The proposed action by EWEB included a number of conservation measures to minimize project effects to bull trout and designated critical habitat, and to inform relicensing studies ahead of license expiration in 2008. The conservation measures included: fish passage and entrainment studies and interim upstream passage at Trail Bridge Dam; studies assessing the influence of the Carmen Smith Project on water temperature, hydrology, bull trout abundance and fish stranding; nutrient enhancement via the outplanting of excess hatchery Chinook salmon, and implementation of habitat restoration projects above and below Trail Bridge Dam.

2.5 Federal Columbia River Power System

Throughout the Willamette Project ESA consultation, the Action Agencies and Services have considered the degree to which it should be consistent with other ESA consultations within the

region, especially the ongoing ESA activities related to the federal projects on the Columbia and Snake River mainstems being collectively addressed under the FCRPS BO. Although the FCRPS and Willamette Project operations are separate actions, they share many similarities and are closely linked. Both involve complex continued operations of systems of multiple purpose dams and reservoirs federally authorized to meet variety of operating purposes. The ESA species being addressed in the consultations are similar and in some cases involve overlapping evolutionarily significant units (ESUs) (salmon species under the jurisdiction of the NMFS). The parties involved in both consultations, including the Action Agencies and Services, are similar.

The Willamette Project consultation has trailed behind the FCRPS consultation in that Columbia River ESUs of salmonids received ESA listing earlier than the Willamette ESUs. Since 1999, the NMFS has completed multiple separate BOs for the FCRPS operation. The FWS completed a non-jeopardy BO for FCRPS operational effects on bull trout in December, 2000. Both the Action Agencies and Services agreed that the approaches and procedures applied to the FCRPS should generally be adhered to in the Willamette Project consultation to the extent practicable.

In October 2005, U.S. District Court Judge James Redden found the 2004 FCRPS BO invalid and remanded it to NMFS. Judge Redden directed NMFS to work with the sovereign parties (the Action Agencies, tribes, and States of Oregon, Idaho, Washington and Montana) to develop a new BO. Since November of 2005, the parties have been working diligently toward completing the new FCRPS proposed action and BO as part of a broader overall salmon recovery effort.

2.6 Oregon Chub Spawning Habitat Enhancement at Hospital Pond

In 2001, the USACE initiated a project to enhance the population of the Oregon chub in Hospital Pond (Middle Fork Willamette River Subbasin) by installing a culvert gate to manage the pond's water level independently of the water elevation in Lookout Point Reservoir in years of below-average precipitation when the reservoir does not fill. The FWS issued a no-jeopardy BO for the project on June 7, 2001. Following construction, monitoring showed that the culvert gate project did not resolve the problem, and it became apparent that the roadbed which forms one side of the pond was too porous to hold water levels in the pond at the elevation needed to promote chub spawning. In 2002, the USACE developed a new plan to maintain water levels in Hospital Pond, which entailed placing a bentonite lining along the roadbed separating the pond from Lookout Point Reservoir. The FWS issued a no-jeopardy BO for the project on February 12, 2002.

The FWS issued concurrences (informal consultation) on not likely to adversely affect determinations by the USACE regarding two further efforts to repair the culvert and create a spawning cove in September 2002, and February 2003, respectively. The USACE continues to monitor the success of the project, and will determine, in coordination with FWS and ODFW, if further measures must be taken to protect and enhance the Hospital Pond population of Oregon chub.

2.7 USACE Management Activities for Rare Plants and Insects at Fern Ridge Reservoir

On October 31, 2006, the FWS designated critical habitat for two plants, Willamette daisy (*Erigeron decumbens* var. *decumbens*), Kincaid's lupine (*Lupinus oreganus* var. *kincaidii*), and for Fender's blue butterfly (*Icaricia icarioides fenderi*). Around the perimeter of Fern Ridge Reservoir, most high quality wet prairie sites and upland prairie habitats occupied by these species were included in this designation. The USACE actively manages this habitat to benefit these species. Consultation on the effects of these management activities to the species and their critical habitat was completed on March 21, 2007. The program is described in *Management Activities for Rare Plants and Insects, Fern Ridge* (USACE 2006b) and in the subsequent non-jeopardy BO (USFWS 2007b).

3. CONCURRENCES

3.1 Background

In the Action Agencies 2000 BA, an effects determination of "likely to adversely affect" was made for water Howellia (*Howellia aquatilis*). A determination of "not likely to adversely affect" was made for Fender's blue butterfly (*Icaricia icarioides fenderi*), Willamette Daisy (*Erigeron decumbens* var. *decumbens*), Kincaid's lupine(*Lupinus oreganus* var. *kincaidii)*, Bradshaw's desert parsley (*Lomatium bradshawii*), Nelson's checker-mallow (*Sidalcea nelsoniana*), Northern spotted owl (*Strix occidentalis*), bald eagle (*Haliaeetus leucocephalus*), Aleutian Canada goose(*Branta Canadensis leucopareia*), Columbian white-tailed deer (*Odocoileus virginianus leucurus*), and Canada lynx (*Lynx canadensis*).

In 2000, our review of available information on these species and information on the likely effects of the action did not support a number of the effects determinations made by the Action Agencies. We discussed these issues with the Action Agencies and reached agreement on a revised list of species that were likely to be adversely affected by the action. These included: Fender's blue butterfly, Kincaid's lupine, Bradshaw's desert parsley, and Willamette Daisy. We also reached agreement on a list of species not likely to be adversely affected by the proposed action and these included: Columbian white-tailed deer, bald eagle, Northern spotted owl, Nelson's checker-mallow, and water howellia. Lastly, we reached agreement that the proposed action would have no effect on Canada lynx and Aleutian Canada goose (the latter has since been delisted).

In the Action Agencies Addendum to the 2007 Supplemental BA, the "likely to adversely affect" determinations for the three plants and butterfly were changed to "may affect, not likely to adversely affect." This change in effects determinations from the 2000 BA to the 2007 Supplemental BA Addendum occurred for several reasons; one, a new assessment of potential effects based on updated species and habitat information was conducted in 2007 by the USACE which found potential adverse effects unlikely or discountable. Second, restoration and management activities for all four species that are conducted annually by the USACE, and which were included as part of the proposed action in the 2000 BA, were considered separately from this consultation in a BO finalized in March 2007 (USFWS 2007b).

3.2 Plant and Invertebrate Species

Based on information provided in the 2007 Supplemental BA and Addendum, the FWS concurs with the "may affect, not likely to adversely affect" determinations made for Kincaid's lupine, Willamette daisy, Bradshaw's desert parsley, and Fender's blue butterfly. We also concur with the determination that the proposed action will not adversely affect designated critical habitat for Willamette daisy, Kincaid's lupine or Fender's blue butterfly.

Our concurrence was made for the following reasons:

- Kincaid's lupine, Willamette daisy, and Fender's blue butterfly, and the primary constituent elements (PCEs) of their critical habitat, are not generally impacted by USACE dam operations.

- The BA concluded that continued operation of Fern Ridge Dam will have no effect on listed plant or insect species or their critical habitat. The two-year study of hydrology at Fern Ridge (Finley 1994) provided evidence that rainfall was the primary driver of hydrology on wetland species at Fern Ridge sites. There is no credible evidence that routine water management affects the hydrology of habitat sites for these species, and stable or increasing population numbers further suggest a lack of harm from recent operations.

- During rare flood events, water has been held above the full pool level at Fern Ridge Reservoir. It is likely that these emergency events have inundated wet prairie habitat for brief periods of time and we expect these events are possible under the proposed action. However, substantial damage to wetland-adapted species from this brief flooding during the dormant season is unlikely. Some transport of weed propagules in normal years consistent with background levels, may occur but effects are expected to be insignificant and discountable. The wet prairie habitat is typically inundated during much of the flood control season. Emergency flooding deeper than typically occurs due to rainfall effects is likely to be of short duration. The sites are routinely managed for invasive weeds. Therefore, the effects of short-duration emergency inundation would be insignificant

- Although a few sites of terrestrial prairie species occur in areas where Willamette Project operations have altered the flood regime, these sites appear to include only a minority of remaining individuals and effects are expected to be insignificant and discountable. At no site is Willamette Project operations a threat to the continued presence of a listed terrestrial prairie species. In addition, no credible scientific information is available to allow us to describe a chain of cause and effect involving flood control operations of the 13 Willamette Project dams and specific rare terrestrial species or their critical habitats.

3.3 Vertebrate Species

3.3.1 Columbian White-Tailed Deer

Two populations of this subspecies exist, one in Douglas County, Oregon, (Douglas County population), and the other in Columbia and Clatsop counties, Oregon, and Wahkiakum County, Washington (Columbia River population). The Douglas County population occurs outside of the Willamette Basin, and is no longer listed under the ESA (68 FR 43647 43659). The Columbia River population occurs on islands and mainland habitats in the lower Columbia River. Although these habitats are sensitive to flooding, the operation of the Willamette Project would likely have an insignificant effect on the habitat used by the deer. Based on monthly average observed regulated flows, the Willamette River provides three to five percent of the total flow of the Columbia River measured at Vancouver, Washington (USACE data provided by Al Donner, Portland District). Operation of the Willamette Project likely results in an insignificant effect, at most, to water levels within the deer's habitat. Thus, the FWS concurs with the Action Agencies

determination in the BA that the operation and maintenance of the Willamette Project is "not likely to adversely affect" this species.

3.3.2 Bald Eagle

The bald eagle was delisted on July 9, 2007, (72 FR 37346) and thus will not be considered further in this BO.

3.3.3 Northern Spotted Owl

Suitable habitat for the northern spotted owl is found adjacent to many of the reservoirs in the Willamette Project, and individual owls are known to occur near Fall Creek, Green Peter, Lookout Point, and Cougar reservoirs. Where owls are known to occur, USACE project lands are managed to protect the species by minimizing potential disturbance. Management objectives on project lands that support the species include managing forests for natural succession toward old-growth conditions for the benefit of old-growth-dependent species including spotted owls. Effects to spotted owls from the operation and maintenance of the dams and other hydrological elements of the Willamette Project are expected to be insignificant and discountable, as the species is not dependent upon, or require, aquatic, wetland, or riparian habitats. Thus, the FWS concurs with the Action Agencies' determination in the 2000 BA that the operation and maintenance of the Willamette Project is not likely to adversely affect this species or its critical habitat.

4. DESCRIPTION OF THE PROPOSED ACTION

As noted in the Introduction above, the NMFS, in collaboration with the Action Agencies, developed an RPA in anticipation of making a jeopardy determination based on effects to Chinook and steelhead and critical habitat from the proposed action. The RPA is additive to (i.e., builds upon) the proposed action described below. In the event there are differences between the proposed action and RPA, the RPA will take precedence. For the purposes of this BO, the FWS is consulting on the proposed action, as modified by the NMFS RPA, as requested by the Action Agencies.

The proposed action, excluding modifications and additions contained in the NMFS RPA, is described in detail in the 2000 BA (USACE 2000), and the 2007 Supplemental BA and Addendum (USACE 2007a,b) and these descriptions are hereby incorporated by reference and summarized below. Additional actions, and further specificity of the proposed action that were outlined in the December 14, 2007, and January 30, 2008, letters (see section 1.1 above) from the Action Agencies were incorporated into the NMFS RPA (Appendix B).

The action proposed by the Action Agencies is the continued operation and maintenance (for a period of fifteen years beginning on the date consultation is completed with the FWS and NMFS) of the 13 multipurpose dams and maintenance of approximately 43 miles of revetments in the Willamette Basin. The proposed action includes hydropower generation at eight of the dams by BPA, allocation of irrigation water stored in the Willamette Project reservoirs by BOR, management of land around Willamette Project dams and reservoirs, the bank protection program, emergency assistance program, and a suite of conservation actions to minimize Willamette Project effects on listed species and designated critical habitat. Relevant background information on the Willamette Project (e.g., project authorities and purposes, and system operation) that is integral to the proposed action can be found in USACE (2000) and is summarized in Section 4.1 below.

An action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR 402.02). Direct effects may extend upstream or downstream based on the potential for impairing fish passage, flow, hydraulics, sediment and pollutant discharge, and the extent of riparian and instream habitat modifications. Indirect effects may occur throughout the watershed where the proposed action leads to additional activities or affects ecological functions that contribute to habitat degradation. Willamette Project dams and reservoirs directly affect the channels and valley floodplains downstream as well as portions of upstream channels and valleys that are impounded. The Project indirectly affects stream reaches upstream that are or could otherwise be accessed and used by listed fish. The Willamette Project could have an indirect effect on the amount of marine derived nutrients returning to spawning and rearing areas due to a reduction in the number of adult anadromous fish returning to spawn and die. For the purposes of this BO, the action area includes:

- All river reaches, riparian zones, and floodplain areas located downstream of the 13 Willamette Project dams, including the mainstem Willamette River and the tributaries on

which these facilities are located (i.e., mainstem reaches of the North Santiam and South Santiam rivers, Santiam River, McKenzie River, South Fork McKenzie River, Blue River, Fall Creek, Middle Fork Willamette River, Row River, Coast Fork Willamette River, and the Long Tom River). This action area also encompasses the 42 miles of streambank revetments maintained by the USACE and the adjacent stream reaches affected by those revetments.

- Stream reaches and land areas permanently or seasonally inundated by Willamette Project reservoirs in dry, average, and wet years.

- All reaches of tributaries located upstream of Willamette Project dams that are presently or were historically accessible to listed fish before construction of the 13 dams in the Willamette Project.

4.1 General Description of Willamette Project Base Operations

This section summarizes and describes the Federal action under consultation, which encompasses the continued operation and maintenance of the Willamette Project and related activities, including maintenance of approximately 42 miles of revetments. The Willamette Project is comprised of 13 USACE dam facilities and associated impoundments that are operated both as a system and independently to meet a number of purposes and needs.

The 13 Willamette Project dams (Figure 4.0) were constructed by the USACE between the years 1941 and 1969. Although flood control is the primary authorized purpose of the Willamette Project, the dams and reservoirs are managed to support many other authorized project purposes including irrigation, municipal and industrial water supply, navigation, fish and wildlife conservation, flow augmentation, hydroelectric power generation, and recreation.

4.1.1 Willamette Project Development Timeline

The USACE built Fern Ridge Dam near Eugene in 1941 as the first element (multipurpose storage) of the Willamette Basin Plan. Since then, 12 additional projects have been constructed (Figure 4.0 below): Cottage Grove (1942); Dorena (1949); Detroit (1953); Lookout Point, Dexter, and Big Cliff (1954); Hills Creek (1961); Cougar (1963); Fall Creek (1966); Green Peter and Foster (1968); and Blue River (1969). Big Cliff and Dexter are reregulation projects, linked to operation of the Detroit and Lookout Point projects, respectively. Foster serves as both a storage reservoir and as a reregulation facility for Green Peter.

4.1.2 Project Administration

Flow management in the Willamette Basin is the responsibility of the USACE. The USACE's responsibilities include coordination among agencies and interested parties and development of plans for water management within the basin. The USACE must consider power demands, irrigation demands, minimum stream flow requirements, and other uses of reservoir water during annual plan development. Seasonal planning for the spring and summer is based in part on seasonal forecasts by the National Resources Conservation Service (NRCS).

The USACE's Reservoir Control Center (RCC) is responsible for reservoir regulation and flow management on a daily basis throughout the Columbia Basin, and provides assistance to the Portland District by making daily decisions on operations that regulate flow and storage in the Willamette Basin. The RCC's daily decisions on flow releases are based in part on the hydrologic model maintained by the National Weather Service River Forecast Center while taking into account current reservoir elevations and inflows, the forecast for precipitation, current snow pack conditions, and runoff conditions. The USACE coordinates these operations with BPA, BOR, NMFS, FWS, Oregon Department of Fish and Wildlife (ODFW), the Oregon Water Resources Department (OWRD), the City of Springfield, and other concerned governmental entities.

4.1.3 Fisheries Mitigation

Congress authorized the construction, operation, and maintenance of hatcheries in cooperation with State and Federal fisheries agencies to mitigate for fish losses due to construction of dams (HD 544, 75th Congress, 3rd Session, 1938; Public Law 732, 79th Congress, 2nd Session, 1946). Hatcheries and provision of fish passage at selected facilities are the primary forms of mitigation for the 13 dams and 42 miles of revetments maintained under the Willamette Project. The Action Agencies also mitigate for the effects of the projects by maintaining instream flows downstream of projects and in the mainstem Willamette River.

4.1.4 System Operation

The 13 dams in the Willamette Project are operated as a system. Seasonal regulation of each reservoir is guided by the flood control rule curves. Rule curves are presented in Appendix C in USACE (2000) for each project; the plots also include actual reservoir elevations for the period 1990 through 1999. The function of the rule curve is to show how much storage space a reservoir should reserve for flood control at any given time of the year based on water supply forecast. There are three defined control periods in a year: flood control, conservation storage, and conservation holding and release. The dates of these seasons vary slightly by project. The RCC is responsible for the daily regulation of all 13 dams, and for coordination with other Federal agencies, such as BPA. During wet winter conditions, when flood control is the primary authorized purpose, coordination with BPA can occur as infrequently as once a week. At other times, coordination can occur several times a day.

Each project is drawn down according to a prioritization system based primarily on hydrologic flood control, recreational needs, and fish flow targets. Drawdown priorities are presented in Table 4.0, below. These priorities are balanced against individual project priorities that are also presented in Table 4.0.

The Willamette Project is operated in conjunction with the Federal Columbia River Power System (FCRPS) to provide power to the Northwest power grid system. Generally, power production in the Willamette Basin is not adjusted directly to compensate for power shortfalls elsewhere within the system, except insofar as individual projects are operated under a load-following schedule to meet additional power demands within the Willamette Basin and nearby

areas. However, during power emergencies (i.e., winter "cold snaps"), BPA can call upon increased releases for generation, which uses water from designated power pools, as long as the operation does not have a negative effect on flood control. Under certain low-flow conditions, the USACE shuts down the turbines at some Willamette Project facilities and spills through regulating outlets and/or over spillways to provide a volume of water with reduced total dissolved gas levels to dilute levels in the lower Columbia River.

4.1.5 Land Use Management

Within the Willamette Basin, the USACE administers over 30,000 acres of project lands. The USACE Regulation 1130-2-435 directs that the land use classifications for project lands be consistent with project land allocations. A project land's "allocation" identifies and documents the specific or generally authorized purposes for which the land was acquired. USACE lands are further classified based on their highest and best uses. The process of zoning the project area into land use classifications represents a further distribution of management categories which, based on the resource available and public need, will allow for full use while protecting project resources. USACE land use classifications define resource management and development practices, which may be either appropriate or inappropriate for that parcel of land. There are five land use categories into which lands at USACE projects may be classified: Project Operations, Recreation, Mitigation, Environmental Sensitive Areas, and Multiple Resource Management. The last can be further subdivided into Low-Density Recreation Use, General Wildlife Management, Vegetative Management, Inactive and/or Future Recreation Areas, and Easement Lands.

4.1.6 Bank Protection Program

The Flood Control Acts of 1936, 1938, and 1950 authorized the Willamette River Bank Protection Program, which allowed the USACE to construct and maintain 450,000 linear feet of protection works. The program acts to prevent bank erosion, which destroys productive farmland, roads, bridges, and other improvements. In 1971, the Senate and House Committees on Public Works expanded the program's scope to 510,000 linear feet. The Water Resources Development Act (WRDA) of 1950 required local sponsorship for any new bank protection projects, and it transferred responsibility for maintenance of revetments constructed after 1950 from the USACE to the local sponsor. Maintenance activities include vegetation control among revetment structures, which in the past has included the application of herbicides. Under the Willamette River Vegetation Maintenance Demonstration Project, bank protection works were classified in part according to the state of vegetation. Bank structures classified as being at high risk of damage or destruction, or those protecting features of high value, were not allowed to support vegetation that would hinder aerial inspection or have a reasonable chance of impacting structural integrity. Over the past few years, the USACE's inspection letters to sponsors have not required vegetation removal.

Figure 4.0. The Thirteen Dams Associated with the USACE's Willamette Project

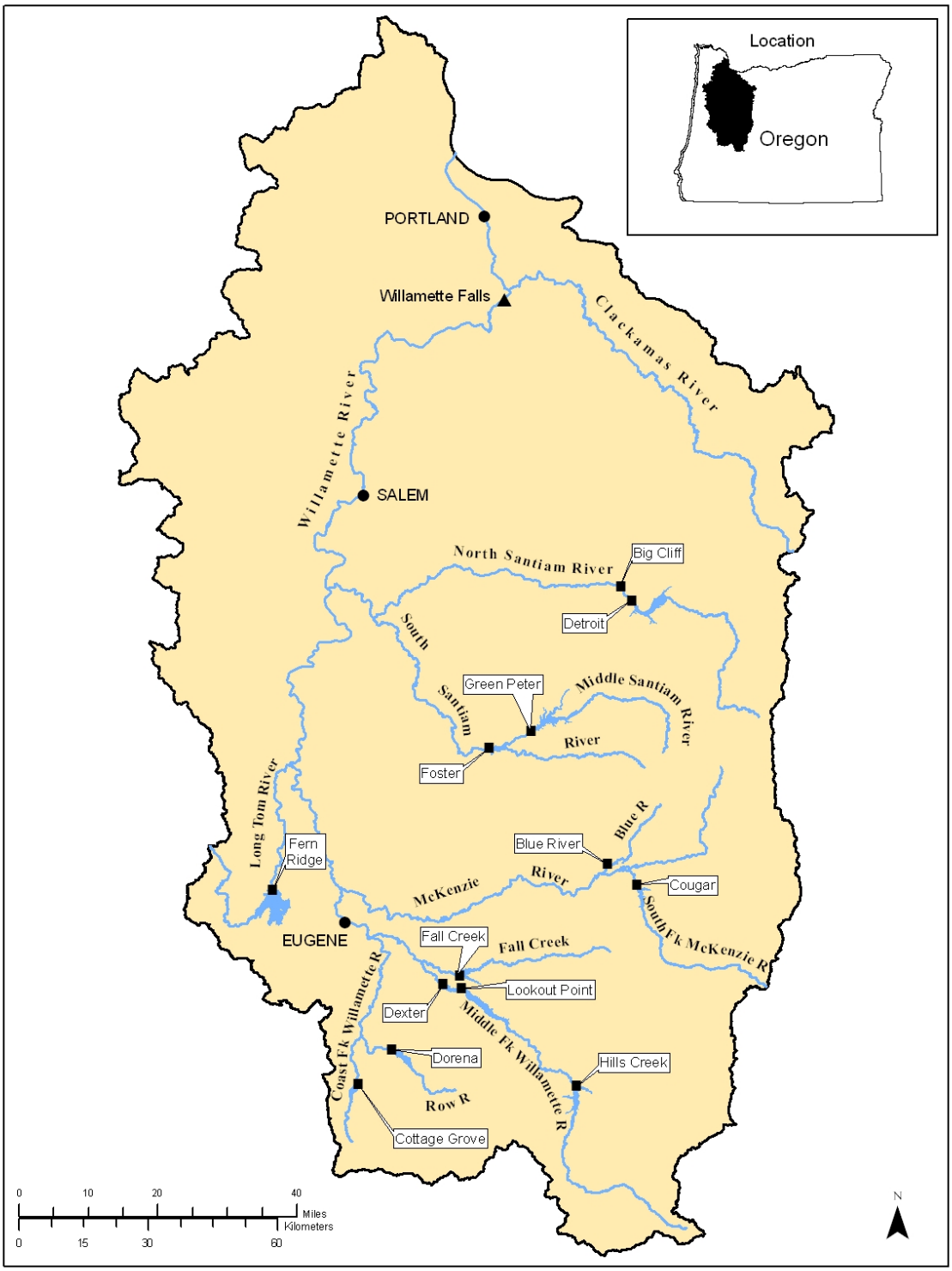


Table 4.0. Priorities of Willamette Basin Storage Projects.

		Priority Purposes (USACE 1989a)				
Project	**Drawdown Priority for Augmenting Summer Stream Flow**	**Flood Control[1]**	**Power Generation**	**Recreation[2]**	**Navigation**	**Irrigation**
Detroit	Last	✓	✓	✓	✓	✓
Big Cliff	NA		✓			
Green Peter	5th	✓	✓		✓	✓
Foster	Last	✓	✓	✓	✓	✓
Blue River	3rd	✓			✓	✓
Cougar	2nd	✓	✓		✓	✓
Fall Creek	5th	✓			✓	✓
Hills Creek	4th	✓	✓		✓	✓
Lookout Point	1st	✓	✓		✓	✓
Dexter	NA	✓	✓		✓	✓
Dorena	5th	✓		✓	✓	✓
Cottage Grove	5th	✓		✓		
Fern Ridge	Last	✓		✓	✓	✓

[1] Has highest priority to ensure public safety.
[2] During summer months.

About 489,800 linear feet of erosion protection has been provided at 230 locations in the system. These projects are commonly rock revetments constructed of heavy quarry stone (riprap) placed on river- banks to keep them from being eroded by the force of flowing water, wind, and/or wave action. Construction specifications have normally called for the use of Class III riprap, where stone weights are generally less than 800 lbs, of which at 30 percent by weight are heavier than 400 pounds (USACE 1975). There are three main erosive processes in the Willamette River and tributaries that include bank scour, bank failure resulting from changes to surface soil conditions; and bank failure resulting from change in bank support. Greater details are provided in Weber (1989) and USACE (1999). Bank protection structures associated directly or indirectly with the Willamette Project are summarized in Table 2-11 in USACE (2000). Bank protection structures below River Mile (RM) 59.6 are not part of the Willamette Project and are not maintained by the USACE. New erosion areas, tabularized in USACE (1999), are associated primarily upstream or downstream of existing revetments or on the outside bends of unprotected reaches. The USACE's Willamette River Floodplain Restoration Study will identify opportunities for

correcting bank erosion problems in the future. The purpose of the Willamette Floodplain Restoration Study is to evaluate opportunities to modify existing floodplain features that may help reduce flood damages by increasing natural flood management capability. The reconnaissance phase of the study was completed in 1999. Specific floodplain restoration actions cannot be identified prior to completion of the remaining study phases.

4.1.7 Emergency Assistance Program

Willamette Project operations are influenced by the Emergency Assistance Program under Public Law 84-99. Table 2-12 in USACE (2000) lists the variety of activities and types of assistance that the USACE may provide in association with flood control and bank protection works. Activities that most directly influence listed species include assisting with emergency bank reconstruction work, and preparation for anticipated, unusually large flood events.

4.1.8 Bureau of Reclamation Activities

The BOR markets water stored by the Willamette Project that is deemed by the USACE to be available for irrigation uses, per the authority given the Secretary of the Interior by Section 8 of the Flood Control Act of 1944. A series of letters exchanged during 1952 and 1953 constitute the agreement between the BOR and the USACE for the sale of water from USACE Willamette Basin reservoirs for irrigation purposes. The BOR has filed permits with the Oregon Water Resources Department (OWRD) to store irrigation water in the storage space allocated to irrigation. Contracting activities began in 1953 to market irrigation water from the three reservoirs existing at that time.

Initially, the BOR accepted, but did not process, new applications for irrigation water service contracts while this BO was in preparation, with the exception of 10 applicants who requested contracts prior to the initiation of the consultation process. However, because of the length of time required to complete consultation, the proposed action was modified in May 2002 to add 26 new contract applications to the 249 existing contracts. This raised the total number of existing water service contracts to 275, for a total of about 85,000 acre-ft. An additional 10,000 acre-ft (for a total of 95,000 acre-ft) was included to accommodate small, new applications that might be received before consultation is completed. This would increase the amount of storage used for water service contracts to about 5.9 percent of total storage. Existing and proposed storage releases for water service contracts can be met through the minimum downstream releases from the projects, and it is not necessary for the USACE to make special operational adjustments, such as increasing flow releases, to meet contract requirements.

At present a total of 205 long-term water service contracts are in effect. The largest contract can provide up to 9,625 acre-feet of water for the irrigation of 3,500 acres of land served by the Junction City Water Control District. Another five contracts are also with water user entities that each serve more than 400 acres and can provide more than 1,000 acre-feet annually. The remaining 199 contracts serve smaller acreages and are almost all with individual water users. Cumulatively, the 205 contracts can provide up to a maximum of 50,230.802 acre-feet of stored water for irrigation of 25,026.64 acres of land. Sixty-two percent (127) of existing contracts have been entered into since 1990. The increase in contracting activity during the 1990s is

attributable to several factors: (1) below average precipitation in some years, (2) the state's determination that Willamette natural stream-flows are fully appropriated in the summer with referral of applicants to Reclamation for stored water contracts, (3) initiation by the state of a contested case process on the Coast Fork (initially) to define USACE discretionary flow releases as in-stream flows with a 1964 priority date, and (4) the federal listing of the Oregon chub as endangered in 1993. Upper Willamette River Chinook salmon and winter steelhead were both listed as threatened in March 1999.

No new long-term contracts have been executed since 1999. Per an agreement reached between Reclamation and USACE subsequent to the listing of UWR Chinook salmon and winter steelhead, Reclamation observed a moratorium on the processing and approval of contract applications for water service from the Project. At the time of the initiation of the moratorium, Reclamation had 11 contract requests (each less than 1,000 acre-feet) pending approval. The decision was made to offer temporary contracts for the 1999 irrigation season to these applicants. Given the favorable hydrologic conditions, as well as the temporary nature of the contracts and their language, Reclamation concluded that execution of the contracts would not result in any irreversible or irretrievable commitments of resources and therefore, were in accord with §7(d) of the ESA. For the same reasons, temporary contracts were offered to these contractors in 2000 and 2002 (due to extremely dry conditions in 2001, the USACE determined that no water was available for temporary contracts).

The moratorium was lifted in January 2003 upon agreement with the USACE and Services that it was no longer necessary to discontinue water marketing activities in order to protect listed species. The rationale was that listed species would be protected through the USACE's ongoing flow management and through the appropriate language in Reclamation contracts.

Although the moratorium was lifted, Reclamation has yet to enter into any water service contracts with terms longer than 1 year. In preparation for execution of new contracts with terms up to the statutory maximum of 40 years, Reclamation revised its form of contract and continues to plan, coordinate, and accomplish the environmental compliance necessary to approve requests for contracts. Consequently, in 2003 and subsequent years when water was determined to be available from the project, temporary contracts were offered to all pending applicants that could meet the same criteria as those that received 1 year temporary contracts in 1999, 2000, and 2002.

As of March 2007, there are a total of 62 applications pending for water service from the project in the various stages of processing (a summary of applications per reach is included in Appendix D, USACE 2007a). These requests, if approved, would provide up to 30,199.87 acre-feet of stored water to irrigate 17,648.690 acres of land. Upon execution of these contracts, the water marketing program will include 267 active long-term contracts for the annual irrigation of 42,675.330 acres with up to 80,430.672 acre-feet of stored water; approximately 5% of the active conservation storage space available in project reservoirs. Table 3-25 (USACE 2007a) identifies the number of contracts and quantity of stored water provided under each of the 15 reaches downstream of USACE dams and includes the storage volumes associated with the pending contracts. Water users continue to be interested in securing a supply of stored water from the project for irrigation purposes. Each year, Reclamation continues to receive applications for new water service contracts. Estimates of future irrigation demand vary greatly. The state's policies

for applications for new surface water rights in the Willamette Basin will continue to be the main factor influencing the water marketing program. As a result, Reclamation anticipates that the water marketing program will continue to grow.

At the current low level of use for water service contracts, it is not necessary for the USACE to make special operational adjustments, such as increasing flow releases, to meet contract requirements. The USACE believes that the release of stored water for pending and future contracts within the 95,000 acre-feet would result in insignificant incremental effects on listed species. The relatively small amount of additional water proposed for contracting still would not raise the amount of water under contract above the threshold where the USACE would need to make special additional flow adjustments to fulfill contract obligations. The amount of water obligated under existing, pending, and proposed contracts remains below a level at which the USACE believes individual reservoir or system effects can be modeled. Furthermore, Reclamation and the USACE believe that any potential impacts of water service contracts on listed species can be avoided through the USACE's ongoing reservoir management activities and through continued inclusion of protective language developed for contracts. Reclamation has developed a revised form of water service contract that will be used for all new long-term contracts from the project. Evaluation and accomplishment of NEPA and ESA compliance requirements will be done by Reclamation prior to execution of new long-term contracts.

Reclamation and the USACE propose to continue the existing irrigation contract water marketing program for the Willamette Project. No formal discussions have taken place between Reclamation and the USACE to identify a future cap on irrigation water marketing from the Project. For the purposes of the proposed action, the Action Agencies agree that a water marketing program of up to 95,000 acre feet can be supported by current reservoir operations. Taking both existing contracts and pending contract applications into account, 14,569.33 acre-feet would remain available to meet future irrigation demands under the duration of the consultation. In the event that future irrigation demand exceeded 95,000 acre-feet, it will be necessary for Reclamation and the USACE to reevaluate the availability of water from conservation storage for the water marketing program and consult with the Services.

4.1.9 Bonneville Power Administration Activities

BPA markets and distributes power generated at Federal dams on the Columbia River and its tributaries, and power from other generating plants, to public and private utilities and large industries. It also builds and operates transmission lines that deliver the electricity. Federal law requires that BPA, when providing electricity produced at the Federal dams, give preference to publicly-owned utilities and to entities in the Pacific Northwest. Eight of the USACE-owned and operated dams in the Willamette Project produce power for BPA, which pays for approximately 37 percent of the capital, operations, and maintenance costs of those eight projects (Table 4.2). Five projects have capacities of less than 30 megawatts (MW). The eight projects have a combined capacity of 408 MW. Lookout Point, Detroit and Green Peter are storage projects associated with downstream reregulation dams (Dexter, Big Cliff, and Foster, respectively). The Foster project also acts as a storage facility. The Hills Creek and Cougar storage projects do not have reregulation dams. Power facilities have not been installed at the Fall Creek, Blue River, Dorena, Cottage Grove, or Fern Ridge projects (USACE 2000).

Table 4.2 BPA's Power Share of Expenses at the Eight Willamette Project Dams That Generate Hydroelectricity (USACE 2007).

Project Name	Capacity (MW)	Operations and Maintenance	Capital Costs
Hills Creek	30	21.5%	24.5%
Lookout Point	120	36.0%	31.0%
Dexter	15	36.0%	31.0%
Cougar	25	19.5%	23.0%
Green Peter	80	44.5%	49.5%
Foster	20	44.5%	49.5%
Detroit	100	50.5%	40.5%
Big Cliff	18	50.5%	40.5%
TOTAL	408		

The USACE has a major role in coordinating multiple uses of the Willamette Project, developing operating plans according to authorized uses and in conjunction with the needs of multiple users. These plans define the normal range within which a reservoir or dam is operated. Within these operating limits, BPA schedules hydropower projection and dispatches the power produced. This process requires continuous communication and coordination through the RCC and between the USACE and BOR.

The protection, mitigation, and enhancement of fish and wildlife resources of the Columbia River and its tributaries are goals of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Northwest Power Act). That Act requires that the Northwest Power and Conservation Council (NPCC) develop both a program to protect and rebuild Columbia Basin fish and wildlife resources (the Columbia River Basin Fish and Wildlife Program; NPCC 1994) and a 20-year plan for meeting the region's electrical energy needs (the Northwest Conservation and Electric Power Plan). The Act also requires that BPA fund protection, mitigation, and enhancement activities consistent with the NPCC's Fish and Wildlife Program, the Power Plan, and other purposes of the Northwest Power Act throughout the Columbia Basin, including the Willamette Basin.

4.2 Project Operations Described by Purpose

The following seven subsections describe features of project operations that are common to several or all facilities and that pertain to specific authorized and incidental purposes of the Willamette Project. Detailed descriptions of the facilities and operations at each project are provided in Chapter 2 of USACE (2000). The NMFS RPA (Appendix B) does not modify or change the base operations described in this section.

4.2.1 Flood Control

Flood control is the primary authorized purpose of the Willamette Project. Willamette Project reservoirs are drawn down to minimum flood control pool between September and December according to established operating criteria and State water management objectives. The primary flood control season begins in December and ends in late January, after the fall drawdown has been accomplished. During this period, the reservoirs are ideally kept at minimum flood-control levels (or "minimum flood-control pool") so that water can be stored during flood events for subsequent controlled release. A normal operation during a flood event usually requires quick reductions in project releases, sometimes in a matter of hours, in order to prevent overbank or flooding conditions at control points located immediately downstream of each project and at other locations in the system.

Given the rain-driven nature of the Willamette Basin, and the fact that river levels can rise quite quickly, it is crucial that the USACE reduce peak flow and flood damages as quickly as possible. Storm tracks and the antecedent conditions in each subbasin determine which projects are subject to controlled releases during any given flood event. The USACE depends on real-time continuous monitoring of hydrometeorological conditions in and near the basin when it prepares flood forecasts and schedules project releases, generally for the next 72-hour period, in 6-hour increments. Inflow is generally passed through each project until flood forecasts predict that outflows must be reduced to prevent project releases from combining with uncontrolled local flow from downstream areas to exceed flood regulation goals at the downstream control points. After flows have receded and the danger of flooding has passed, the USACE coordinates the release of stored flood water among the projects to prevent overbank conditions downriver, and to return the reservoir to the minimum flood-control pool in anticipation of the next potential flood.

According to established operating criteria, downward ramping rates (reducing project releases to prevent flooding) or upward ramping rates (increasing flows to evacuate flood water) depend on factors such as weather, flow forecasts, and flood control storage, which result in a high or low flow situation. During a high flow situation, ramping rates for reducing or increasing releases must be rapid in order to provide flood control. During a low flow situation, ramping rates are more restrictive with respect to hourly and daily changes in order avoid rapid fluctuations in flow levels. If the forecasted flood runoff volume indicates that reservoir space will be exceeded, a special flood regulation schedule is used. This special schedule calls for gradual increases in reservoir releases to avoid sudden increases in outflow as each reservoir fills.

Flood control space in power-producing reservoirs is divided between primary and secondary storage. Primary flood control storage is that space needed to control floods that statistically have a two percent chance of happening in any year (50-year flood). Secondary flood control storage provides additional space to control larger floods that statistically have a one percent chance of occurring (100-year flood). Evacuation of water stored in the primary flood control zone is made through spillway and/or regulating outlets as rapidly after a flood as downstream conditions permit. Water constituting secondary flood control space is generally discharged through the turbines. The ideal power generation situation occurs when it is possible to discharge all of secondary flood control space and reservoir inflows through the turbines. An exception to this is when another flood is imminent, and additional releases must be made

through regulating outlets and/or spillways to evacuate more rapidly to minimum flood-control pool.

Floods are less likely to occur from February through early May. This period is referred to as the conservation storage season. Storage space in the reservoirs is filled gradually during this period for later use (irrigation, recreation, power production, water quality, etc.). Each project has a refill rule curve that provides guidance in refilling a project in a controlled manner to desired reservoir elevations by specific dates. Departures from refill rule curves may result from regulation of floods, excessive snow pack above the reservoirs, inadequate water supply, or critical power needs. Excess flood water stored above the rule curve during the conservation storage season is evacuated in accordance with downstream channel capacity. However, when the water supply is inadequate to maintain both minimum flows and the scheduled rate of filling, maintaining minimum instream flows downstream of the facility generally takes precedence. Deficiencies in storage can be made up at any time beyond early May when the water supply is adequate. Refill of a project can also be delayed when excessive snow pack above the reservoirs causes concern for flooding.

4.2.2 Irrigation

Irrigation is practiced throughout the Willamette Basin to provide water for dairy and beef cattle pasture, mint, nurseries, grass, legume seed, fruit, and other produce. Congress recognized irrigation as a major purpose in the authorizing project legislation. Collectively, the total joint-use conservation storage at all 13 projects totals 1.6 million acre-ft. The BOR is responsible for management and development of contracts for use of irrigation water that is stored at USACE projects. On behalf of the Federal government, the BOR obtained two water rights certificates (No. 72755 and 72756) from the State of Oregon. These two certificates total 1,640,100 acre-ft of water for irrigation only.

Contracts established between the contractor and the BOR specify the amount of water that the user may take. Little of the reservoir storage available for irrigation in the Willamette Basin has been contracted (i.e., purchased) for delivery. The largest contract can provide up to 9,625 acre-ft for the irrigation of 3,500 acres. Another six contracts individually serve more than 400 acres and can provide more than 1,000 acre-ft annually. The other 179 contracts currently in effect serve smaller acreages and are almost all with individual water users. The amount of water actually used is less than the amount contracted presently, and is estimated to be less than the 30,025 acre-ft for which the BOR billed contractors in 1999 (USACE 2000).

Contracts vary in their term from one to 40 years. All contracts entered into since 1996, with the exception of 11 proposed temporary contracts for 1999, contain a 10-year term that renews automatically three times. The contract may be terminated unilaterally by either the contractor or the BOR following the first 10-year term or any year thereafter. All contracts are subject to the operating plan of the Willamette Project per laws governing the Willamette Project, and the United States is not liable for shortages.

Since 1994, the OWRD has required applicants for new water right permits to install, operate, and maintain fish screens at diversion intakes and provide for passage past a diversion structure

if necessary, unless it has been determined by the ODFW that such measures are unnecessary. By state law, older diversions pulling more than 30 cubic feet per second (cfs) must be screened. Older, smaller diversions are not required to be screened, but ODFW has a cost-share program making money for screening available to the diversion owners.

There are presently no supplemental USACE releases intended specifically for irrigation use except at Fern Ridge Reservoir, and on very hot days at Detroit Reservoir. Irrigation contracts are generally met within normal dam operations.

The USACE estimated future water use in the Willamette Basin Reservoir Study (WBRS) (USACE 1999b). The projected area of irrigated land area in the year 2020 is approximately 333,000 acres, requiring approximately 811,000 acre-ft from storage. The USACE based this estimate on the assumption that more than 65 percent of new supplies will come from surface water sources, primarily Willamette Project storage. The relatively small magnitude of current and projected demands for irrigation water in the Willamette Basin has led to recommendations, including by the Willamette River Basin Task Force in the 1960s, to take a portion of active storage presently allocated for irrigation and reallocate it to other uses.

4.2.3 Municipal and Industrial Water Supply

The need for Municipal and Industrial storage was found to be relatively low at the time that the storage capacity of the Willamette Project reservoirs was planned. However, the Flood Control Act of 1950 authorized the USACE to construct and operate the Willamette Project, as described in HD 531, which included water supply as an intended and authorized project purpose. Because of the potential future demand, USACE policy makes provisions for reallocating existing storage space and use at a later time, if necessary.

4.2.4 Navigation

Navigation is an authorized purpose for the upper Willamette River above Willamette Falls. However, navigation has not become as significant of a demand on the water resources as Congress originally anticipated. The history of authorized navigation dates back to 1871 when Congress authorized the first plan for improving the channel between Portland and Eugene (River and Harbor Act of 1871). The plan has been modified several times since to provide for an eight foot deep channel between Portland and Oregon City and a 2.5- to 3.5-ft deep channel between Oregon City and Albany, both of which the USACE completed in 1939. A 2.5- to 3.5-ft deep channel was completed between Albany and Corvallis in 1945. Uncompleted work on the upper navigation channel consisted of channel improvements and streamflow regulation to control depths of six feet at low water from Oregon City to the mouth of the Santiam River and five feet from that point to Albany. The USACE maintained the completed portion of the navigation channel to the vicinity of Corvallis until 1973 when commercial navigation traffic declined to a point where further maintenance could not be justified. The portion between Corvallis and Eugene was deauthorized by the Water Resources Development Act of 1986. In the early 1990s, the Mid-Valley Council of Governments investigated the feasibility of deepening the upper Willamette River navigation channel between Newberg and Independence

to facilitate recreational and commercial boat traffic. The study found it was not cost effective to deepen the navigation channel at that time.

4.2.5 Flow Augmentation

The original authorized plan for the Willamette Project is described in HD 544, 75th Congress, third session, March 16, 1938. The plan for open-river navigation improvement above Willamette Falls stipulates a minimum flow of 5,000 cfs between Albany and the Santiam River, and 6,500 cfs downstream to Salem to provide navigation depths of six feet and five feet, respectively. It was also recognized in HD 544 that these navigation flows would increase flows during the low-water period and would "benefit sanitary conditions along the mainstream" by diluting wastes and increase "the dissolved oxygen content of the stream with a resultant beneficial effect on fish life." HD 531, 81st Congress, second session, March 20, 1950, also stipulates the above minimum flows to allow open-river navigation from Portland to Corvallis. It also recognizes that these flows would reduce pollution concentrations in the river, and would make oxygen available for fish life. The water quality and fishery strategies for the Willamette River are currently based on the navigation flow requirements originally established at Albany and Salem.

The RCC and USACE coordinate an annual summer flow augmentation plan and conduct a coordination meeting with various Federal, State, and local agencies to determine instream flows downstream of each project. Agencies include NMFS, FWS, OWRD, ODFW, Oregon State Marine Board, and Oregon Department of Environmental Quality (ODEQ). Through the coordination process, the USACE tries to balance the State's water management objectives for the Willamette Project with USACE policy, flexibility, and project authorizations. The OWRD is the lead agency for the State's water management objectives. The objectives are site-specific conditions that drive the State's decision-making process within the existing Federal-State coordination framework. Flexibility to manage any one reservoir is influenced both by project authorizations and the USACE's discretionary authority. There are provisions for adjustments to the State's water management objectives for flow conditions in terms of average, better, or below normal water conditions.

Water rights issued prior to 1964 are senior to instream flow requirements because that is the year the State of Oregon first established minimum instream flows for the Willamette basin. Water rights issued in 1964 and later are junior, and must rely on stored water when natural flows fall below minimum instream flow requirements. Water users with contracts have highest priority during extremely dry years.

4.2.6 Hydroelectric Power Generation

Hydroelectric power facilities are installed at eight of the 13 USACE projects in the Willamette Basin; electrical energy generated at these projects is marketed by BPA throughout the Pacific Northwest and Pacific Southwest. There are two types of Federal hydropower projects in the basin: storage and reregulation. Lookout Point, Detroit, and Green Peter are storage projects and are associated with reregulation dams located downstream (Dexter, Big Cliff, and Foster, respectively). The Foster project also acts as a storage facility. The Hills Creek and Cougar

storage projects do not have reregulation dams located downstream. Power facilities do not exist presently at the Fall Creek, Blue River, Dorena, Cottage Grove, or Fern Ridge projects.

Power generation at the Willamette Project dams depends typically on releases for other project purposes such as flood control and environmental needs. However, some flexibility exists within the operating criteria to generate electricity at different levels throughout the day and during different seasons. Projects with hydropower facilities include exclusive storage space for power generation, but the quantity of storage is relatively small. Drawdowns into power storage are limited to special power requirement periods that may develop during extended cold spells. In general, exclusive power storage is kept full to increase the hydraulic head for power generation. Generation from the storage projects is often based upon daily and weekly fluctuations in power demand ("load"), and flows downstream are therefore subject to frequent fluctuations that require reregulation. Power generation is more uniform at the reregulation projects. The reregulation reservoirs are used to absorb the fluctuations in flows from their upstream storage projects and ensure that downstream flows are more uniform for protection of aquatic and human habitat and life.

The larger, high-head projects of Detroit, Green Peter, Lookout Point, and Cougar generate considerably more power than the lower-head reregulation dams of Big Cliff, Foster, and Dexter. Monthly generation can change drastically from year to year depending on the amount and timing of runoff that occurs in the basin.

4.2.7 Recreation

Recreation use and development is authorized at all the Willamette projects under Federal legislation, including the Federal Water Projects Recreation Act of 1964 (Public Law 89-72) and the Flood Control Act of 1944. Under these authorities, the USACE is primarily responsible for providing recreation facilities. The USACE cooperates with the U.S. Forest Service (USFS), Oregon State Parks, ODFW, and Linn and Lane counties to build and manage a system of water-related recreation facilities. Recreation facilities are provided at all of the Willamette projects and along most of the downstream reaches. Annual visitation to the reservoirs includes 3.6 million recreation visits to USACE-managed areas, in addition to the estimated 700,000 visits to USFS areas managed by the State of Oregon (including Detroit State Park) and county parks located on the reservoirs.

Recreational demand in the basin is putting more pressure on maintaining reservoirs at high levels for the entire recreational season. A drawdown priority for the projects has evolved over time. Maintenance of high pool elevations in priority recreation reservoirs is an important consideration in operation of the Willamette Project. Those projects with the highest recreation demand are the last to be used for meeting flow requirements at Albany and Salem, so their pool elevations usually are high until early September. On the other hand, those projects with lower recreation demand are used for meeting summer mainstem Willamette flows, and are drawn down earlier. The three most important recreational lakes in the system, Detroit, Fern Ridge, and Foster, are the last to be evacuated to meet summer flow requirements.

4.3 Willamette Project Authorizations

The primary reason the Action Agencies developed the Supplemental BA (USACE 2007a) was to present a revised proposed action for addressing ESA concerns associated with continued operation and maintenance of the Willamette Project. The revised proposed action included minimization measures for ESA species not included in the proposed action in the 2000 BA (USACE 2000), but which are within the scope of the Action Agencies current missions, authorities, and programs. There have been no significant changes in Willamette Project authorizations since the 2000 BA. Key Willamette Project authorizations are summarized below:

- Although there are multiple project authorities pertaining to development of the Willamette Project, House Document (HD) 531, authorized by the Flood Control Act of May 17, 1950 (81st Congress, 2nd Session), remains the overall guiding legislation pertaining to operation and maintenance of the project. It provides the basic authorization for balancing operations of the system to meet authorized operating purposes.

- The Willamette Project was authorized with the full recognition that it would cut off extensive areas of upstream habitat for migratory salmon and steelhead (HD 531, Appendix J, Willamette River Basin, p. 1732-1734, paragraphs 181-185, especially 181).

- To compensate for this loss of fish habitat, a series of fish hatcheries were authorized; some new, some in replacement of Oregon state hatcheries that would be destroyed by the dams and reservoirs. In addition, HD 531 contained continuing authority for the USACE to construct fish passage facilities at several of the dams in the basin. It also contained language from Congress encouraging the USACE to try to solve the problem of fish passage over high-head dams of the type to be constructed in the Willamette Basin [HD 531, Appendix J, Willamette River Basin; p. 1746-1747, para. 236; p. 1765, para. 305 (Cougar Dam); para. 384 (White Bridge Dam later moved to Foster under the 1960 Rivers and Harbors Act; para. 411 (hatchery summary); and para. 532 (continue efforts at fish passage)].

  Although the Action Agencies' stance is that they may not include measures or activities in the revised proposed action for which they do not currently have implementation authority and appropriation, they do generally have broad authorities to evaluate and make recommendations for ESA and related mitigation measures through their agency review and approval procedures (e.g., reconnaissance and feasibility studies, research, monitoring and evaluation). Where there is regional consensus among the Action Agencies, the Services, and other federal and state resource agencies that potential measures would be technically feasible, biologically justified, and cost effective for protecting and recovering ESA-listed species, the Action Agencies are willing to seek the necessary authorization and appropriation for implementation of the potential ESA measures. However, implementation of the measures would be contingent upon favorable administration support and Congressional authorization and funding.

5. REVISED PROPOSED ACTION WITH NMFS RPA INCORPORATED

In addition to the proposed continuation of the base operations described above, the Action Agencies proposed the following measures in the revised proposed action (USACE 2007a). These measures, many of which were developed to minimize adverse project effects on listed species and designated critical habitat, are generally conservation oriented and thus will be referred to as "conservation measures" for the remaining sections of this BO.

We have merged the Supplemental BA's Revised Proposed Action and Addendum (USACE 2007a,b) with NMFS' RPA since the RPA is additive to the Action Agencies' overall proposed action. Where there are discrepancies, the RPA supercedes. Portions of the Revised Proposed Action and NMFS' RPA that have no relevance to bull trout, Oregon chub or their habitat (i.e., actions directed towards species under the jurisdiction of NMFS), have generally been excluded from the section below. The text below was taken directly from the Supplemental BA and Addendum (USACE 2007a,b) or from NMFS' RPA. To distinguish between them, the limited text taken from the Supplemental BA and Addendum is in italics. The complete version of the NMFS RPA (Appendix B of this BO) contains rationale/effect for each RPA element listed below in Section 5. The Action Agencies are in general agreement on the actions contained in NMFS' RPA per a January 30, 2008, letter from the Action Agencies to the FWS (see Section 1.1 above).

5.1 Coordination

The RPA measures in this section are based on Section 3.1 of the Supplemental BA (USACE 2007a). In that section, the Action Agencies propose to organize the WATER group, prepare a charter, and establish various subcommittees. In recent years, the USACE has informally coordinated flow management and project operation issues with other federal agencies, state agencies, local government, and other organizations, but there were no guidelines for how this coordination should take place or what would happen if technical participants could not agree. The Action Agencies proposed the WATER group to formalize this process and to ensure consistent coordination and decision-making. NMFS supports the Action Agencies' proposal, but we include it here with minor revisions to clarify the decision-making process and agency roles. This clarification is needed in the RPA because most of the actions that will be taken to avoid and minimize effects on listed salmonids and critical habitat rely on either in-season management (mainstem and tributary flows, response to emergency operations), review of RM&E studies (e.g., downstream fish passage measures) and review of engineering design alternatives (e.g., adult fish collection facilities, temperature control facilities. In order to ensure these ongoing decisions are implemented in a fashion consistent with the analysis in this Opinion, the following measures are needed:

5.1.1 Charter of WATER

By December, 2008, the Action Agencies, in coordination with the Services and other federal and state agencies with fisheries and water resource management responsibilities in the Willamette River Basin, and affected Tribes, will complete a Charter for a collaborative advisory body to be known as the Willamette Action Team for Ecosystem Restoration (WATER). Once the Charter is completed, the Action Agencies will coordinate with the WATER on operation of the Willamette Project consistent with the Charter. The WATER will be a formalized, collaborative body to advise the Action Agencies in the coordinated implementation of the environmental protection and conservation measures described in the Proposed Action, RPA, and other actions that may develop while operating the project.

5.1.2 Technical Sub-Committees of WATER

The Action Agencies will establish technical coordinating committees as part of the WATER to provide review and recommendations of Action Agencies' products. Technical experts from applicable state agencies and the Tribes may participate on committees based on the subject matter of each committee and the scope of each organization's respective areas of responsibility and expertise. Other parties may participate on the subcommittees depending on the subject area and agreement by the Action Agencies and Services. The number, responsibilities, and scope of the technical committees formed will be determined by the Action Agencies and the Services through development of a charter for WATER. However, at a minimum, these will address flow management; fish passage and hatchery management; environmental coordination for construction projects; water quality/temperature control; habitat restoration; and research, monitoring, and evaluation.

5.1.3 WATER Decision-Making Process

The Action Agencies will ensure that the Charter for WATER and its technical coordinating committees describes a decision-making process that recognizes the unique role played by NMFS and USFWS in decisions related to measures covered in their respective Biological Opinions. In this process, the Action Agencies will prepare initial proposals for operations, studies, or structural changes and will seek review and comment by the applicable WATER subcommittee. Committee members, including NMFS and USFWS, will provide feedback to the Action Agencies within a maximum 60-day period, or less, depending on the magnitude and complexity of the proposal. The Action Agencies will then modify the proposal as they determine necessary to address committee members' comments and to meet their ESA responsibilities. NMFS or USFWS (or both, depending on the subject and what species might be affected) will review the final document and inform the Action Agencies whether they agree with it. If NMFS or USFWS disagrees with a proposal based on concerns that the proposal may adversely affect species within their respective authorities or be inconsistent with their respective Biological Opinions[1], the Action Agencies will either modify the proposal to address the Services' concerns, elevate the decision following a process described in the Charter, or seek reinitiation of consultation.

1 This measure does not broaden either of the Services authority to engage in issues outside of each agency's authority, except that it does permit both agencies to engage in issues that affect species listed by both agencies.

The basic purpose and goals of WATER will be to:

- *Facilitate a long-term partnership among the Action Agencies and the Services for implementation of measures for recovery of ESA-listed species.*
- *Provide a forum for coordination and decision-making among the sovereign governments (federal/state/tribal) working to implement strategies for ESA compliance and related missions and authorities, including Clean Water Act (CWA) compliance associated with the 13 federal dams operated and maintained by the USACE in the Willamette River Basin.*
- *Provide an opportunity for input and thorough discussion amongst the federal and state agencies and tribes actively engaged in these efforts.*
- *Increase the transparency of decisions on operation and configuration of the Willamette Basin dams as they relate to ESA and CWA compliance.*
- *Clearly define decision authority and provide a vehicle for elevating decision-making and conflict resolution associated with those efforts to appropriate levels of the involved governmental bodies.*

The roles of the Federal Agency Manager's Forum, the WATER Steering Committee and the Technical Coordinating Committees under WATER are described in detail in Section 3.1 of the Supplemental BA (USACE 2007a). The Action Agencies proposed organizational structure of WATER is presented in Figure 5.0 below.

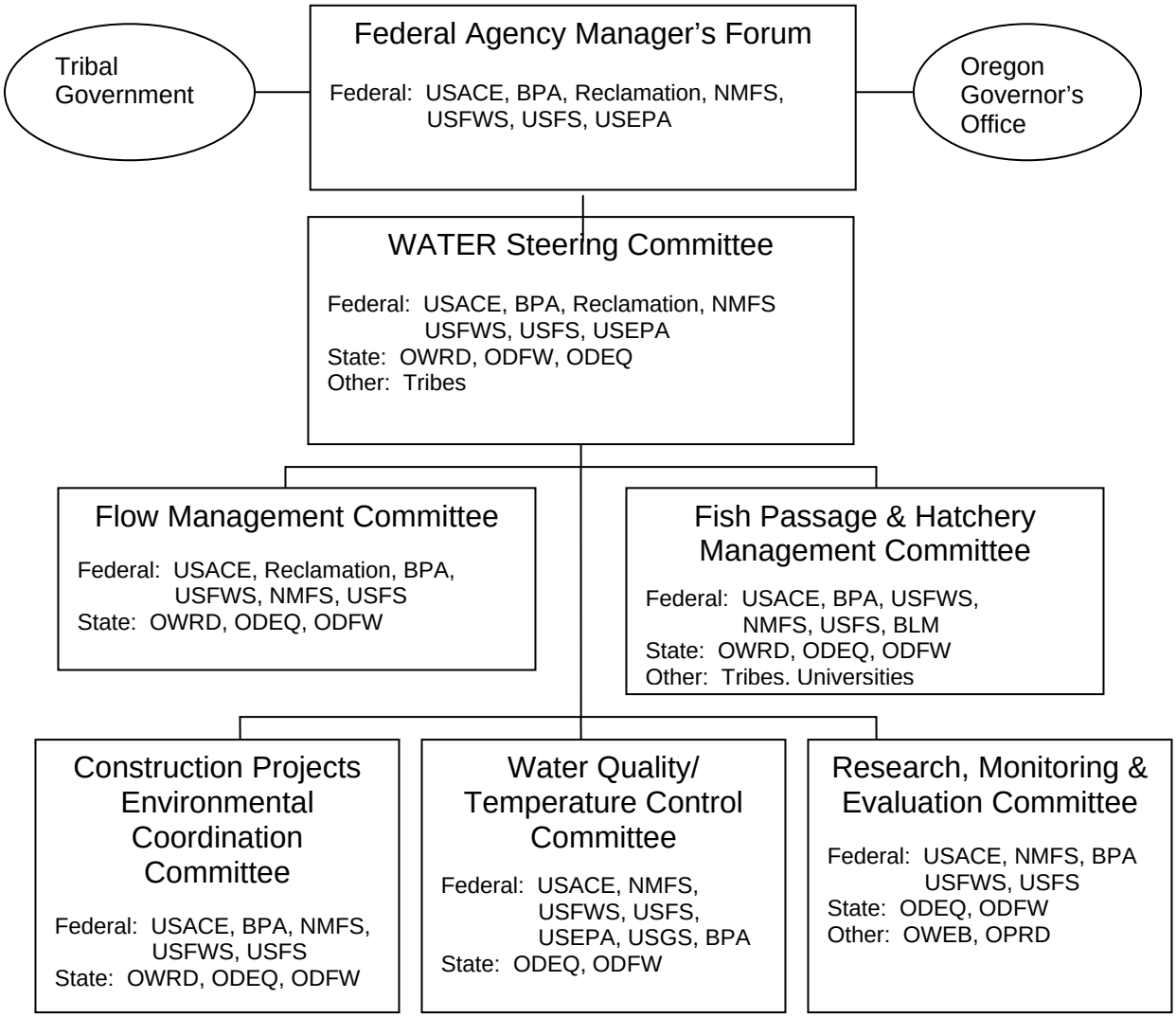
5.1.4 Role of Services in Decision-Making (Agreement with Action Agencies)

The Action Agencies will provide NMFS, USFWS, or both, as appropriate depending on the action and species affected, with draft documents for comment. The Action Agencies will address comments received from NMFS and USFWS when finalizing a document. If the Services do not agree with the final document, then they will elevate the issues for resolution, if appropriate.

5.2 Flow Management

The measures in this section are based on Section 3.3 of the Supplemental BA (USACE 2007a). In that section, the Action Agencies propose to do the following: 1) organize a Flow Management Committee of the WATER group; 2) develop a protocol for notification when Project operations cause deviations from flow and ramping objectives; 3) operate to make every effort to meet or exceed minimum mainstem Willamette flow objectives; 4) operate to make every effort to meet or exceed minimum tributary flow objectives; 5) operate to follow hourly and daily ramp-down rates under normal operating conditions; 6) release spill at Foster Dam during spring for downstream fish passage; and 7) develop and carry out a comprehensive RM&E program to evaluate and monitor these flow management actions.

Figure 5.0. Proposed Organizational Structure, Willamette Action Team for Ecosystem Restoration (WATER) (USACE 2007a).



5.2.1 WATER Flow Management Committee

The USACE will establish a Flow Management (FM) Committee under WATER to advise USACE on streamflow management issues related to operation and maintenance of the Willamette Project. The USACE will take a leadership role in the administration of this committee, providing for coordination, administration costs, and meeting space. The USACE, with review by the FM Committee, will develop and implement the annual Willamette Conservation Plan,[2] and coordinate on all issues related to listed fish with the

2 The Annual Willamette Conservation Plan is reviewed and revised each year. It describes minimum and maximum mainstem and tributary flow objectives that guide the Action Agencies' operation of the 13-dam Willamette Project, and it includes specific operational priorities for the given year.

Services and with Federal and state agencies, Tribes, and entities throughout each flow management season.

5.2.2 Protocol for Notification of Deviations

The Action Agencies will notify the Services when turbine units, regulating outlets, and spillway gates malfunction or are placed out of service for an emergency which results in an unscheduled outage that may have an impact on ESA-listed fish species. The Action Agencies will follow the notification protocol described in RPA measure #5.4.3 (Willamette Fish Operations Plan) below.

5.2.3 Minimum Mainstem Flow Objectives

The USACE will operate the system in a manner to meet or exceed minimum mainstem flow objectives listed in Table 5.0 as measured at Salem and Albany, Oregon, following the framework described in Appendix D (NMFS 2008) and in collaboration with the Services and other entities as provided in sections 5.1 and 5.2.1 above. Based on RM&E results (section 5.9 below) and operational experience, and with the approval of the Services and review by the FM Committee, the USACE will amend mainstem flow objectives (Table 5.0) in its Annual Willamette Conservation Plan.

5.2.4 Tributary Flow Objectives –Project Release Minimums

The USACE will operate Willamette project dams as described in this subsection to meet or exceed minimum tributary flow objectives listed in Table 5-2 to ensure adult fish access to existing spawning habitat below USACE dams, protect eggs deposited during spawning, and provide juvenile rearing and adult holding habitat for listed salmonids and other fishes within system constraints described in Appendix D (NMFS 2008). If, during annual operations, the system of Willamette Projects is unable to meet both mainstem and tributary flow objectives, the Action Agencies will notify NMFS and will coordinate through WATER to determine a suitable course of action to protect priority fish habitat needs. Consistent with Appendix D (NMFS 2008), USACE will operate to meet interim draft limits.

Table 5.0. Mainstem Willamette Flow Objectives (USACE 2007a)

Time Period	7-Day Moving Average [1] Minimum Flow at Salem (cfs)	Instantaneous Minimum Flow at Salem (cfs)	Minimum Flow at Albany (cfs) [2]
April 1 - 30	17,800	14,300	---
May 1 - 31	15,000	12,000	---
June 1 - 15	13,000	10,500	4,500 [2]
June 16 - 30	8,700	7,000	4,500 [2]
July 1 - 31	---	6,000 [1]	4,500 [2]
August 1 - 15	---	6,000 [1]	5,000 [2]
August 16 - 31	---	6,500 [1]	5,000 [2]
September 1 - 30	---	7,000 [1]	5,000 [2]
October 1 - 31	---	7,000	5,000

[1] An average of the mean daily flows in cubic feet per second (cfs) observed over the prior 7-day period.
[2] Congressionally authorized minimum flows (House Document 531). September flows were extended into October.

Table 5.1. Characterization and Historic Frequency (N=64; 1936-1999) of Water Year Types in the Willamette River Basin (USACE 2007a).

Characteristics of Water Year Types	Abundant	Adequate	Insufficient	Deficit
Mid-May Storage (MAF) [1]	≥ 1.48	1.20 to 1.47	0.90 to 1.19	< 0.90
Frequency	58%	17%	9%	16%
Meet All Mainstem Flow Objectives?	Yes	Yes	No	No
Alternative Flow Targets below Objectives	N/A	N/A	Linear sliding scale based on flow targets used during 2001 water year [2]	Balance seasonal flows to retain some control of discharge [2]
Likely Status of Priority Recreational Reservoirs [3]	Full throughout most or all of recreation season	Full through most of recreation season	May fill; unlikely to remain full throughout season	Unlikely to fill
Likely Status of Other Reservoirs	Likely to fill; drafted as necessary to meet mainstem flows	May fill; unlikely to remain full throughout season	Unlikely to fill	Unlikely to fill

[1] Forecasted useable system-wide reservoir storage accumulated by May 10-20 in millions of acre-feet (MAF).
[2] Reservoir-specific draft limits will be used to ensure projects can meet minimum flows through the fall.
[3] Detroit, Fern Ridge, and Foster are considered the high-priority reservoirs. "Full" designation means that the project is at an acceptable level for recreation, but physically may not be at maximum conservation pool, or normal summer levels.

Table 5.2. Minimum and Maximum Tributary Flow Objectives below Willamette Dams (USACE 2007a)

Dam	Period	Primary Use	Minimum Flow (cfs) [1]	Chance of Not Meeting Flow	Maximum Flow (cfs) [2]	Chance of Not Meeting Flow	
Hills Creek	Sep 1 - Jan 31	Migration & rearing	400	12%			
	Feb 1 - Aug 31	Rearing	400	3%			
Fall Creek	Sep 1 - Oct 15	Chinook spawning	200	10%	400 through Sep 30, when possible	43%	Sep
	Oct 16 - Jan 31	Chinook incubation	50 [3]	1%			
	Feb 1 - Mar 31	Rearing	50	0%			
	Apr 1 - May 31	Rearing	80	0%			
	Jun 1 - Jun 30	Rearing/adult migration	80	0%			
	Jul 1 - Aug 31	Rearing	80	10%			
Dexter	Sep 1 - Oct 15	Chinook spawning	1,200	8%	3,500 through Sep 30, when possible	14%	Sep
	Oct 16 - Jan 31	Chinook incubation	1,200 [3]	5%			
	Feb 1 - June 30	Rearing	1,200	0%			
	Jul 1 - Aug 31	Rearing	1,200	3%			
Big Cliff	Sep 1 - Oct 15	Chinook spawning	1,500	17%	3,000 through Sep 30, when possible	0%	Sep
	Oct 16 - Jan 31	Chinook incubation	1,200 [3]	5%			
	Feb 1 - Mar 15	Rearing/adult migration	1,000	2%			
	Mar 16 - May 31	Steelhead spawning	1,500	0%	3,000	11%	Mar 16 - May 31
	Jun 1 – Jul 15	Steelhead incubation	1,200 [3]	0%			
	Jul 16 - Aug 31	Rearing	1,000	1%			
Foster	Sep 1 - Oct 15	Chinook spawning	1,500	71%	3,000 through Sep 30, when possible	0%	Sep
	Oct 16 - Jan 31	Chinook incubation	1,100 [3]	13%			
	Feb 1 - Mar 15	Rearing	800	3%			
	Mar 16 - May 15	Steelhead spawning	1,500	1%	3,000	44%	Mar 16 - May 15
	May 16 - Jun 30	Steelhead incubation	1,100 [3]	9%			
	Jul 1 - Aug 31	Rearing	800	74%			
Blue River	Sep 1 - Oct 15	Chinook spawning	50	67%			
	Oct 16 - Jan 31	Chinook incubation	50	1%			

Dam	Period	Primary Use	Minimum Flow (cfs) [1]	Chance of Not Meeting Flow	Maximum Flow (cfs) [2]	Chance of Not Meeting Flow	
	Feb 1 - Aug 31	Rearing	50	3%			
Cougar	Sep 1 - Oct 15	Chinook spawning	300	24%	580 through Sep 30, when possible	38%	Sept
	Oct 16 - Jan 31	Chinook incubation	300	6%			
	Feb 1 - May 31	Rearing	300	0%			
	Jun 1 - Jun 30	Rearing/adult migration	400	5%			
	Jul 1 - Jul 31	Rearing	300	13%			
	Aug 1 - Aug 31	Rearing	300	19%			

Exceedence of maximum flow objective over a 66-year record from 1936-2001 (probability figures are approximate).
[1] Minimum flow will equal inflow or Congressionally authorized minimum flows, whichever is higher, when the reservoir is at a minimum conservation pool elevation. This avoids drafting the reservoir below minimum conservation pool and, where applicable, into the power pool.
[2] Maximum flows are intended to minimize the potential for spawning to occur at stream elevations that might subsequently be dewatered at the specified minimum flow during incubation. It may not be possible to stay below these maxima, especially in the fall when drafting reservoirs in preparation for the flood damage reduction management period. Project operations will be managed to minimize the frequency and duration of necessary periods of exceedence.
[3] When feasible, incubation flows should be no less than ½ the maximum 72-hour average discharge observed during the preceding spawning season. Efforts will be made to avoid prolonged releases in excess of the recommended maximum spawning season discharge to avoid spawning in areas that would require high incubation flows that would be difficult to achieve and maintain throughout the incubation period.

In order to improve the likelihood of meeting tributary minimum flow objectives, the Action Agencies will complete the following actions:

5.2.4.1 Lower River Gages

The USACE will establish and operate gage stations at locations near the mouths of the tributaries listed below in this paragraph, by July 1, 2009, and will operate the stations through the term of this Opinion to develop relationships between release flows and gage flows. The plan will initially assess the adequacy of existing gages, if any, and need for new gages where none exist, in the lower reaches of the

- North Santiam River
- South Santiam River
- McKenzie River
- Middle Fork Willamette River below Dexter
- Middle Fork Willamette River below Hills Creek, and
- Fall Creek

The need for each gage will be determined based on fish use of lower river habitat and number of consumptive water diversions in each tributary. The USACE will complete a plan identifying the number and specific location of existing and new gages that are needed, in coordination with and review by the Services,[3] by January 1, 2009. At a minimum, river stage and water

3 See RPA 5.1.3 & 5.1.4 for elaboration of decision making process.

temperature will be measured at those sites where gages are needed. Stage-flow relationships will be developed and maintained for accuracy. Unless good cause is given, USACE will work with U.S. Geological Survey to ensure that these stations will be part of the USGS' water data program and maintained in USGS' Real-Time data system.

5.2.4.2 Tributary Instream Flow Studies

In coordination with the Services, the Action Agencies will develop a detailed study plan by December 2008 to conduct instream flow studies in 2009 and 2010. The primary goal of these studies will be to identify the relationships between river flow rates and habitat conditions for adult passage, holding, and spawning and juvenile rearing in the following tributaries: N. Santiam, S. Santiam, Fall Creek, Middle Fork Willamette, SF McKenzie, and McKenzie (listed in priority order).

5.2.4.3 Revise Minimum Flow Table

Following completion of the studies specified in 5.2.4.2 above, the USACE, in coordination with the Services, will determine if the minimum and maximum flow objectives in Table 5.2 are appropriate. If the studies suggest that fish protection goals can be better met with different flow levels than those specified in Table 5.2, then USACE, consistent with 5.2.4.4 below, will recommend any changes in flow objectives in applicable tributaries to improve benefits to listed fish while continuing to meet Project purposes. The Services will inform the USACE whether they agree[4] with the modified flow objectives. By January 2011, the USACE will revise its annual water management plan to include the revised flow objectives indicated by studies in 5.2.4.2 above, provided these flows are acceptable to the Services and that the flows can be released from Project reservoirs within existing system constraints. By January 2011, the USACE will use these flow objectives in operating the Project to the extent possible.

5.2.4.4 Modify Project Operations

Following completion of the study specified in 5.2.4.2 above and determination of revised minimum flow objectives as described in 5.2.4.3 above, the USACE will complete system operational modeling and NEPA analyses, if appropriate, including consideration of all project purposes, to identify modified project operations that optimize dam operations to best meet tributary and mainstem minimum flows needed to protect fish. The USACE will conduct these analyses as a high-priority element of the COP (Section 5.4.17 below). The USACE will carry out alternatives deemed feasible, as selected by the COP analysis, by January 2012.

5.2.5 Tributary Flows –Project Release Maximums

During winter steelhead and spring Chinook salmon spawning seasons, the USACE will maintain flows below the specified maximum flow objectives listed in Table 5.2 to the

4 See RPA5.1.3 & 5.1.4 for elaboration of decision making process.

extent practical when the reservoirs are below their respective rule curves. The USACE will notify the Services when maximum flow rates are exceeded according to the protocol described in section 5.2.2 above.

5.2.6 Ramping Rates

When project outflows are less than those in Table 5.3, the USACE will restrict down-ramping (the rate at which outflows are decreased) to the hourly and daily rates listed in Table 5.4 to minimize stranding of juvenile fish and aquatic invertebrates and dessication of redds. NMFS' goal is for down-ramping rates not to exceed 0.1 ft/hour during nighttime hours and 0.2 ft/hour during daytime hours. Table 5.4 shows the increment of flow estimated to achieve a 0.1 ft/hour nighttime and 0.2 ft/hour daytime rampdown rates for a range of outflow rates.

i. When system operations or equipment limits prevent USACE from meeting rampdown rates at all projects, USACE will place priority on achieving ramp rates at those projects marked in Table 5.4 as high priority for fish protection.

ii. The USACE will identify mechanical, operational, or equipment modifications needed to achieve these ramping rates. The Action Agencies will evaluate structural modifications in the COP[5] study, where indicated, to improve their ability to meet ramping rates.

iii. During active flood damage reduction operations, the USACE may deviate from the ramping rates in Table 5.4. However, the USACE will comply again with to these ramping rates as soon as the flood risk has abated. The USACE must follow the protocol for deviations from Table 5.4 described in RPA measures 5.2.2 and 5.4.3.

iv. As noted in RPA measure #5.2.10 below, the Action Agencies will conduct research, monitoring and evaluation of ramping rate restrictions to determine if the Table 5.4 ramping rates are effectively protecting fish and macroinvertebrates from stranding and redds from dewatering. Additionally, these studies will assess the effect of higher ramping rates that are presently permitted at flows greater than those in Table 5.3, to determine if these higher ramping rates are causing harm to ESA-listed fish or the critical habitat on which they depend. The Action Agencies will recommend appropriate changes to applicable ramping rates in Table 5.4 if indicated by results of the studies and consistent with authorized Project purposes. The Services will inform the Action Agencies whether they agree[6] with the modified ramping rates. The Action Agencies will implement modified ramping rates as soon as studies are completed, but no later than January 2011.

5 (C)onfigurations (O)peration (P)lan is Action Agencies' study and feasibility process described in section 9.4.
6 See RPA 5.1.3 & 5.1.4 for elaboration of decision making process.

Table 5.3. Project outflow rates: below these rates, down-ramping limits in Table 5.4 apply.

Project	Project Outflow (cfs)
Hills Creek	1500
Dexter	3000
Fall Creek	700
Dorena	1000
Cottage Grove	800
Cougar	1200
Blue River	700
Fern Ridge	300
Foster	2000
Detroit	2000

Table 5.4. Maximum Ramping Rates During Flow Level Changes Below Upper Willamette Basin Dams (cfs)

Nighttime Rampdown Rates to Achieve 0.1 ft/hour [1,2,4,6,7]

HCR[5]		LOP[5]		FAL[5]		DOR		COT		CGR[5]		BLU[5]		FRN		FOS[5]		DET[5]	
Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change
400		1200		50				50		400		50		30		800		1000	
600	60 [3]	1500	125	100	20 [3]	100		300	30 [3]	500	80 [3]	250	30 [3]	80	20 [3]	900	100	1200	100
1000	75 [3]	2000	145	300	40 [3]	500	50 [3]	500	40 [3]	1200	100 [3]	500	50 [3]	150	30 [3]	1900	150	1500	110
1500	90 [3]	2500	150	500	50	1000	60 [3]	800	50	2400	150	700	60 [3]	300	40	2000	155	2000	130
1700	100	3000	170	700	60	3700	100					2300	100	1000	50				

Highlighted flows are higher than the minimum flows needed to protect ESA species, but are included to represent the lowest flow rate at which 0.1 ft/hr ramp rate is currently possible at these dams.

Daytime Rampdown Rates to Achieve 0.2 ft/hour [1,2,6,7]

HCR[5]		LOP[5]		FAL[5]		DOR		COT		CGR[5]		BLU[5]		FRN		FOS[5]		DET[5]	
Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change
400		1200		50				50		400		50		30		800		1000	
600	120	1500	250	100	40 [3]	100		300	60	500	160	250	60 [3]	80	40	900	200	1200	200
1000	150	2000	290	300	80	500	100	500	80	1200	200	500	100	150	60	1900	300	1500	220
1500	180	2500	300	500	100	1000	120	800	100			700	120	300	80	2000	310	2000	260
		3000	340	700	120									1000	100				

[1] Avoid a flow volume reduction of more than 50% per hour or the lesser of 1 foot or 50% per 24 hours.
[2] Listed are decrements in release that approximately yield the resulting change in flow of 0.1 foot/hour or 0.2 foot/hour. The accuracy of any flow change is subject to the variability of the equipment and instrumentation.
[3] Small listed increments in flow are impractical to achieve under current equipment capability.
[4] From 1 January - 31 March a nighttime ramp is preferable. A rate of 0.2 ft/hour is considered acceptable for protecting juvenile spring Chinook salmon.
[5] Higher priority because of the presence of ESA listed salmon and steelhead. When system operations prevent USACE from meeting rampdown rates at all projects, USACE will place priority on achieving ramp rates at these projects noted as high priority for fish protection.
[6] Change in flow at flows higher than those listed are less critical for protecting ESA species because of proportionally smaller flow volume change.
[7] Ramping rates listed are for reservoir operation other than when reducing project outflow to manage for downstream flood damage reduction.

5.2.7 Environmental Flow[7]/Pulse Flow Components

The Action Agencies will work through the WATER Flow Management Committee and with the Services, and other aquatic scientists with expertise in Willamette basin fish ecology and fluvial geomorphology, and stakeholders, to identify environmental flow improvement opportunities for the mainstem Willamette River and the lower reaches of tributaries with USACE dams. The Action Agencies will design, test, and carry out modifications to flow releases from USACE dams to improve channel morphology in a manner that would create and sustain new, and improve existing, fish habitat through changes in project operations, while still addressing other authorized Project purposes. For each tributary, the process will begin by identifying fluvial morphology components8 important to ESA-listed salmonids and other biota that are currently underrepresented in the watershed. Following identification of these morphological conditions, the Action Agencies will examine the potential for improving these conditions through modification of project operations, as the Sustainable Rivers Project has done for the Middle Fork Willamette River in an effort summarized by Gregory et al. (2007). The Action Agencies will identify weak or missing morphological characteristics and, where feasible, will incorporate remedies to these conditions into one or more flow modification proposals. The Action Agencies will then submit proposals to the Flow Management Committee of WATER, which will recommend adjustments, if appropriate. The Services will inform the Action Agencies if they agree with the proposals. The Action Agencies will then carry out these flow modification proposals, initially as pilot studies and then, if determined feasible, as part of its regular water management operations. The Action Agencies will monitor the effectiveness of each environmental flow operation at achieving specific ecological objectives beneficial to ESA-listed salmonids and/or other aquatic biota. The Action Agencies will complete appropriate NEPA evaluation for alternatives being considered

Flow changes that may result from this measure could fall into one of three implementation types: (1) flow volume and timing adjustments that are within the operational flexibility of the USACE under current project authorizations and water control manuals; (2) larger scale adjustments that may fall within current operational flexibility and authority but whose implementation requires detailed evaluation of tradeoffs; and (3) major changes in operation which are clearly outside of the USACE's operational discretion and would require a thorough feasibility evaluation and possible reauthorization action. The USACE will begin implementing proposals for Type 1 environmental flow modifications on the lower Middle Fork Willamette, below Dexter Dam, in FY 2009, and explore with the Services and the Flow Management Committee of WATER any needs and opportunities to implement Type 2 or 3 flow modifications there in subsequent years. The Action Agencies will develop and carry out proposals for environmental flow modifications below other USACE dams in the Willamette Basin during the term of this Biological Opinion, with priorities among rivers identified by the Flow Management Committee. Within this period, a full effort will be made to optimize

7 "Environmental flows" are used in this context to refer to a full range of pulses or high flows that accomplish various fish habitat maintenance and creation through mechanisms such as sediment distribution, channel forming processes, overbank flows, maintaining access to side or off-channel habitat.

8 Such components may include appropriate seasons, magnitudes, durations, or rates of change in specific components of the annual hydrograph, including fall transition flows, small fall pulses in flow, winter bankfull flow pulses, small or larger floods above bankfull river levels, spring pulse flows, spring-to-summer transitions in flow, and summer baseflows.

USACE management of flows in the tributaries and mainstem so as to achieve improved fish habitat benefits that are not incompatible with other purposes of the dams.

5.2.8 Foster Spring Spill

The USACE will continue to spill at Foster Dam between 0.5 and 1.5 feet of water (approximately 92 to 238 cfs), depending upon inflow and forebay elevation fluctuations, over the spillway fish weir. This operation will occur from 0600 through 2100 hours daily during the primary fish passage season, April 15 through May 15. The Action Agencies will evaluate the effectiveness of this operation on downstream fish passage as part of RME (RPA #5.2.10) and COP studies (RPA measure 5.4.17). Based on the results of these studies, the Action Agencies will recommend modifications to this spill operation or new downstream fish passage facilities or operations. If modified operations are warranted and can be carried out within existing physical and operational constraints, the Action Agencies will begin to carry out these operations consistent with RPA measure #5.4.8, "Interim Downstream Fish Passage." If more extensive modifications are needed, the Action Agencies will follow the process described in the COP study, RPA measure 5.4.17.

5.2.9 Protecting Stored Water Released for Fish

In coordination with the OWRD and ODFW, the Action Agencies will facilitate conversion of stored water to an instream flow water right. Oregon adopted minimum perennial streamflows for Willamette tributaries in Oregon's Willamette Basin Program (Table 1 in ORS 690-502). After being converted to water rights under Oregon law, OWRD can protect the minimum perennial stream flows from illegal diversion. The State of Oregon is solely responsible for administering and enforcing state water rights.

Additionally, the Action Agencies will identify stored water in addition to the minimum perennial streamflows that could be allocated from reservoirs to enhance salmon and steelhead survival. The Action Agencies will proceed with necessary actions to allocate and protect water for this purpose. In particular, USACE and Reclamation will coordinate with OWRD on several tasks to accomplish this measure: 1) identify current water storage at USACE reservoirs that could be allocated to instream flow for ESA listed fish; 2) determine how to legally transfer flow for instream purposes; and 3) proceed with the necessary analyses to implement the agreed upon transfers. The tasks necessary to accomplish this action may require approval from Congress. This effort will begin immediately. By the end of 2009, the Action Agencies will have coordinated with all appropriate agencies and determined the path forward in order to accomplish this action.

5.2.10 Flow Related Research, Monitoring and Evaluation

As part of the RM&E plan described in RPA measure #5.9 below, the Action Agencies will plan and carry out studies and monitoring of mainstem and tributary flow rates and Project ramping rate restrictions necessary to protect fish and aquatic habitat, as well as other evaluations required by measures in this section. The flow and ramping rate studies will be considered high

priority and field studies should begin in 2009, with initial results available to inform modified flows and ramping rates by January 2011.

5.3 Water Contract Program

One of the authorized purposes of the Willamette Project is the distribution of stored water to users who have contracts with Reclamation for irrigation use. These RPA measures are intended to minimize the effects of diverting water served by Reclamation contracts on listed species by limiting the volume of new contracts that can be issued, requiring existing contract diversions to install screens and other fish passage devices within specified timeframe, requiring screening of all new contract diversions, ensuring that water released to serve contracts does not diminish water available to meet minimum flow objectives, and reducing the volume of stored water diverted to contract holders in low water years to ensure minimum objectives are met. These measures will also minimize destruction and adverse modification of critical habitat due to water diversions because they limit the total amount of water that can be diverted and require fish protection measures at the diversions.

5.3.1 Bureau of Reclamation Water Contract Program

Reclamation and the USACE will continue the existing irrigation contract water marketing program for the Willamette Project. Reclamation will issue new contracts, except as specified in RPA# 5.3.2 below regarding new contracts in the N. and S. Santiam subbasins, and provided that the total water marketing program, including existing contracts, does not exceed a total of 95,000 acre feet. In the event that future irrigation demand exceeds 95,000 acre-feet, Reclamation and the USACE will reevaluate the availability of water from conservation storage for the water marketing program and reinitiate consultation with the Services if they propose to issue additional contracts.

In addition, all contracts will be subject to the availability of water, as determined by USACE. Therefore water may not be available for some or all of each year in order to meet ESA requirements and other project obligations for instream flows (e.g. minimum flows to protect water quality). Reclamation may issue notices, orders, rules, or regulations governing water service as necessary to comply with the requirements of the ESA, including appropriate biological opinions and Incidental Take Statements.

5.3.2 New Contract Issuance

Reclamation will not issue irrigation water service contracts in the North Santiam River and the South Santiam River that would in total exceed the current total of 11,574 ac ft (85 cfs) and 1,096 ac ft (7 cfs) respectively.

The USACE will update its flow exceedence models (similar to Appendix C of the Supplemental BA; USACE 2007a) every five years, and, together with results of fish flow studies, determine whether additional water is available during most years for new irrigation contracts based on this information. If, based on these analyses and other information, the USACE determines that additional water is available to serve irrigation demand (beyond the volumes specified above)

without adversely affecting listed fish and their critical habitats, then the USACE will inform Reclamation and seek the written agreement of the Services. The Services will inform the USACE in writing whether they agree[9] with the USACE's determination. If the result of this process is an affirmative determination that additional water is available, Reclamation may issue new contracts based on and limited by the USACE's determination.

5.3.3 Existing Contracts

Existing Contracts: All existing contracted diversions will be required, as a condition of continuing to receive project water, to have fish protection devices that comply with NMFS design criteria, and are approved by NMFS.[10] While this clause is primarily about fish screens, it is not limited to fish screening. Based on the effect of the diversion on anadromous fish, fish protection devices could include upstream passage at dams, exclusion of fish from irrigation water return channels, and other fish hazards presented by water diversion practices. Contractors that do not comply with Reclamation's notice or otherwise fail to obtain certification by NMFS as having adequate fish protection devices will not be eligible to continue to receive irrigation water service from the Project and their contract may be subject to termination. The compliance deadline is April 1, 2010, unless a later date is authorized by NMFS.[11]

1. By October 1, 2008, Reclamation will send written notification to all existing contractors notifying them that in order for them to continue receiving irrigation water service from the Project, their diversions must have fish protection devices that comply with current NMFS fish protection requirements,[12] and are approved by NMFS. Contractors will be required to request assessment by entities listed in the Bureau's written notification letter. Within the time frame specified by Reclamation in its notice, contractors will be required to provide Reclamation with written assessment[13] that their diversions conform to NMFS criteria. Reclamation will assemble this information and provide it to NMFS. NMFS will then make a determination as to whether NMFS agrees that the fish protection measures are sufficient to protect ESA-listed fish, and will advise the water user and Reclamation of this determination. NMFS may ask for additional information, or may need to visit the diversions in order to make its determination. If NMFS requests a site visit, NMFS will inform Reclamation.[14]

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9 See RPA 5.1.3 & 5.1.4 for elaboration of decision making process.

10 Projects that have had, within the last 15 years, site-specific ESA Section 7 consultations performed with respect to fish protection devices are deemed compliant.

11 Reasons for extending this date might include challenging design requirements, or atypically large and complicated projects.

12 See Anadromous Salmonid Passage Facility Design, National Marine Fisheries Service, Northwest Region, February 2008 http://www.nwr.noaa.gov/Salmon-Hydropower/FERC/upload/Fish_Passage_Design.pdf

13 NMFS will accept assessments by ODFW, Reclamation, or others, based on a Memoranda of Understanding between these Agencies and NMFS with respect to technical acceptance criteria.

14 Initially, all diversions will require a site inspection by NMFS; ideally, however, USBR and NMFS will develop a protocol to avoid site visits for every pumped, diversion, particularly small ones.

2. While contractors proceed with the fish protection device installation or modification and approval process, they may continue to divert water under the terms and conditions of their existing contracts, as long as they meet the deadline provided to them by Reclamation.
3. As another condition of receiving water, every five to seven years, contractors must re-confirm that their diversions are still in conformance with NMFS design guidelines.

5.3.4 New and Renewed Contracts – Conditions

Reclamation will require renewed and new contracts to meet all of the following:

1. Compliance with NMFS fish protection criteria, as required for existing diversions in 5.3.3 above.

2. Surface water diversions must have lockable headgates that are capable of easily starting, adjusting and stopping the flow of water.

3. Diversions greater than 3 cfs must have devices to enable measurement of the instantaneous rate of water delivery, within 5% accuracy. Diversions over 10 cfs must also have a flow totalizer that calculates total volume of water diverted.

4. Reclamation will include provisions to curtail or cease entirely all water deliveries in specific areas, if certain flows are necessary to protect listed species and their critical habitats.

5.3.5 Annual Availability of Contract Water for Irrigation

Contract fulfillment is subject to the USACE's annual operating plan for the Willamette Basin Project in which the USACE determines availability of water for Reclamation contracts. If USACE determines that a shortage will occur, or is forecasted to occur, USACE can designate this shortage to specific tributary subbasins, certain reaches, or throughout the Willamette basin, limiting the availability of the contract water supply. Reclamation will notify contractees of storage water shortages as described below. Appendix D (NMFS 2008) further describes how water years are designated and is hereby incorporated into this RPA by reference.

Each year on or before April 1, the USACE will determine availability of water for irrigation contracts based on the best information available at that time.

DEFICIT YEARS:

(a) In "deficit" water years (as defined in Appendix D, NMFS 2008), the USACE will inform Reclamation that either (1) a specified partial supply or (2) no supply is available for the upcoming irrigation season in specific tributaries and will include this determination in the annual operating plan. The April 1

determination will remain in effect until October 31. The Corps may revise its "deficit" water year determination after April 1 if forecasts change significantly toward a wet year, and may make additional stored water available to meet irrigation contracts.

(b) Reclamation will notify affected contractees that water deliveries will be ceased or curtailed under these circumstances. Reclamation may apply the curtailment or cessation of water deliveries to specific tributaries where it is needed, but not in others, depending on water availability and storage capacity in each basin's reservoirs. Reclamation will also inform the OWRD of such actions.

(c) If the USACE determines initially that a partial supply is available for contractees, but later forecasts indicate even less water is available, in order to protect fish habitat the USACE will release additional flow from the applicable dams to offset the amounts diverted by contractees, based on the partial use that had been permitted on April 1. This additional flow will not be released if, based on coordination through WATER, it is determined these additional flows would impact ability to meet Table 5.0 (mainstem) and 5.2 (tributary) minimum flows during other seasons.

INSUFFICIENT, ADEQUATE, and ABUNDANT YEARS:

(a) In these water years (as defined in Appendix D, NMFS 2008), the USACE will usually not make a determination that would curtail contractees' use of water.

(b) Instead, the USACE will release additional flow (over the Table 5.4 flow rates) to offset the amount of flow diverted by contractees, as estimated in Table 3-26 of the Proposed Action (USACE 2007a) (or based on updated estimates by Reclamation of actual use). This measure does not apply to the Coast Fork or Long Tom subbasins.

(c) The schedule for when and if to begin and end additional flow releases will be annually determined through the WATER Flow Management Committee, which will consider fish flow needs, Reclamation's estimate of contract water usage, and reservoir storage available for meeting tributary and mainstem flow objectives throughout the water year.

(d) In tributaries and reaches where the sum total of existing and new contracts is less than 20 cfs or otherwise beyond adjustment capabilities at each project dam, the USACE will attempt to release these additional increments. However, downstream gage data may not detect relatively small increases in flow over Table 8-2 (NMFS 2008) releases.

(e) The USACE will not be required to make RPA measure #5.2.2 deviation reports where contracted flow is less than 20 cfs; NMFS will consider requests to waive RPA measure 5.2.2 deviation reports in other situations, as well, on a case-by-case basis.

5.4 Fish Passage

The Proposed Action included studies to consider passage at Project dams, but did not include specific passage measures and time frames associated with the measures. As discussed in the Effects and Synthesis sections of NMFS (2008), for UWR Chinook salmon and UWR steelhead, lack of passage is one of the single most significant adverse

effects on both the fish and their habitat. In its jeopardy and destruction and adverse modification analyses, NMFS (2008) identified the need for more specific measures with associated time frames. Specific passage measures are necessary to address the effects of the Project. Therefore, NMFS includes specific passage measures to be completed and operational by set deadlines. NMFS also includes a measure to ensure that the Action Agencies continue to work toward providing more specific passage measures, if appropriate, past the time frame of this RPA.

5.4.1 Adult Chinook Salmon Outplanting

The Action Agencies will continue capturing spring Chinook salmon below USACE dams and transporting them into habitat above the following dams:

- Detroit Dam in the North Santiam River basin;
- Foster Dam in the South Santiam River basin;
- Cougar Dam in the South Fork McKenzie River basin;
- Lookout Point and Hills Creek dams in the upper Middle Fork Willamette River subbasin; and
- Fall Creek Dam in the Fall Creek River basin.

Additionally, if NMFS, after coordination with the Fish Passage and Hatchery Management Committee (FPHM) of WATER, determines it is necessary to evaluate passage at Green Peter Dam, then the Action Agencies will also release Chinook salmon above that dam in the South Santiam.

The Outplant Program will provide upstream fish passage for adults via "trap and haul" facilities while USACE carries out studies to assess upstream and downstream fish passage alternatives at these dams and reservoirs (see RPA# 5.4.11, 5.4.12 and 5.4.13 below). The interim operational guidelines and protocols for outplanting fish will be as described in section 3.4.5 of the Supplemental BA (USACE 2007a), and section 15 of each of the spring Chinook HGMPs.[15] The Outplant Program will be carried out consistently with the guidelines, protocols, and criteria specified in the Willamette Fish Operations Plan (see RPA measure #5.4.3 below) and annual revisions to this plan (see RPA measure #5.4.4 below).

5.4.2 Winter Steelhead Passage

The Action Agencies will continue to trap adult winter steelhead at Foster Dam in the South Santiam River and transport them to release sites above Foster reservoir. If NMFS and the Action Agencies, in coordination with the FPHM of WATER, determine it necessary for evaluation of winter steelhead passage at Green Peter Dam, then the Action Agencies will release some portion of the winter steelhead captured at the Foster Dam trap above Green Peter reservoir in the South Santiam. Additionally, if NMFS and the Action Agencies, in coordination

15 Hatchery and Genetic Management Plans (HGMPs) are described in the salmon and steelhead 4(d) rule as a mechanism for addressing "take" of ESA-listed species that may occur as a result of artificial propagation activities.

with the FPHM, determine it necessary for evaluation of steelhead passage at Detroit and Big Cliff dams, then the Action Agencies will trap winter steelhead at the Minto Trap or other locations in the North Santiam River below Big Cliff Dam and release them above Detroit and/or Big Cliff dams, as directed by NMFS.

5.4.3 Willamette Fish Operations Plan

The Action Agencies will complete a Willamette Fish Operations Plan (WFOP) by October 1, 2008. The Action Agencies will coordinate with the Services when preparing the WFOP. This Plan and its annual revisions will be consistent with this Opinion (NMFS 2008) and incidental take statement and will take into account and be coordinated with related biological opinions issued by the USFWS to the fullest extent practicable. The Action Agencies will carry out measures identified in the WFOP and in annual revisions to the WFOP. The WFOP will include, but not be limited to, the following:

1. Identify optimal operating criteria for Green Peter, Foster, Detroit, Big Cliff, Cougar, Fall Creek, Dexter, Lookout Point, and Hills Creek dams to minimize adult and juvenile fish injury and mortality to the extent possible with existing facilities and operational capabilities;

2. Identify protocols for optimal handling, sorting, and release conditions for ESA-listed fish collected at USACE-funded fish collection facilities, including but not limited to those at Minto fish facility, Foster Dam fish collection facility, McKenzie Hatchery, Fall Creek fish facility, Dexter Dam fish collection facility, and at the new facilities at Cougar and Leaburg dams, when they are constructed;

3. Identify the number, origin, and species of fish to be released into habitat upstream of USACE dams, incorporated into the hatchery broodstock, or taken to other destinations;

4. Describe scheduled and representative types of unscheduled maintenance of existing infrastructure (dams, transmission lines, fish facilities, etc) that could negatively impact listed fish, and describe measures to minimize these impacts;

5. Describe procedures for coordinating with federal and state resources agencies in the event of scheduled and unscheduled maintenance.

6. Describe protocols for emergency events and deviations:

   a) Protocol Development: The USACE will establish a formal, written procedure for taking actions to prevent or minimize adverse impacts to ESA-listed fish, including water quality impacts, during unusual events/conditions. These protocols will guide the actions of project personnel.

   b) In the event of an emergency outage or malfunction, the Action Agencies will inform the Services of the emergency by phone or email, as soon as practical, but not later than 24 hours after the event. This process will also apply whenever the Action Agencies carry out flood

reduction operations that result in deviations from the flow measures described in this section.

c) The Action Agencies may initiate work prior to notifying the Services, when delay of the work will result in an unsafe situation for people, property, or fish. For each occurrence of unscheduled maintenance and each flood damage reduction operation that results in a deviation from minimum mainstem flow objectives, minimum and maximum tributary flow objectives, ramping rates, spill at Foster Dam, or adverse TDG and water temperature conditions, the USACE will inform the Services in writing (or email) within 24 hours, and include a description of the problem, type of outage required, potential impact on ESA-listed fish, estimated length of time for repairs or flood damage reduction operation, and proposed measures to minimize effects on fish or their habitat. This approach will be taken only if it is not possible to coordinate with the Services prior to starting the maintenance event or flood damage reduction operation.

5.4.4 Annual Revision of Willamette Fish Operations Plan (WFOP)

The Action Agencies will annually revise and update the WFOP, including the "Fish Disposition and Outplant Protocol" sections of each chapter to describe how and where outplanted fish will be collected, held, marked, sampled, transported, and released and to incorporate changes in operations needed to protect fish. The WFOP will be revised annually based on results of RM&E activities, construction of new facilities, recovery planning guidance, predicted annual run size, and changes in hatchery management. Annual revisions will be submitted to the Services by January 15 of each year for review and comment; the Services will inform the Action Agencies by February 15, whether they agree[16] with the revised WFOP. The Action Agencies will release a final updated WFOP by March 14 of each year. Annual revisions will be considered an "Annual Milestone" as defined below in RPA measure #5.4.17.

5.4.5 Employee Training for Fish Protection Operations at Project Dams and Fish Facilities

The Action Agencies will ensure that fish facility personnel, operators, and managers responsible for operating and maintaining fish facilities at each project complete an annual employee environmental awareness training program. The training will include a review of the status of ESA listed aquatic species, the WFOP, and each fish facility's standard operation procedures (SOPs). Prior to conducting the annual training, the Action Agencies will coordinate with the WATER and appropriate natural resource agencies to identify any specific resource issues that should be addressed or emphasized at that time. The Action Agencies will maintain records of the training including agendas, attendance lists, and any handout materials.

16 See RPA 5.1.3 & 5.1.4 for elaboration of decision making process.

5.4.6 Upgrade Existing Adult Fish Collection and Handling Facilities

The Action Agencies will design, construct, install, operate and maintain new or rebuilt adult fish collection, handling and transport facilities at the sites listed below. The Services will inform the Action Agencies whether they agree[17] with each facility's planned configuration and operation. The Action Agencies will design each facility with and incorporate NMFS' Anadromous Salmonid Passage Facility Design (NMFS 2008b) and the best available technology. During the design phase, the Action Agencies will coordinate[18] with the Services to determine if the design should accommodate possible later connection to a fish ladder, if determined necessary in future years beyond 2015.

The Action Agencies will complete all necessary interim steps in a timely fashion to allow them to meet the following deadlines for completing construction and beginning operation of the facilities listed below. These steps may include completing a DDR and plans and specifications. The Action Agencies will give NMFS periodic updates on their progress. The order in which these facilities are completed may be modified based on interim analyses and biological priorities, and with agreement[19] of NMFS and USFWS.

1. North Santiam Fish Facility (currently at Minto Pond) – complete construction no later than December 2012; begin operation no later than March 2013.
2. Foster Fish Facility – complete construction by December 2013; begin operation by March 2014.
3. Dexter Ponds Fish Facility – complete construction by December 2014; begin operation by March 2015.
4. Fall Creek Dam Trap – complete construction by December 2015; begin operation by March 2016.

5.4.7 Adult Fish Release Sites Above Dams

The Action Agencies, working in coordination with the Forest Service or other applicable landowners[20], will:

- Complete a site/concept study by February 28, 2009, that will identify at least four to six potential locations suitable for new adult fish release sites for Chinook salmon above Detroit, Foster, Lookout Point, Hills Creek, Fall Creek, and Cougar reservoirs. Sites located above

17 See RPA 5.1.3 & 5.1.4 for elaboration of decision making process.

18 See RPA 5.1.3 & 5.1.4 for elaboration of decision making process.

19 See RPA 5.1.3 & 5.1.4 for elaboration of decision making process.

20 NMFS acknowledges that establishment of release sites above reservoirs may be contingent upon securing funds and agreement with non-Action Agency landowners/land managers such as USFS and BLM. NMFS also understands that some entities such as USFS and BLM may elect to undertake work on the property they manage themselves, in which case Action Agencies would cooperate with them, including funding the work, if necessary. Environmental permitting not provided by this or other ESA consultations may also be required before this work can be accomplished.

Foster Reservoir will be suitable for releasing both Chinook salmon and winter steelhead; site(s) above Detroit and Green Peter dams should also be suitable for winter steelhead, should adult steelhead be released in these locations in future years.

- The Action Agencies will work with the USFS and the Services to prioritize and design each release site, which may include infrastructure to minimize stress and injury of adults (e.g., piping systems, vehicle ramps, etc). The release sites will be prioritized in the context of the Configuration Operation Plan (COP) (see RPA measure #5.4.17). The Services will inform the Action Agencies whether the sites as designed are consistent with the Opinion.
- The Action Agencies will complete construction of all selected sites by June 2012. If another entity, by December 2010, takes on the responsibility for constructing or improving these sites, the Action Agencies will not be responsible for construction of those sites completed by another entity. Additionally, if, based on results of the COP, additional sites are warranted, construction of additional sites will be completed as soon as possible after identified by the COP. Construction of the sites will be contingent upon availability of funds (which may include a non-federal cost-sharing requirement) and cooperation of landowners. Prior to construction, the Action Agencies will need to complete processes to ensure compliance with all applicable statutes and regulations not provided by this or other ESA consultations, as required by applicable law.

5.4.8 Interim Downstream Fish Passage through Reservoirs and Dams

Until permanent downstream passage facilities are constructed or operations are established at Project dams and reservoirs in subbasins where outplanting of UWR Chinook salmon and steelhead is underway, the Action Agencies will carry out interim operational measures to pass downstream migrants as safely and efficiently as possible downstream through Project reservoirs and dams under current dam configurations and physical and operational constraints, and consistent with authorized Project purposes.

Near-term operating alternatives will be identified, evaluated, and implemented if determined to be technically and economically feasible and biologically justified by the Action Agencies and Services, within the framework of the Annual Operating Plan updates and revisions and in coordination with the WATER Flow Management Committee.[21]

The Action Agencies will evaluate potential interim measures that require detailed environmental review, permits, or Congressional authorization as part of the COP (see RPA #5.4.17 below). The Action Agencies will complete this component of the COP by April 2011, including seeking authorization (if necessary) and completing design or operational implementation plans for those operations selected by the COP. The measures that will be considered in the COP include, but are not limited to, partial or full reservoir drawdown during juvenile outmigration period, modification of reservoir refill rates, and using outlets, sluiceways, and spillways that typically are not opened to pass outflow. The Services will inform the Action Agencies whether they agree[22] with the interim downstream passage measures. The Action

21See RPA 5.1.3 & 5.1.4 for elaboration of decision making process.

22 See RPA 5.1.3 & 5.1.4 for elaboration of decision making process.

Agencies will begin to carry out measures selected by the COP by May 2011, contingent on funding, authorization, and compliance with all applicable statutes and regulations. One specific measure is listed below, and others may be developed in coordination with the WATER, if appropriate.

5.4.9 Fall Creek Drawdown

Beginning in Water Year 2008, the Action Agencies will adjust timing of storage and release of flow at Fall Creek Reservoir to promote downstream passage of juvenile Chinook salmon through the reservoir and dam. Drawdown will be to at least elevation 714.0 by the end of November each year, and the Action Agencies will hold the reservoir at this elevation during all of December and January except during flood events, and possibly longer. The Action Agencies will conduct monitoring and evaluation studies to determine the effectiveness of the operation and to assist in deciding whether or not to continue the operation in future years. The depth and timing of the drawdown may be adjusted in subsequent years, based upon monitoring results, with NMFS' agreement.[23] During this operation, when inflow is less than Project minimum flow objectives and the reservoir is at or below 714.0', then outflow will equal inflow and this will not be considered a deviation from flow objectives.

5.4.10 Head-of-Reservoir Juvenile Collection Prototype

The Action Agencies will plan, design, build, and evaluate a prototype head-of-reservoir juvenile collection facility above either Lookout Point or Foster reservoir. If Foster reservoir is chosen for testing the prototype, the Action Agencies will design for collecting both juvenile salmonids and steelhead kelt. The Action Agencies will complete construction by September 2014. As an interim step, the Action Agencies will complete feasibility studies as part of the COP (described in RPA measure #5.4.17) near the end of 2010. At that time, the Action Agencies will make a "go/no go" decision on the feasibility of the prototype facility(s) and the preferred location(s) and design(s) for construction of the prototype(s). The Action Agencies will make the go/no go decision in coordination with the FPHM, and after agreement by NMFS.

After construction is completed, the Action Agencies will conduct biological and physical evaluations of the head-of-reservoir prototype collection facilities in 2015 and 2016, with opportunities for review and comment by the FPHM and RM&E committee of study proposals and draft reports. After receiving comments, including the Services' statements regarding whether they agree[24] with the draft report, the Action Agencies will make necessary revisions to the draft report and issue a final report by December 31, 2016, on the effectiveness of the facilities, including recommendations for installing full-scale head-of-reservoir facilities at this and other reservoirs. If the report concludes that head-of-reservoir facilities are technically feasible, capable of safely collecting downstream migrating fish, and capable of increasing the overall productivity of the upper basins, then the Action Agencies will include such facilities in the design alternatives that they consider in the COP studies described in RPA measure #5.4.17 below.

23 See RPA 5.1.3 & 5.1.4 for elaboration of decision making process.
24 See RPA 5.1.3 & 5.1.4 for elaboration of decision making process.

5.4.11 Assess Downstream Juvenile[25] Fish Passage through Reservoirs

The Action Agencies will, in coordination with and review by the Services, assess juvenile fish passage through the following Project reservoirs:

1. Cougar
2. Lookout Point and Dexter
3. Detroit and Big Cliff
4. Green Peter and Foster
5. Fall Creek
6. Hills Creek

These evaluations will be developed consistent with the RM&E process described below in RPA measure #5.9 (RM&E). The Action Agencies must seek NMFS' review of evaluation proposals. Comments submitted by NMFS on draft evaluation proposals must be reconciled by the Action Agencies in writing to NMFS' satisfaction prior to initiating any research-related activities anticipated in this RPA.[26] The proposals must identify annual anticipated incidental take levels by species, life stage, and origin[27] for each year. The Services will inform the Action Agencies whether they agree[28] with the proposed studies, reports, and NEPA alternatives. The Action Agencies will begin these studies in 2008; field investigations, study reports, and NEPA analyses, if necessary, will be completed by December 31, 2015.

5.4.12 Assess Downstream Juvenile Fish Passage through Dams

At Cougar, Lookout Point and Dexter, Detroit and Big Cliff; Foster and Green Peter, Fall Creek, and Hills Creek dams, the Action Agencies will, in coordination with and review[29] by the Services, do the following:

1. Assess passage survival and efficiency through all available downstream routes, including turbines, spillways, regulating outlets, hatchery water supplies, etc., noting injury and mortality through each route.
2. Identify and propose alternatives for reducing juvenile mortality passing through the routes noted above, including, but not limited to, operational and structural modifications.
3. The Action Agencies will begin these studies in 2008 and will complete all field investigations, study reports, and NEPA analyses, if necessary, by December 31, 2015 (except as noted below for Cougar, Lookout Point, and Detroit, which have earlier completion dates).

25 Include downstream steelhead kelt passage in Santiam studies through Detroit, Big Cliff, Green Peter, and Foster.
26 See RPA 5.1.3 & 5.1.4 for elaboration of decision making process.

27 That is, hatchery-origin or non-hatchery origin fish.

28 See RPA 5.1.3 & 5.1.4 for elaboration of decision making process.

29 See RPA 5.1.3 & 5.1.4 for elaboration of decision making process.

4. These evaluations will be developed consistent with the RM&E process described below in RPA measure #5.9. The Action Agencies must seek NMFS' review of evaluation proposals. Comments submitted by NMFS on draft evaluation proposals must be reconciled by the Action Agencies in writing to NMFS' satisfaction prior to initiating any research-related activities anticipated in this RPA. The proposals must identify anticipated take levels of each species and life stage for each year. The Services will inform the Action Agencies whether they agree with the proposed studies, draft reports, and alternatives.
5. The Action Agencies will conduct additional studies in anticipation of additional passage measures constructed and operated beyond 2023.

5.4.13 Long Term Fish Passage Solutions

Based on the best available scientific information at the time of development of this RPA, additional structural and operational modifications are needed to allow safe fish passage and access to habitat above and below Willamette project dams.

The Action Agencies will complete this work as part of the COP described in RPA #5.4.17 below. The dates for completing interim steps are guidance. However, the dates for completion and operation are fixed. Measures #5.4.14 through 5.4.16 identify dates for making structural modifications (or biologically equivalent operational measures), based on the best available information at the time of development of the RPA.

These structural or operational modifications will be analyzed and developed as high priority measures in the Willamette Configuration Operation Plan (COP) (see RPA measure #5.4.17). The COP will evaluate a range of structural and operational alternatives for improving fish passage and water quality conditions associated with the Willamette dams. The three alternatives described above will be priority actions evaluated in the COP to determine whether they are biologically and technically feasible. The Action Agencies, FWS, and NMFS will evaluate the information gathered through the COP, NEPA, RM&E measures, and any other sources of information such as ESA recovery planning (including life cycle modeling developed as part of the recovery planning process), university studies, local monitoring efforts and public comment, to determine whether the scheduled action, or an alternative, will provide the most cost-effective means to achieve benefits to ESA-listed fish. If the information gathered confirms that the scheduled action is best suited to addressing the effects of the Project, the Action Agencies will proceed with implementation. If the information shows that an alternative action would provide similar biological benefits, is technically feasible, and would be more cost-effective, then the Action Agencies will implement the alternative action. The Action Agencies may need to complete appropriate NEPA analyses and obtain authorization and appropriation before implementation.

The Action Agencies will present specific implementation plans to NMFS, and NMFS will evaluate whether the actions proposed in the implementation plans meet the biological results NMFS relied on in its 2008 biological opinion. NMFS will notify the Action Agencies as to whether the proposal is consistent with the analysis in the biological opinion.

The Action Agencies will analyze additional structural and operational measures for downstream fish passage (beyond the three listed in measures 5.4.14 through 5.4.16 below) as part of the COP. The measures will be investigated in the same manner as for the three measures listed below. The time frame for construction and operation of these additional passage measures may extend beyond the time frame of this Opinion. However, the Action Agencies must begin certain actions, such as investigating feasibility, completing plans, conducting NEPA, if necessary, and requesting authorization, during the term of this Opinion. These studies will be included in the COP.

5.4.14 Cougar Dam Downstream Passage

The Action Agencies will investigate the feasibility of improving downstream fish passage at Cougar Dam through structural modifications as well as with operational alternatives, and if found feasible they will construct and operate the downstream fish passage facility.

- The Action Agencies will take necessary initial steps beginning no later than 2010, which may include a site/concept study, design report, plans and specifications, if appropriate.
- The Action Agencies will establish a Major Milestone (MM2) (described in measure 5.4.17 below) near the end of 2010, in conjunction with completion of the Cougar Site/Concept Study and DDR. The Action Agencies will make "go/no go" decisions on the feasibility of Cougar downstream passage facilities. In the case of the decision to move forward on implementation, the decision will potentially be focused on alternative locations and designs for downstream passage facilities and operations. (NMFS assumes that fish passage improvements at Cougar Dam will not require further authorization because passage was specifically authorized and constructed as part of the original Cougar Dam plans[30]; NMFS also assumes that the proposed Cougar trap will be used for upstream fish passage.)
- The Action Agencies will complete construction of any structural fish passage facilities by Dec. 2014; and by 2015, begin operating downstream fish passage facilities at Cougar Dam. Any necessary NEPA compliance required for implementation of the proposed facilities will occur in conjunction with development of the DDR.

5.4.15 Lookout Point Dam Downstream Passage

The Action Agencies will investigate the feasibility of improving downstream fish passage at Lookout Point Dam, and if found feasible, they will construct and operate downstream fish passage facilities there. The Action Agencies will take necessary initial steps, beginning no later than 2012, which may include feasibility studies, a design report, authorization and appropriation, and plans and specifications, if appropriate.

The Action Agencies will complete construction of any structural fish passage facilities by December 2021.

30 Due to temperature changes caused by construction of the reservoir, original passage efforts failed. Since 2005, however, temperature problems have been largely solved, and passage is once again feasible.

- By March 2022, the Action Agencies will begin operating downstream fish passage facilities at Lookout Point that will enable collection and transport of fish from above Lookout Point to habitat downstream of Dexter.
- The Action Agencies will establish a Major Milestone (MM6) near the end of 2014 in conjunction with completion of the Lookout Point Feasibility Study. The major decision associated with that milestone will be "go/no go" decisions on the feasibility of Lookout Point fish passage facilities. Another Major Milestone (MM7) may be needed near the end of 2016 pending actions on authorization and appropriation of proposed facilities.

5.4.16 Detroit Dam Downstream Passage

The Action Agencies will investigate the feasibility of improving downstream fish passage at Detroit Dam and if found feasible they will construct and operate downstream passage facilities. Temperature control will also be considered in designing the passage facility.

- The Action Agencies will take necessary initial steps beginning no later than 2015, which may include feasibility studies, a design report, authorization and appropriation, and plans and specifications, if appropriate.
- The Action Agencies will establish a Major Milestone (MM8) near the end of 2017 in conjunction with completion of the Feasibility Study. The major decision associated with that milestone will be "go/no go" on the feasibility of fish passage facilities at Detroit Dam. Another Major Milestone (MM9) may be needed near the end of 2019 pending actions on authorization and appropriation of proposed facilities.
- The Action Agencies will complete construction of any structural fish passage facilities by December 2023. (This measure may be completed earlier in conjunction with Detroit temperature control efforts, as described in RPA measure # 5.5.2 below).
- By March 2024, the Action Agencies will begin operating downstream fish passage facilities at Detroit that would enable collection and transport of fish from above Detroit to habitat downstream of Big Cliff Dam. Any necessary NEPA compliance required for implementation of proposed facilities will occur in conjunction with preparation of the Feasibility Report.

5.4.17 Willamette Configuration Operation Plan (COP)

The Action Agencies will carry out the COP, a multi-year, multi-level study process, to evaluate a range of potentially beneficial actions for listed fish species at Project dams and reservoirs. Figure 9.4-1 [31] (see Appendix B) identifies specific measures, studies, and milestones that will be accomplished through the COP. The interim steps will be completed in a timely manner; however, the dates shown in Figure 9.4-1 (see Appendix B) for interim steps are not firm. Regardless of the timing of interim steps, the Action Agencies will complete each Project measure no later than the final date listed for each measure. The Action Agencies will keep the Services appraised of their progress.

31 This is a revised Gantt chart produced by the Action Agencies (USACE January 30, 2008)

The Action Agencies will evaluate in the COP a variety of potential actions intended to benefit ESA-listed fish, including but not limited to, the following measures:

- Upstream fish passage facilities, other than the collection facilities described in RPA# 5.4.6, above;
- Adult fish release sites that require detailed study, as described in RPA# 5.4.7, above;
- Interim operations for downstream fish passage that require detailed study, as described in RPA# 5.4.8, above;
- Head-of-reservoir juvenile collection facilities that require detailed study, as described in RPA# 5.4.10, above;
- Downstream passage facilities or operations, as described in RPA# 5.4.13, above;
- Temperature control facilities or operations, described in RPA# 5.5.2, below;
- Interim operations for temperature control that require detailed study, described in RPA# 5.5.1, below; and
- System-wide operational changes, including "balancing" reservoir refill and release rates, to meet tributary and mainstem flow targets, as described in RPA# 5.2.4, above.

1. Definition of Milestones: The COP and related actions will rely on a series of established milestones at key decision points at which the Action Agencies will coordinate and review key decisions with the Services. There will also be regular, continuous coordination between the Action Agencies, NMFS, USFWS, and other affected agencies and Tribes through the WATER process throughout implementation of proposed measures.

There are three types of milestones identified in this RPA and defined below:

Annual Milestones (AM) for interagency coordination of annual and recurring activities associated with planning and implementation of ongoing ESA Measures related to operations, including completion of annual Willamette Fish Operations Plan (WFOP) revisions, and annual review of research, monitoring and evaluation (RM&E) results.

Interim Milestones (IM) for interim decision points in the planning and development of specific actions, including completion of site/concept studies, detailed design reports, and other key steps in the decision-making process. Interim Milestones will include decision points on the scope, scale, and location of ESA measures under consideration with NMFS and USFWS review and comment.

Major Milestones (MM) are forecasted key points in the planning, design and implementation process involving decisions on the feasibility of major elements of the RPA and Proposed Action. They may include "go/no go" decisions on implementation of proposed major structural elements, such as fish passage or temperature control facilities, and/or significant operational changes. They may also involve decisions to shift efforts to different alternatives or priorities.

Depending on decisions reached regarding the feasibility of proposed measures, it may be necessary to identify other alternatives or reinitiate ESA Section 7 consultation as a result of new information produced through the COP and related studies and coordinated through the Major Milestones.

2. Research, Monitoring and Evaluation: RM&E will be a substantial component of the COP. The focus will be on collection and evaluation of biological and physical information required to determine the feasibility of alternative structural and operational measures under consideration in interim and major milestones. The COP RM&E program will be initiated in FY 08 and continue through the term of the Opinion. The Action Agencies will conduct an Annual Review of the Willamette COP and other related RM&E programs to review the results from previous years and revise RM&E program for upcoming years.

3. Reconnaissance Phase Study: The Action Agencies will initiate Phase I of the COP, the Reconnaissance Study (USACE 2007, Section 3.6.4.3) by September 2008 and complete it by October 2009. The Reconnaissance Report will identify the range of structural and operational alternatives to be evaluated, establish preliminary basin priorities, define biological and other criteria to be used in evaluating alternatives, and provide the detailed SOW for the COP Feasibility Phase. The Action Agencies will establish a Major Milestone (MM1) at the completion of the Reconnaissance Report. The primary purpose of this milestone will be to seek interagency review and concurrence on the scope and content of the subsequent Feasibility Phases. One of the key decision points at this milestone will be to review and possibly refine the priority of long term fish passage and water quality solutions for the COP (described in RPA measures 5.4.13 and 5.5.2, respectively).

4. Comprehensive Feasibility Study: The Action Agencies will initiate the Comprehensive Feasibility Study (USACE 2007, Section 3.6.4.4) by October 2009 and will complete it by September 2012. The Comprehensive Feasibility Study will consider and incorporate relevant results of any life-cycle modeling developed as part of the Upper Willamette recovery planning process. If needed, the Action Agencies will complete appropriate NEPA coverage addressing the range of structural and operational alternatives addressed as part of the COP Comprehensive Study Phase. The Feasibility Report will reflect Action Agency preliminary determinations regarding the feasibility of fish passage, temperature control and other related structural and operational alternatives in the North Santiam, South Santiam, McKenzie, and Middle Fork Willamette basins. It is expected to provide specific recommendations for improvements to highest priority subbasins and/or features and to include recommendations for major operational changes. It will also evaluate the "high priority actions" (long term fish passage and water quality solutions described in RPA measures 5.4.13 and 5.5.2, respectively), and may suggest modifying the scope or timelines of these "high priority actions" based on the outcome of RM&E efforts.

The Action Agencies will establish a major milestone (MM3) at the completion of the COP Comprehensive Feasibility Study. At this point the Action Agencies will have completed initial studies and evaluations on a number of major alternatives, including prototype head-of-reservoir fish collection, downstream passage at Cougar Dam, and temperature control at Detroit Dam. The key decisions at this milestone are whether or not to continue toward fish passage and temperature control modifications of the dams as described in measures # 5.4.13 and 5.5.2, to evaluate whether or not the correct priorities were established for these measures # 5.4.13 and 5.5.2, and whether other alternatives are determined more feasible. If the downstream fish

passage improvements at Cougar Dam and other locations are determined not likely to be feasible at this milestone, then the Action Agencies may identify other alternatives that would be implemented within the same timelines as those identified in this RPA, or agree to reinitiate Section 7 consultation.

The Action Agencies will present specific implementation plans to NMFS, and NMFS will evaluate whether the actions proposed in the implementation plans are likely to have the biological results that NMFS relied on in this Opinion. NMFS will notify the Action Agencies as to whether the proposal is consistent with the analysis in this Opinion.

5.5 Water Quality

The RPA measures in this section are based on sections 3.6 and 3.7 of the Supplemental BA (USACE 2007a). In section 3.6, the Action Agencies propose to evaluate the need and opportunities to achieve water temperature control at Project dams as part of the Willamette System Review Study. In section 3.7, the Action Agencies propose to do the following: 1) continue to operate the Cougar WTC to meet downstream water temperature targets; 2) conduct extended RM&E for Cougar WTC; and 3) carry out ongoing and new RM&E for water quality in Project-affected tributaries and the mainstem Willamette River.

NMFS agrees (in McKenzie Effects section 5.3, NMFS BO) that continued operation of the Cougar WTC will provide more normative water temperatures in the South Fork McKenzie and mainstem McKenzie rivers, and will continue to support adult spawning, egg incubation, and fry and juvenile rearing for UWR Chinook salmon. While NMFS agrees that extensive RM&E studies are needed at Cougar to evaluate the effectiveness of the WTC and throughout the basin (General Effects, section 5.1, NMFS BO) to monitor water quality and determine appropriate courses of action to achieve water quality standards, the Proposed Action does not provide sufficient certainty that these RM&E studies will be sufficient to provide necessary data and guide decision-making. Additionally, while NMFS agrees that further alternatives analysis is needed to identify priorities for implementing temperature control measures at Project dams (General Effects, section 5.1, NMFS BO), the Proposed Action does not require any interim temperature control measures nor does it provide certainty that any permanent facilities will be constructed or operations will be carried out. RPA Measure #5.5 is intended to address these issues.

The adverse effects of the Proposed Action on listed fish and critical habitat include unacceptable water temperature and TDG downstream of the Project dams where listed fish are forced to spawn because they have inadequate access to upstream habitat. The Proposed Action also causes adverse effects on critical habitat conditions downstream of the dam for the same reasons listed above. The water quality measures in the RPA will minimize these project-related adverse effects because they will make water temperatures and TDG more similar to natural conditions. The RPA measures will also provide for fish protection when there are emergencies causing the facilities to operate outside their normal procedures.

Some of the measures in this section of the RPA provide interim protection for listed fish and critical habitat by requiring the Action Agencies to implement certain temperature control measures in the next few years. These measures will address immediate needs of listed fish by providing more suitable habitat downstream of certain dams in areas used for spawning. In addition, the emergency protocols and actions will prevent further harm to listed fish and critical habitat by providing measures for listed fish protection the USACE can take immediately when emergencies arise.

5.5.1 Interim Temperature Control Measures

Until permanent temperature control facilities and water quality improvements are constructed or operations are established, the Action Agencies will evaluate and carry out, where feasible, interim operational measures and use existing conduits such as spillways, regulating outlets, and turbine outlets to achieve some measure of temperature control and reduced TDG exceedences below Project dams, including Detroit/Big Cliff, Green Peter/Foster, Hills Creek, Lookout Point/Dexter, Fall Creek, and Blue River.

5.5.1.1 Temperature Control at Detroit/Big Cliff Dams

By March 2009, the Action Agencies will complete an evaluation of the feasibility of modifying operations at Detroit/Big Cliff Dams to improve downstream temperature and TDG conditions, with the objective of achieving similar benefits to water temperature below the dams as was attained in 2007. This analysis will build on information developed during the summer 2007 emergency operation at Detroit Dam in which spill volumes were balanced with releases from the regulating outlets to achieve more desirable downstream temperatures during turbine outages.

The Action Agencies will establish a Major Milestone (MM) to occur by March 2009, when the evaluation of feasibility is completed. If determined feasible, the Action Agencies will begin to implement the proposed operation beginning in Water Year 2009. If implemented, the Action Agencies will conduct monitoring and evaluation studies to determine the effectiveness of the operation and determine whether the operation should continue in future years. This operational alternative is considered a critical component of Configuration/Operation Planning (COP); effectiveness of using operations of existing facilities to achieve desired downstream water quality conditions will be important in future milestone decisions regarding whether or not to pursue structural water quality improvements.

5.5.1.2 Additional Interim Water Quality Measures

By March 2010, the Action Agencies will identify measures, in addition to those described in RPA #5.1.1 above, that they can start implementing in April 2010, if feasible. By April 2010, the Action Agencies will carry out those operational changes that will result in immediate downstream temperature and TDG benefits; and that do not require congressional authorization, detailed environmental review, extensive permitting, and that are within existing physical or structural limitations. Specific interim operational measures will be determined by the Action Agencies, with the advice of and review by the Services.

5.5.1.3 Complex Interim Water Quality Measures

The Action Agencies will evaluate measures that require detailed environmental review, permits, and/or congressional authorization as part of the COP (see RPA #5.4.17 above). The Action Agencies will complete this component of the COP by April 2011, including seeking authorization and completing design or operational implementation plans for those operations that are determined feasible. The Action Agencies will carry out operations that are feasible by May 2011, contingent on funding, issuance of necessary permits and authorization. The Services will comment on the measures and inform the Action Agencies whether they agree[32] with the interim water quality measures.

5.5.1.4 Monitoring and Reporting of Interim Water Quality Improvement Measures

Each year from 2009 through the term of this Opinion, the USACE will monitor and evaluate the effectiveness of interim and permanent water quality improvement measures, and will produce an annual report, by March 1 of the following year, for review and comment by the Water Quality/Temperature committee. The report will include recommendations, if any, to modify project operations to further improve water quality. The Services will comment on the draft report and inform the Action Agencies if they agree[33] with the recommendations.

5.5.1.5 Modifying Interim Water Quality Improvement Measures

Each year from 2010 through the term of this Opinion, the USACE will carry out modified project operations proposed in the annual reports described above in RPA # 5.5.1.4 unless such modifications require detailed analysis and authorization. If such additional analysis is needed, then the Action Agencies will analyze those proposed modifications as part of the COP (see RPA #5.4.17).

5.5.2 Water Temperature Control Facilities and Operations

During the term of this Opinion, the Action Agencies will make structural modifications or major operational changes for improved water quality to at least one of the Project dams. Based on the best available information at the time of development of the RPA, NMFS identifies Detroit as the highest priority dam for construction of a temperature control structure or operational changes to achieve temperature control.

The Action Agencies will investigate the feasibility of improving downstream temperatures and reducing TDG exceedences in the North Santiam River for ESA-listed fish species. The Action Agencies will take necessary interim steps beginning no later than 2010, which may include feasibility studies, a design report, authorization and appropriation, and plans and specifications, if appropriate. As part of this effort, the Action Agencies will evaluate alternatives to achieve both temperature control and downstream fish passage. If feasible and more efficient to achieve

32 See RPA 1.3 & 1.4 for elaboration of decision making process.

33 See RPA 1.3 & 1.4 for elaboration of decision making process.

both purposes through one construction project, the Action Agencies will include downstream fish passage in this effort, rather than delaying it until 2023, as stated in RPA measure #5.4.16 "Detroit Dam downstream passage." The Action Agencies will complete construction of any structural temperature control facilities by December 2018. By March 2019, the Action Agencies will begin operation of permanent downstream temperature control at Detroit Dam.

The Action Agencies will establish a Major Milestone (MM4) near the end of 2011 in conjunction with completion of the Detroit Feasibility Study. The major decision associated with that milestone will be "go/no go" on the feasibility of temperature control facilities. Because temperature control was not included as part of the original project authorization, NMFS assumes that construction of temperature control facilities at Detroit Dam may require Congressional action. Another Major Milestone (MM5) may be needed near the end of 2012 pending congressional action on authorization and appropriation of proposed facilities.

5.5.3 Protecting Water Quality During Emergency and Unusual Events or Conditions

The Action Agencies will apply protocols developed under RPA measure #5.4.3 and take actions within existing operational and structural capabilities at all project dams and reservoirs to protect water quality during unusual events and conditions.

i. Where the protocols described in RPA measure #5.4.3 above cannot ensure adequate protection of water quality and other impacts to ESA-listed fish during unusual events/conditions, the USACE will identify structural or mechanical changes that could be made at project facilities for this purpose. The USACE will produce a draft report by September 1, 2009, proposing to make structural or mechanical changes to protect water quality during anomalous events

ii. With review and comment by the WATER Water Quality/Temperature committee, the USACE will produce a final report by January 1, 2010. NMFS and FWS will inform the USACE if the report's recommendations are inconsistent with this RPA.

iii. The Action Agencies will begin to carry out structural and mechanical changes that will protect water quality during anomalous events and that do not require congressional authorization, detailed environmental review, or extensive permitting by March 1, 2010. These minor changes include only those that meet all of the following criteria: no need to prepare an EIS pursuant to NEPA; no need to obtain additional congressional authorization; no need to submit to extensive permitting procedures; and within reasonable cost.

iv. The Action Agencies will evaluate those measures that require detailed environmental review, permits, and congressional authorization as part of the COP (see measure #5.4.17). The Action Agencies will complete this component of the COP by April 2011, including seeking authorization and completing design for those structural measures that are determined feasible. The Action Agencies will begin to construct and operate those measures determined feasible by May 2011,

contingent on funding and issuance of necessary permits. The Services will inform the Action Agencies whether they agree[34] with the structural measures.

v. As structural and mechanical changes are completed, the USACE will update the protocols described in measure #5.4.3 above to include any new instructions for operating the modified facilities

vi. Any structural or mechanical improvements that are carried out will be continued through the term of this Opinion unless the Action Agencies and the Services determine, as more information is obtained, that there is a better way (that is obviously feasible) to operate for water quality.

5.5.4 Cougar Dam RM&E

The Action Agencies will fund and carry out an extended biological RM&E program associated with the Cougar Dam WTC. The RM&E program will begin in 2011, after completion of the RM&E program included in the previously authorized Cougar Trap project. The RM&E program will evaluate effects of the WTC operation on the downstream ecosystem (including TDG), fish passage through the reservoir, dam, and regulating outlet, and effectiveness of the trap-and-haul program. It will also quantitatively assess biological benefits realized from these protective and restorative measures. By September 2010, the Action Agencies will prepare a revised Cougar Dam WTC Monitoring and Evaluation Plan, based on the original plan developed as part of a previous consultation, subject to review and comment by the Services, and consistent with the RM&E process described below in RPA measure #5.9 (RM&E). The Action Agencies must obtain NMFS' review of the plan prior to initiating any research-related activities anticipated in this RPA. The proposals must identify anticipated take levels of each species and life stage for each year. The Services will inform the Action Agencies whether they agree[35] with the revised plan, proposed studies, draft reports, and NEPA alternatives. The Action Agencies will begin to carry out the extended RM&E program by March 1, 2011.

5.6 Hatcheries

Many components of this revised proposed action, and actions modified by NMFS' RPA, are specific to species under the jurisdiction of NMFS and thus have little or no relevance to bull trout and Oregon chub. For brevity, a number of components specific to Chinook salmon and steelhead hatchery operations and reform actions have been excluded from the Hatcheries section below (see Appendix B for the NMFS RPA in its entirety).

5.6.1 Rainbow Trout Mitigation Program

The primary ESA-related concerns with the rainbow trout program are predation on wild juvenile spring Chinook and incidental harvest of ESA-listed fish associated with the popular

34 See RPA 5.1.3 & 5.1.4 for elaboration of decision making process.

35 See RPA 5.1.3 & 5.1.4 for elaboration of decision making process.

rainbow trout fishery, particularly in the McKenzie River. As required by the NMFS 2000 BO, the USACE funded ODFW to assess these impacts. The results of these assessments are described in Firman and others (2006).

An incidental effect of the rainbow trout program is that the program has increased the prevalence of IHN virus in the natural environment, a disease that can also affect native species. The IHN virus has caused large losses of rainbow trout at Leaburg Hatchery. To reduce the risk of loss, ODFW has devised rearing strategies that involve incubation of eggs and rearing of fry at other hatcheries, including Willamette Hatchery. Despite these actions, large losses of rainbow trout persist at Leaburg Hatchery. The changes in production strategies have taxed the capabilities of staff at other facilities and decreased ODFW's flexibility in managing other hatchery programs, including USACE-funded UWR spring Chinook program in the Middle Fork Willamette, which is managed for conservation purposes. Fish stocked from Leaburg Hatchery may be causing amplification of IHN virus in the natural environment. The impacts of IHN virus on ESA-listed salmon and steelhead are unknown, but could be substantial.

Because there are impacts of the rainbow trout program on ESA-listed species, the Action Agencies propose to implement changes to the program. However, because the primary purpose of the rainbow trout program is to provide a harvestable trout fishery, the Action Agencies do not wish to unilaterally implement full-scale modifications to the rainbow trout program without involvement of other entities, including ODFW. Thus the Action Agencies propose a phased approach to addressing reform of the Rainbow Trout Mitigation Program that allows for interaction with ODFW, the Services, and non-governmental entities (including recreational fishing groups and conservation groups) who would have an interest in changes to production or hatchery management strategy.

Section 3.4.1.1.3 (USACE 2007a) summarizes the key issues associated with the current program and poses several potential modifications to address these issues. Furthermore, the Columbia Basin Hatchery Reform Project (CBHRP) will be reviewing the impacts of the rainbow trout program on ESA-listed species in 2007, and will provide recommendations for alternatives to the current program operation. The Action Agencies believe it is prudent for this effort to inform any potential changes to the program, particularly given the importance of the program to harvest opportunities in the State of Oregon. This approach also allows the USACE and ODFW to develop a strategy to meet its mitigation requirements for rainbow trout, given the uncertainty regarding the production capability of Leaburg Hatchery and other USACE-funded hatcheries in their current condition.

<u>Proposed Action:</u> The Action Agencies propose the following actions associated with reform of the Rainbow Trout Mitigation Program. The Agencies also propose a 5-year check-in evaluation to verify with the Services that the implementation plan meets ESA requirements.

- *Continue current operations, production schedules, and releases as described in the Upper Willamette Rainbow HGMP and summarized in sec 3.4.11.3 (USACE 2007a).*

- *Work with ODFW to develop a strategy for long term production of fish to meet the USACE's mitigation responsibility (i.e., including addressing IHN virus outbreaks at Leaburg*

Hatchery). Alternatives include installation of a UV filtration system at Leaburg, shifting production of rainbow trout to other facilities, and purchasing a portion (or all) of the fish required to meet the mitigation requirement.

- *Conduct short-term RM&E (in collaboration with other funding entities) to further define effects of the Upper Willamette Rainbow Trout Program on ESA-listed species. RM&E activities will focus on the following objectives:*
  - *Determine the spatial distribution of rainbow trout after release. Angler evidence indicates that releases migrate within basins to areas used heavily by rearing UWR spring Chinook.*
  - *Determine the impact of rainbow trout predation on juvenile ESA-listed species in 2008. The original study involved several assumptions that were likely invalid. Combine this study effort with results regarding the spatial and temporal distribution of rainbow trout. Use these results to develop changes in management strategy for rainbow trout, including potential changes to harvest regulations.*
  - *RM&E activities will be incorporated into the overall RM&E plan.*

- *Convene an interagency Rainbow Trout Working Group (as a subcommittee of the WATER FPHM Committee) to discuss options for long-term management of the rainbow trout program in light of ESA-requirements and harvest goals. This group should seek input from non-governmental entities, such as sport fishing groups, and contain representation from other funding entities. The group will:*
  - *Discuss feasibility of implementing changes to the program as identified in the HGMP or to change the type and species of release to meet the USACE mitigation responsibility.*
  - *Review results from the CBHRP.*
  - *Review additional RM&E results that will inform priorities for shifts in management.*
  - *Prioritize implementation of reform actions, including changes to harvest regulations.*
  - *The Action Agencies will begin programming funding for hatchery reform efforts according to the implementation plan and implement actions as funds become available.*

Proposed Action: Spring Chinook Outplant Program – Consistent with the "Action Agencies Policy and Philosophical Approach to Outplanting and Reintroduction" described in Section 3.4.4.5 (USACE 2007a), the Action Agencies will continue the Spring Chinook Outplant Program and will use the program to evaluate the long-term feasibility of establishing viable spring Chinook salmon populations in existing habitat in the North Santiam above Detroit Dam, South Santiam above Foster Dam/Green Peter Dam, South Fork McKenzie above Cougar Dam, and into the Middle Fork Willamette above Lookout Point and Hills Creek dams.

5.6.2 The Action Agencies will work cooperatively with the State of Oregon to ensure that Willamette Project hatchery programs are not reducing the viability of listed ESUs/DPSs

5.6.2.1 Implementation of Hatchery and Genetic Management Plans (Willamette Basin-wide)

The Action Agencies will implement the actions described in the Willamette Hatchery and Genetic Management Plans (HGMPs) for spring Chinook, summer steelhead, and rainbow trout, after NMFS approval of these plans. Implementation of these actions requires cooperation with the State of Oregon, who partially funds and operates many of the facilities associated with the Hatchery Mitigation Program.

5.6.2.2 Hatchery Facility Improvements (Willamette Basin-wide)

The Action Agencies will improve fish collection facilities associated with the hatchery mitigation program; including salmonid ladders, traps, holding, and acclimation facilities associated with hatchery broodstock collection and the outplanting program. Facilities will be rebuilt according to the schedule described in RPA measures #5.4.6 and 5.4.7 above.

5.6.2.3 Improvements at Leaburg Dam (McKenzie)

The Action Agencies will fund the design, construction, and operation[36] of a sorting facility at Leaburg Dam on the McKenzie River to reduce hatchery fish straying into core spring Chinook natural production areas upstream. Modification of the existing facilities, or construction of new ones, is contingent on agreement by the facility owner, Eugene Water & Electric Board (EWEB), and collaboration with EWEB and ODFW. The Action Agencies will establish a Working Group, comprised of representatives from BPA, COE, NMFS, ODFW, and EWEB, to scope the design and implementation of the sorting facility. The design philosophy for this facility will be that it automatically separates hatchery-origin adults from other fish.[37] If it is not feasible to design the facility with automatic sorting capability, the Action Agencies will seek NMFS' agreement[38] to use an alternative facility design that minimizes harm to UWR Chinook salmon. The Action Agencies will complete construction of the sorting facilities by December 2013, and begin operation in time for the spring Chinook upstream migration beginning in 2014. If an acceptable sorting facility at this site is deemed infeasible by the Working Group and agreed to by NMFS, then the Action Agencies will take alternative actions to reduce hatchery fish straying to less than 10% of the total population spawning in the wild.

5.6.2.4 Management of Hatchery-origin Spring Chinook Upstream of Cougar Dam (McKenzie)

The Action Agencies will discontinue releases of all hatchery spring Chinook salmon above Cougar Dam on the South Fork McKenzie River once sufficient numbers of wild fish can be safely collected at the rebuilt Cougar Dam trap and outplanted above the dam.

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36 Operation could be partially or completely funded by another entity.

37 Hatchery-origin fish have had small metal tags implanted in them. These tags may be electronically sensed and the resulting signal used to operate sorting devices. Non-hatchery origin fish do not have these tags and could theoretically be allowed to pass upstream without human intervention, reducing the injury and stress that they experience.

38 See RPA 5.1.3 & 5.1.4 for elaboration of decision making process.

The minimum number of wild fish needed for the outplanting program will be determined by the Fish Passage and Hatchery Management Committee. If insufficient numbers of wild fish (e.g., less than 100 wild fish) are collected at Cougar Dam, then hatchery fish may be used to supplement natural spawning above Cougar Dam, up to a maximum of 50% of the outplanted fish. The FPHM committee will annually update the Willamette Fish Operations Plan with the appropriate number of hatchery-origin fish to be released upstream of Cougar Dam.

5.6.2.5 Future Summer Steelhead Management Actions

The Action Agencies, in cooperation with ODFW, will implement future management actions aimed at reducing the impacts of the summer steelhead hatchery program on ESA-listed species. These actions will be developed according to the process described in section 3.4.10.2 of the Supplemental Biological Assessment (USACE 2007a), which will incorporate the results of research, monitoring, and evaluation.

5.6.3 The Action Agencies will preserve and rebuild genetic resources through conservation and supplementation objectives to reduce extinction risk and promote recovery.

5.6.3.1 Implementation of Hatchery and Genetic Management Plans

When approved by NMFS, the Action Agencies, in cooperation with ODFW, will implement the actions described in the NMFS-approved Willamette Hatchery and Genetic Management Plans (HGMPs) for spring Chinook, summer steelhead, and rainbow trout.

5.6.3.2 Continue Adult Chinook Outplanting Program

The Action Agencies will continue the existing Adult Chinook Salmon Outplanting program, capturing spring Chinook salmon below USACE projects and transporting them into habitat that is currently inaccessible above the following dams: in the North Santiam, above Detroit Dam; in the South Santiam, above Foster Dam; in the South Fork McKenzie, above Cougar Dam; and in the Middle Fork Willamette, above Lookout Point and Hills Creek dams; and carry out the operational and handling protocols described in the HGMP for each subbasin hatchery. The Action Agencies will use hatchery fish in each population area as described in the HGMP sliding scale matrices. See measures #5.4.1 through 5.4.4 of this RPA for additional details.

5.7 Habitat

Proposed Action: The USACE will continue to use existing authorities and programs for land and water resource stewardship on USACE-administered lands at the 13 Willamette projects to manage onsite habitat to benefit and protect ESA-listed species.

Proposed Action: For offsite river reaches upstream and downstream of USACE project lands, the USACE will use its existing authorities under the General Investigations (GI), Continuing Authorities Program (CAP), and Planning Assistance to States to undertake habitat restoration projects in the Willamette Basin. Under these programs, the USACE has standing authorities to evaluate and implement aquatic ecosystem restoration projects throughout the basin. These programs do require cost-sharing and other forms of support from qualified non-federal sponsors. They also are not currently a high budgetary priority of the administration and federal funds can be difficult to obtain. However, these programs are the only vehicle available to the USACE for undertaking habitat restoration off of USACE project lands.

5.7.1 Willamette River Basin Mitigation and Habitat Restoration

The Action Agencies will plan and carry out habitat restoration programs on off-site lands. Existing programs will continue (5.7.1); a comprehensive program will be established (5.7.2); and additional projects will be done (5.7.3). The purpose of the program will be to protect and restore aquatic habitat to address limiting habitat factors for ESA-listed fish.

5.7.1.1 The Action Agencies will Continue to Carry Out The Projects Listed in Table 5.6 below.

Table 5.6 Ongoing Habitat Restoration Projects in the Willamette Basin

Project/Program	Water Body	Description
Willamette Basin Mitigation (BPA 199206800)	Mainstem Willamette	Integrative mitigation program that protects, conserves, and restores areas containing diverse habitats that assist the life history needs and resources for multiple terrestrial and aquatic species in the Willamette Basin.
Delta Ponds (Section 206, USACE)	Mainstem Willamette near Eugene	Construction initiated in 2005 with the City of Eugene, and will continue. The project is providing floodplain and hydraulic connectivity to the Willamette River through a series of old gravel pits.
Springfield Millrace (Section 206, USACE)	Middle Fork Willamette near Springfield	Construction initiated 2008 with the City of Springfield. The project will restore historic millrace and mill pond and creation of wetlands, fish passage and water quality improvements.
North Santiam Gravel Study (Planning Assistance to States, USACE)	North Santiam River	This study was initiated in 2008 and will assess the need and potential locations for gravel placement in the North Santiam River.

5.7.1.2 The Action Agencies will develop and carry out a comprehensive habitat restoration program, in collaboration with the Services, which will include funding for carrying out habitat restoration projects during the term of this Opinion. The Action Agencies will work with the Services to pursue authorization, if necessary, and appropriations to carry out the habitat restoration program.

The Action Agencies will work closely with the Services to accomplish the following:

1. Develop project selection criteria aimed specifically at addressing factors limiting the recovery of Willamette basin ESA-listed fish populations, focusing on, but not limited to, those factors caused at least partially by the Willamette Project. These criteria

should be informed by regional plans including Willamette Basin Recovery Plans for anadromous salmonids (ODFW 2007I), Willamette Aquatic Habitat Assessment (unpublished, see RPA measure #5.7.6), Willamette Subbasin Plan (WRI 2004), Willamette River Basin Planning Atlas (Hulse et al. 2002), and the COP evaluation (measure #5.4.17).

2. Identify proposals for habitat restoration projects.

3. Forward those proposals that meet project selection criteria to NMFS for review and determination if they are consistent with improving survival and recovery.

4. Fund priority projects, through applicable programs and processes (see Table 5.7), that NMFS and FWS determine to be consistent with recovery plans for their respective ESA-listed species.

Table 5.7 Authorities/Programs to Facilitate Implementation of Habitat Restoration Projects in the Willamette Basin

Program	Water Body	Description
Columbia River Basin Fish and Wildlife Program	Columbia Basin (including Willamette)	The Northwest Power Act of 1980 directs the Council to develop a program to protect, mitigate and enhance fish and wildlife of the Columbia River Basin that have been impacted by hydropower dams, and make annual funding recommendations to the Bonneville Power Administration for projects to implement the program. The Bonneville Power Administration then decides which projects to fund and implements the selected projects.
Continuing Authorities Program (CAP); (USACE Sections 206 & 1135 Programs)	Oregon	Continuing Authorities Program funds small restoration projects that address a variety of water resource and land related problems. A description of the CAP program is provided in section 3.5.2.3 of the Supplemental BA (USACE 2007)
General Investigation Program (GI); USACE)	Oregon	Authority to conduct complex, large-scale, multiple purpose water resource projects. Applicable existing GI studies are described in Section 3.5.2.2 of the Supplemental BA and include: the Willamette River Floodplain Restoration Study; Eugene-Springfield Metro Area Watershed Feasibility Study, Lower Willamette Ecosystem Restoration Feasibility Study

Program	Water Body	Description
Planning Assistance to States (PAS); USACE)		Authority to work with non-Federal sponsor to study and evaluate water and related land resource problems. Current study of North Santiam Gravel under this authority
Upper Willamette Watershed Ecosystem Restoration Authority (USACE Sec 3138 program)	Willamette watershed upstream of Albany	New authority from WRDA 2007 to conduct ecosystem restoration studies for the upper Willamette basin to protect, monitor, and restore fish and wildlife habitat.
Ecosystem Restoration and Fish Passage Improvement Authority (USACE Sec 4073)	Oregon	New authority in WRDA 2007 to conduct studies for ecosystem restoration and fish passage improvement on rivers throughout Oregon. Emphasis on fish passage and restoration to benefit species that are ESA listed. In conjunction with study, pilot project to demonstrate effectiveness of actions is authorized.
Sustainable Rivers Partnership with The Nature Conservancy	Willamette Basin	Cooperative agreement between USACE and the Nature Conservancy to assess and implement dam operational changes to better mimic natural river flows in the Willamette basin

5.7.1.3 By 2010, the Action Agencies will complete at least two of the highest priority projects that should result in significant habitat improvement for listed fish species. The Action Agencies will complete additional habitat projects each year from 2011 through the term of this Opinion. Alternatively, larger projects that might require several years to complete could be funded over a multi-year period instead of funding individual, smaller projects each year. NMFS will inform the Action Agencies whether they agree with the decision to fund and carry out these projects.

5.7.2 Habitat Restoration and Enhancement on USACE Lands at Project Dams and Reservoirs

The USACE will continue to use existing authorities and programs for land and water resource stewardship on the lands it administers at the 13 Willamette projects to carry out aquatic and riparian habitat projects to benefit terrestrial organisms and resident fish species, in ways that do not harm ESA-listed species. Additionally, the USACE may design projects on USACE lands to benefit ESA-listed anadromous species. These actions will be carried out consistent with the best management practices identified in the "SLOPES IV Restoration" (NMFS 2008f) or other applicable biological opinions.

5.7.3 Large Wood Collected at Project Dams

During annual maintenance operations, the Action Agencies will collect large wood that accumulates at Project dams and make it available for habitat restoration projects above and below Project dams.

5.7.4 Restoration of Habitat at Revetments

In coordination with the Services, the Action Agencies will undertake a comprehensive assessment of revetments placed or funded by the USACE Willamette River Bank Protection Program. The USACE will complete the revetment assessment, including identifying sites with potential for modification by December 31, 2010. The Action Agencies will use applicable existing authorities and programs for funding habitat restoration identified in Table 5.7, as well as new programs that are applicable, to fund priority project identified in the assessment.

5.7.5 Aquatic Habitat Assessment

By June 2008, the Action Agencies will complete surveys of spawning and holding habitat availability and condition in the major spawning tributaries with USACE dams (N. Santiam, S. Santiam, South Fork McKenzie, and Middle Fork Willamette rivers). The Action Agencies will distribute copies of the final report to the Services and will make the report available on the USACE's Portland District's website. Habitat survey data will also be available to the public in a GIS format. The Action Agencies will use the assessment to inform habitat restoration priorities for RPA measure #5.7.1.

5.8 ESA Compliance and Coordination

These measures are based on similar Proposed Action measures in section 3.6.5 of the Supplemental BA (USACE 2007a). Additionally, the coordination process described in these measures is encompassed within RPA #5.1 "Coordination". However, the following measures add specificity to those measures with regard to design review and construction implementation. Specificity is necessary to ensure that needed reviews will happen and that construction will be accomplished in a way that minimizes impacts on listed fish.

5.8.1 Review of Design and Construction Reports

The Action Agencies will collaborate with the Services on the design, construction and operation of all potential structural modifications to the dams and associated facilities, including fish collection and handling facilities, fish passage improvements, and water temperature control facilities. The Action Agencies will obtain the Services' review of design reports and will address their recommendations in subsequent design reports. The Action Agencies will provide final design reports and drawings to the Services at least 30 days in advance of making the final design decision to allow time for their review and comment.

5.8.2 Construction Practices

Construction and operation will be carried out according to Best Management Practices (BMPs) and design specifications agreed to by the Services. The Action Agencies will follow BMPs provided in Section 12, Incidental Take Statement (NMFS 2008). If these are updated, the Services will provide the updates to the Action Agencies, and the Action Agencies should follow the updated BMPs.

5.9 Research, Monitoring, and Evaluation (RM&E)

In their Proposed Action, the Action Agencies identify the need for developing a comprehensive research, monitoring, and evaluation (RM&E) program that will provide information necessary for making informed adaptive management decisions, in addition to tracking and documenting progress toward achievement of these RPA measures. They further identify the practicality of developing and managing this RM&E program under the auspices of the cooperative WATER subcommittee structure.

The Action Agencies provide certain guiding principles and strategic questions for consideration in developing a sound RM&E program. They also provide areas of concern where RM&E studies are needed. However, they generally do not make specific study recommendations.

The following RPA measures combine with portions of the PA and RPA measures described above to identify the broad outlines of an adaptive RM&E program. A comprehensive RM&E program is essential to guiding Action Agencies' decisions in carrying out PA and RPA measures and that will affect productivity, abundance, spatial distribution, and genetic diversity of listed fish species. Additional and specific details of the RM&E program, study objectives, and methodologies will be developed and refined through the WATER process.

5.9.1 Comprehensive Program

The Action Agencies will, in consultation with the WATER RM&E subcommittee, established as a technical committee as described in RPA measure #5.1.2, develop and manage the comprehensive Willamette Project RM&E program. In developing and conducting the RM&E studies, the Action Agencies will work closely with the Services to ensure that the studies will provide information useful to the Services and the Action Agencies in making decisions regarding the effectiveness of mitigation measures in the Proposed Action and the RPA, including alternatives for downstream flows and ramping, fish passage, water quality, hatchery program operations, habitat restoration and other measures. The Action Agencies will seek NMFS' review of draft study proposals and draft reports. Comments submitted by NMFS on draft evaluation proposals must be reconciled by the Action Agencies in writing to NMFS' satisfaction prior to initiating any research-related activities anticipated in this RPA. The proposals must identify annual anticipated incidental take levels by species, life stage, and origin for each year. The Services will inform the Action Agencies whether they agree with the

proposed studies, reports, and NEPA alternatives. The Action Agencies will make modifications to operations and facilities based on the results of the RM&E information.

5.9.2 Mainstem Flow, Tributary Flow, and Ramping RM&E

The Action Agencies will develop and carry out RM&E to determine compliance with, and effectiveness of, flow and ramping measures and to better discern and evaluate the relationships between flow management operations and the resulting dynamics of ecosystem function and environmental conditions downstream of Willamette Project dams. Because flow releases and ramping rates are measures that can be implemented immediately, the Action Agencies should give high priority to studies to evaluate their effectiveness. The Action Agencies will begin flow and ramping rate studies by 2009. The Action Agencies will make modifications to Project operations and facilities that affect mainstem and tributary flows, ramping, and Reclamation water contract implementation, including RPA measures #5.2 and #5.3 listed above, no later than January 2011, as indicated by results of the monitoring and evaluation, and with NMFS' agreement.

5.9.3 Fish Passage RM&E

The Action Agencies will develop and carry out RM&E to determine the most effective and efficient means to accomplish safe fish passage at applicable Project dams. The studies will be used to determine 1) locations where it is feasible to re-establish self sustaining populations; 2) potential population size for each subbasin; 3) effectiveness of rebuilt trap-and-haul facilities; 4) downstream fish passage timing and survival through Project reservoirs; 5) downstream fish passage timing and survival through Project dams; 6) operational methods for higher juvenile and adult survival at Project facilities; 7) infrastructure needs to ensure long term viability of populations; and 8) selection of hatchery or natural-origin broodstock, as well as life stage, for release into habitat above Project dams.

These facilities must meet performance standards consistent with NMFS' Fish Passage Criteria and Guidelines (NMFS 2008b) or as determined through the FPHM committee of WATER and agreed to by the Services. The Action Agencies will monitor the effectiveness of the fish passage facilities. The Action Agencies will make modifications to Project operations and facilities that affect fish passage, including RPA #5.4 measures listed above, as indicated by results of the monitoring and evaluation, and with NMFS' agreement.

5.9.4 Water Quality RM&E

The Action Agencies will develop and carry out RM&E to monitor the effectiveness of measures in the RPA and Proposed Action to improve water quality, including but not limited to: 1) monitor operational performance and associated biological response of water temperature control in the McKenzie River Subbasin at Cougar Dam; 1a) quantify effects of USACE dams on water temperature; 2) evaluate biological effects of water temperature alteration caused by USACE dams on ESA listed fish species in the Santiam and Middle Fork Willamette rivers; 2a) quantify the effects of USACE dissolved gas and turbidity; 3) evaluate the effects of dissolved gas supersaturation and of turbidity alterations caused by USACE dams on ESA listed fish species in

the Santiam, McKenzie, and Middle Fork Willamette rivers; and 4) conduct an aquatic macroinvertebrate species abundance and community structure study at USACE projects on the Santiam, McKenzie, and Middle Fork Willamette rivers to discern the extent to which project operations affect macroinvertebrate community composition, structure, and function. The Action Agencies will make modifications to Project operations and facilities that affect water quality, including RPA# 5.5 measures listed above as indicated by results of the monitoring and evaluation, and with NMFS' agreement.

5.9.5 Hatchery Programs RM&E

The Action Agencies will develop and carry out RM&E to monitor the effectiveness of hatchery measures in the RPA and Proposed Action to improve hatchery effectiveness and reduce adverse effects to listed fish species, including but not limited to the following:

5.9.5.1 Spring Chinook

1. Broodstock Management- Determine collection and spawning timing of broodstock, composition of hatchery and wild fish.

2. Composition of Hatchery Fish on the Spawning Grounds- Determine the abundance, distribution, and percent hatchery-origin Chinook on the spawning grounds of each population annually.

3. Survival of Adult Hatchery Fish Outplanted above Federal Dams- Determine the survival rate of outplanted fish and abundance of spawners above the dams.

4. Reproductive Success of Hatchery Fish in the Wild- Determine juvenile production by hatchery and wild spawners above the dams.

5. Use of Hatchery Fish to Evaluate Migration and Survival through Reservoirs and Dams- As hatchery program reforms are implemented to make hatchery fish more similar to wild fish, use hatchery fish as a surrogate for wild fish in the testing and evaluation of migration, behavior, and survival of fish through the reservoirs and dams. Wild fish may be used in the future if risks are deemed acceptable.

5.9.6 Habitat Restoration RM&E

The Action Agencies will develop and carry out RM&E for habitat restoration projects identified in the Proposed Action and this RPA to document changes in ecosystem function and biological response. The Action Agencies will make modifications to Project-related habitat restoration activities and structures, including RPA #5.7 measures listed above, as indicated by the results of the monitoring and evaluation and with NMFS' agreement.

5.10 Maintenance

These maintenance RPA measures are based on similar measures[39] described in the Proposed Action and apply to any constructed or fabricated features whose failure or improper function might affect fisheries such as, but not limited to, dams, gates, valves, pumps, access roads, fish hauling trucks, electrical power transmission grids, signal, control devices, and fish facilities. These measures do not apply to the following:

- riverine components of the Willamette Project such as revetments, riprap, or riparian habitat improvements,
- re-configuration or rebuilding[40] of existing facilities (until they are placed in service.),
- items that are not likely to affect fish, such as building renovations, campground maintenance, recreational facilities, and
- preventative maintenance, routine maintenance.

The following measures add specificity to those maintenance measures in the Proposed Action:

5.10.1 Identify Fish Protection Maintenance Needs

The USACE will develop and maintain a list of scheduled and unscheduled maintenance needs of existing infrastructure that could potentially negatively impact listed fish and will place high priority on maintaining at least good performance of all such facilities. The scope of maintenance activities included encompasses all USACE dams, facilities, and appurtenances that *may significantly and adversely affect listed fish*, and includes not only "fisheries" facilities such as fish traps but all facilities required to meet the operations described in this Opinion (e.g. because forced spill can adversely affect downstream water quality, items such as turbines and generators may fall within this purview). This measure also affects those hatcheries raising listed fish, and all related hatchery facilities, including fish hauling trucks and related equipment utilized in fish transfers.

The timeline for database modification and data entry:

1) All new items entered after 2008 shall include information noting whether they *may significantly and adversely affect listed fish*[41].

2) All items, both new and pre-existing, shall be so notated by and after 2015.

39 USACE 2007 including, but not limited to, pages 3-5, 6, 17, 18, 40, 41, 53, 54, 55, 56, 59, 68, 69, 71, 79-81, 91,136,137.

40 Defined as measures costing more than 25% of the replacement cost of the existing structure.

41 That is, this is not an immediate requirement to go through the existing database—at least for five years-- to determine whether the items in the existing backlog *may significantly and adversely affect listed fish.*

5.10.2 Inventory of Needed Maintenance

The USACE will provide the maintenance report described in the Proposed Action (USACE 2007a p. 3-18 Item 2 in Section 3.2.242) in electronic[43] database format to NMFS by February 1, 2009, and thereafter whenever requested in writing by NMFS. This report will include an inventory of current major deficiencies, (i.e., where facilities are in need of maintenance or replacement) and the anticipated date of correction, and for those previously identified maintenance items that have been corrected, the report will identify the date the deficiencies were corrected. To aid in the identification of repeated problems, all corrected deficiencies will be retained in the database.

5.10.3 Perform Timely Maintenance

The Action Agencies will correct the items noted in the inventories identified in RPA measures #5.10.1 and 5.10.2 above in a timely manner, and all identified maintenance needs will be corrected within 5 years of being identified, unless otherwise concurred with by NMFS. The USACE will correct deficiencies likely to cause extensive fish injury or mortality as soon as possible after discovery.

5.11 Implementation Timeframe, Certainty and Milestones

The term of this biological opinion is 15 years, beginning July 11, 2008. Many components of the proposed action are conservation measures based upon an adaptive management strategy reliant on several factors: (1) availability of program funds appropriated by Congress or provided by others; (2) completion of more detailed evaluation to determine the feasibility of implementation of significant structural or operational modifications; and (3) continued RM&E resulting in better determining the biological feasibility of the alternatives being considered.

Consequently, the measures required to address ESA requirements in the Willamette Basin will evolve and be refined over time. The Action Agencies believe that implementation of the critical elements of the revised proposed action, particularly potential large-scale structural modifications for fish passage and water temperature control, will require close coordination with the Services as feasibility and timelines are determined. Where possible in the Supplemental BA, the Action Agencies identified “off ramps” with estimated time frames to reflect the feasibility of the proposals and certainty of meeting the biological objectives.

The certainty of program funding for the actions proposed is complicated by the fact that this consultation is on the operation of an on-going project. For existing operational projects such as the Willamette Project, funding is programmed and appropriated annually. The President’s proposed 2008 budget included Willamette Basin ESA actions within the Columbia River Fish Mitigation Project. As a result, the Action Agencies may have a funding mechanism in place to pursue implementation of many of the actions described in the Supplemental BA and Addendum

42 Now within the Willamette Fish Operations and Management Plan--WFOP

43 MS Access format, or other mutually agreed upon format.

(USACE 2007a,b) as modified by NMFS' RPA. If appropriate resources are not be provided for the measures described in the Supplemental BA and Addendum, as modified by NMFS' RPA, the Action Agencies have acknowledged the likelihood of reinitiating consultation with the Services.

For many components of the proposed action, modified by NMFS RPA, the Action Agencies attempted to define key steps or milestones in the individual actions to be used by the Action Agencies and the Services to determine relative progress toward implementation. Due to the uncertainties associated with the revised proposed action, the Action Agencies pledged to work with the Services to identify milestones or decision points within shorter timeframes that may be used as off ramps to reinitiating consultation if certain defined actions are not implemented.

For example, the most significant decision points facing the Action Agencies and Services in the process of implementing the revised proposed action, as modified by NMFS' RPA, is determining the feasibility of fish passage and related WTC improvements to increase habitat suitability, provide safe passage, restore connectivity to isolated fish populations and fish access to historic habitat above Willamette Project dams (see Section 5.4 and 5.5 above). This process will occur under the Willamette Configuration Operation Plan (COP), formerly described in the Supplemental BA as the Willamette System Review Study. The COP and related actions will rely on a series of established milestones (annual, interim, major) at key decision points at which the Action Agencies will coordinate and review key decisions with the Services (see Section 5.4.17 above). The Major Milestones include "go/no go" decisions on implementation of proposed major structural elements, such as fish passage or WTC facilities, and/or significant operational changes. They may also involve decisions to shift efforts to different alternatives or priorities. Depending on decisions reached regarding the feasibility of proposed measures, it may be necessary to identify other alternatives or reinitiate ESA Section 7 consultation as a result of new information produced through the COP and related studies and coordinated through the Major Milestones.

5.12 Conservation Measures Specific to Bull Trout and Oregon Chub

As described and summarized above, the revised proposed action, as modified by NMFS' RPA, includes a number of "conservation measures" to minimize project related effects to ESA listed species. In the Addendum to the Supplemental BA (USACE 2007b), the Action Agencies highlighted specific components of the revised proposed action they believe will specifically minimize project related effects to bull trout and Oregon chub, and to designated bull trout critical habitat. Though generally encapsulated in the broader revised proposed action, as modified by NMFS' RPA, summarized above, these conservation measures from the Addendum are summarized below. Several bull trout specific measures from the Addendum have been excluded from the summaries below because the actions were determined to be covered under a preexisting BO (see Section 2.0 above) and are thus considered part of the environmental baseline (i.e., construction and initial operation of the Cougar Dam upstream fish collection facility and associated RM&E).

5.12.1 Bull Trout Conservation Measures

i. The Action Agencies proposed to continue the spring Chinook outplant program and will use the program to evaluate the long-term feasibility of establishing viable spring Chinook salmon populations in existing habitat in the North Santiam above Detroit Dam, South Santiam above Foster Dam/Green Peter Dam, South Fork McKenzie above Cougar Dam, and into the Middle Fork Willamette above Lookout Point and Hills Creek dams. The spring Chinook outplant program above Willamette Project dams minimizes project effects to bull trout in the McKenzie and Middle Fork Willamette rivers by reestablishing an important historical forage base (through natural production by the outplanted adults) as well by providing marine derived nutrients (salmon carcasses) that increase stream productivity.

ii. The Action Agencies proposed, under the RM&E program, to develop a Genetic Management Plan (GMP) for bull trout in the upper Willamette Basin. A GMP would specify the rate of artificial gene flow necessary to minimize the risk of inbreeding depression and genetic drift while maintaining population structure. The development and implementation of a GMP for bull trout in the upper Willamette River would provide valuable information on current gene flow among bull trout populations and baseline information on the genetic health of each population. Most importantly, a GMP would provide appropriate guidance towards stabilizing and possibly increasing the genetic diversity among these at-risk bull trout populations by transferring genetic material among existing local populations.

iii. The Action Agencies proposed to continue to cooperate with the reintroduction of bull trout into the upper Middle Fork Willamette River Subbasin through technical participation with the Service, ODFW, and others on associated planning committees (e.g., under the WATER Group structure) and through the contribution of funds that are budgeted and approved (i.e., appropriated and prioritized) for the purpose of assisting with reintroduction efforts.

iv. The Action Agencies proposed to conduct Willamette System Review studies (see Section 5.3.11 above) that would investigate alternatives for providing upstream and downstream fish passage at priority Willamette Project dams, including USACE dams in the McKenzie and Middle Fork Willamette rivers. If feasible, these facilities would provide re-connectivity for bull trout population segments located above and below USACE dams. In addition, the biological benefits of providing WTC capability at these dams will be evaluated. If warranted, WTC capabilities will be designed and constructed at appropriate dams. The Agencies will work with the Service, NMFS, ODFW and others under the WATER Group structure to define needs and to scope and design associated studies.

v. The Action Agencies proposed to conduct habitat suitability studies to discern the quantity and quality of bull trout habitat above and below Willamette Project dams. Among other potential parameters appropriate for consideration, data regarding water temperatures will be gathered and assessed to identify potential bull trout

spawning areas in the Middle Fork Willamette River Subbasin, and potentially, by mutual discernment of need, in the Santiam River Subbasin.

5.12.2 Oregon Chub Conservation Measures

i. The Action Agencies will continue annual flow management plan coordination and implementation in a manner that protects Oregon chub populations and habitat while meeting other ESA and water use demands.

ii. When necessary, the Action Agencies will assist in the implementation of the *Oregon Chub Drought Contingency Plan* (ODFW 2005) (see Appendix C of this BO) in considering appropriate actions that may need to be taken to protect this species. This plan may be cooperatively revised by the WATER Flow Management Committee to better address real-time drought management needs.

iii. The Agencies will continue to aid in species recovery and delisting, where appropriate, through the identification of opportunities to secure additional population segments, especially in subbasins outside of the Middle Fork Willamette River (e.g., in the Santiam Subbasin). Populations on USACE property (e.g., at Fall Creek) will be better secured, where necessary, to help ensure their long-term persistence.

iv. In the Action Agencies' pursuit of floodplain and ecosystem function restoration activities, project designs will be considered to encourage habitat use by native fish species, including Oregon chub.

v. The Action Agencies will continue RM&E activities aimed at monitoring the status of protected (i.e., isolated) Oregon chub populations on USACE lands (e.g., Hospital Pond, Fall Creek spillway ponds) consistent with the recovery plan for the species.

6. STATUS OF THE SPECIES AND CRITICAL HABITAT

6.1 Bull Trout

6.1.1 Analytical Framework for the Jeopardy Analysis

The following analysis relies on four components to support the jeopardy analysis for the bull trout: (1) the *Status of the Species*, which evaluates the bull trout's range-wide condition, the factors responsible for that condition, and its survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the bull trout in the action area, the factors responsible for that condition, and the role of the action area in the bull trout's survival and recovery; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the bull trout; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the bull trout.

In accordance with the implementing regulations for section 7 and FWS policy, the jeopardy determination is made in the following manner: the effects of the proposed Federal action are evaluated with the aggregate effects of everything that has led to the bull trout's current status and, for non-Federal activities in the action area, those actions that are reasonably certain to occur that are likely to affect the bull trout in the future. This evaluation is assessed to determine if, given the aggregate of all of these effects, implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the bull trout in the wild.

Interim recovery units were defined in the final listing rule for the bull trout for use in completing jeopardy analyses. Pursuant to FWS policy, when an action impairs or precludes the capacity of a recovery unit from providing both the survival and recovery function assigned to it, that action may represent jeopardy to the species. When using this type of analysis, the BO describes how the action affects not only the recovery unit's capability, but the relationship of the recovery unit to both the survival and recovery of the listed species as a whole. The following analysis utilizes this approach and considers the role of the action area and core area (discussed below under the *Status of the Species* section) in the function of the recovery unit as context for evaluating the effects of the proposed Federal action, combined with other relevant effects, on the survival and recovery of the bull trout to make the jeopardy determination.

6.1.2 Analytical Framework for the Adverse Modification Analysis

This BO does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.

The following analysis relies on four components to support the adverse modification determination: (1) the *Status of Critical Habitat*, which evaluates the range-wide condition of designated critical habitat for the bull trout in terms of primary constituent elements (PCEs), the factors responsible for that condition, and the intended recovery function of the critical habitat

overall; (2) the *Environmental Baseline*, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the PCEs and how they may influence the recovery role of affected critical habitat units; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the PCEs and how these may influence the recovery role of affected critical habitat units.

In accordance with FWS policy and guidance, the adverse modification determination is made in the following manner: the effects of the proposed Federal action on critical habitat are evaluated with the aggregate effects of everything that has led to the current status of the critical habitat range-wide and, for non-Federal activities in the action area, those actions likely to affect the critical habitat in the future, to determine if, given those aggregate effects, the critical habitat would remain functional (or retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve the intended recovery role for the species with implementation of the proposed Federal action.

6.1.3 Taxonomy

The bull trout is a native char found in the coastal and intermountain west of North America. Dolly Varden (*Salvelinus malma)* and bull trout were previously considered a single species and were thought to have coastal and interior forms. However, Cavender (1978) described morphometric, meristic and osteological characteristics of the two forms, and provided evidence of specific distinctions between the two. In 1980, the American Fisheries Society formally recognized bull trout and Dolly Varden as separate species (Robins et al. 1980). Despite an overlap in the geographic range of bull trout and Dolly Varden in the Puget Sound area and along the British Columbia coast, there is little evidence of introgression (Hass and McPhail 1991). The Columbia River Basin is considered the region of origin for the bull trout. From the Columbia, dispersal to other drainage systems was accomplished by marine migration and headwater stream capture. Behnke (1980) postulated dispersion to drainages east of the continental divide may have occurred through the North and South Saskatchewan Rivers (Hudson Bay drainage) and the Yukon River system. Marine dispersal may have occurred from Puget Sound north to the Fraser, Skeena and Taku Rivers of British Columbia.

6.1.4 Listing History

The coterminous United States population of the bull trout (*Salvelinus confluentus*) was listed as threatened on November 1, 1999 (64 FR 58910). A 5-year review was conducted in 2008 and reaffirmed the species status as threatened (USFWS 2008b). The threatened bull trout generally occurs in the Klamath River Basin of south-central Oregon; the Jarbidge River in Nevada; the Willamette River Basin in Oregon; Pacific Coast drainages of Washington, including Puget Sound; major rivers in Idaho, Oregon, Washington, and Montana, within the Columbia River Basin; and the St. Mary-Belly River, east of the Continental Divide in northwestern Montana (Cavender 1978; Bond 1992; Brewin and Brewin 1997; Leary and Allendorf 1997).

6.1.5 Reasons for Listing

Bull trout distribution, abundance, and habitat quality have declined rangewide (Bond 1992, Schill 1992, Thomas 1992, Ziller 1992, Rieman and McIntyre 1993, Newton and Pribyl 1994, McPhail and Baxter 1996). Several local extirpations have been documented, beginning in the 1950s (Rode 1990, Ratliff and Howell 1992, Donald and Alger 1993, Goetz 1994, Newton and Pribyl 1994, Berg and Priest 1995, Light et al. 1996, Buchanan et al. 1997, WDFW 1998). Bull trout were extirpated from the southernmost portion of their historic range, the McCloud River in California, around 1975 (Moyle 1976, Rode 1990). Bull trout have been functionally extirpated (i.e., few individuals may occur there but do not constitute a viable population) in the Coeur d'Alene River basin in Idaho and in the Lake Chelan and Okanogan River basins in Washington (63 FR 31647).

These declines result from the combined effects of habitat degradation and fragmentation, the blockage of migratory corridors; poor water quality, angler harvest and poaching, entrainment (process by which aquatic organisms are pulled through a diversion or other device) into diversion channels and dams, and introduced nonnative species. Specific land and water management activities that depress bull trout populations and degrade habitat include the effects of dams and other diversion structures, forest management practices, livestock grazing, agriculture, agricultural diversions, road construction and maintenance, mining, and urban and rural development (Beschta et al. 1987; Chamberlain et al. 1991; Furniss et al. 1991; Meehan 1991; Nehlsen et al. 1991; Sedell and Everest 1991; Craig and Wissmar 1993; Frissell 1993; Henjum et al. 1994; McIntosh et al. 1994; Wissmar et al. 1994; MBTSG 1995a-e, 1996a-f; Light et al. 1996; USDA and USDI 1995, 1996, 1997).

6.1.6 Distinct Population Segments and Population Units

The bull trout was initially listed as three separate Distinct Population Segments (DPSs) (63 FR 31647; 64 FR 17110). The preamble to the final listing rule for the United States coterminous population of the bull trout discusses the consolidation of these DPSs with the Columbia and Klamath population segments into one listed taxon and the application of the jeopardy standard under section 7 of the Act relative to this species (64 FR 58910):

Although this rule consolidated the five bull trout DPSs into one listed taxon, based on conformance with the DPS policy for purposes of consultation under section 7 of the Act, we retain recognition of each DPS in light of available scientific information relating to their uniqueness and significance. Under this approach, these DPSs will be treated as interim recovery units with respect to application of the jeopardy standard until an approved recovery plan is developed. Formal establishment of bull trout recovery units will occur during the recovery planning process (USFWS 2006).

At the time of publication of the Draft Bull Trout Recovery Plan (USFWS 2002), there were 27 recovery units described. Almost immediately upon publication, the FWS recognized that these units may not meet the FWS standard for “recovery units” and decided to call them “management units.” In addition, the five DPSs described in the June 10, 1998, listing of bull trout (FR 63, 31647) were subsequently recognized as “interim recovery units” in the November

1, 1999, final listing rule for bull trout (FR 64, 58910). In summary, until the Draft Bull Trout Recovery Plan is finalized, the FWS has adopted the use of local population, core area, management unit, and interim recovery unit for purposes of consultation and recovery. Table 6.0 below illustrates the language used by the FWS for purposes of consultation for bull trout, including this biological opinion, as well as the hierarchal relationships between these geographical units of analysis.

Table 6.0. Hierarchy of Units of Analysis for Bull trout Jeopardy Analysis for the Continued Operation and Maintenance of the Willamette Project.

Name	Hierarchal Relationship
Columbia River Interim Recovery Unit (formerly a DPS)	One of 5 interim recovery units in the range of the species within the coterminous U.S.
Willamette River Management Unit (formerly a Recovery Unit)	One of 23 management units in the Columbia River Interim Recovery Unit
Upper Willamette Core Area (no change in terminology)	The only core area in the Willamette River Management Unit
South Fork McKenzie Local Population (no change in terminology)	One of four local populations in the Upper Willamette Core Area

6.1.7 Distribution

The historical range of bull trout includes major river basins in the Pacific Northwest at about 41 to 60 degrees North latitude, from the southern limits in the McCloud River in northern California and the Jarbidge River in Nevada to the headwaters of the Yukon River in the Northwest Territories, Canada (Cavender 1978, Bond 1992). To the west, the bull trout's range includes Puget Sound, various coastal rivers of British Columbia, Canada, and southeast Alaska (Bond 1992). Bull trout occur in portions of the Columbia River and tributaries within the basin, including its headwaters in Montana and Canada. Bull trout also occur in the Klamath River basin of south-central Oregon. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta and Montana and in the MacKenzie River system in Alberta and British Columbia, Canada (Cavender 1978, Brewin et al. 1997).

6.1.8 Life History

Bull trout exhibit both resident and migratory life history strategies, but both forms may be found together, and either form may produce offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. The resident form tends to be smaller than the migratory form at maturity and also produces fewer eggs (Fraley and Shepard 1989; Goetz 1989). Migratory bull trout spawn in tributary streams where juvenile fish rear one to four years before migrating to either a lake (adfluvial form), river (fluvial form) (Fraley and Shepard 1989; Goetz 1989), or saltwater (anadromous form) to rear as subadults and to live as adults (Cavender 1978, McPhail and Baxter 1996, WDFW et al. 1997). Bull trout normally reach sexual maturity in four to seven years and may live longer than 12 years. They are iteroparous (they spawn more than once in a lifetime). Repeat- and alternate-year spawning has been reported, although repeat-

spawning frequency and post-spawning mortality are not well documented (Leathe and Graham 1982, Fraley and Shepard 1989, Pratt 1992, Rieman and McIntyre 1996).

The iteroparous reproductive strategy of bull trout has important repercussions for the management of this species. Bull trout require passage both upstream and downstream, not only for repeat spawning but also for foraging. Most fish ladders, however, were designed specifically for anadromous semelparous salmonids (fishes that spawn once and then die, and require only one-way passage upstream as adults). Therefore, even dams or other barriers with fish passage facilities are a factor in isolating bull trout populations if they do not provide a safe downstream passage route.

Growth varies depending upon life-history strategy. Resident adults range from 6 to 12 inches total length, and migratory adults commonly reach 24 inches or more (Pratt 1985, Goetz 1989). The largest verified bull trout is a 32-pound specimen caught in Lake Pend Oreille, Idaho, in 1949 (Simpson and Wallace 1982).

6.1.9 Habitat Affinities

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993). Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors (Fraley and Shepard 1989, Goetz 1989, Hoelscher and Bjornn 1989, Sedell and Everest 1991, Howell and Buchanan 1992, Pratt 1992, Rieman and McIntyre 1993, 1995, Rich 1996, Watson and Hillman 1997). Watson and Hillman (1997) concluded that watersheds must have specific physical characteristics to provide the habitat requirements necessary for bull trout to successfully spawn and rear and that these specific characteristics are not necessarily present throughout these watersheds. Because bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993), bull trout should not be expected to simultaneously occupy all available habitats (Rieman et al. 1997b).

Migratory corridors link seasonal habitats for all bull trout life histories. The ability to migrate is important to the persistence of bull trout (Rieman and McIntyre 1993, Rieman et al. 1997b). Migrations facilitate gene flow among local populations when individuals from different local populations interbreed or stray to nonnatal streams. Local populations that are extirpated by catastrophic events may also become reestablished by bull trout migrants. However, it is important to note that the genetic structuring of bull trout indicates there is limited gene flow among bull trout populations, which may encourage local adaptation within individual populations, and that reestablishment of extirpated populations may take a long time (Spruell et al. 1999, Rieman and McIntyre 1993). Migration also allows bull trout to access more abundant or larger prey, which facilitates growth and reproduction. Additional benefits of migration and its relationship to foraging are discussed below under “Diet.”

Cold water temperatures play an important role in determining bull trout habitat, as these fish are primarily found in colder streams (below 15 °C or 59 °F), and spawning habitats are generally characterized by temperatures that drop below 9 °C (48 °F) in the fall (Fraley and Shepard 1989; Pratt 1992; Rieman and McIntyre 1993).

Thermal requirements for bull trout appear to differ at different life stages. Spawning areas are often associated with cold-water springs, groundwater infiltration, and the coldest streams in a given watershed (Pratt 1992; Rieman and McIntyre 1993; Baxter et al. 1997; Rieman et al. 1997). Optimum incubation temperatures for bull trout eggs range from 2 °C to 6 °C (35 °F to 39 °F) whereas optimum water temperatures for rearing range from about 6 °C to 10 °C (46 °F to 50 °F) (McPhail and Murray 1979; Goetz 1989; Buchanan and Gregory 1997). In Granite Creek, Idaho, Bonneau and Scarnecchia (1996) observed that juvenile bull trout selected the coldest water available in a plunge pool, 8 °C to 9 °C (46 °F to 48 °F), within a temperature gradient of 8 °C to 15 °C (4 °F to 60 °F). In a landscape study relating bull trout distribution to maximum water temperatures, (Dunham et al. 2003) found that the probability of juvenile bull trout occurrence does not become high (i.e., greater than 0.75) until maximum temperatures decline to 11 °C to 12 °C (52 °F to 54 °F).

Although bull trout are found primarily in cold streams, occasionally these fish are found in larger, warmer river systems throughout the Columbia River basin (Fraley and Shepard 1989; Rieman and McIntyre 1993, 1995, Buchanan and Gregory 1997, Rieman et al. 1997b). Availability and proximity of cold water patches and food productivity can influence bull trout ability to survive in warmer rivers (Myrick et al. 2002). For example, in a study in the Little Lost River of Idaho where bull trout were found at temperatures ranging from 8 °C to 20 °C (46 °F to 68 °F), most sites that had high densities of bull trout were in areas where primary productivity in streams had increased following a fire (Bart Gamett, U.S. Forest Service, pers. comm. 2002).

All life history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Fraley and Shepard 1989, Goetz 1989, Hoelscher and Bjornn 1989, Sedell and Everest 1991, Pratt 1992, Thomas 1992, Rich 1996, Sexauer and James 1997, Watson and Hillman 1997). Maintaining bull trout habitat requires stability of stream channels and maintenance of natural flow patterns (Rieman and McIntyre 1993). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997). These areas are sensitive to activities that directly or indirectly affect stream channel stability and alter natural flow patterns. For example, altered stream flow in the fall may disrupt bull trout during the spawning period, and channel instability may decrease survival of eggs and young juveniles in the gravel from winter through spring (Fraley and Shepard 1989, Pratt 1992, Pratt and Huston 1993). Pratt (1992) indicated that increases in fine sediment reduce egg survival and emergence.

Bull trout typically spawn from August through November during periods of increasing flows and decreasing water temperatures. Preferred spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989, Pratt 1992, Rieman and McIntyre 1996). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992). After hatching, fry remain in the substrate, and time from egg deposition to emergence may surpass 200 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Pratt 1992, Ratliff and Howell 1992).

6.1.10 Migratory corridors

Migratory bull trout ensure regular interchange of genetic material between local populations within core areas (USFWS 2002), and sometimes facilitate genetic interchange among core areas on an evolutionary time scale (Whitesel et al. 2004), thereby promoting genetic variability. Intact migratory corridors also allow for the potential reestablishment of extirpated local populations (USFWS 2002). Unfortunately, many populations of migratory bull trout have been restricted or eliminated due to stream habitat alterations, including seasonal or permanent obstructions, detrimental changes in water quality, increased temperatures, and the alteration of natural stream flow patterns. Migratory corridors tie seasonal foraging, migrating and overwintering habitat to spawning and rearing habitat for anadromous, adfluvial, and fluvial forms (USFWS 2002). Such corridors could potentially allow for dispersal of resident forms for recolonization of recovering habitats (Rieman and McIntyre 1993), though evidence indicates that resident fish are naturally less likely to disperse (Nelson et al. 2002). Dam and reservoir construction and operation have altered major portions of migratory bull trout habitat throughout the Columbia River Basin (USFWS 2002, 2005a). Dams without fish passage create barriers to fluvial and adfluvial bull trout which isolates populations, and dams and reservoirs alter the natural hydrograph, thereby affecting forage, water temperature, and water quality (USFWS 1999). In addition, reservoirs sometimes do not contain suitable bull trout habitat during certain portions of the year when temperature or other factors may be limiting (USFWS 2002, 2005a).

6.1.11 Population Dynamics

Although bull trout are widely distributed over a large geographic area, they exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993). Increased habitat fragmentation reduces the amount of available habitat and increases isolation from other populations of the same species (Saunders et al. 1991). Burkey (1989) concluded that when species are isolated by fragmented habitats, low rates of population growth are typical in local populations and their probability of extinction is directly related to the degree of isolation and fragmentation. Without sufficient immigration, growth for local populations may be low and probability of extinction high (Burkey 1989, 1995).

Metapopulation concepts of conservation biology theory have been suggested relative to the distribution and characteristics of bull trout, although empirical evidence is relatively scant (Rieman and McIntyre 1993, Dunham and Rieman 1999, Rieman and Dunham 2000). A metapopulation is an interacting network of local populations with varying frequencies of migration and gene flow among them (Meffe and Carroll 1994). For inland bull trout, metapopulation theory is likely most applicable at the watershed scale where habitat consists of discrete patches or collections of habitat capable of supporting local populations; local populations are for the most part independent and represent discrete reproductive units; and long-term, low-rate dispersal patterns among component populations influences the persistence of at least some of the local populations (Rieman and Dunham 2000). Ideally, multiple local populations distributed throughout a watershed provide a mechanism for spreading risk because the simultaneous loss of all local populations is unlikely. However, habitat alteration, primarily through the construction of impoundments, dams, and water diversions has fragmented habitats,

eliminated migratory corridors, and in many cases isolated bull trout in the headwaters of tributaries (Rieman et al. 1997a, Dunham and Rieman 1999, Spruell et al. 1999, Rieman and Dunham 2000).

Human-induced factors as well as natural factors affecting bull trout distribution have likely limited the expression of the metapopulation concept for bull trout to patches of habitat within the overall distribution of the species (Dunham and Rieman 1999). However, despite the theoretical fit, the relatively recent and brief time period during which bull trout investigations have taken place does not provide certainty as to whether a metapopulation dynamic is occurring (e.g., a balance between local extirpations and recolonizations) across the range of the bull trout or whether the persistence of bull trout in large or closely interconnected habitat patches (Dunham and Rieman 1999) is simply reflective of a general deterministic trend towards extinction of the species where the larger or interconnected patches are relics of historically wider distribution (Rieman and Dunham 2000). Recent research (Whiteley et al. 2003) does, however, provide genetic evidence for the presence of a metapopulation process for bull trout, at least in the Boise River Basin of Idaho.

6.1.12 Population Structure

Whitesel et al. (2004) noted that although there are multiple resources that contribute to the subject, Spruell et al. (2003) best summarized genetic information on bull trout population structure. Spruell et al. (2003) analyzed 1,847 bull trout from 65 sampling locations, four located in three coastal drainages (Klamath, Queets, and Skagit Rivers), one in the Saskatchewan River drainage (Belly River), and 60 scattered throughout the Columbia River Basin. They concluded that there is a consistent pattern among genetic studies of bull trout, regardless of whether examining allozymes, mitochondrial DNA, or most recently microsatellite loci. Typically, the genetic pattern shows relatively little genetic variation within populations, but substantial divergence among populations. Microsatellite loci analysis supports the existence of at least three major genetically differentiated groups (or evolutionary lineages) of bull trout (Spruell et al. 2003). They were characterized as:

a) "Coastal", including the Deschutes River and all of the Columbia River drainage downstream, as well as most coastal streams in Washington, Oregon, and British Columbia. A compelling case also exists that the Klamath Basin represents a unique evolutionary lineage within the coastal group.

b) "Snake River", which also included the John Day, Umatilla, and Walla Walla rivers. Despite close proximity of the John Day and Deschutes Rivers, a striking level of divergence between bull trout in these two systems was observed.

c) "Upper Columbia River" which includes the entire basin in Montana and northern Idaho. A tentative assignment was made by Spruell et al. (2003) of the Saskatchewan River drainage populations (east of the continental divide), grouping them with the upper Columbia River group.

Spruell et al. (2003) noted that within the major assemblages, populations were further subdivided, primarily at the level of major river basins. Taylor et al. (1999) surveyed bull trout populations, primarily from Canada, and found a major divergence between inland and coastal populations. Costello et al. (2003) suggested the patterns reflected the existence of two glacial refugia, consistent with the conclusions of Spruell and the biogeographic analysis of Haas and McPhail (2001). Both Taylor et al. (1999) and Spruell et al. (2003) concluded that the Deschutes River represented the most upstream limit of the coastal lineage in the Columbia River Basin.

6.1.13 Conservation Needs

Conservation needs reflect those biological and physical requirements of a species for its long-term survival and recovery. Based on the best available scientific information (Hard 1995, Healy and Prince 1995, MBTSG 1998, Rieman and Allendorf 2001, Rieman and McIntyre 1993) the conservation needs of the bull trout are to: (1) Maintain and restore multiple, interconnected populations in diverse habitats across the range of each DPS (interim recovery unit); (2) Preserve the diversity of life-history strategies (e.g., resident and migratory forms, emigration age, spawning frequency, local habitat adaptations); (3) Maintain genetic and phenotypic diversity across the range of each DPS (interim recovery unit); and, (4) Protect populations from catastrophic fires across the range of each DPS (interim recovery unit). Each of these needs is described below in more detail.

a) Maintain and Restore Multiple, Interconnected Populations in Diverse Habitats Across the Range of Each Interim Recovery Unit)

Multiple local populations distributed and interconnected throughout a watershed provide a mechanism for spreading risk from stochastic events (Hard 1995, Healy and Prince 1995, Rieman and Allendorf 2001, Rieman and McIntyre 1993, Spruell et al. 1999). Current patterns in bull trout distribution and other empirical evidence, when interpreted in view of emerging conservation theory, indicate that further declines and local extinctions are likely (Dunham and Rieman 1999, Rieman and Allendorf 2001, Rieman et al. 1997b, Spruell 2003). Based in part on guidance from Rieman and McIntyre (1993), bull trout core areas with fewer than five local populations are at increased risk of extirpation; core areas with between 5 to 10 local populations are at intermediate risk of extirpation; and core areas which have more than 10 interconnected local populations are at diminished risk of extirpation.

Maintaining and restoring connectivity between existing populations of bull trout is important for the persistence of the species (Rieman and McIntyre 1993). Migration and occasional spawning between populations increases genetic variability and strengthens population variability (Rieman and McIntyre 1993). Migratory corridors allow individuals access to unoccupied but suitable habitats, foraging areas, and refuges from disturbances (Saunders et al. 1991).

Because bull trout in the coterminous United States are distributed over a wide geographic area consisting of various environmental conditions, and because they exhibit considerable genetic differentiation among populations, the occurrence of local adaptations is expected to be extensive. Some readily observable examples of differentiation between populations include external morphology and behavior (e.g., size and coloration of individuals; timing of spawning

and migratory forays). Conserving many populations across the range of the species is crucial to adequately protect genetic and phenotypic diversity of bull trout (Hard 1995, Healy and Prince 1995, Leary et al. 1993, Rieman and Allendorf 2001, Rieman and McIntyre 1993, Spruell et al. 1999, Taylor et al. 1999). Changes in habitats and prevailing environmental conditions are increasingly likely to result in extinction of bull trout if genetic and phenotypic diversity is lost.

b) Preserve the Diversity of Life-history Strategies

The bull trout has multiple life history strategies, including migratory forms, throughout its range (Rieman and McIntyre 1993). Migratory forms appear to develop when habitat conditions allow movement between spawning and rearing streams and larger rivers or lakes where foraging opportunities may be enhanced (Frissell 1997). For example, multiple life history forms (e.g., resident and fluvial) and multiple migration patterns have been noted in the Grande Ronde River (Baxter 2002). Parts of this river system have retained habitat conditions that allow free movement between spawning and rearing areas and the mainstem of the Snake River. Such multiple life history strategies help to maintain the stability and persistence of bull trout populations to environmental changes. Benefits to migratory bull trout include greater growth in the more productive waters of larger streams and lakes, greater fecundity resulting in increased reproductive potential, and dispersing the population across space and time so that spawning streams may be recolonized should local populations suffer a catastrophic loss (Frissell 1997, MBTSG 1998, Rieman and McIntyre 1993).

c) Maintain the Genetic Diversity and Evolutionary Potential of Bull Trout Populations

When the long-term persistence of a species, taxon, or phylogenetic lineage is considered, it is necessary to consider the amount of genetic variation necessary to uphold evolutionary potential needed for that taxon to adapt to a changing environment. Effective population size provides a standardized measure of the amount of genetic variation that is likely to be transmitted between generations within a population. Effective population size is a theoretical concept that allows one to predict potential future losses of genetic variation within a population due to small population size and genetic drift. Individuals within populations with very small effective population sizes are also subject to inbreeding depression because most individuals within small populations share one or more immediate ancestors (parents, grandparents, etc.) after only a few generations and will be closely related.

Effective population sizes (Ne) of 500 to 5000 have been recommended for the retention of evolutionary potential (Franklin and Frankham 1998, Lynch and Lande 1998). Populations of this size are able to retain additive genetic variation for fitness related traits gained via mutation (Franklin 1980).

Bull trout specific benchmarks have been developed concerning the minimum Ne necessary to maintain genetic variation important for short-term fitness and long-term evolutionary potential. These benchmarks are based on the results of a generalized, age-structured, simulation model, VORTEX (Miller and Lacy 1999), used to relate effective population size to the number of adult bull trout spawning annually under a range of life histories and environmental conditions

(Rieman and Allendorf 2001). In this study, the authors estimated Ne for bull trout to be between 0.5 and 1.0 times the mean number of adults spawning annually. Rieman and Allendorf (2001) concluded that an average of 100 (i.e., 100 x 0.5 = 50) adults spawning each year would be required to minimize risks of inbreeding in a population and 1000 adults (i.e., 1000 x 0.5 = 500) is necessary to maintain genetic variation important for long-term evolutionary potential. This latter value of 1000 spawners may also be reached with a collection of local populations among which gene flow occurs.

The combination of resident forms completing their entire life cycle within a stream and the homing behavior of the migratory forms returning to the streams where they hatched to spawn promotes reproductive isolation among bull trout local populations. This reproductive isolation creates the opportunity for genetic differentiation and local adaptations to occur. Nevertheless, within a core area local populations are usually connected through low rates of migration. This connection of local populations, linked by migration, is termed a metapopulation (Hanski and Gilpin 1997). Within a metapopulation, evolution primarily occurs at the local population level (i.e., it is the main demographic and genetic unit of concern). However, when longer time frames are considered (e.g., 10-plus generations), metapopulations become important. For example, metapopulations allow for the reintroduction of lost alleles and recolonization of extinct local breeding populations. Migration and gene flow among local populations ensures that the alleles within a metapopulation will be present in most local breeding populations and can be acted upon by natural selection (Allendorf 1983).

d) Maintain Phenotypic Diversity

Healy and Prince (1995) reported that, because phenotypic diversity is a consequence of the genotype interacting with the habitat, the conservation of phenotypic diversity is achieved through conservation of the sub-population within its habitat. They further note that adaptive variation among salmonids has been observed to occur under relatively short time frames (e.g., changes in genetic composition of salmonids raised in hatcheries; rapid emergence of divergent phenotypes for salmonids introduced to new environments). Healy and Prince (1995) conclude that while the loss of a few sub-populations within an ecosystem might have only a small effect on overall genetic diversity, the effect on phenotypic diversity and, potentially, overall population viability could be substantial (Healy and Prince 1995). This concept of preserving variation in phenotypic traits that is determined by both genetic and environmental (i.e., local habitat) factors has also been identified by Hard (1995) as an important component in maintaining intraspecific adaptability (i.e., phenotypic plasticity) and ecological diversity within a genotype (Hard 1995). He argues that adaptive processes are not entirely encompassed by the interpretation of molecular genetic data; in other words, phenotypic and genetic variation in adaptive traits may exist without detectable variation at the molecular genetic level, particularly for neutral genetic markers. Therefore, the effective conservation of genetic diversity necessarily involves consideration of the conservation of biological units smaller than taxonomic species (or DPSs). Reflecting this theme, the maintenance of local sub-populations has been specifically emphasized as a mechanism for the conservation of bull trout (Rieman and McIntyre 1993, Taylor et al. 1999).

e) Protect Bull Trout from Catastrophic Fires

Bull trout evolved under historic fire regimes in which disturbance to streams from forest fires resulted in a mosaic of diverse habitats. However, forest management and fire suppression over the past century have increased homogeneity of terrestrial and aquatic habitats, increasing the likelihood of large, intense forest fires in some areas. Because the most severe effects of fire on native fish populations can be expected where populations have become fragmented by human activities or natural events, an effective strategy to ensure persistence of native fishes against the effects of large fires may be to restore aquatic habitat structure and life history complexity of populations in areas susceptible to large fires (Gresswell 1999).

Rieman and Clayton (1997) discussed relations among the effects of fire and timber harvest, aquatic habitats, and sensitive species. They noted that spatial diversity and complexity of aquatic habitats strongly influence the effects of large disturbances on salmonids (Rieman and Clayton 1997). For example, Rieman et al. (1997) studied bull trout and redband trout responses to large, intense fires that burned three watersheds in the Boise National Forest in Idaho. Although the fires were the most intense on record, there was a mix of severely burned to unburned areas left after the fires. Fish were apparently eliminated in some stream reaches, whereas others contained relatively high densities of fish. Within a few years after the fires and after areas within the watersheds experienced debris flows, fish had become reestablished in many reaches, and densities increased. In some instances, fish densities were higher than those present before the fires or in streams that were not burned (Rieman et al. 1997a). These responses were attributed to spatial habitat diversity that supplied refuge areas for fish during the fires, and the ability of bull trout and the redband trout to move among stream reaches. For bull trout, the presence of migratory fish within the system was also important (Rieman and Clayton 1997, Rieman et al. 1997a).

In terms of conserving bull trout, the appropriate strategy to reduce the effects of fires on bull trout habitat is to emphasize the restoration of watershed processes that create and maintain habitat diversity, provide bull trout access to habitats, and protect or restore migratory life-history forms of bull trout. Both passive (e.g., encouraging natural riparian vegetation and floodplain processes to function appropriately) and active (e.g., reducing road density, removing barriers to fish movement, and improving habitat complexity) actions offer the best approaches to protect bull trout from the effects of large fires.

6.1.14 Range-wide Trends

In the rules listing the bull trout as threatened, the Service identified local populations (i.e., isolated groups of bull trout thought to lack two-way exchange of individuals), for which status, distribution, and threats to bull trout were evaluated. Because habitat fragmentation and barriers have isolated bull trout throughout their current range, a local population was considered a reproductively isolated group of bull trout that spawns within a particular river or area of a river system. Overall, 187 local populations were identified throughout their coterminous range in the following interim recovery units: 7 in the Klamath River, 141 in the Columbia River, 1 in the Jarbidge River, 34 in the Coastal-Puget Sound, and 4 in the St. Mary-Belly River populations.

No new local populations have been identified and no local populations have been lost since listing.

6.1.15 New Threats

The overall status of the Columbia River interim recovery unit has not changed appreciably since its listing on June 10, 1998. Populations of bull trout and their habitat in this area have been affected by a number of federal actions that have been reviewed under section 7 of the Act. Most of these actions resulted in degradation of the environmental baseline of bull trout habitat, and analyzed and exempted incidental take of bull trout.

6.1.16 Climate Change

Global climate change, and the related warming of global climate, have been well documented (IPCC 2007, ISAB 2007, WWF 2003). Evidence of global climate change/warming includes widespread increases in average air and ocean temperatures and accelerated melting of glaciers, and rising sea level. Given the increasing certainty that climate change is occurring and is accelerating (IPCC 2007, Battin et al. 2007), we can no longer assume that climate conditions in the future will resemble those in the past.

Patterns consistent with changes in climate have already been observed in the range of many species and in a wide range of environmental trends (ISAB 2007, Hari et al. 2006, Rieman et al. 2007). In the northern hemisphere, the duration of ice cover over lakes and rivers has decreased by almost 20 days since the mid-1800's (WWF 2003). The range of many species has shifted poleward and elevationally upward. For cold-water associated salmonids in mountainous regions, where their upper distribution is often limited by impassable barriers, an upward thermal shift in suitable habitat can result in a reduction in range, which in turn can lead to a population decline (Hari et al. 2006).

In the Pacific Northwest, most models project warmer air temperatures and increases in winter precipitation and decreases in summer precipitation. Warmer temperatures will lead to more precipitation falling as rain rather than snow. As the seasonal amount of snow pack diminishes, the timing and volume of stream flow are likely to change and peak river flows are likely to increase in affected areas. Higher air temperatures are also likely to increase water temperatures (ISAB 2007). For example, stream gauge data from western Washington over the past 5 to 25 years indicate a marked increasing trend in water temperatures in most major rivers.

Climate change has the potential to profoundly alter the aquatic ecosystems upon which the bull trout depends via alterations in water yield, peak flows, and stream temperature, and an increase in the frequency and magnitude of catastrophic wildfires in adjacent terrestrial habitats (Bisson et al. in press).

All life stages of the bull trout rely on cold water. Increasing air temperatures are likely to impact the availability of suitable cold water habitat. For example, ground water temperature is generally correlated with mean annual air temperature, and has been shown to strongly influence the distribution of other chars. Ground water temperature is linked to bull trout selection of

spawning sites, and has been shown to influence the survival of embryos and early juvenile rearing of bull trout (Rieman et al. in press). Increases in air temperature are likely to be reflected in increases in both surface and groundwater temperatures.

Climate change is likely to affect the frequency and magnitude of fires, especially in warmer drier areas such as are found on the eastside of the Cascade Mountains. Bisson et al. (in press) note that the forest that naturally occurred in a particular area may or may not be the forest that will be responding to the fire regimes of an altered climate. In several studies related to the effect of large fires on bull trout populations, bull trout appear to have adapted to past fire disturbances through mechanisms such as dispersal and plasticity. However, as stated earlier, the future may well be different than the past and extreme fire events may have a dramatic effect on bull trout and other aquatic species, especially in the context of continued habitat loss, simplification and fragmentation of aquatic systems, and the introduction and expansion of exotic species (Bisson et al. in press).

Migratory bull trout can be found in lakes, large rivers and marine waters. Effects of climate change on lakes are likely to impact migratory adfluvial bull trout that seasonally rely upon lakes for their greater availability of prey and access to tributaries. Climate-warming impacts to lakes will likely lead to longer periods of thermal stratification and coldwater fish such as adfluvial bull trout will be restricted to these bottom layers for greater periods of time. Deeper thermoclines resulting from climate change may further reduce the area of suitable temperatures in the bottom layers and intensify competition for food (WWF 2003).

Bull trout require very cold water for spawning and incubation. Suitable spawning habitat is often found in accessible higher elevation tributaries and headwaters of rivers. However, impacts on hydrology associated with climate change are related to shifts in timing, magnitude and distribution of peak flows that are also likely to be most pronounced in these high elevation stream basins (Battin et al. 2007). The increased magnitude of winter peak flows in high elevation areas is likely to impact the location, timing, and success of spawning and incubation for the bull trout and Pacific salmon species. Although lower elevation river reaches are not expected to experience as severe an impact from alterations in stream hydrology, they are unlikely to provide suitably cold temperatures for bull trout spawning, incubation and juvenile rearing.

As climate change progresses and stream temperatures warm, thermal refugia will be critical to the persistence of many bull trout populations. Thermal refugia are important for providing bull trout with patches of suitable habitat during migration through or to make feeding forays into areas with greater than optimal temperatures.

There is still a great deal of uncertainty associated with predictions relative to the timing, location, and magnitude of future climate change. It is also likely that the intensity of effects will vary by region (ISAB 2007) although the scale of that variation may exceed that of States. For example, several studies indicate that climate change has the potential to impact ecosystems in nearly all streams throughout the State of Washington (ISAB 2007, Battin et al. 2007, Rieman et al. 2007). In streams and rivers with temperatures approaching or at the upper limit of allowable water temperatures, there is little if any likelihood that bull trout will be able to adapt

to or avoid the effects of climate change/warming. There is little doubt that climate change is and will be an important factor affecting bull trout distribution. As its distribution contracts, patch size decreases and connectivity is truncated, bull trout populations that may be currently connected may face increasing isolation, which could accelerate the rate of local extinction beyond that resulting from changes in stream temperature alone (Rieman et al. 2007). Due to variations in land form and geographic location across the range of the bull trout, it appears that some populations face higher risks than others. Bull trout in areas with currently degraded water temperatures and/or at the southern edge of its range may already be at risk of adverse impacts from current as well as future climate change.

6.1.17 Consulted on Effects

Consulted-on effects are those effects that have been analyzed through section 7 consultation as reported in a biological opinion. These effects are an important component of characterizing the current condition of the species. To assess consulted-on effects to bull trout, we analyzed all of the BOs received by the Region 1 and Region 6 Offices, from the time of listing until August 2003; this totaled 137 BOs. Of these, 124 BOs (91 percent) applied to activities affecting bull trout in the Columbia Basin DPS, 12 BOs (9 percent) applied to activities affecting bull trout in the Coastal-Puget Sound DPS, 7 BOs (5 percent) applied to activities affecting bull trout in the Klamath Basin DPS, and 1 BO (<1 percent) applied to activities affecting the Jarbidge and St. Mary Belly DPSs (Note: these percentages do not add to 100, because several BOs applied to more than one DPS). The geographic scale of these consultations varied from individual actions (e.g., construction of a bridge or pipeline) within one basin to multiple-project actions occurring across several basins.

Our analysis shows that we consulted on a wide array of actions which had varying level of effects. Many of the actions resulted in only short-term adverse effects – some with long-term beneficial effects. Some of the actions resulted in long-term adverse effects. No actions that have undergone consultation were found to appreciably reduce the likelihood of survival and recovery of the bull trout (jeopardy determination) or adversely modify critical habitat.

6.1.18 Ongoing Conservation Actions

a) Federal Conservation Actions

Federal conservation actions include: (1) the development of a draft *Bull Trout Recovery Plan*; (2) ongoing implementation of the *Interim Strategy for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California* (PACFISH; USDA and USDI 1995) and the *Interim Strategy for Managing Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, Western Montana and Portions of Nevada* (INFISH; USDA 1995); (3) ongoing implementation of the Northwest Forest Plan; (4) ongoing implementation of the Northwest Power and Conservation Council Fish and Wildlife Program targeting subbasin planning; (5) ongoing implementation of the Federal Caucus Fish and Wildlife Plan; and, (6) ongoing implementation of Department of Agriculture Conservation Reserve Programs.

b) State Conservation Actions

Idaho: Conservation actions by the State of Idaho include: (1) the development of a management plan for bull trout in 1993 (Conley 1993); (2) the approval of the *State of Idaho Bull Trout Conservation Plan* (Idaho Plan) in July 1996 (Batt 1996); (3) the development of 21 problem assessments involving 59 key watersheds; (4) the implementation of conservation actions identified in the problem assessments; and, (5) the implementation of more restrictive angling regulations.

Montana: Conservation actions by the State of Montana include: (1) development of the *Montana Bull Trout Restoration Plan* issued in 2000 (MBTRT 2000), which defines strategies for ensuring the long-term persistence of bull trout in Montana; (2) formation of the Montana Bull Trout Restoration Team (MBTRT) and Montana Bull Trout Scientific Group (MBTSG) to produce a plan for maintaining, protecting, and increasing bull trout populations; (3) the development of watershed groups to initiate localized bull trout restoration efforts; (4) funding of habitat restoration projects, recovery actions, and genetic studies throughout the state; (5) the abolition of brook trout stocking programs; and, (6) restrictive angling regulations.

Nevada: Conservation actions by the State of Nevada include: (1) the preparation of a *Bull Trout Species Management Plan* that recommends management alternatives to ensure that human activities will not jeopardize the future of bull trout in Nevada (Johnson 1990); (2) implementation of more restrictive State angling regulations in an attempt to protect bull trout in the Jarbidge River in Nevada; and, (3) the abolition of a rainbow trout stocking in the Jarbidge River.

Oregon: Since 1990, the State of Oregon has taken extensive action to address the conservation of bull trout, including: (1) Establishing bull trout working groups in the Klamath, Deschutes, Hood, Willamette, Odell Lake, Umatilla and Walla Walla, John Day, Malheur, and Pine Creek river basins for the purpose of developing bull trout conservation strategies; (2) establishment of more restrictive harvest regulations in 1990; (3) reduced stocking of hatchery-reared rainbow trout and brook trout into areas where bull trout occur; (4) angler outreach and education efforts are also being implemented in river basins occupied by bull trout; (5) research to further examine life history, genetics, habitat needs, and limiting factors of bull trout in Oregon; (6) reintroduction of bull trout fry from the McKenzie River watershed to the adjacent Middle Fork of the Willamette River, which is historical but currently unoccupied, isolated habitat; (7) the Oregon Department of Environmental Quality (DEQ) established a water temperature standard such that surface water temperatures may not exceed 10 degrees Celsius (50 degrees Fahrenheit) in waters that support or are necessary to maintain the viability of bull trout in the State (Oregon 1996); and, (8) expansion of the Oregon Plan for Salmon and Watersheds (Oregon 1997) to include all at-risk wild salmonids throughout the State.

Washington: Conservation actions by the State of Washington include: (1) establishment of the Salmon Recovery Act (ESHB 2496) and Watershed Management Act (ESHB 2514) by the Washington State legislature to assist in funding and planning salmon recovery efforts; (2) abolition of brook trout stocking in streams or lakes connected to bull trout-occupied waters; (3) changing angling regulations in Washington prohibit the harvest of bull trout, except for a few

areas where stocks are considered "healthy"; (4) collecting and mapping updated information on bull trout distribution, spawning and rearing areas, and potential habitat; and, (5) adopting new emergency forest practice rules based on the "Forest and Fish Report" process. These rules address riparian areas, roads, steep slopes, and other elements of forest practices on non-Federal lands.

c) Tribal Conservation Activities

Many Tribes throughout the range of the bull trout are participating on bull trout conservation working groups or recovery teams in their geographic areas of interest. Some tribes are also implementing projects which focus on bull trout or that address anadromous fish but benefit bull trout (e.g., habitat surveys, passage at dams and diversions, habitat improvement, and movement studies).

6.1.19 Conservation Needs and Status of Bull Trout in the Columbia River Interim Recovery Unit

In recognition of available scientific information relating to their uniqueness and significance, five segments of the coterminous United States population of the bull trout are considered essential to the survival and recovery of this species and are identified as interim recovery units: 1) Jarbidge River, 2) Klamath River, 3) Columbia River, 4) Coastal-Puget Sound, and 5) St. Mary-Belly River (USFWS 2002; 2004a,b). Each of these interim recovery units is necessary to maintain the bull trout's distribution, as well as its genetic and phenotypic diversity, all of which are important to ensure the species' resilience to changing environmental conditions.

The conservation needs of bull trout are often generally expressed as the four Cs: cold, clean, complex, and connected habitat. Cold stream temperatures, clean water quality that is relatively free of sediment and contaminants, complex channel characteristics (including abundant large wood and undercut banks), and large patches of such habitat that are well connected by unobstructed migratory pathways are all needed to promote conservation of bull trout at multiple scales ranging from the coterminous to local populations. The recovery planning process for bull trout (USFWS 2002; 2004a,b) has also identified the following conservation needs: 1) maintenance and restoration of multiple, interconnected populations in diverse habitats across the range of each interim recovery unit; 2) preservation of the diversity of life-history strategies; 3) maintenance of genetic and phenotypic diversity across the range of each interim recovery unit; and, 4) establishment of a positive population trend. Recently, it has also been recognized that bull trout populations need to be protected from catastrophic fires across the range of each interim recovery unit (Rieman et al. 2003).

Central to the survival and recovery of bull trout is the maintenance of viable core areas (USFWS 2002; 2004a,b). Each of the interim recovery units listed above consists of one or more core areas. There are 121 core areas recognized across the coterminous range of the bull trout (USFWS 2002; 2004a,b).

The Columbia River interim recovery unit includes bull trout residing in portions of Oregon, Washington, Idaho, and Montana. Bull trout are estimated to have occupied about 60 percent of

the Columbia River Basin, and presently occur in 45 percent of the estimated historical range (Quigley and Arbelbide 1997). This interim recovery unit currently contains 97 core areas and 527 local populations. About 65 percent of these core areas and local populations occur in central Idaho and northwestern Montana.

The condition of the bull trout within these core areas varies from poor to good. Core areas have been subject to the combined effects of habitat degradation and fragmentation caused by the following activities: dewatering; road construction and maintenance; mining; grazing; the blockage of migratory corridors by dams or other diversion structures; poor water quality; incidental angler harvest; entrainment into diversion channels; and introduced non-native species. The Service completed a core area conservation assessment for the 5-year status review and determined that, of the 97 core areas in this interim recovery unit, 38 are at high risk of extirpation, 35 are at risk, 20 are at potential risk, two are at low risk, and two are at unknown risk (USFWS 2005).

The Columbia River interim recovery unit has declined in overall range and numbers of fish (63 FR 31647). Although some strongholds still exist with migratory fish present, bull trout generally occur as isolated local populations in headwater lakes or tributaries where the migratory life history form has been lost. Though still widespread, there have been numerous local extirpations reported throughout the Columbia River basin. In Idaho, for example, bull trout have been extirpated from 119 reaches in 28 streams. The draft Columbia River bull trout recovery plan (USFWS 2002) identifies the following conservation needs for this interim recovery unit: 1) maintain or expand the current distribution of the bull trout within core areas; 2) maintain stable or increasing trends in bull trout abundance; 3) restore and maintain suitable habitat conditions for all bull trout life history stages and strategies; and, 4) conserve genetic diversity and provide opportunities for genetic exchange.

6.1.20 Conservation Needs and Status of Bull Trout in the Willamette River Management Unit

Bull trout were historically widespread in multiple tributaries of the Willamette River but are now limited to less than 300 adults in the McKenzie River and Middle Fork Willamette River. A translocation program to move bull trout fry from the McKenzie to the Middle Fork Willamette River began in 1997 and has occurred annually to augment the small, or perhaps extirpated, population of bull trout last documented in the 1980s above Hill's Creek Dam. Spawning and reproductive success, likely a result of the translocation program, was documented for the first time in 2005 and 2006. The current number of spawning adults in the Middle Fork Willamette River is estimated to be less than 15 fish.

The bull trout population in the McKenzie River was likely a single fluvial population prior to the construction of flood control and hydropower dams in the 1960s. Cougar Dam on the South Fork McKenzie River, and Trail Bridge Dam on the upper mainstem McKenzie River, effectively isolated bull trout above these projects, resulting in two adfluvial populations that continue to exist today despite each numbering less than 100 spawning adults. The remaining fluvial population in the McKenzie River below these dams is the most viable of the three

populations, although abundance is likely depressed. Bull trout in the McKenzie River subbasin have been monitored since the mid-1990s.

The conservation needs of bull trout in the Willamette Management Unit are: (1) restoring connectivity between isolated populations; (2) restoring viable bull trout populations in currently and historically occupied areas; (3) restoring anadromous fish in areas currently occupied by the bull trout in order to restore a portion of their historical prey base; (4) restoring, to the degree possible, normal flow and stream temperature patterns by constructing water temperature control towers and adopting alternative flow management strategies; and, (5) reducing bull trout injury and mortality from entrainment into turbine intakes, regulating outlets, and spillways (USFWS 2005).

6.1.21 Bull Trout Critical Habitat (Range-wide)

As noted previously in Section 6.1.2, this BO does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statute and the August 6, 2004, Ninth Circuit Court of Appeals decision in Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service (No. 03-35279) to complete the following analysis with respect to critical habitat.

6.1.22 Legal Status

The Service published a final critical habitat designation for the coterminous United States population of the bull trout on September 26, 2005 (70 FR 56212); the rule became effective on October 26, 2005. The scope of the designation involved the Klamath River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments (also considered as interim recovery units). Rangewide, the Service designated 143,218 acres of reservoirs or lakes and 4,813 stream or shoreline miles as bull trout critical habitat (Table 6.1).

Table 6.1. Stream/Shoreline Distance and Acres of Reservoir or Lakes Designated as Bull Trout Critical Habitat by State.

	Stream/shoreline Miles	Stream/shoreline Kilometers	Acres	Hectares
Idaho	294	474	50,627	20,488
Montana	1,058	1,703	31,916	12,916
Oregon	939	1,511	27,322	11,057
Oregon/Idaho	17	27		
Washington	1,519	2,445	33,353	13,497
Washington (marine)	985	1,585		

Although critical habitat has been designated across a wide area, some critical habitat segments were excluded in the final designation based on a careful balancing of the benefits of inclusion versus the benefits of exclusion (see Section 3(5)(A) and Exclusions under Section 4(b)(2) in the final rule). This balancing process resulted in all proposed critical habitat being excluded in 9 proposed critical habitat units: Unit 7 (Odell Lake), Unit 8 (John Day River Basin), Unit 15

(Clearwater River Basin), Unit 16 (Salmon River Basin), Unit 17 (Southwest Idaho River Basins), Unit 18 (Little Lost River), Unit 21 (Upper Columbia River), Unit 24 (Columbia River), and Unit 26 (Jarbidge River Basin). The remaining 20 proposed critical habitat units were designated in the final rule. It is important to note that the exclusion of waterbodies from designated critical habitat does not negate or diminish their importance for bull trout conservation.

6.1.23 Conservation Role and Description of Critical Habitat

The conservation role of bull trout critical habitat is to support viable core area populations (70 FR 56212). The core areas reflect the metapopulation structure of bull trout and are the closest approximation of a biologically functioning unit for the purposes of recovery planning and risk analyses. Critical habitat units generally encompass one or more core areas and may include foraging, migration, and overwintering (FMO) areas, outside of core areas, that are important to the survival and recovery of bull trout.

Because there are numerous exclusions that reflect land ownership, designated critical habitat is often fragmented and interspersed with excluded stream segments. These individual critical habitat segments are expected to contribute to the ability of the stream to support bull trout within local populations and core areas in each critical habitat unit.

The primary function of individual critical habitat units is to maintain and support core areas which: 1) contain bull trout populations with the demographic characteristics needed to ensure their persistence and contain the habitat needed to sustain those characteristics (Rieman and McIntyre 1993); 2) provide for persistence of strong local populations, in part, by providing habitat conditions that encourage movement of migratory fish (Rieman and McIntyre 1993, MBTSG 1998); 3) are large enough to incorporate genetic and phenotypic diversity, but small enough to ensure connectivity between populations (Rieman and McIntyre 1993, Hard 1995, Healey and Prince 1995, MBTSG 1998); and 4) are distributed throughout the historic range of the species to preserve both genetic and phenotypic adaptations (Rieman and McIntyre 1993, Hard 1995, MBTSG 1998, Rieman and Allendorf 2001).

Within the designated critical habitat areas, the PCEs for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal, genetic exchange, or sheltering. Note that all except PCE 3 apply to FMO habitat identified as critical habitat.

The PCEs are as follows:

(1) Water temperatures that support bull trout use. Bull trout have been documented in streams with temperatures from 32 to 72 ºF (0 to 22 ºC) but are found more frequently in temperatures ranging from 36 to 59 ºF (2 to 15 ºC). These temperature ranges may vary depending on bull trout life-history stage and form, geography, elevation, diurnal and seasonal variation, shade, such as that provided by riparian habitat, and local groundwater influence. Stream reaches with temperatures that preclude bull trout use are specifically excluded from designation.

(2) Complex stream channels with features such as woody debris, side channels, pools, and undercut banks to provide a variety of depths, velocities, and instream structures.

(3) Substrates of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. This should include a minimal amount of fine substrate less than 0.25 inch (0.63 centimeter) in diameter.

(4) A natural hydrograph, including peak, high, low, and base flows within historic ranges or, if regulated, currently operate under a biological opinion that addresses bull trout, or a hydrograph that demonstrates the ability to support bull trout populations by minimizing daily and day-to-day fluctuations and minimizing departures from the natural cycle of flow levels corresponding with seasonal variation.

(5) Springs, seeps, groundwater sources, and subsurface water to contribute to water quality and quantity as a cold water source.

(6) Migratory corridors with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows.

(7) An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

(8) Permanent water of sufficient quantity and quality such that normal reproduction, growth, and survival are not inhibited.

Critical habitat includes the stream channels within the designated stream reaches, the shoreline of designated lakes, and the inshore extent of marine nearshore areas, including tidally influenced freshwater heads of estuaries.

In freshwater habitat, critical habitat includes the stream channels within the designated stream reaches, and includes a lateral extent as defined by the ordinary high-water line. In areas where ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge that generally has a recurrence interval of one to two years on the annual flood series.

Activities that cause adverse effects to critical habitat are evaluated to determine if they are likely to "destroy or adversely modify" critical habitat by altering the PCEs to such an extent that critical habitat would not remain functional to serve the intended conservation role for the species (70 FR 56212). Our evaluation must be conducted at the scale of the entire critical habitat area designated. Therefore, adverse modification of bull trout critical habitat is evaluated at the scale of the final designation, which includes the critical habitat designated for the Klamath River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments.

6.1.24 Current Condition of Bull Trout Critical Habitat Range-wide

The condition of bull trout critical habitat varies across its range from poor to good. Although still relatively widely distributed across its historic range, the bull trout occurs in low numbers in many areas, and populations are considered depressed or declining across much of its range (67 FR 71240).

There is widespread agreement in the scientific literature that many factors related to human activities have impacted bull trout and their habitat, and continue to do so. Among the many factors that contribute to degraded PCEs, particularly significant and causing a legacy of degraded habitat conditions are: 1) fragmentation and isolation of local populations due to the proliferation of dams and water diversions that have eliminated habitat, altered water flow and temperature regimes, and impeded migratory movements (Rieman and McIntyre 1993, Dunham and Rieman 1999); 2) degradation of spawning and rearing habitat and upper watershed areas, particularly alterations in sedimentation rates and water temperature, resulting from forest and rangeland practices and intensive development of roads (Fraley and Shepard 1989, MBTSG 1998); 3) the introduction and spread of nonnative fish species, particularly brook trout and lake trout as a result of fish stocking and degraded habitat conditions, which compete with bull trout for limited resources and, in the case of brook trout, hybridize with bull trout (Leary et al. 1993, Rieman et al. 2006); 4) in the Coastal-Puget Sound region where amphidromous bull trout occur, degradation of mainstem river FMO habitat, and the degradation and loss of marine nearshore foraging and migration habitat due to urban and residential development; and 5) degradation of FMO habitat resulting from reduced prey base, roads, agriculture, development, and dams.

6.2 Oregon Chub

The Oregon chub (*Oregonensis crameri)* exists entirely within the action area of the USACEs Willamette Project, thus information presented in the Status of the Species and Environmental Baseline sections below pertains to the species and its habitat range-wide. Detailed accounts of the taxonomy, ecology, and life history of the Oregon chub can be found in the final rule listing the species as endangered (USFWS 1993), the annual progress reports for Oregon chub investigations (Scheerer et al. 2001, 2002, 2003, 2004, 2005, 2006, 2007) and the Final Recovery Plan (USFWS 1998), and are hereby incorporated by reference.

6.2.1 Listing History

On October 18, 1993, the Service issued a final rule listing the Oregon chub as endangered (USFWS 1993). The Oregon chub occurs only in the Willamette Basin, Oregon. The FWS was litigated on our failure to designate critical habitat and we entered into a settlement agreement in 2008. The settlement agreement stipulated we publish a proposed rule designating critical habitat for the species by March 2009 and a final designation by March 2010.

In 2008, the FWS completed a five year review of the species, concluding that down listing criteria had been met and the species should be downlisted to threatened. A proposal to down list the species is expected by the FWS in 2009.

6.2.2 Life History

The Oregon chub is a small minnow (Family: *Cyprinidae*) endemic to the Willamette River drainage of western Oregon (Markle et al. 1991). Individual Oregon chub as old as eight years have been documented (Paul Scheerer, ODFW, pers. comm., 2000). The largest Oregon chub on record was collected from the Santiam River and measured 3.5 inches (89 mm) (Scheerer et al. 1995). Oregon chub spawn from April through September. Individuals are not known to spawn more than once a year. Spawning activity has only been observed at water temperatures exceeding 61 ^{0}F. Males over 1.4 inches have been observed exhibiting spawning behavior (Pearsons 1989). Egg masses have been found to contain 147 to 671 eggs (Pearsons 1989).

Oregon chub are obligatory sight feeders (Davis and Miller 1967). They feed throughout the day and stop feeding after dusk (Pearsons 1989). Chub feed mostly on water column fauna. The diet of Oregon chub adults collected in a May sample consisted primarily of minute crustaceans including copepods, cladocerans, and chironomid larvae (Markle et al. 1991). The diet of juvenile chub also consists of minute organisms such as rotifers, copepods, and cladocerans (Pearsons 1989).

6.2.3 Habitat

Oregon chub are found in slack water off-channel habitats such as beaver ponds, oxbows, side channels, backwater sloughs, low gradient tributaries, and flooded marshes. These habitats usually have little or no water flow, are dominated by silty and organic substrate, and contain considerable aquatic vegetation providing cover for hiding and spawning (Pearsons 1989, Markle et al. 1991, Scheerer and McDonald 2000). The average depth of habitat utilized by Oregon chub is less than six feet, and summer water temperatures typically exceed 61 ^{o}F. Adult chub seek dense vegetation for cover and frequently travel in the mid-water column in beaver channels or along the margins of aquatic plant beds. Larval chub congregate in shallow near-shore areas in the upper layers of the water column, whereas juveniles venture farther from shore into deeper areas of the water column (Pearsons 1989). In the winter months, Oregon chub can be found buried in the detritus or concealed in aquatic vegetation (Pearsons 1989). Fish of similar size school and feed together. In the early spring, Oregon chub are most active in the warmer, shallow areas of the ponds.

6.2.4 Distribution

This species was formerly distributed throughout the Willamette River Valley in off-channel habitats such as beaver ponds, oxbows, side channels, backwater sloughs, low gradient tributaries, and flooded marshes (Snyder 1908). Historical records show Oregon chub were found as far downstream as Oregon City and as far upstream as Oakridge. Records of Oregon chub collections exist for the Clackamas River, Molalla River, Mill Creek, South Santiam River, North Santiam River, Luckiamute River, Long Tom River, McKenzie River, Calapooia River, Muddy Creek, Mary's River, Coast Fork Willamette River, Middle Fork Willamette River, and the mainstem Willamette River (Markle et al. 1991, Scheerer and McDonald 2000).

The current pattern of distribution and abundance of Oregon chub populations reflects the fundamental alteration in the natural processes under which the species evolved. Sites with Oregon chub can be categorized as having high or low connectivity to the Willamette River and its tributaries; those sites with low connectivity tend to have large populations of chub and fewer species of non-native fish (Scheerer et al. 2002). Thus, Oregon chub now thrive particularly in habitats that are isolated and bear little resemblance to the species' dynamic natural environment. Efforts to restore floodplain function and connectivity may facilitate the introduction of non-native fishes into isolated habitats, which could have devastating effects to populations of Oregon chub (Scheerer et al. 2002).

Of the known Oregon chub populations, the sites with the highest diversity of native fish, amphibian, and reptile species have the largest populations of Oregon chub (Scheerer and McDonald 2000). Beavers (*Castor canadensis*) appear to be especially important in creating and maintaining habitats that support these diverse native species assemblages (Scheerer and Apke 1998).

Based on a 1987 survey (Markle et al. 1989) and compilation of all known historical records, at the time of the petition for listing in 1991, viable populations of the Oregon chub occurred in Dexter Reservoir, Shady Dell Pond, Buckhead Creek near Lookout Point Reservoir, Elijah Bristow State Park, William L. Finley National Wildlife Refuge, Greens Bridge, and East Fork Minnow Pond. These locations represented a small fraction (estimated as two percent based on stream miles) of the species' formerly extensive distribution within the Willamette River drainage.

6.2.5 Population Dynamics

Since the time of listing, several Oregon chub populations have been extirpated, a number of new populations have been discovered, and there have been a number of successful introductions (Figures 6.2 and 6.3). According to ODFW's 2007 Monitoring Report, Oregon chub now occur at approximately 35 locations in the North and South Santiam River, McKenzie River, Middle Fork Willamette River, Coast Fork, and several tributaries to the mainstem Willamette River downstream of the Coast Fork Willamette River/Middle Fork Willamette River confluence (Scheerer et al. 2007).

The Oregon Chub Recovery Plan (USFWS 1998) established recovery criteria for downlisting the species to "threatened" and for delisting the species. The criteria for downlisting the species are: 1) establish and manage 10 populations of at least 500 adult fish; 2) all ten populations must exhibit a stable or increasing trend for five years; and 3) at least three populations meeting criterion 1 and 2 must be located in each of the three recovery areas (Middle Fork Willamette River, Santiam River, and Mid-Willamette River tributaries).

In 2006, there were 18 populations totaling 500 or more individuals. Thirteen of these populations also met the second criteria. Of the 13 populations meeting criteria 1 and 2, eight were located in the Middle Fork Willamette drainage, three were located in the Mid-Willamette drainage, and two were located in the Santiam drainage. In 2007, downlisting criteria were met when a determination was made that the Santiam drainage now had three populations that met

criteria 1 and 2. Achieving downlisting criteria was formally announced in the FWS' 5-year review for Oregon chub, completed early in 2008 (USFWS 2008). A proposal from the FWS to downlist the species from endangered to threatened is expected in 2009.

Figure 6.2. Historical Records of Oregon Chub

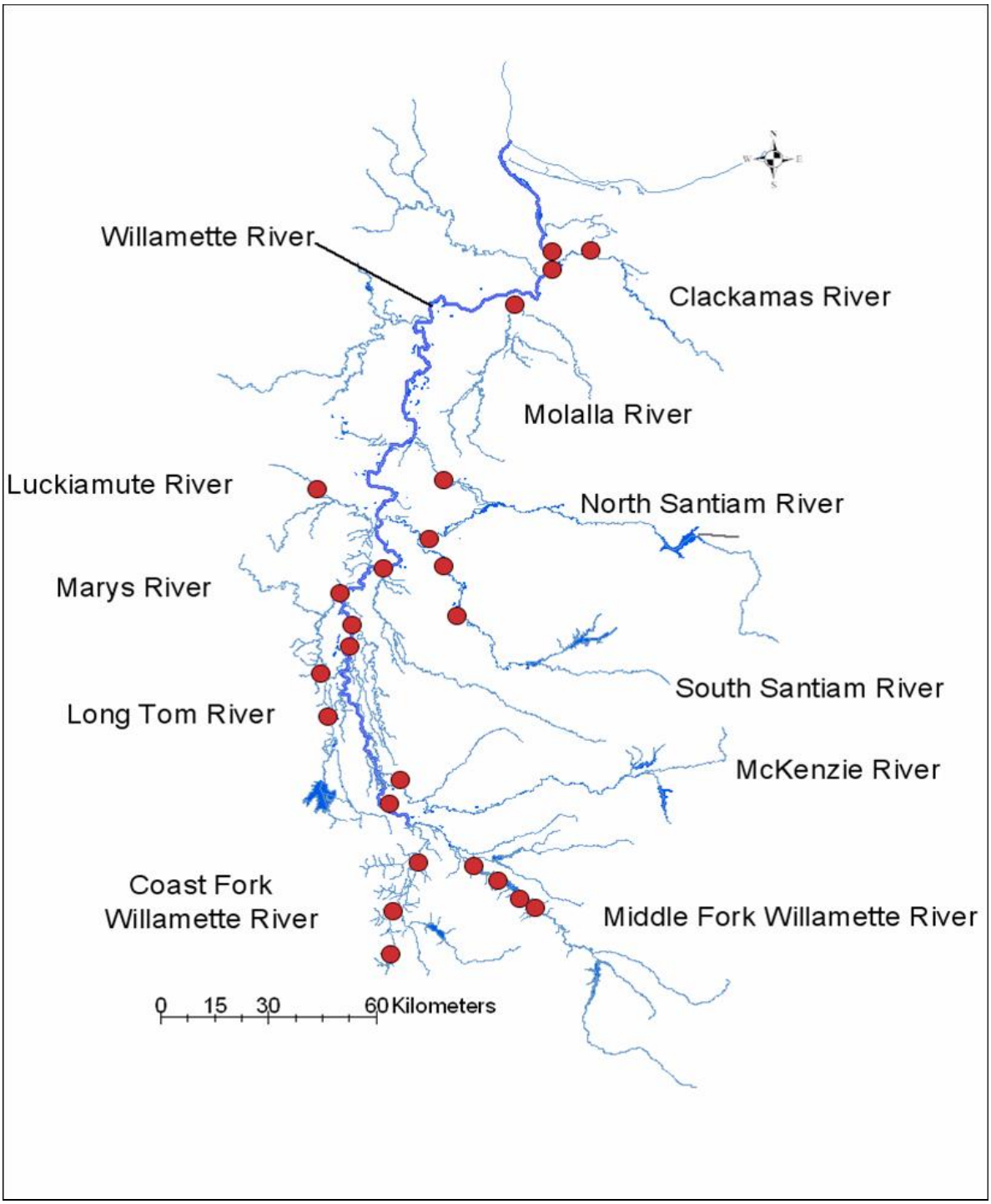
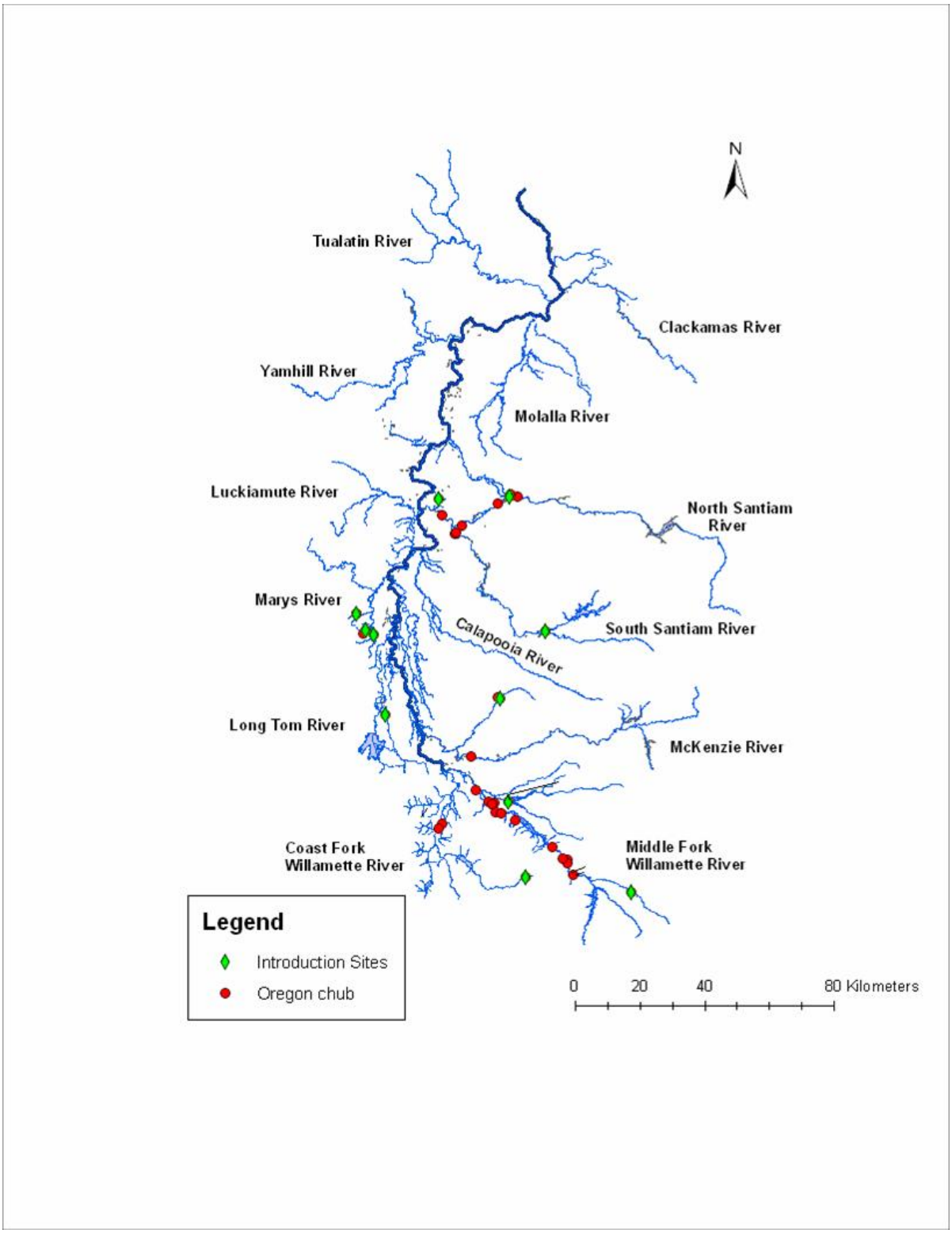


Figure 6.3. Current Oregon Chub Populations



7. ENVIRONMENTAL BASELINE

Regulations implementing the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area. The environmental baseline also includes the anticipated impacts of all proposed Federal projects in the action area that have already undergone section 7 consultations, and the impacts of state and private actions that are contemporaneous with the consultations in progress.

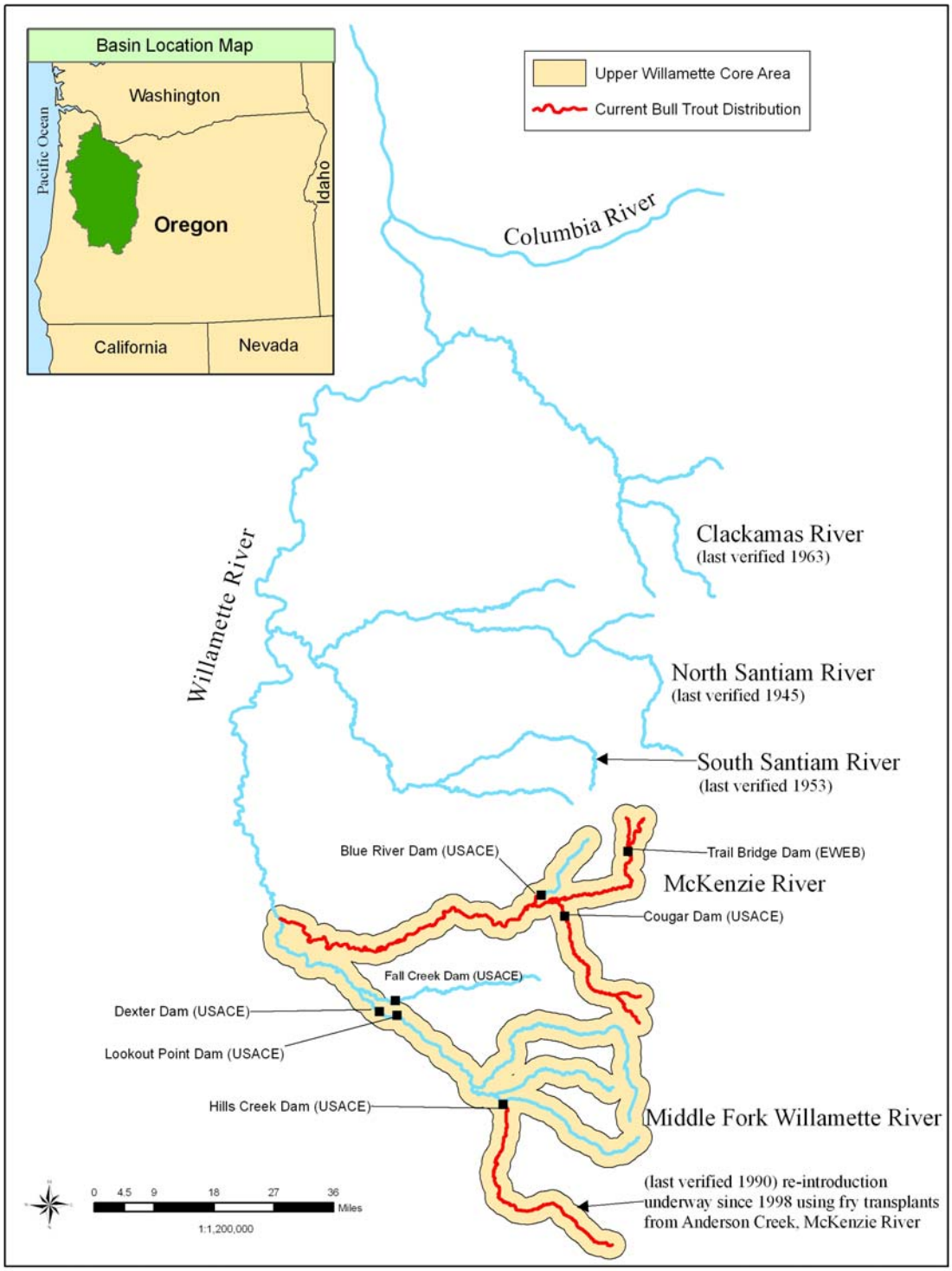
7.1 Bull Trout Status in the Willamette River Basin

Once widely distributed within the Willamette River Basin, bull trout are now confined to the McKenzie and Middle Fork Willamette rivers and their tributaries. Collectively, bull trout in these two subbasins comprise the Upper Willamette Core Area (Figure 7.0). Bull trout were likely extirpated from the Middle Fork Willamette River in the 1980s, but have been reintroduced through a fry transfer program that began in 1997 and has continued through 2007. The project has resulted in the transfer of approximately 10,000 bull trout fry from the McKenzie River to tributaries of the Middle Fork Willamette River above Hills Creek Reservoir (ODFW 2007b). Spawning and reproductive success was first documented in 2005, in the Middle Fork Willamette River, and has occurred annually, albeit in small numbers, through 2007.

Bull trout were last observed in the Clackamas and the North and South Santiam rivers in 1963, 1945 and 1953 respectively. Little information exists about bull trout historical abundance and distribution in the Santiam River Subbasin, however bull trout were documented regularly in the Clackamas River through State creel surveys from the 1940s through the 1960s and anecdotal evidence suggests they were potentially present through the early 1970s. The Clackamas River Bull Trout Working Group began assessing the feasibility of reintroducing bull trout to the Clackamas River in 2005, and completed a final feasibility assessment in November, 2007. The document concluded that a reintroduction is biologically feasible and a subsequent proposal to transfer donor stock from the Metolius River beginning in 2009, is under development.

The limited distribution of bull trout in the Willamette Basin is the result of many factors including: dams, which constitute barriers to fish migration, significantly alter natural flow patterns, water temperatures, forage base, insect diversity and productivity, and disrupt or preclude natural sediment and large wood transport; bank stabilization, stream cleaning, and filling for agriculture, urban development, highways and other development; extensive road construction and timber harvest in the forested portions of the Basin; water diversion; fragmentation or elimination of riparian forests that provide large wood for channel and habitat complexity; direct removal of large wood from stream channels; sand and gravel mining; water pollution; increased sedimentation; extensive loss of off-channel habitat; impassable culverts; the introduction of non-native brook trout; and angling pressure. For a more detailed discussion of these factors, see Chapter 5 of the *Draft Bull Trout Recovery Plan* (USFWS 2005).

Figure 7.0. Upper Willamette Core Area and Current Bull Trout Distribution



Dams have fragmented the bull trout population within the McKenzie and Middle Fork Willamette subbasins into four local populations: (1) South Fork McKenzie River local population above the USACE's Cougar Dam; (2) Trail Bridge Reservoir local population in the upper McKenzie River above Eugene Water and Electric Board's (EWEB) Trail Bridge Dam; (3) fluvial Mainstem McKenzie River local population; and (4) Middle Fork Willamette River local population above USACE's Hill's Creek Dam. Current habitat and population baseline conditions for the bull trout in the Willamette Basin are degraded; there is an elevated risk of extirpation from stochastic events due to limited spawning and rearing areas; and, there is a low probability of recolonization through dispersal due to the distance to other bull trout populations external to the Willamette River Basin (USFWS 2005).

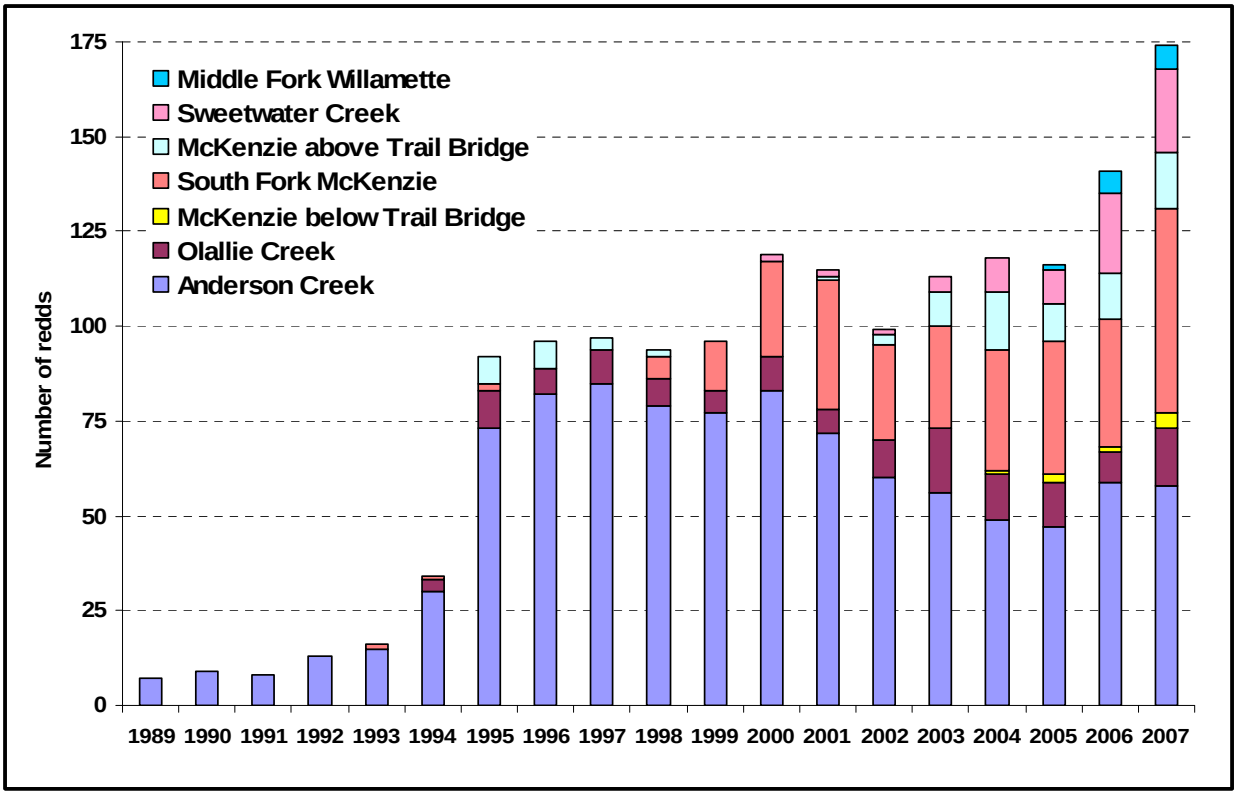
Current population estimates for bull trout in the McKenzie and Middle Fork Willamette rivers are approximations based on redd counts, standard pool counts, juvenile trapping, radio-tracking, video, and electronic fish counters. The total population of spawning adult bull trout in the McKenzie River subbasin has been estimated at approximately 250 to 300 adults based on survey data from 2005 to 2007. Based on redd counts, the mainstem McKenzie River local population consists of 100 to 150 spawning adults, whereas the South Fork McKenzie River and Trail Bridge Reservoir local populations support approximately 75 to 100 spawning adults each (Table 7.0). In the Middle Fork Willamette River, the adult population size is currently 20 to 30 adults, although the number of fish documented spawning was 12 in 2005 and 2006 (ODFW 2007b). The isolation of these local populations, due in great part to barriers imposed by dams, exacerbates the potential for genetic loss due to inbreeding, and for extirpation due to stochastic events.

Chapter 5 of the *Draft Bull Trout Recovery Plan* (USFWS 2005) noted that bull trout local populations in the Willamette River Management Unit are at risk of extinction in part because of their small population size and physical isolation by dams. Dams act as barriers preventing gene flow from the mainstem McKenzie River local population to the local populations above Cougar and Trail Bridge dams and inhibit gene flow from the local populations above the dams to the mainstem McKenzie River local population. Lack of passage at dams in the Middle Fork Willamette River (Dexter, Lookout Point and Hill's Creek dams) prevent gene flow between populations in the McKenzie and the small local population of bull trout above Hill's Creek Dam. Due to continuing lack of passage, bull trout that survive passing downstream at the dams through the regulating outlets or turbines are lost to the local populations above the dams.

Current population theory (Rieman and Allendorf 2001) suggests that bull trout abundance in the Upper Willamette Core Area is significantly below the threshold thought to be necessary to maintain genetic variation important for long-term evolutionary potential and persistence (1000 spawning adults). Only one of the four local populations in the Upper Willamette Core Area (mainstem McKenzie local population) exceeds the minimum number of spawning adults thought to be necessary to minimize inbreeding effects and maintain an ability to adapt to changing environmental conditions (100 spawning adults). As a result, maximizing adult bull trout abundance in Upper Willamette Core Area local populations is essential for their long-term genetic health. Current lack of passage restricts access to suitable habitat and may limit attainment of viable numbers in each bull trout local population. Restoring passage would be

expected to increase overall fitness of bull trout in the core area by allowing genetic interchange among isolated local populations.

Table 7.0. Upper Willamette Core Area Redd Counts 1989 to 2007.



As noted above in the Status of the Species, the conservation needs of the bull trout in the Willamette Management Unit are: (1) restoring connectivity between isolated populations; (2) restoring viable bull trout populations in currently and historically occupied areas; (3) restoring anadromous fish in areas currently occupied by the bull trout in order to restore a portion of their historical prey base; (4) restoring, to the degree possible, normal flow and stream temperature patterns by constructing water temperature control towers and adopting alternative flow management strategies; and (5) reducing bull trout injury and mortality from entrainment into turbine intakes, regulating outlets, and spillways (USFWS 2005).

7.1.1 Mainstem McKenzie River Local Population

The mainstem McKenzie River local population inhabits the McKenzie River and tributaries below Cougar, Blue River and Trail Bridge dams. Distribution extends downstream to the Willamette River although generally fewer than 20 adult bull trout annually pass below Leaburg Dam in the lower mainstem McKenzie River.

Although redd counts in Anderson and Olallie creeks, and monitoring of out-migrating fry and juveniles (Anderson Creek), occurs annually, limited information exists on bull trout use of the mainstem McKenzie River. BPA funded investigations in the 1990s indicated that adult bull

trout utilize the entire mainstem McKenzie River down to its confluence with the Willamette River, though generally fewer than 20 adults migrate below EWEB's Leaburg Dam in the lower McKenzie River. The area immediately above Leaburg Dam was identified as an area several radiotagged bull trout overwintered during monitoring efforts in the late 1990s.

Effects to mainstem McKenzie River bull trout from the operation of USACE's Cougar and Blue River dams, and EWEB's Carmen-Smith and Leaburg-Walterville hydroelectric projects, is generally unknown. A number of studies on the general effects of dams in the McKenzie River Subbasin have documented a reduction in channel complexity, loss of pool habitat, decrease in large woody debris, and a coarsening of substrate, all caused by reductions in high and low flows, and the blockage of sediment and large wood at dams. These effects to bull trout FMO habitat, combined with effects to water temperatures not completely ameliorated by the operation of Cougar Dam WTC, are likely causing a reduction in the carrying capacity of the mainstem McKenzie River local population. Investigations of these potential limiting factors for the mainstem McKenzie River local population are identified as a priority recovery need in Chapter 5 of the *Draft Bull Trout Recovery Plan* (tasks 1.1.3, 1.1.4 and 5.2.2 in USFWS 2005).

The majority of spawning for the McKenzie River local population occurs in Anderson Creek in approximately 3.8 kilometers (2.4 miles) of stream and to a lesser extent in Olallie Creek. Limited spawning has been documented in recent years in the artificial spawning channel immediately below Trail Bridge Dam. Access to approximately 3.2 kilometers (2.0 miles) of spawning and rearing habitat in Olallie Creek upstream of Highway 126 was restored in 1995, when an additional culvert was installed to provide fish passage. Based on redd counts from 1995 through 1999, spawning in Anderson and Olallie creeks peaks during the third week of September (Taylor and Reasoner 2000). Most fry and juveniles rear in these two spawning streams or in an eight mile reach of the McKenzie River below the confluence of the two spawning streams. Adults over-winter and forage in the mid to lower sections of the McKenzie River, some migrating as far as the McKenzie River's confluence with the Willamette River near the city of Springfield.

In recent years, redd counts that are strongly correlated to adult population size, suggest the mainstem McKenzie River bull trout population is comprised of approximately 150 spawning adults. Redd counts peaked in 1997 at 94 and averaged 88 redds from 1995 through 2000. Counts began to decline in 2001, reaching a low of 61 in 2005. The annual redd count from 2001 through 2006 have averaged 68 redds (Table 7.1).

Concern over evidence of declining redd counts in Anderson Creek in 2005 prompted the FWS in 2005, to request ODFW to temporarily suspend the ongoing transfer of fry annually from Anderson Creek to the Middle Fork Willamette River above Hill's Creek Reservoir in an effort to rehabilitate bull trout in that subbasin. At question was the contribution of fry captured migrating out of Anderson Creek in the spring to the McKenzie River to future reproduction and overall abundance of the mainstem McKenzie River local population. Habitat and juvenile bull trout surveys by ODFW (Taylor 2001) suggested that little fry habitat exists in the McKenzie River below Anderson Creek. Consequently the fry transfer program had been operating under the assumption that the removal (captured by a screw trap) of fry outmigrating from Anderson Creek would have little if any impact on the number of spawning adults in Anderson Creek

because of the high mortality rate of fry in the mainstem McKenzie River (ODFW 2007b). While we agreed with ODFW that fry survival in the mainstem McKenzie River was likely low, we felt a cautious approach to addressing donor risk was appropriate given the decline in adult spawning bull trout in Anderson Creek.

Following a year of no fry transfers to the Middle Fork Willamette River, the FWS agreed to a one-year interim plan that involved the captive rearing of 300 wild bull trout fry from Anderson Creek. The use of 300 fry was a significant reduction from the numbers typically removed from Anderson Creek annually for the project, and by captively rearing the fish in a hatchery setting it was hoped that survival would be significantly higher than in a natural environment. Importantly, it allowed for the continuation of an important bull trout recovery project, while reducing risk to the donor population in Anderson Creek.

The bull trout fry were reared for approximately six months in ODFW's Leaburg Hatchery on the McKenzie River. Ultimately, 238 of the original 300 fry survived the six month captive rearing period and in late October, 2007, the fish were tagged with passive integrated transponder (PIT) tags and released in Swift and Bear creeks in the Middle Fork Willamette River above Hill's Creek Reservoir. Viewed in the short-term, the captive rearing at Leaburg Hatchery was successful in that it demonstrated wild bull trout fry could be raised successfully in a hatchery setting, which is an important management tool to have as an option when recovering critically small populations of threatened species, such as bull trout in the Willamette River Basin. The long-term success of the captive-reared fry will be determined by future RM&E. Continuation of the fry transfer program, while dependant in part on the status of the donor stock (Anderson Creek), will be considered necessary until the number of spawning adults in the Middle Fork Willamette River attains a population size that is considered viable and sustainable. Future captive rearing of wild bull trout fry as part of the Middle Fork Willamette Bull Trout Rehabilitation Project will be dependent in part on the status and availability of donor stock from the McKenzie River and on direction provided to the program by the FWS, ODFW, USFS and other members of the Upper Willamette Bull Trout Working Group.

7.1.2 South Fork McKenzie Local Population

The South Fork McKenzie River local population exists primarily above Cougar Dam but documented entrainment through the dam has resulted in some individuals from this population occupying the South Fork below Cougar Dam and perhaps the mainstem McKenzie River. Upstream of Cougar Dam, bull trout distribution extends to approximately the Three Sisters Wilderness boundary and also the lower portions of French Pete Creek and Roaring River; a total of 29.3 kilometers (18.2 miles) of stream habitat. Spawning and juvenile rearing occurs in approximately 5 kilometers (3 miles) of Roaring River, a large, spring-fed tributary of the South Fork McKenzie River (Ziller and Taylor 2000). Additional juvenile rearing has been documented in the South Fork McKenzie River downstream from the Roaring River confluence (ODFW 2003). Subadults and adults rear and overwinter in Cougar Reservoir, generally moving upstream out of the reservoir in the spring and returning in the fall.

Table 7.1. Bull trout redds counted in the McKenzie River Basin, 1989-2007.

	Mainstem McKenzie Population											**Trail Bridge Population**				**South Fork McKenzie Population**
	Anderson Creek					Olallie Creek										
year	Below Hwy 126	Above Hwy 126	USFS index reach	Total		Below Hwy 126	Above Hwy 126	Total	McKenzie below Trail Bridge Dam	Total		McKenzie above Trail Bridge Res.	Sweetwater Creek	Total		Roaring River
1989	--	--	7	--		--	--	--	--	--		--	--	--		--
1990	--	--	9	--		--	--	--	--	--		--	--	--		--
1991	0	8	8	--		--	--	--	--	--		--	--	--		--
1992	4	9	13	--		--	--	--	--	--		--	--	--		--
1993	4	11	15	--		--	--	--	--	--		--	--	--		1
1994	7	23	22	30		3	--	3	--	**33**		0	0	**0**		1
1995	3	70	30	73		1	9	10	--	**83**		7	0	**7**		2
1996	1	81	26	82		0	7	7	--	**89**		7	0	**7**		0
1997	7	78	18	85		0	9	9	--	**94**		3	0	**3**		0
1998	4	75	29	79		0	7	7	--	**86**		2	0	**2**		6
1999	13	64	47	77		0	6	6	--	**83**		0	0	**0**		**13**
2000	15	68	44	83		0	9	9	--	**92**		0	2	**2**		**25**
2001	6	66	23	72		2	4	6	--	**78**		1	2	**3**		**34**
2002	9	51	31	60		5	5	10	--	**70**		3	1	**4**		**25**
2003	6	50	23	56		7	10	17	0	**73**		9	4	**13**		**27**
2004	6	43	24	49		7	5	12	1	**62**		16	9	**25**		**32**
2005	7	40	24	47		7	5	12	2	**61**		10	9	**19**		**35**
2006	5	54	30	59		6	2	8	1	**68**		12	21	**33**		**34**
2007				58				15	4	**73**		15	22	**37**		**54**

Count does not cover the entire area of bull trout spawning in this stream.

Intensive monitoring of the South Fork McKenzie River population of bull trout by the ODFW began in 2001 and has continued through 2006, in association with the USACE's Cougar Dam Water Temperature Control Project (Cougar WTC Project). Monitoring has been conducted by use of radio-telemetry and PIT tags, use of video and electronic fish counters, redd counts, snorkeling, and sampling by use of minnow traps and downstream migrant fish traps. Data collected to date, in conjunction with information from previous studies of bull trout in the South Fork McKenzie River, suggests Cougar Reservoir is utilized by adult and sub-adult bull trout for

foraging and overwintering from late fall through early spring. Adult and sub-adult bull trout move into the South Fork McKenzie River upstream from Cougar Reservoir in April and May, remaining in the South Fork until migrating into Roaring River to spawn in late-August through early-October (ODFW 2003). Post-spawning fish have been documented returning to Cougar Reservoir immediately following spawning.

In 2001 and 2002, a downstream migrant trap was operated in Roaring River about 550 feet above its confluence with the South Fork McKenzie River. Peak out-migration of bull trout fry occurred in March and April, and peak out-migration of age 1 and older juvenile bull trout occurred from May through July (ODFW 2003).

Redd counts in Roaring River since 2000 have ranged between 25 (2002) and 54 (2007). The electronic fish counter utilized in Roaring River beginning in 2003, combined with PIT tag monitoring and trapping of downstream migrating post-spawning bull trout, has allowed for a complete census of spawning bull trout in the South Fork McKenzie River population. The number of adult bull trout that entered Roaring River in 2003 was approximately 37. The following year, 38 spawners were detected entering Roaring River. Trapping of downstream migrating (post spawning) adults provided evidence that 23 were female and 15 were male. The 32 redds observed in 2004, compared with the known number of spawning individuals, suggests the ratio of redds to female bull trout is 1.4:1. There could be several explanations for more redds counted than females spawning; female bull trout deposit eggs in more than one redd, females dig without depositing eggs, and features are sometimes counted as redds that were not constructed by bull trout (ODFW 2003, 2004).

In 2005, 50 bull trout spawned in Roaring River, 25 females and 25 males. The number of redds observed was 35. In 2006, the number of redds counted was similar to 2005 (34), but the number of spawners decreased to 22 females and 19 males. Demographically males and females spawning in Roaring River are very different. Of the 25 females that spawned in 2005, 18 returned to spawn in 2006 along with 4 recruits. In contrast, only 8 of the 25 males that spawned in 2005 returned to spawn in 2006 along with 11 first time spawners. These data are similar to observations from previous years. Female first time spawners averaged 629 mm Fork Length (FL) while first time spawning males averaged 429 mm. Researchers noted that 2006 was the first year mature males less than 300 mm were observed spawning (ODFW 2006b).

a) Cougar Water Temperature Control Project

Cougar Dam is a 452 foot tall rock fill structure that creates a 6.5 mile long reservoir with a surface area of 1,280 acres at full pool. In 1999, the USACE initiated construction to modify the intake tower at Cougar dam because the system used for drawing water from the reservoir was significantly altering the natural water temperature regime downstream, making the South Fork and mainstem McKenzie River less productive for bull trout, Chinook salmon and other native fish.

As part of the Cougar WTC Project, the USACE funded a monitoring program implemented over the term of the construction period (1999-2005) and for a year following completion of the project. Important components of the monitoring program included the development of baseline

information on bull trout in Cougar Reservoir and in the South Fork upstream of the reservoir, monitoring of their status during project construction, and development and implementation of a plan to protect the South Fork McKenzie bull trout population from potential construction related impacts.

Although bull trout had been documented moving through Cougar Dam prior to the Cougar WTC Project, the three-year seasonal drawdown associated with project construction was anticipated to entrain bull trout at a greater rate than before due to the concentration of bull trout in the reduced reservoir pool and the proximity to the diversion tunnel which replaced the turbine and regulating outlets as the primary method of moving water past the project. Although survival through the diversion tunnel was predicted to be poor, over the course of the three year drawdown period, 27 adult and sub-adult bull trout - many previously tagged above the dam - were captured by hook and line in the dam's tailrace and moved by vehicle back above the dam. At least two of the 27 were entrained through the diversion tunnel and moved back above the dam twice. The importance of the temporary program to move entrained bull trout back above Cougar Dam is underscored further by the fact that one of the two individuals noted above, a female entrained through Cougar Dam in the spring and again in the fall of 2003, subsequently spawned four consecutive years (2003 to 2006) in Roaring River (Mark Wade, biologist, ODFW, pers. comm., 2007). This represents reproductive effort and/or success that would otherwise have been lost had the fish not been captured and transported back above the dam.

In 2004, the 38 bull trout that spawned in Roaring River included nine fish (eight females and one male) that had been entrained through Cougar Dam and subsequently captured below the dam in the spring of 2003 and 2004, and released back in Cougar Reservoir (ODFW 2004). The eight adult females that had been entrained represented 35 percent of the total number of female spawners in Roaring River in 2004. In total, 27 uniquely tagged bull trout were entrained, 22 of which were recovered and moved back above Cougar Dam between 2002 and 2005. The 22 individuals moved back above Cougar dam have accounted for 40 individual spawning events through fall 2007 (Vince Tranquilli, ODFW, pers. comm., 2007).

Completion of the water temperature control tower occurred in the spring of 2005, at which time the pool level was raised to normal operating levels, the diversion tunnel was closed, and water temperature control was brought online. To protect the turbines from debris, grates (screening) were installed over the entrance to the penstock. The spacing in the grates is small enough it may prevent entrainment of adult bull trout but small sub-adult fish may still be vulnerable to entrainment. In contrast, the regulating outlet does not have grating or screens and bull trout of all sizes are vulnerable to entrainment. Monitoring at the base of Cougar dam in 2006 and 2007 has detected only three entrained bull trout, suggesting that the rate of entrainment has decreased from that observed during construction of the Cougar WTC project and that entrainment rates through the turbine and regulating outlet may be low.

Despite the success of the temporary program to move entrained bull trout over Cougar Dam, current abundance of the local population above Cougar Dam has likely been adversely affected by entrainment. Not all bull trout above the dam are PIT tagged, thus some individuals may have been entrained and not detected by the remote antennas. Others, tagged or not, may have been injured or killed and thus not readily accounted for. For example, five of the 27 bull trout

entrained through Cougar Dam during the WTC project were not recovered, or later detected and their status is uncertain.

Adult and sub-adult bull trout also inhabit the South Fork McKenzie River below Cougar Dam, but spawning and juvenile rearing (except by sub-adults) does not occur in this area. The fish present in this area most likely originated from the South Fork McKenzie local population located above Cougar Dam and passed downstream to below the dam. However, they may also originate from the mainstem McKenzie River local population.

Habitat complexity is an important variable in sustaining bull trout populations. The main factors that are affecting bull trout rearing in the South Fork McKenzie above Cougar Dam (in terms of habitat complexity) are the loss of deep pool habitat and large woody debris, both of which provide cover and stream stability, and help maintain optimal stream temperatures (WNF BRRD 1994). Habitat complexity may also be reduced in the Roaring River due to the location of Forest Road 19, forest salvage activities in the lower reach, and riparian degradation due to designated and dispersed camping areas next to the Roaring River. The reduction in habitat complexity within the South Fork McKenzie River has lowered the capability of the habitat to produce salmon, trout, and other aquatic species. The reduction in side channel habitat throughout the South Fork McKenzie River equates to a loss of bull trout rearing habitat. South Fork McKenzie River pool habitat has been reduced from 1937-1938 levels by approximately 60 to 90 percent (WNF BRRD 1994).

Bull trout habitat below Cougar Dam, and to a lesser extent in the mainstem McKenzie River, has been impacted by the disruption of natural stream processes common below most large dams. Cougar Dam traps sediment and large wood within the impoundment thereby robbing downstream reaches of materials that are important for building and maintaining fish habitat. In addition, the altered hydrologic regime below Cougar Dam reduces natural disturbance which is also important for building and maintaining fish habitat. Stream temperatures below Cougar Dam were modified starting in 2005 to mimic historic conditions via the operation of the Cougar WTC tower. Although data are limited, improved temperature conditions below Cougar Dam as a result of the project have likely increased stream productivity and Chinook salmon production, resulting in an increase in available forage base for bull trout.

7.1.3 Trail Bridge Local Population

The Trail Bridge local population exists primarily above EWEB's Trail Bridge Dam but documented entrainment through the dam has resulted in some individuals from this population occupying the mainstem McKenzie River below Trail Bridge Dam. In recent years ODFW and the USFS, in cooperation with EWEB, have implemented a program to capturing adult bull trout in the tailrace of Trail Bridge Dam for transfer back above the dam. In 2007, 13 adult bull trout were hook and line captured and moved back above Trail Bridge Dam.

This local population occurs in Trail Bridge Reservoir, Sweetwater Creek (a direct tributary to Trail Bridge Reservoir), McKenzie River above Trail Bridge Reservoir to Tamolitch Falls, and Smith River upstream to Smith Dam. There is no information to suggest bull trout historically occupied the McKenzie River above Tamolich Falls, a natural barrier to upstream fish migration.

However, bull trout historically utilized habitat in Smith River above Smith Dam, and individuals were observed in Smith Reservoir following completion of project construction in 1963.

Spawning for the Trail Bridge Reservoir local population occurs in two locations: the McKenzie River upstream of Trail Bridge Reservoir provides approximately 1.1 kilometers (0.68 miles) of available spawning and rearing habitat; and Sweetwater Creek, following a 1992 culvert project that restored passage, provides 2.4 kilometers (1.49 miles) of spawning and rearing habitat (Ziller and Taylor 2000). A program to transfer fry from Anderson Creek to Sweetwater Creek to reestablish spawning in this tributary was implemented from 1993 to 1999, with numbers of fry transferred ranging from 308 to 1,889 annually. The first adult bull trout to be documented ascending Sweetwater Creek occurred in 1999, when five adults were video-recorded moving through the culvert. In 2000 and 2001, two redds were counted, and in 2002, one redd was observed. In December 2001, four bull trout juveniles measuring 60 to 70 millimeters (2.4 to 2.8 inches) in length were observed during snorkel surveys in Sweetwater Creek (USFS 2001).

Redd counts in Sweetwater Creek have been increasing since 2003 when four redds were counted. Nine redds were counted in 2004 and 2005 and 21 redds were observed in 2006.

Counting bull trout redds in the McKenzie River upstream of Trail Bridge Reservoir is complicated by the presence of redds created by spawning chinook salmon outplanted above Trail Bridge Dam. However, more intensive efforts to observe fish on redds in recent years have confirmed that a significant number of bull trout from the Trail Bridge population spawns in this reach. Redd counts increased from 2001 through 2004, peaking at 16. In 2005 and 2006, redd counts were 10 and 12 respectively.

EWEB is licensed by FERC to operate the Carmen Smith Hydroelectric Project (which includes Trail Bridge, Smith and Carmen dams) and the current license will expire in 2008. In its Final License Application (Eugene Water and Electric Board 2006) to FERC for a new license to operate the Carmen Smith Hydroelectric Project (FERC # 2242), EWEB proposed to install both up and downstream fish passage facilities at Trail Bridge Dam. Thus, construction of fish passage facilities are anticipated after the new FERC license is issued.

7.1.4 Middle Fork Willamette Local Population

Little information exists on historical distribution and abundance of bull trout in the Middle Fork Willamette subbasin. Buchanan *et al*. (1997) reported that historic distribution included the mainstem Middle Fork Willamette subbasin from its confluence with the Willamette River upstream to its headwaters, including Salmon Creek and Salt Creek below Hills Creek Reservoir; and the Middle Fork Willamette River above Hills Creek Reservoir, including Swift Creek and Staley Creek. It is likely that historic over-wintering and foraging would have extended bull trout distribution into many other tributaries in the subbasin including the North Fork of the Middle Fork Willamette River.

Extensive surveys for bull trout during the 1990s led Buchanan *et al*. (1997) to conclude that bull trout in the Middle Fork Willamette subbasin were “probably extinct.” However, several

confirmed and unconfirmed sightings of bull trout were reported in the early 1990s. A verified photograph was taken of a bull trout caught by an angler at the head of Hills Creek Reservoir in 1990 (Buchanan *et al*. 1997), and Ambrosier *et al*. (1995) reported several 1990s sightings of bull trout in the Middle Fork Willamette River subbasin near Big Pine Opening and in the lower reaches of Swift Creek.

Middle Fork Willamette River Bull Trout Rehabilitation Program. A plan to rehabilitate bull trout to the upper Middle Fork Willamette River was completed and approved by the Willamette Basin Bull Trout Working Group in 1997 (ODFW 1997b). Beginning in 1997, and continuing through 2003, bull trout fry from Anderson Creek in the McKenzie River subbasin were reintroduced by the USFS and ODFW to four cold water springs and four creeks above Hills Creek Reservoir as part of the rehabilitation plan (ODFW and USFS 1998). Information on survival and dispersal of the nearly 9,696 fry is limited, although distribution in 2001 was documented to be at least 5.5 miles in the Middle Fork Willamette from approximately Chuckle Springs downstream to Sacandaga Campground (ODFW 2001). ODFW and USFS personnel observed 28 bull trout and sampled approximately 25 percent of available habitat in the survey reach.

Assuming an observation probability of 50 percent for night snorkeling, an estimate was made of approximately 230 bull trout present in the survey reach. Of these 230, an estimated 40 were greater than 10 inches (25 cm) in length. For the second consecutive year, juvenile bull trout were observed eating young-of-the-year chinook salmon during snorkel surveys, underscoring the importance of this historic and recently reintroduced prey base for bull trout (ODFW 2001).

A single sub-adult bull trout was captured by an angler in the Middle Fork Willamette River below Hill's Creek Dam in June 2000. The origin of this fish is unknown, although it was likely an individual stocked above Hill's Creek Reservoir during the first few years of the rehabilitation program. If this individual originated from the rehabilitation program that began in 1997, migration downstream through Hill's Creek Reservoir and entrainment through Hills Creek Dam would have been necessary. Additional evidence that introduced bull trout fry were surviving to sub-adult age and moving downstream to rearing habitat in Hill's Creek Reservoir was documented in 2003 when four sub-adult bull trout were reportedly caught and released by anglers in Hill's Creek Reservoir, one of which was photographed and measured by USFS personnel (D. Bickford, USFS, pers. comm.).

Beginning in 2003, ODFW began tagging and tracking individual bull trout using 23 mm long, half-duplex, PIT tags. Adult and sub-adult bull trout were captured in a screw trap as they migrated downstream after spawning or by angling. The PIT tags were inserted into the dorsal sinus of bull trout longer than 30 cm. Through 2006, ODFW PIT tagged 21 bull trout longer than 40 cm FL (Table 7.2) (ODFW 2007b).

Table 7.2. Number of Bull Trout PIT Tagged by Size Group, From 2003 Through 2006 in the Middle Fork Willamette Basin upstream of Hills Creek Dam

Life Stage	2003	2004	2005	2006	Total
Adult (> 40 cm FL)	1	3	11	6	21
Subadult (20 – 40 cm FL)			3	6	9

The current abundance of adult and sub-adult bull trout in the Middle Fork Willamette River is believed to be approximately 20 to 30 fish. Spawning and successful reproduction was first documented by ODFW and the USFS in 2005 and again in 2006. PIT tag monitoring and trapping of adult bull trout documented at least 12 adults spawning in 2005 and 2006 (ODFW 2007b).

Although entrainment of bull trout through Hill's Creek Dam has not been documented through recent monitoring, a reasonable assumption based on the evidence of entrainment of bull trout through Cougar Dam, and a similar program of dam operation at Hill's Creek, suggests entrainment is likely occurring at a low level. Despite efforts to monitor entrainment, the likelihood of detecting entrained bull trout below Hill's Creek Dam is low due to the small population size above the dam, the limited number of bull trout that are PIT tagged, limited surveys below the dam, and limited visibility due to turbidity that prevents observations by snorkeling.

Bull trout entrained through Hill's Creek dam are highly susceptible to injury and death. The limited entrainment data at Hill's Creek Dam suggests turbine mortality (of Chinook smolts) is significantly higher than the seven percent mortality rate observed at Cougar Dam and regulating outlet mortality rates are similar to that observed by Taylor (2000) at Cougar Dam (approximately 30 percent). Although the Hill's Creek local population has been less intensively monitored than the South Fork McKenzie local population above Cougar dam, especially in the reservoir environment, we expect conditions are similar and that bull trout that spend Fall through Spring in Hill's Creek Reservoir are generally sub-adult and adults. Based on information from Taylor (2000) correlating fish length with mortality rate, sub-adult and adult bull trout would be expected to have a significantly higher entrainment mortality rates than observed for Chinook salmon smolts due to their greater size.

7.2 Conservation Role of Bull Trout in the Action Area

The basic unit for ensuring long-term sustainability and conservation of the coterminous U.S. population of bull trout is the aggregation of local populations into core areas (Whitesel et al. 2004). In turn, the preservation of viable core areas requires protecting bull trout genetic variation (i.e., genetic diversity) and phenotypic adaptation within each core area, and spreading/reducing the risk of extinction through the maintenance of multiple populations across each of the five interim recovery units (USFWS 2002; 2004a, b). Scientific evidence supports

this approach as the best strategy to ensure the bull trouts survival and recovery (USFWS 2003, Rieman and McIntyre 1995, Rieman and McIntyre 1993).

The action area for this biological opinion fully encompasses the Willamette Basin's single core area – *The Upper Willamette Core Area* and its four local populations of bull trout. This core area represents one of 97 core areas identified within the Columbia River Interim Recovery Unit. The FWS completed a core area conservation assessment to inform the on-going 5-year status review and determined that, of the 97 core areas in the Columbia River Interim Recovery Unit, 38 are at high risk of extirpation, 35 are at risk, 20 are at potential risk, two are at low risk, and two are at unknown risk (USFWS 2005). The *Upper Willamette Core Area* was ranked high risk of extirpation in the conservation assessment based on population size, distribution, trend, and threats. Other factors in the assessment included the presence/absence of certain life history forms, and the degree of connectivity between and among core areas.

Recent genetic and biogeographical analyses (Spruell et al. 2003, Costello et al. 2003, Haas and McPhail 2001, Taylor et al. 2001, and Williams et al. 1997) support the delineation of three major evolutionary lineages within the coterminous range of bull trout. The Upper Willamette Core Area is a component of the Coastal evolutionary group, which includes bull trout populations in western Washington and in tributaries of the lower Columbia River up to and including the Deschutes River. The two remaining evolutionary lineages are the Snake River, which includes the John Day River and other tributaries in northeast Oregon, southeast Washington, and central Idaho; and, the Upper Columbia River, which includes central and northeastern Washington, northern Idaho, and western Montana.

The integration of biological attributes and recent genetic studies (Spruell et al. 2003 and Leary et al. 1993) point towards organizing conservation units along the Coastal-Puget Sound, Upper Columbia River, and Snake River lineages. Given the present biological information, we believe these conservation units are the best estimate for delineation of areas that are necessary to ensure evolutionary persistence of bull trout. To this extent we feel the recent genetic data and analyses and biogeographical analyses (Spruell et al. 2003, Costello et al. 2003, Haas and McPhail 2001, Taylor et al. 2001, and Williams et al. 1997) are important information to guide the organization of local populations into discrete units to conserve and recover bull trout.

The concept of establishing core areas "that contain bull trout populations with the demographic characteristics needed to ensure their persistence and with the habitat needed to sustain those characteristics" (Rieman and McIntyre 1993) for the purposes of bull trout conservation is reflected in the scientific literature (Rieman and McIntyre 1993, MBTSG 1998, Morita and Yamamoto 2002, Frissel et al. 1993). Further, a significant amount of information has been collected on bull trout presence, population status, migratory behavior, spawning behavior, and habitat relationships has been developed since the 1998 listing action (USFWS 2002b, Whitesel et al. 2004, USFWS 2005a). This scientific literature suggests that core areas do not contribute equally to the regional persistence of bull trout due to the wide differences between local populations that result from the variability of habitat quality and population conditions found in individual watersheds that comprise the core areas. Core areas that have large, stable bull trout populations and high quality habitat are the primary sources for re-colonization if other areas fail

and are the mainstay to ensure a high probability of persistence despite deterministic and stochastic threats.

In terms of management, it is these "stronghold" core areas where conservation should be emphasized (Rieman and McIntyre 1993). In other core areas, the likelihood of persistence is not as strong and the probability of persistence is less than desired. These core areas may require more intensive management and monitoring to ensure that desirable demographic and habitat characteristics are protected, enhanced, or restored (Rieman and McIntyre 1993). The Upper Willamette Core Area falls into this later category of needing intensive management to reach recovery goals.

Retaining a species' genetic variation is important because this variation allows populations to adapt to changing environmental conditions over short (inter-generational) and long (evolutionary) time frames (Meffe and Carroll 1997). Loss of genetic variation negatively impacts the development, growth, fertility, and disease resistance of fishes. This loss of variation may also reduce fitness and preclude adaptive change in populations (Frankham 1995). Genetic variation needs to be preserved in order to increase the likelihood of a species survival (Allendorf and Leary 1986), and maintaining genetic variation within populations should be a primary goal of conservation and management of species (Wang et al. 2002).

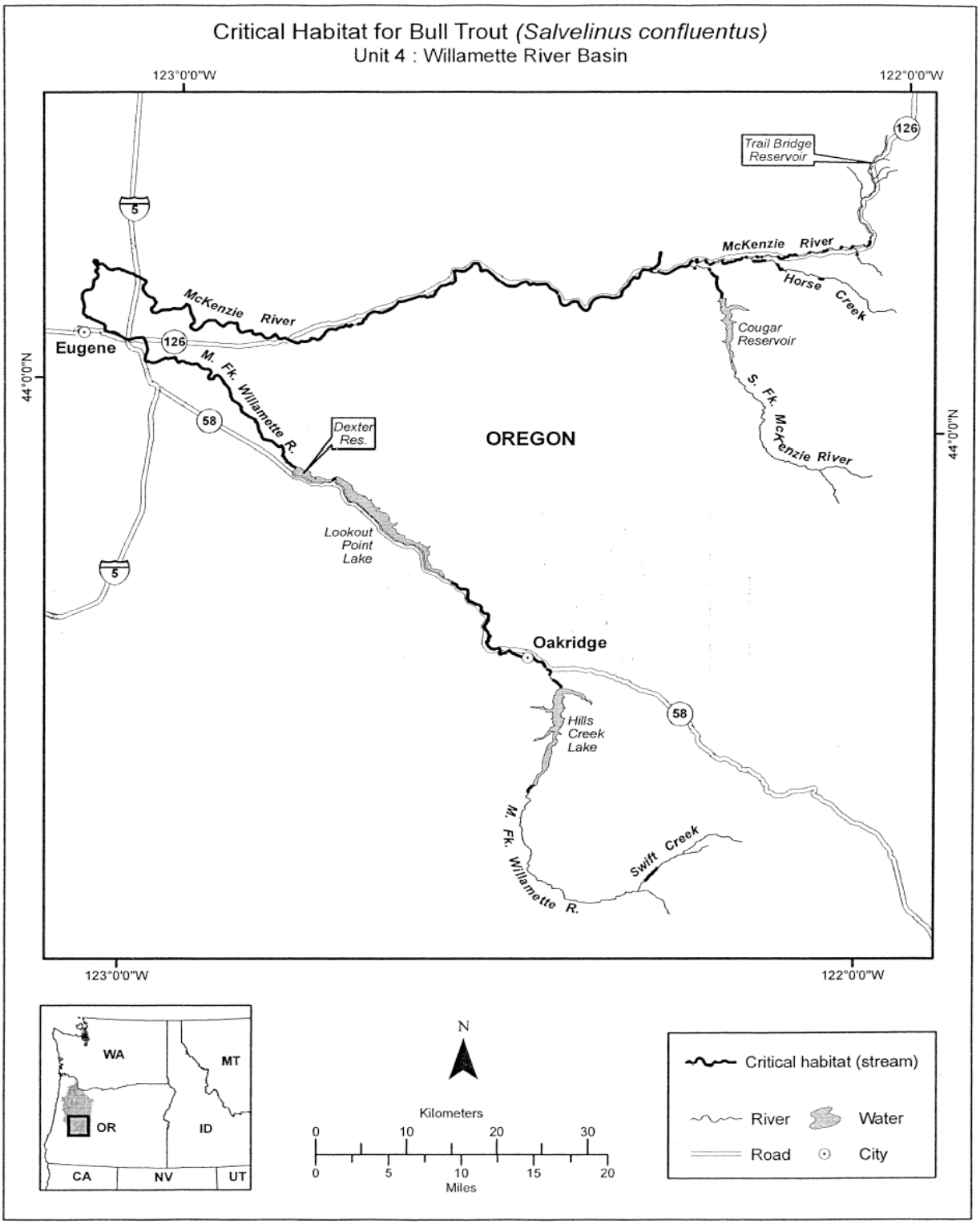
7.3 Status of Critical Habitat in the Action Area

The conservation role of bull trout critical habitat is to support viable core area populations (70 FR 56212). The core areas reflect the metapopulation structure of bull trout and are the closest approximation of a biologically functioning unit for the purposes of recovery planning and risk analyses. Critical habitat units generally encompass one or more core areas and may include foraging, migration, and overwintering (FMO) areas, outside of core areas, that are important to the survival and recovery of bull trout.

Critical habitat for bull trout in the Upper Willamette River Core Area was designated in the following locations: mainstem Middle Fork Willamette River from its confluence with the mainstem Willamette River upstream to Hill's Creek Dam, excluding reservoir reaches; a short reach of the mainstem Willamette River connecting the Middle Fork and McKenzie rivers; the mainstem McKenzie River from its confluence with the Willamette River upstream to its confluence with the South Fork McKenzie and sporadically on reaches upstream (see Figure 7.1); the South Fork McKenzie River upstream to Cougar Dam, and Blue River upstream to Blue River Dam. Short sections of Lost Creek and Horse and West Fork Horse creeks were also designated critical habitat in the McKenzie River Subbasin. A short section of Swift Creek above Hill's Creek Reservoir in the Middle Fork Willamette River Subbasin was also designated critical habitat (Table 7.3).

Federal lands were excluded from the designation due to the fact that existing management plans were deemed protective of bull trout PCEs (70 FR 56212). One hundred and eleven miles were designated CH in the Willamette Basin. No reservoirs or lakes were designated in the

Figure 7.1. Bull Trout Critical Habitat in the Willamette River Basin



Willamette Basin. The designation encompasses very little spawning or juvenile rearing habitat (estimated < 5 percent of the total critical habitat designation) because the majority of spawning and juvenile rearing habitat is in headwater areas on Federal lands. The remaining portion of designated critical habitat (estimated > 95 percent) is FMO habitat.

Designated critical habitat in the Middle Fork Willamette River below Dexter Dam is currently unoccupied by bull trout. Designated critical habitat between Hill's Creek Dam and the upstream end of Lookout Point Reservoir may be occupied by bull trout entrained through Hill's Creek Dam but documentation is limited to a single individual caught by an angler in 2000. In the McKenzie River Subbasin all designated critical habitat is considered occupied, and the majority is FMO habitat.

Table 7.3. Streams Designated Critical Habitat for Bull Trout in the Willamette Basin

(10) Unit 4: Willamette River Basin. (i) Critical habitat is designated on the water bodies listed in the following table:

Name	Stream end-point latitude	Stream end-point lon-gitude	Stream end-point latitude or lake cen-ter	Stream end-point lon-gitude or lake center
Blue River	44.153 N.	122.342 W.	44.172 N.	122.328 W.
Horse Creek	44.170 N.	122.174 W.	44.125 N.	122.036 W.
Lost Creek	44.190 N.	122.066 W.	44.162 N.	122.022 W.
Mckenzie River	44.126 N.	123.106 W.	44.309 N.	122.028 W.
Middle Fork Willamette River	44.023 N.	123.017 W.	43.481 N.	122.254 W.
South Fork Mckenzie River	44.159 N.	122.295 W.	43.953 N.	122.017 W.
Swift Creek	43.502 N.	122.299 W.	43.560 N.	122.162 W.
West Fork Horse Creek	44.172 N.	122.206 W.	44.170 N.	122.174 W.
Willamette River	44.126 N.	123.106 W.	44.023 N.	123.017 W.

7.3.1 Baseline Condition of Critical Habitat in the Action Area

As noted above, the majority of designated critical habitat in the Upper Willamette Core Area is in mainstem river reaches below flood control and hydropower dams. Although construction and operation of flood control and hydropower dams are the biggest contributors to the current status of critical habitat in the Upper Willamette Core Area, other significant impacts to these river reaches have been caused by forest management practices, construction of roads, floodplain development, irrigation and municipal water use diversions, agriculture practices, and residential development (USFWS 2005). Together, these impacts have resulted in degraded conditions for some bull trout PCEs, while others are functioning in a manner that supports current or future bull trout use of these areas. Table 7.4 below summarizes the current baseline condition of each PCE and identifies the leading cause(s) of the baseline condition.

Table 7.4. Baseline Condition of Critical Habitat in the Upper Willamette Core Area

PCE#	Primary Constituent Element	Baseline Condition	Leading Cause(s) of Baseline Condition
1	Water temperatures that support bull trout use - temperatures ranging from 36 to 59 ºF (2 to 15 ºC).	South Fork and mainstem McKenzie River water temperatures sufficient for bull trout FMO needs. Currently degraded temperature baseline, at least seasonally, in the Middle Fork Willamette River.	McKenzie – naturally cool stream temps due to parent geology with benefits provided by Cougar WTC. Middle Fk. Willamette – altered temperature regime caused by operation of Willamette Project dams.
2	Complex stream channels with features such as woody debris, side channels, pools, and undercut banks to provide a variety of depths, velocities, and instream structures.	Degraded baseline condition in both the McKenzie and Middle Fork Willamette rivers. Construction and operation of flood control and hydropower dams trap sediment and large woody debris and reduce peak flow events important to maintain and create channel complexity. The result is a relatively static and simplified riverine aquatic habitat below dams that has a low carrying capacity for bull trout.	Construction and operation of flood control and hydropower dams owned by USACE and EWEB.
3	Substrates of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence and young-of-the-year and juvenile survival.	Critical habitat area does not support this bull trout PCE.	

PCE#	Primary Constituent Element	Baseline Condition	Leading Cause(s) of Baseline Condition
4	A natural hydrograph, including peak, high, low, and base flows or, if regulated, currently demonstrates the ability to support bull trout populations.	Generally altered hydrograph in the McKenzie though current FMO conditions support the mainstem McKenzie local population of bull trout. Degraded hydrograph in the Middle Fork Willamette River – ability of this PCE to support bull trout FMO unknown.	McKenzie River – construction and operation of hydropower and flood control dams owned by USACE and EWEB. Middle Fork Willamette River – construction and operation of USACE dams.
5	Springs, seeps, groundwater sources, and subsurface water to contribute to water quality and quantity as a cold water source.	Critical habitat area does not support this bull trout PCE.	
6	Migratory corridors with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows.	Degraded baseline condition in both the McKenzie and Middle Fork Willamette rivers. Three of four bull trout local populations isolated above dams. Lack of access to historical FMO habitat. Lack of passage at numerous dams within and outside designated critical habitat.	Construction and operation of flood control and hydropower dams owned by USACE and EWEB.

PCE#	Primary Constituent Element	Baseline Condition	Leading Cause(s) of Baseline Condition
7	An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.	Significantly degraded baseline. Altered flow and temperature regimes below dams (and associated habitat effects) along with migratory blockage of anadromous fish at impassable dams, have significantly impacted the productivity of stream reaches within bull trout critical habitat.	McKenzie River – construction and operation of hydropower and flood control dams owned by USACE and EWEB. Middle Fork Willamette River – construction and operation of USACE dams.
8	Permanent water of sufficient quantity and quality such that normal reproduction, growth, and survival are not inhibited.	As noted above in PCE# 1 & 4, the quantity and quality of flow is negatively affected by flood control management that has altered the natural flow and temperature regimes in the McKenzie and Middle Fork Willamette rivers.	Construction and operation of USACE dams in the McKenzie and Middle Fork Willamette rivers.

7.4 Oregon Chub

The Oregon chub evolved in a dynamic network of slack water habitats in the floodplain of the Willamette River. Major alteration of the Willamette River for flood control and navigation improvements eliminated a large proportion of the River's historic floodplain. This alteration has also impaired or eliminated the environmental conditions in which the Oregon chub evolved. Many of the remaining suitable habitats have been invaded by non-native fish predators and competitors.

A variety of factors are likely responsible for the decline of the Oregon chub. These include habitat loss and alteration; the proliferation of non-native fish and amphibians; accidental chemical spills; runoff from herbicide or pesticide application on farms and timberlands or along roadways, railways, and power line rights-of way; the application of rotenone to manage sport fisheries; desiccation of habitats; unauthorized water withdrawals, diversions, or fill and removal activities; sedimentation resulting from timber harvest in the watershed, and possibly the demographic risks that result from a fragmented distribution of small, isolated populations (USFWS 1998).

The decline of Oregon chub has been correlated with the construction of dams. Based on the date of last capture at a site, Pearsons (1989) estimated that the most severe decline occurred during the 1950s and 1960s. Ten of the 13 dams that make up the Willamette Project were completed between 1953 and 1969 (USACE 2000). Other structural changes along the Willamette River corridor such as revetment and channelization, diking and drainage, and the

removal of floodplain vegetation have eliminated or altered the slack water habitats of the Oregon chub (Hjort et al. 1984, Sedell and Froggatt 1984, Li et al. 1987). Channel confinement, isolation of the Willamette River from the majority of its floodplain, and elimination or degradation of both seasonal and permanent wetland habitats within the floodplain began as early as 1872 and has significantly changed the system. For example, along the 15.5 mile reach of the Willamette between Harrisburg and the McKenzie River confluence, the length of shoreline has declined from over 155 miles of shoreline in 1854 to less than 40 miles currently (Sedell and Froggatt 1984, Sedell et al. 1990).

The construction and operation of the Willamette Project, in combination with the construction and maintenance of revetements, has facilitated floodplain development, urbanization and rural development due to the annual protections against flooding. We cannot assume, however, that all floodplain development, urbanization and rural development was due to the construction and operation of the Willamette Project since a great deal of development occurred before the Project was completed despite the known risk of flooding (USACE 2000).

The impacts of urbanization on aquatic ecosystems are severe and long-lasting. Urbanization virtually eliminates natural vegetation in affected areas, which in turn disrupts hydrologic and erosional processes, as well as the physical characteristics of aquatic habitats. Urban developments (including roads, buildings, sidewalks, and other impervious surfaces) greatly reduce water infiltration, which alters the routing and storage of water in the affected basin. Many of the resulting changes are intended to make the land more amenable to specific human uses (e.g., transportation, human habitation), but other important resource values (e.g., water supplies, fisheries, and wildlife) may be damaged by unintended effects on aquatic ecosystems, including: increased peak flows; channel erosion; loss of riparian habitats which results in increased stream temperatures; increased nutrient inputs; landslides; pollution; and channelization (Spence et al. 1996).

The establishment and expansion of non-native species in Oregon have contributed to the decline of the Oregon chub and limits the species' ability to expand beyond its current range. Many species of non-native fish have been introduced to, and are common throughout, the Willamette Valley, including largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieui*), crappie (*Pomoxis sp*.), bluegill (*Lepomis macrochirus*), and western mosquitofish (*Gambusia affinis*). Many of these introduced species are known to prey on and compete for habitat with Oregon chub. The bullfrog, an omnivorous non-native amphibian, also occurs in the valley and breeds in habitats preferred by the Oregon chub (Hjort et al. 1984, Scheerer et al. 1992).

Many sites formerly inhabited by the Oregon chub are now occupied by non-native species (Markle et al. 1991). Of the 30 sites currently known to contain Oregon chub, over half of these sites are also inhabited by non-native fishes or amphibians (Scheerer and McDonald 2000). Since 1995, non-native fish have been discovered for the first time in six locations containing Oregon chub. Oregon chub populations have subsequently declined or remained in low abundance in all of these sites. The 1996 flooding in the Santiam River was probably responsible for three of these movements of non-native fish. The other three sites, located in the Middle Fork Willamette River drainage, were likely the result of unauthorized introductions or

spread of non-native fish from reservoirs (Scheerer and Jones 1997). Because all remaining population sites are easily accessible, there also continues to be a potential for unauthorized introductions of non-native species, particularly mosquitofish and game fishes such as bass and walleye (*Stizostedion vitreum*).

Many of the known extant populations of Oregon chub occur near rail, highway, and power transmission corridors and within public park and campground facilities. These populations face risks of chemical spills from overturned truck or rail tankers; runoff or accidental spills of vegetation control chemicals; overflow from chemical toilets in campgrounds; sedimentation of shallow habitats from construction activities; and changes in water level or flow conditions from construction, diversions, or natural desiccation (USFWS 1998). Oregon chub populations near agricultural areas may be subject to poor water quality as a result of runoff laden with sediment, pesticides, and nutrients. Logging in the watershed adjacent to Oregon chub populations can result in increased sedimentation and herbicide runoff.

Since the time of listing, several Oregon chub populations have been extirpated, a number of new populations have been discovered, and there have been a number of successful introductions (Table 7.5). According to ODFW's 2007 Monitoring Report, Oregon chub now occur at approximately 33 locations in the North and South Santiam River, McKenzie River, Middle Fork Willamette River, Coast Fork, and several tributaries to the mainstem Willamette River downstream of the Coast Fork Willamette River/Middle Fork Willamette River confluence (Scheerer et al. 2006). A summary of the current status of each population by recovery area is provided below in Table 7.5.

Despite the short-term successes in increasing the abundance and distribution of Oregon chub and approaching the down-listing criteria, there are potentially significant long term threats to the species. The recovery strategy has focused on improving Oregon chub habitats in isolation due to the loss and fragmentation of suitable habitats and the threats posed by non-native fishes. Most populations of chub are currently isolated from other chub populations due to the reduced frequency and magnitude of flood events and the presence of migration barriers such as impassible culverts and permanent, high beaver dams. Unfortunately, managing Oregon chub in isolation has potentially severe consequences (Scheerer et al. 2006). Isolating populations that would normally experience gene exchange can result in general decline in local genetic diversity and a corresponding increase in divergence among populations within a drainage system (Meffe and Vrijenhoek 1988). Burkey (1989) concluded that when species are isolated by fragmented habitats, low rates of population growth are typical in local populations and their probability of extinction is directly related to the degree of isolation and fragmentation. Without sufficient immigration, growth for local populations may be low and probability of extinction high (Burkey 1989, 1995). Multiple local populations distributed and interconnected throughout a watershed provide a mechanism for spreading risk from stochastic events (Hard 1995, Healy and Prince 1995, Rieman and Allendorf 2001, Rieman and McIntyre 1993, Spruell et al. 1999).

Table 7.5. Known Oregon Chub Populations (from Scheerer et al. 2006).

Site	Landowner	Population Estimate (2006)	Trend
Santiam River Drainage			
Geren Island North Channel	City of Salem	1,020	Stable
Santiam Easement	Private	3	Unknown
Santiam I-5 Sidechannels	Oregon Dept. of Transportation	330	Unknown
Foster Pullout Pond*	U.S. Army Corps of Engineers	470	Stable
Gray Slough	Private	700	Stable
Pioneer Park Backwater	Santiam Water Control District	110	Unknown
Stayton Public Works Pond	City of Stayton	440	Unknown
South Stayton Pond	ODFW	54	Unknown
Green's Bridge Slough	Private	6	Unknown
Middle Fork Willamette River Drainage			
East Fork Minnow Creek Pond	Oregon Dept. of Transportation	1,730	Declining
Shady Dell Pond	Willamette National Forest	5,430	Increasing
Elijah Bristow State Park - Berry Slough	Oregon Dept. of Parks and Rec.	5,460	Stable
Elijah Bristow State Park – North East Slough	Oregon Dept. of Parks and Rec.	210	Unknown
Elijah Bristow Island Pond	Oregon Dept. of Parks and Rec.	2,310	Unknown
Hospital Pond	U.S. Army Corps of Engineers	2,040	Stable
Dexter Reservoir Alcove - DEX 3	U.S. Army Corps of Engineers	3,130	Stable
Dexter Reservoir Alcove - PIT 1	U.S. Army Corps of Engineers	650	Stable
Buckhead Creek	Willamette National Forest	2,500	Stable
Wicopee Pond*	Willamette National Forest	4,860	Stable
Fall Creek Spillway Ponds*	U.S. Army Corps of Engineers	3,250	Stable

Site	Landowner	Population Estimate (2006)	Trend
Haws Pond	Private	440	Unknown
Rattlesnake Creek	Private	5	Unknown
Mid-Willamette River Drainage			
William L. Finley National Wildlife Refuge - Display Pond*	U.S. Fish and Wildlife Service	240	Unknown
William L. Finley National Wildlife Refuge - Gray Swamp	U.S. Fish and Wildlife Service	1,390	Increasing
Cheadle Pond	U.S. Fish and Wildlife Service	900	Unknown
Ankeny Willow Marsh	U.S. Fish and Wildlife Service	35,650	Unknown
Jampolsky Wetlands*	Private	Unknown	Unknown
Dunn Wetland*	Private	21,530	Stable
Big Island	McKenzie River Trust and G. Grier	380	Unknown
Shetzline Pond.	Private	390	Unknown
Russell Pond*	Private	1,000	Increasing
Coast Fork Willamette River Drainage			
Coast Fork Side Channels	Oregon Dept. of Transportation	150	Unknown
Lynx Hollow Side Channels	Oregon State Parks	2	Unknown
Herman Pond*	Umpqua National Forest	40	Unknown

* denotes introduction site

7.4.1 Santiam River Drainage

Oregon chub currently exist at nine sites in the Santiam River drainage: South Stayton Pond, Geren Island, Santiam I-5 Side Channels, Stayton Public Works Pond, Green's Bridge Backwater, Pioneer Park, Gray Slough, and Foster Pullout Pond. These are naturally occurring populations with the exception of the introduced population at Foster Pullout Pond. The three largest populations in 2006 were introduced populations. ODFW introduced Oregon chub into the South Stayton Pond, a recently restored site located on ODFW property, from Stayton Public Works Pond and Pioneer Park Pond (Scheerer et al. 2006).

In 2006, ODFW estimated the population abundance of Oregon chub at six locations in the Santiam River drainage. There were two populations in the Santiam drainage that totaled 500 or more adult Oregon chub; both populations had a stable or increasing trend in abundance for the

past five years. The largest Oregon chub population in the Santiam drainage was located in the Geren Island North Channel. For this population, abundance declined from 2,630 fish in 2005 to 1,020 fish in 2006 (Scheerer et al. 2006).

Foster Pullout Pond is located on USACE property on the north shore of Foster Reservoir in the South Santiam River drainage. The pond is perched several meters above the reservoir full pool level, is spring-fed, and the water level is maintained by a beaver dam at the outflow. ODFW introduced 500 Oregon chub into the pond from Geren Island between 1999 and 2004. In 2006, ODFW estimated the chub population abundance at 470 fish, an increase from the 2005 estimate of 200 fish (Scheerer et al. 2006).

Menear's Bend Pond is located on USACE property in the Middle Santiam drainage upstream of Foster Reservoir. The pond is a small beaver pond that is fed by a small tributary and springs. ODFW introduced Oregon chub from Geren Island in 2000 (n=15) and 2002 (n=26). The pond dried up in 2003 (Scheerer et al. 2006).

7.4.2 Middle Fork Willamette River Drainage

The Middle Fork Willamette drainage contains the greatest concentration of large Oregon chub populations (>500 fish) in the Willamette Valley. In recent years there have been ten populations in the Middle Fork Willamette drainage that totaled 500 or more adult Oregon chub. Eight of these populations have been stable or increasing in abundance for the past five years. In 2006 ODFW estimated the population abundance of Oregon chub at 11 locations in the Middle Fork Willamette River drainage (two Dexter Reservoir alcoves, East Fork Minnow Creek Pond, Shady Dell Pond, Buckhead Creek, two Elijah Bristow State Park sloughs and an island pond, Haws Pond, and Hospital Pond). Introduced populations were located at Wicopee Pond and Fall Creek Spillway Ponds (Scheerer et al. 2006).

Currently the largest populations of Oregon chub in the Middle Fork Willamette drainage are located at Elijah Bristow Berry Slough, Shady Dell Pond, and Wicopee Pond. Notable increases in Oregon chub abundance occurred at Elijah Bristow Berry Slough, Shady Dell Pond, Dexter Reservoir RV Alcove, and Haws Pond. Notable decreases in Oregon chub abundance occurred at Hospital Pond, Fall Creek Spillway Ponds, Wicopee Pond, and Elijah Bristow Northeast Slough. The East Fork Minnow Creek Pond population was the only Middle Fork Willamette population that had a declining 5-year abundance trend. In 2006, there were 11 naturally occurring populations of Oregon chub that totaled 500 or more individuals in the Willamette River basin; eight were located in the Middle Fork Willamette drainage (Scheerer et al. 2006).

ODFW did not find Oregon chub at several locations where they had been collected on at least one prior occasion between 1991-2005 (Jasper Park Slough, Wallace Slough, East Ferrin Pond, Hospital Impoundment Pond, Elijah Bristow Large Gravel Pit, Elijah Bristow Small Gravel Pit, Little Muddy Creek tributary, Barnhard Slough. Nonnative fish were collected at most of these locations (Scheerer et al. 2006).

Wicopee Pond was the site of a 1988 introduction of 50 Oregon chub from the Dexter Reservoir Alcove "The Pit." The pond is a former borrow pit adjacent to Salt Creek in the Middle Fork

Willamette River drainage. Small numbers of Oregon chub were collected from the pond between 1992 and 1999. In 2000, the population abundance increased dramatically. In 2006, the chub abundance was estimated at 4,860 adults and the population has exhibited a stable five-year abundance trend (Scheerer et al. 2006).

Ferrin Ponds were the sites of habitat restoration projects completed by the USFS in 1993. These former borrow pits were deepened and permanent water control structures were constructed. Non-native fish (largemouth bass, western mosquitofish, and crappies) were poisoned using a rotenone treatment. Oregon chub were introduced into West Ferrin Pond (N=525) and East Ferrin Pond (N=576) in 1994. Oregon chub were collected from both ponds in May 1995; however Oregon chub were last collected from West Ferrin Pond in 1995. The rotenone treatment was ineffective in eliminating the western mosquitofish and they quickly became abundant in both ponds. In 1997, the Oregon chub population in East Ferrin Pond was 7,160 fish. In 1998, largemouth bass were first observed in the pond from a believed illegal introduction. The chub population declined rapidly. No Oregon chub were collected from 2000 through 2006. The rapid increase in abundance of the Oregon chub population was encouraging, however the subsequent collapse of the population after largemouth bass were introduced illustrates the continued threat that non-native predators pose to Oregon chub survival and recovery (Scheerer et al. 2006).

In 1996, Oregon chub were introduced into the Fall Creek Spillway Ponds, located in the overflow channel below Fall Creek Dam on USACE property. The ponds were formed by beaver dams that blocked the spillway overflow channel. The beaver dams have been in existence for approximately 20 years. A total of 500 Oregon chub were introduced in 1996; 150 from Shady Dell Pond and 350 from East Fork Minnow Creek Pond. After the introduction, the chub population abundance increased rapidly. In 2005, the ponds supported 6,250 Oregon chub. In 2006, chub abundance declined to 3,250 fish. This decline was a result of a reduction in habitat; the lower pond dried completely during the summer months. Nonetheless, this population has exhibited a stable five-year abundance trend (Scheerer et al. 2006).

Hospital Impoundment Pond is located in Lookout Point Reservoir (Middle Fork Willamette drainage) adjacent to Hospital Pond. The USFS and USACE constructed the pond in 1994, by excavating within a former railroad grade in the drawdown zone of the reservoir. The outflow from Hospital Pond is diverted into the Hospital Impoundment Pond. The project was designed to benefit western pond turtles and Oregon chub. The fish community in this pond varies each year, depending on which species enter the pond from Lookout Point Reservoir or Hospital Pond. ODFW collected non-native fish, which originate from the reservoir, in 1995, and from 1997 through 2006. ODFW collected a few Oregon chub in 1995, 1997, and 1999. The pond appears to provide few benefits for Oregon chub (Scheerer et al. 2006).

The Lower Buckhead Enhancement Ponds are located in the Buckhead Creek floodplain in the Middle Fork Willamette drainage. The USFS constructed three shallow off-channel ponds in 1998. They excavated these ponds to increase the amount of off-channel habitat available for Oregon chub. Two ponds are connected to the creek during typical winter high-flow events. In 2006, ODFW estimated 1,410 Oregon chub existed in these ponds (Scheerer et al. 2006).

Restoration projects are also planned for 2007 at the Haws Site in the Middle Fork Willamette drainage (Scheerer et al. 2006).

7.4.3 Mid-Willamette River Drainage (Includes the McKenzie River Drainage)

Oregon chub currently exist at the following eight sites in the Mid-Willamette River drainage: Finley Gray Creek Swamp, Shetzline Pond, Big Island, Dunn Wetland, Finley Display Pond, Finley Cheadle Pond, Ankeny Willow Marsh, and Russell Pond. There were six populations in the Mid-Willamette drainage that totaled 500 or more adult Oregon chub. Three of these populations had stable 5-year trends in abundance. The two largest populations in this drainage occurred at sites where chub were initially introduced (Ankeny Willow Marsh, and Dunn Wetland) (Scheerer et al. 2006).

In 1994, a large habitat enhancement project was completed at Dunn Wetlands in the Muddy Creek drainage in Benton County. Approximately 12 hectares of wetland were restored and a permanent (year round) spring-fed pond was constructed. Two additional permanent ponds were constructed in 1997 and 1999. The entire wetland floods during the winter and the ponds are interconnected. Oregon chub were introduced into this site in 1997 (N=200) and 1998 (N=373). In 2006, the population totaled 21,530 fish and was the second largest chub population in existence. This population has exhibited a stable five-year abundance trend (Scheerer et al. 2006).

A multi-year habitat enhancement project was completed in 2003 in the Muddy Creek drainage on Finley National Wildlife Refuge. The goal was to move portions of the Gray Creek chub population to suitable locations on the refuge to reduce their risk of extinction by expanding their numbers. The project involved habitat restoration of two ponds in the Gray Creek drainage (Display and Beaver Ponds) and the creation of another pond (Cheadle Pond). Display Pond was drained in 1996 to remove the nonnative fish. Oregon chub from Gray Creek Swamp were introduced into Display Pond in 1998 (N=60), 1999 (N=45), and 2001 (N=49). The chub population abundance peaked at 1,750 fish in 2000, declined steadily from 2001-2004, then rebounded slightly in 2005 and 2006 (N =240). Recruitment failure was the suspected cause of this decline. Small fish (<50 mm) were rare in most years.

In 2002, 50 chub were introduced from Display Pond into Cheadle Pond. ODFW estimated the chub abundance in Cheadle Pond to be 900 fish in 2006. During the summer of 2003, the FWS completed the Beaver Pond habitat project. They replaced the spillway and water control structure and deepened the pond to prevent desiccation. Native fish were collected from the pond in 2004 and 2005 (threespine sticklebacks, speckled dace, and redside shiners). High water damaged the dike in the winter of 2005-06 and the pond drained. Repairs are slated for 2007. ODFW will continue to monitor the site to determine whether Oregon chub colonize this pond from Gray Creek Swamp, which is located upstream. Oregon chub will be introduced into the pond, if they do not colonize on their own (Scheerer et al. 2006).

Willow Marsh is a large wetland pond located on Ankeny National Wildlife Refuge. The pond was modified in 2003 and 2004 to deepen the pond and isolate it from an adjacent marsh that contains nonnative fish. In 2004, ODFW introduced 500 Oregon chub from Dunn Wetlands.

This population expanded rapidly and dramatically. The 2006 estimate was 35,650 chub (Scheerer et al. 2006).

Jampolsky Wetlands are part of a wetland restoration project completed in 2000 on private land in the Amazon Creek drainage (Long Tom River). In 2004, ODFW introduced 500 Oregon chub from Dunn Wetlands. This population expanded rapidly and in 2006 the estimate was 8,320 chub (Scheerer et al. 2006). In 2007, as the request of the landowner, the majority of the Jampolsky Wetland chub population was moved to Ankeny Willow Marsh.

7.4.4 Coast Fork Willamette River Drainage

Oregon chub currently exist at the following three sites in the Coast Fork Willamette River drainage: Coast Fork Side Channels, Lynx Hollow, and Herman Pond. In 2006, ODFW estimated the Oregon chub population abundance at two sites in the Coast Fork Willamette River drainage. The most abundant chub population in the drainage was located in the Coast Fork Side Channels (N =150).

Herman Pond is an isolated, spring-fed pond located in the Coast Fork Willamette River drainage on USFS Property. In 2002, ODFW introduced 400 Oregon chub. Oregon chub abundance has declined steadily since 2003. In 2006, we estimated the chub population abundance at 40 fish. A habitat enhancement project was initiated in 2005 to remove cattails and increase the amount of open water habitat. It is unclear whether this project will reverse the declining trend in chub abundance.

7.4.5 Ongoing Conservation Actions

The Oregon Chub Working Group was formed in 1991 and includes Federal and State agency biologists, academics, land managers, and other concerned people who are working to improve the status of the species. The Working Group has been proactive in conserving and restoring habitat for the Oregon chub and raising public awareness of the species since before the Federal listing in 1993.

In 1992, an interagency Conservation Agreement for the Oregon Chub in the Willamette Valley, Oregon was completed and signed by the FWS, USFS, BLM, ODFW, and Oregon Parks and Recreation Department (USFWS 1998). The purpose of the coordinated plan was to facilitate Oregon chub protection and recovery and to serve as a guide for all agencies to follow as they conduct their missions. The management guidelines are to: 1) establish a task force to oversee and coordinate Oregon chub conservation and management actions; 2) protect existing populations; 3) establish new populations; and, 4) foster greater public understanding of the Oregon chub, its status, the factors that influence it, and the conservation agreement.

In February 1997, a draft habitat conservation plan was prepared by consultants for the City of Salem to protect and enhance the population of Oregon chub located in the drinking water treatment facility at Geren Island in the North Santiam River. In 1996, a no-spray agreement with the Oregon Department of Transportation (ODOT) was formalized to protect Oregon chub sites located in the Middle Fork Willamette River drainage adjacent to Highway 58 in Lane

County. The agreement prohibits spraying of herbicides in the vicinity of Oregon chub sites and limits vegetation control to mechanical methods if necessary.

Additional conservation measures implemented to improve the status of Oregon chub include reintroductions of Oregon chub within the historical range, habitat enhancement projects, and public education. Also, the FWS has completed three Safe Harbor Agreements (SHA) for Oregon chub. Under a SHA, property owners who undertake management activities that attract listed species onto their properties, or into areas affected by actions undertaken on their property, or that increase the numbers or distribution of listed species already present on their properties, will not incur future property-use restrictions. SHAs provide assurances to the property owner that allow alterations or modifications to enrolled property, even if such action results in the incidental take of the covered listed species or, in the future, returns the species back to an originally agreed-upon baseline condition.

8. EFFECTS OF THE ACTION

"Effects of the action" refers to 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. Direct effects are considered immediate effects of the project on the species or its habitat. Indirect effects are those caused by the proposed action and are later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consultation.

Because the proposed action, as modified by the NMFS' RPA, is generally a continuation of current operations, aggregated with a suite of conservation measures, many of the effects described below are also described in the Environmental Baseline section above. Even with implementation of the conservation measures and NMFS' RPA, we expect operation and maintenance of the Willamette Project to continue to have adverse effects to bull trout and Oregon chub similar to those in the past, especially in the short-term (0-5 years), before the effects of conservation actions can be measured. However, over the 15-year term of the action we expect significantly improved conditions for bull trout, its designated critical habitat, and Oregon chub over baseline conditions.

Our effects analysis is complicated by the magnitude and complexity of the proposed action and its associated components. There is a limited amount of information assessing past and present effects of the Willamette Project on aquatic species and habitat that might inform how the project will affect species and habitat in the future. In addition, there is a significant amount of uncertainty in predicting the species and habitat responses to implementation of the proposed action, as modified by the NMFS' RPA. As a result, our effects analysis is focused on, but not limited to, components of the proposed action we believe have a high probability of effect to bull trout, designated bull trout critical habitat, and Oregon chub (adverse or beneficial) and/or for which we have information, direct or otherwise, to support the determination of affect.

The implementation of many conservation measures in the revised proposed action, as modified by the NMFS' RPA, depends on the outcome of feasibility studies and the procurement of congressional authorization and appropriation. For that reason we acknowledge a degree of uncertainty regarding construction timelines, the priority in which conservation measures will be implemented, and in some cases, the mechanisms for achieving desired conditions (e.g., water temperature control and fish passage potentially accomplished by operational changes versus major structural modification). In addition, there is uncertainty regarding when and to what extent habitat and populations will respond to implementation of conservation measures under the proposed action. That said, for our effects analysis we have made the assumption, based on language in the proposed action, as modified by NMFS' RPA, that significant changes to the operation and maintenance of the Willamette Project (e.g., alternative flow management, fish passage, development of water temperature control, and habitat restoration actions) will be funded and implemented during the 15-year timeframe of the proposed action. While it is

difficult to predict the degree of habitat and population responses to implementation of future conservations measures, we view the overall proposed action as a "conservation action" that will ultimately minimize project effects and move bull trout, Oregon chub, and their relevant habitats towards a recovered condition.

Due to the number and magnitude of the actions proposed, it is unlikely many significant conservation measures will be implemented in the short-term (0-5 years). Consequently, for our effects analysis we consider the proposed action in terms of both short-term and long-term (approximately 5-15 years) implementation timelines, consistent with the term of the proposed action.

8.1 Bull Trout

8.1.1 Effects to Bull Trout Habitat

As noted above, the habitat and population baseline for bull trout in the action area (which fully encompasses the Upper Willamette Core Area) has been significantly affected by the construction, operation, and maintenance of Willamette Project dams. To summarize, the primary baseline habitat conditions adversely affected by the Willamette Project included blockage of migratory corridors, blockage of access to suitable habitat, and probable reduction in carrying capacity of FMO habitat in mainstem river reaches of the McKenzie and Middle Fork Willamette rivers due to habitat and biological effects caused by altered flow and temperature regimes. The baseline condition of bull trout spawning and early juvenile rearing habitat in the Upper Willamette Core Area was not identified as directly impacted by the construction, operation, and maintenance of Willamette Project dams. Indirect effects to bull trout forage base and overall system productivity within spawning and rearing areas are likely affected by reductions, and in some locations, loss of anadromous fish above Willamette Project dams. The proposed action's effects on bull trout habitat are discussed below.

a) Blockage of Migratory Corridors and Access to Suitable Habitat

Cougar Dam, and to a lesser extent Blue River Dam in the McKenzie River Subbasin, and Dexter, Lookout Point, and Hill's Creek dams in the Middle Fork Willamette River Subbasin all constitute major migratory blockages that eliminate access to suitable habitat for bull trout in the Upper Willamette River Core Area. As discussed above in sections 6.1.9 and 6.1.10, the ability to migrate is important to the persistence of local bull trout populations (Rieman and McIntyre 1993, Gilpin 1997, Rieman and Clayton 1997, Rieman *et al.* 1997). Bull trout rely on migratory corridors to move from spawning and rearing habitats to foraging and overwintering habitats and back.

In the short-term we expect the proposed action to largely maintain blockages of migratory corridors and preclude access to suitable habitat thereby harming bull trout and impeding the recovery potential of bull trout in the Upper Willamette Core Area by limiting available habitat for breeding, feeding and sheltering. The partial exception is Cougar Dam, where the proposed action includes operation of an upstream trap and haul collection facility beginning in 2010. As discussed in Section 2.4 above, construction and first year of operation of the trap and haul

facility is covered under an existing BO (USFWS 2007). In the long-term the proposed action, as modified by NMFS' RPA, will result in implementation of fish passage measures at several priority projects including downstream passage at Cougar (completion by 2015) and Lookout point (completion by 2022) dams. In addition, the Action Agencies will analyze additional structural and operational measures for fish passage, as part of the COP. The timeframe for implementation of these additional measures will extend beyond the timeframe of this BO. However, the Action Agencies will likely begin certain actions, such as investigating feasibility, completing plans, conducting NEPA and requesting authorization, during the timeframe of this BO.

b) Carrying Capacity of FMO habitat

Because spawning and juvenile rearing habitats exist solely upstream of Willamette Project dams, or in tributaries not directly influenced by operation of the Willamette Project, the direct influence of the dams and their associated operations on downstream habitats is generally limited to bull trout FMO habitats. These habitats generally coincide with designated critical habitat in the McKenzie and Middle Fork Willamette rivers (see Figure 7.1), although there is no critical habitat designated within these reservoirs.

In the McKenzie River, FMO habitat extends downstream from Cougar and Blue River dams to the McKenzie River mainstem, and on down to its confluence with the Willamette River at the City of Eugene. In the Middle Fork Willamette River FMO habitat includes all mainstem river reaches, including reservoirs, between Hill's Creek Dam and the confluence of the Middle Fork Willamette with the Willamette River and the short section of the Willamette River between it's confluence with the Middle Fork Willamette River and the McKenzie River.

In the short-term, the operation of Willamette Project dams will continue to alter the natural temperature and flow regimes below the dams, as well as sediment and large wood delivery and recruitment below the dams in FMO habitat. The disruption of these habitat processes have caused, and will continue to cause under the proposed action, as modified by the NMFS' RPA, stream channel simplification including reductions in side channels and the quality and quantity of pool habitat important for bull trout foraging, overwintering, and migration. The disruption of these habitat processes constitutes harm to bull trout by impairing essential behavior patterns, including breeding, feeding and sheltering. The altered temperature regime, more profound in the Middle Fork Willamette River as compared to the McKenzie River due to the operation of Cougar Dam WTC, is expected to negatively affect stream productivity by reducing the diversity and abundance of aquatic invertebrates that bull trout (and bull trout prey species) feed upon. In addition, altered temperature regimes may harm bull trout by altering temperature cues that drive bull trout biological processes such as spawning, spawning migration timing, foraging, and overwintering. In the short-term these effects are expected to limit the carrying capacity of FMO habitat for bull trout that may now, or likely will in the future, occupy the mainstem reaches and reservoirs of the Middle Fork Willamette River below Hill's Creek Dam, and FMO habitat in the mainstem McKenzie River.

The NMFS' RPA stipulates that until permanent temperature control facilities are constructed or operations are established, the Action Agencies will evaluate and carry out where feasible,

interim operational measures and use existing conduits such as spillways, regulating outlets, and turbine outlets to achieve some measure of temperature control below project dams, including Hill's Creek, Lookout Point and Dexter dams in the Middle Fork Willamette River, and Blue River dam in the McKenzie River Subbasin. Until evaluations of feasibility are completed, it is uncertain the extent to which these interim measures will be implemented in the short-term. If interim temperature control is provided at Blue River, Hill's Creek, Lookout Point and Dexter dams, we expect a minimization of temperature related effects to bull trout in FMO habitats.

c) Effects of Reservoir Operations

Local populations of bull trout above Cougar and Hill's Creek dams were once fluvial (migratory within a riverine environment) but were forced to adapt to an adfluvial (living a portion of their lives in a reservoir environment) life history with construction of the dams. Monitoring information from local bull trout populations isolated above these dams indicates the reservoir environments are utilized for foraging and overwintering by adult and sub-adult bull trout. No information is available to inform whether reservoir operations, and effects to habitat and forage within the reservoir, are negatively or positively impacting the current status of these two bull trout local populations. As a result, future effects to bull trout from reservoir operations are uncertain. Entrainment of bull trout through Cougar and Hill's Creek dams, while associated with reservoir operations, is addressed below under Section 8.1.2. As discussed in the Environmental Baseline, a small number of bull trout may occupy the Middle Fork Willamette River below Hill's Creek Dam, but there is no information documenting bull trout use of Lookout Point or Dexter reservoirs downstream from Hill's Creek Dam.

In some locations within the range of bull trout, (e.g., Lake Billy Chinook in central Oregon) productive reservoirs have provided a larger forage base than present prior to dam construction, with resulting increases in bull trout population abundance (USFWS 2002) . Although we are not aware of any specific studies on reservoir productivity and fish diversity and abundance in Willamette Project reservoirs, available information suggests Hill's Creek and Cougar reservoirs are not overly productive and thus do not support an abundance of forage fish (native or non-native) for bull trout. In fact, prior to ODFW's implementation of the Chinook salmon outplant program in 1993 above Cougar and Hill's Creek dams, available forage in these reservoirs may have been a limiting factor in the status of these two local populations.

Recent monitoring in Cougar Reservoir by ODFW has shown many of the naturally produced Chinook juveniles from the outplant program rear in the reservoir environment and that bull trout have been observed in association with schools of juvenile Chinook. The outplant program above Hill's Creek Dam also results in naturally produced Chinook juveniles that have been observed utilizing Hill's Creek Reservoir for rearing. In the short-term, we expect the bull trout's forage base to continue to be significantly reduced from historic levels due to the limited production of Chinook above Willamette Project dams. However, the continuation of the Chinook outplant program, as proposed and modified by the NMFS' RPA, above these and other reservoirs is expected to contribute to improved foraging and overwintering conditions in Willamette Project reservoirs for bull trout.

8.1.2 Effects to Bull Trout

As noted above, the habitat and population baseline for bull trout in the action area has been significantly affected by the construction, operation, and maintenance of Willamette Project dams. To summarize, the primary baseline population conditions affected by the Willamette Project included: local population isolation (two of four local populations in the Upper Willamette Core Area are isolated above USACE dams) and associated effects due to lack of upstream and downstream passage at dams in the McKenzie and Middle Fork Willamette river subbasins; entrainment through USACE dam penstocks and regulating outlets (Cougar and Hill's Creek dams); and reduction or loss of historical forage base (Chinook juveniles) above dams due to no passage, and below dams from reduced carrying capacity due to habitat and productivity effects caused by altered flow and temperature regimes.

a) McKenzie River

i. Mainstem McKenzie River Local Population

The proposed action includes operation of water temperature control at Cougar Dam to meet downstream temperature targets required for protection of Chinook salmon, bull trout and other native species. The facility, which has been functional since 2005, has restored the historical temperature regime in the lower South Fork McKenzie, and to a lesser extent contributed to restoring normative temperature patterns in the mainstem McKenzie River downstream to about Leaburg Dam.

Effects to bull trout in the mainstem McKenzie River from the altered flow regime and blockage of sediment and large woody debris caused by the operation of Cougar and Blue River dams are generally unknown, though we suspect the carrying capacity for bull trout has been reduced, and we don't expect the proposed action, as modified by the NMFS' RPA, to significantly change this condition. The operation of Cougar and Blue River dams under the proposed action will continue to trap sediment and large woody debris, and reduce peak flow events important to maintain and create channel complexity. The result is a relatively static and simplified riverine aquatic habitat below dams that constitutes harm to bull trout by reducing carrying capacity and by impairing essential behavior patterns such as feeding, breeding, and sheltering.

ii. South Fork McKenzie River Local Population

In the short-term, the proposed action will affect the South Fork McKenzie local population primarily by entrainment through Cougar Dam (described in the Environmental Baseline section above) and by continued isolation from other bull trout distribution areas within the McKenzie River Subbasin. The proposed operation of a trap and haul fish collection facility at the base of Cougar Dam in the short-term (beginning in 2010) will significantly minimize the Project's entrainment effects on fish that survive passage through the dam's turbines and regulating outlet, by allowing those fish to be safely captured and moved back above Cougar Dam during upstream migration to spawning and rearing habitat.

The NMFS' RPA directs the Action Agencies to investigate the feasibility of improving downstream fish passage at Cougar Dam through structural modifications as well as with

operational alternatives (see Section 5.3.10 above). The RPA stipulates that the Action Agencies will take interim steps beginning no later than 2010, and completion of permanent structural downstream fish passage facilities by December 2014. The operation of the downstream fish passage facility by 2014, in combination with the trap and haul facility scheduled to be operational by 2010, will be expected to significantly minimize passage related effects to bull trout that have been occurring since Cougar Dam was built in 1964.

Bull trout in the South Fork McKenzie River above Cougar Dam have been isolated from other bull trout in the McKenzie River for over 40 years and during that time evidence suggests population abundance dropped to levels that would be expected, based on Rieman and Allendorf (2003), to cause genetic impacts from inbreeding (< 100 spawning adults). In the short-term, at least until connectivity is fully established among isolated bull trout populations in the Upper Willamette Core Area, the proposed development and implementation of a genetic management plan (see Section 5.10.1.ii above) is expected to provide critical guidance on establishing the appropriate level of gene flow between local populations in the McKenzie and Middle Fork Willamette rivers to maximize genetic health.

A study of entrainment mortality by Taylor (2000) suggests that mortality of Chinook smolts through Cougar Dam's penstock and turbines is approximately 7 to 18 percent, whereas mortality through the regulating outlet was approximately 32 percent. The study indicated there was a strong relationship between mortality rate and fish size, with larger fish being more susceptible to injury and mortality. The study estimated that mortality through both the turbine and regulating outlet may be greater than 50 percent for fish over 20 centimeters. This information will be updated in 2008 and 2009, during Cougar Dam RM&E entrainment studies. Until permanent downstream fish passage is implemented at Cougar Dam (2014), we assume a high probability of harm to bull trout from entrainment caused injury or mortality. Even a low level of entrainment is considered significant due to the small population size (estimated at 50 to 75 adults) of the South Fork McKenzie River local population and the frequency with which bull trout have been observed to move downstream through the dam.

Based on recent monitoring of the South Fork McKenzie local population of bull trout (see Section 7.1.2 above), we expect up to 20 percent of the adult and sub-adult population to be entrained on an annual basis. Further, we anticipate that approximately half (10 percent of the adult and sub-adult population) of the individuals entrained annually will be injured or killed. The construction and operation of the downstream passage facility by 2014, as proposed, is expected to significantly minimize entrainment impacts in the long-term.

b) Middle Fork Willamette River

i. Middle Fork Willamette River Local Population

Bull trout were last documented in the Middle Fork Willamette River in 1990 from a photograph of a bull trout caught by an angler at the head of Hill's Creek Reservoir. Although a few bull trout from the original population may have persisted into the 1990s, the best available information suggests bull trout were functionally extirpated from the Middle Fork Willamette River by this time. In response, a rehabilitation program was initiated in the upper Middle Fork

Willamette River above Hill's Creek Dam in 1997 by ODFW and USFS, and has continued to present. A more extensive description of the program and the status of bull trout in the Middle Fork Willamette River is provided in the Environmental Baseline (Section 7.1.4) above.

Over time, the USACE has provided significant funding support to the Middle Fork Willamette Bull Trout Rehabilitation Project and the proposed action includes continued support of the project. This support is critical because the program, while showing some success as evidenced by spawning adults in recent years, will need to continue to transplant individuals from the McKenzie River Subbasin in order to increase the likelihood of reestablishing a viable local population of bull trout in this stream.

Although entrainment of bull trout through Hill's Creek Dam has not been documented through recent monitoring, it is a reasonable assumption based on evidence of entrainment of bull trout through Cougar Dam, and a similar program of dam operation, that it is likely occurring and will continue in the short-term under the proposed action. The likelihood of detecting entrained bull trout below Hill's Creek Dam is low due to the small population size above the dam (estimated to be 20 to 30 adults), the limited number of bull trout that are PIT tagged, limited surveys below the dam, and limited visibility due to turbidity that prevents observations by snorkeling.

In the short-term, we expect bull trout entrained through Hill's Creek Dam will continue to be highly susceptible to injury and death. The limited entrainment data at Hill's Creek Dam suggests turbine mortality (of Chinook smolts) is significantly higher than the seven percent mortality rate observed at Cougar Dam, and that regulating outlet mortality rates are similar to that observed by Taylor (2000) at Cougar Dam (approximately 30 percent). Although the Hill's Creek local population has been less intensively monitored than the South Fork McKenzie local population above Cougar dam, especially in the reservoir environment, we expect conditions are similar and that the bull trout that reside in Hill's Creek Reservoir are generally sub-adult and adults. Based on information from Taylor (2000) that correlated fish length with mortality rate, sub-adult and adult bull trout would be expected to have a significantly higher entrainment mortality rate than Chinook salmon smolts due to their greater size. Though information on the rate of entrainment is limited, and based primarily on data collected on the South Fork McKenzie local population of bull trout, we anticipate up to 20 percent of the adult and sub-adult population of bull trout in Hill's Creek Reservoir will be susceptible to entrainment on an annual basis and that all entrained individuals would be subject to injury or death.

As part of the COP, described as a NMFS RPA measure in Section 5.3.11 above, the Action Agencies will assess the feasibility of interim and permanent fish passage and water temperature control at a number of Willamette Project dams, including the three dams in the Middle Fork Willamette River. Although it is likely that some degree of interim fish passage and water temperature control may be achieved at Middle Fork Willamette dams over the timeframe of this BO, the only permanent structural measure agreed to in the proposed action, as modified by the NMFS RPA, is downstream fish passage at Lookout Point Dam by 2022.

ii. Effects of the Action on Potential Expansion of Bull Trout in the Middle Fork Willamette Below Hill's Creek, Lookout Point, and Dexter Dams

As noted above, bull trout that reside above Hill's Creek Dam are likely entrained and though undocumented, may currently inhabit the downstream river reaches of the Middle Fork Willamette River. It is largely unknown whether suitable spawning and juvenile rearing habitat exists for bull trout in tributaries of the Middle Fork Willamette River downstream of Hill's Creek Dam, but the Draft Recovery Plan (USFWS 2005) identified Salt Creek, Salmon Creek, and the North Fork of the Middle Fork Willamette River as tributaries that may be suitable for future reintroduction efforts or population expansion.

In order to assess the potential for bull trout to reproduce below Hill's Creek Dam, the proposed action included a habitat suitability study that would assess the suitability of current habitat to support bull trout spawning and early juvenile rearing. Restoring viable bull trout populations in current and historical habitat is one of the five conservation needs identified for bull trout in the Willamette Basin (USFWS 2005). Until it is confirmed that current habitats in tributaries below Hill's Creek Dam are suitable for bull trout spawning and rearing, or until a fish collection facility or program are in place to capture and move entrained bull trout back above Hill's Creek Dam (not currently in the proposed action, as modified by NMFS RPA), we assume that bull trout that survive entrainment through the dam will not contribute to future establishment of a viable local population of bull trout in the Middle Fork Willamette River (i.e., are lost to the local population above the dam and will not contribute to the establishment of a local population below the Hill's Creek dam).

Although we make no assumptions at this time about the ability of tributaries below Hill's Creek Dam to support spawning and early juvenile rearing of bull trout, we determined in Chapter 5 of the *Draft Recovery Plan*, and in the final critical habitat designation, that the Middle Fork Willamette River below Hill's Creek Dam extending downstream past Lookout Point and Dexter dams to the Willamette River, is FMO habitat important to the recovery of bull trout in the Willamette Basin Management Unit. However, for this habitat to be functional for bull trout, access to suitable spawning and juvenile rearing habitat will be required. At this point, suitable spawning and rearing habitat has been identified only above Hill's Creek Dam, in the Middle Fork Willamette Subbasin, and in the upper McKenzie River Subbasin.

One of the other five conservation needs identified for bull trout in the Willamette Basin is connectivity among local populations of bull trout in the McKenzie and Middle Fork Willamette rivers (Upper Willamette Core Area). In the Middle Fork Willamette, connectivity to local populations in the McKenzie River Subbasin will require upstream and downstream fish passage at Hill's Creek, Lookout Point, and Dexter dams. The proposed action, as modified by the NMFS' RPA, committed to constructing downstream fish passage at only Lookout Point Dam (2022). However, the Action Agencies have proposed to investigate the technological feasibility and biological need for additional fish passage in the Middle Fork Willamette River (as well as water temperature control) and they have proposed to seek authorization and funding if feasibility studies determine they meet those criteria.

Bull trout that reside in Lookout Point Reservoir or stream reaches between Lookout Point and Hill's Creek dams, would be expected to experience similar affects as described above for bull trout residing in Cougar and Hill's Creek reservoirs. Aquatic habitat in the reach of the Middle Fork Willamette River between Hill's Creek Dam and Lookout Point Reservoir is heavily

influenced by the presence of Hill's Creek Dam and operations associated with releases of water from Hill's Creek Dam. The operation of Hill's Creek Dam has altered, and will continue to alter in the short-term under the proposed action, as modified by NMFS' RPA, the natural temperature and flow regime below the dam, as well as sediment and large wood delivery and recruitment below the dam. The disruption of these habitat processes, as a result of project operations, have caused, and will continue to cause, stream channel simplification including reductions in side channels and the quality and quantity of pool habitat important for bull trout foraging, overwintering, and migration. The altered temperature regime is expected to negatively affect stream productivity by reducing the diversity and abundance of aquatic invertebrates that bull trout (and bull trout prey species) feed upon, as well as temperature cues that drive bull trout biological processes such as spawning, spawning migration timing, foraging, and overwintering. In the short-term these effects are expected to limit the suitability of FOM habitat for bull trout that may now, or likely will in the future, occupy the mainstem reaches and reservoirs of the Middle Fork Willamette River below Hill's Creek Dam.

In summary, the operation of Dexter, Lookout Point, and Hill's Creek dams in the short-term will continue to maintain degraded habitat conditions below and between these dams. While these conditions may support foraging, overwintering, and to a degree, migration of bull trout, the current and near-term condition of this habitat may limit the carrying capacity and reestablishment of viable bull trout populations in the Middle Fork Willamette River. The operation of Hill's Creek Dam in the short-term is expected to harm bull trout by entraining individuals through the turbines or regulating outlets and through the disruption of breeding, feeding and sheltering from altered flow and temperature regimes and associated habitat impacts below the dams.

We expect the operation and maintenance of USACE's dams in the Middle Fork Willamette River Subbasin to cause adverse effects to bull trout and bull trout habitat over the timeframe of the proposed action. However, we also believe that implementation of the conservation measures in the proposed action, as modified by NMFS RPA, will contribute significantly to the recovery of bull trout in the Upper Willamette Core Area by providing: (1) improved connectivity (i.e., downstream fish passage) between local populations in the McKenzie and Middle Fork Willamette rivers; (2) interim measures to address access to, and potential recolonization of, bull trout historical habitat in other areas of the subbasin below Hill's Creek Dam; (3) restoration of an important component of the historical forage base by reestablishment of Chinook salmon above Lookout Point and Hill's Creek dams; and (4) restoration of bull trout foraging, overwintering, and migratory habitat in the mainstem river reaches between Hill's Creek Dam and the mainstem Willamette River by implementation of water temperature control, alternative flow management, and habitat restoration actions that include large wood and gravel supplementation.

8.1.3 Other Direct and Indirect Effects of the Proposed Action on Bull Trout

a) Sport Angling and the USACE's Resident Trout Mitigation Program

Sport angling has the potential to directly and indirectly impact bull trout in the Upper Willamette Core area in several ways. Bull trout are aggressive feeders and have a reputation for

being easily caught. Even when individual harvest limits are set to zero (i.e., catch and release only), a combination of hooking mortality and noncompliance may lead to fishing mortality rates that are not sustainable if angling effort is sufficiently high (Post et al. 2003). Although angling for bull trout in the Willamette Basin is prohibited, bull trout are regularly caught in the McKenzie and Middle Fork Willamette rivers and in several reservoirs in these subbasins by anglers fishing for other species of salmonids (e.g., rainbow and cutthroat trout).

Currently there are numerous locations within the Upper Willamette Core Area where hatchery rainbow trout are stocked by ODFW in areas occupied by bull trout. These areas include: Hill's Creek Reservoir and the Middle Fork Willamette River upstream of Hill's Creek Reservoir; the middle and upper mainstem McKenzie River; and, Trail Bridge Reservoir in the upper McKenzie River. Although all rainbow trout stocked in these areas are finclipped, thereby identifying them as hatchery fish, potential impacts to bull trout occur by anglers concentrating in areas stocked with hatchery trout. The concentration of anglers increases the likelihood of incidental catch of bull trout, increases the potential for misidentification, and increases the potential for poaching. Other potential impacts to bull trout include competition and predation by hatchery rainbow trout, especially if hatchery rainbow trout are stocked in areas utilized by rearing juvenile bull trout (e.g., Trail Bridge Reservoir and the upper McKenzie River below Trail Bridge Dam).

To address impacts to bull trout from sport angling, ODFW has changed angling regulations in areas occupied by bull trout in the Middle Fork Willamette and McKenzie river subbasins. Regulations now prohibit angling for bull trout, require the release of all wild (unmarked) trout, and prohibit angling with bait (i.e., flies and lures only). These regulation changes, combined with programs implemented by ODFW and the USFS to educate anglers about bull trout, have likely limited, but not eliminated, sport angling impacts to bull trout.

In the South Fork McKenzie River, the rebound of the bull trout local population from critically low numbers in the late 1990s has been attributed in part to the elimination of the hatchery trout stocking program and the resulting decrease in angling pressure. Although speculative, the significant increase in redds in 2007, (a count of 54, up from 34 in 2006) in Roaring River may be reflective of the significant increase in production observed from 1999 to 2001, that was attributed in part to the elimination of the hatchery trout stocking program in the South Fork McKenzie River (i.e., fry produced from 1999 to 2001would just now be reaching maturity) (Greg Taylor, fish biologist, USACE, pers. comm. November, 2007).

As noted in the proposed action, the USACE funds ODFW to propagate and release rainbow trout throughout the Willamette Basin to mitigate for lost angling opportunities for resident trout by the construction and operation of Willamette Project dams. Rainbow trout are propagated and raised at Leaburg and Willamette hatcheries in the McKenzie and Middle Fork Willamette subbasins. Although the Supplemental BA identified the Resident Trout Mitigation Program as having potential effects to ESA listed anadromous fishes (predation, competition, disease), there was no mention of potential impacts to bull trout. We believe the Resident Trout Mitigation Program, when implemented in areas occupied by bull trout, is likely causing harm and mortality due to a tendency to concentrate sport anglers thereby increasing the likelihood of incidental catch, misidentification, and poaching, as well as subjecting young bull trout to predation and competition from hatchery rainbow trout. In the Supplemental BA, the Action Agencies

acknowledged a need for program reform and to that end, proposed to conduct short-term RM&E and to phase in reform over the next five years.

8.2 Effects of the Action to Bull Trout Critical Habitat

As noted frequently in this BO, the implementation of many conservation measures in the revised proposed action, as modified by the NMFS' RPA, is reliant on the outcome of feasibility studies and the procurement of authorizations and appropriations. Consequently, our analysis of effects of the proposed action on designated critical habitat requires an assumption that significant changes to the operation of the Project (e.g., alternative flow management, fish passage, development of water temperature control, and habitat restoration actions) will be funded and implemented in the 15-year timeframe of the proposed action. However, it is unlikely many significant conservation measures will be implemented in the short-term (0-5 years) thus our analysis considers the effects of implementing short-term and long-term (approximately 5-15 years) components of the proposed action.

As noted above in the Environmental Baseline section, critical habitat for bull trout is designated for one hundred and eleven miles of streams in the Upper Willamette Core Area (Figure 7.1 above), the majority of which comprises mainstem river reaches below Willamette Project dams in the McKenzie and Middle Fork Willamette rivers. No spawning or juvenile rearing habitat is included in the critical habitat designation as this habitat is on USFS lands excluded from the final designation due to pre-existing management plans.

The following table summarizes the environmental baseline and the probable short and long-term effects of the proposed action on designated bull trout critical habitat:

Table 8.0. Effects of the Action on Designated Bull Trout Critical Habitat

PCE#	Primary Constituent Element	Baseline Condition	Effect of the Action	
			Short-term	Long-term
1	Water temperatures that support bull trout use -temperatures ranging from 36 to 59 ºF (2 to 15 ºC).	South Fork and mainstem McKenzie River water temperatures sufficient for bull trout FOM needs. Currently degraded baseline, at least seasonally in Middle Fork Willamette River due to altered temperature regime from operation of USACE dams.	Interim WTC measures at mainstem Middle Fork Willamette River expected to improve conditions over baseline.	Interim and permanent WTC features and/or operational modifications at the three mainstem Middle Fork Willamette River dams will significantly improve conditions over baseline.

PCE#	Primary Constituent Element	Baseline Condition	Effect of the Action	
			Short-term	Long-term
2	Complex stream channels with features such as woody debris, side channels, pools, and undercut banks to provide a variety of depths, velocities, and instream structures.	Degraded baseline in both the McKenzie and Middle Fork Willamette rivers. Construction and operation of flood control and hydropower dams trap sediment and large woody debris and reduce peak flow events important to maintain and create channel complexity. The result is a relatively static and simplified riverine aquatic habitat below dams that has a low capacity for bull trout.	Pulse flows, LWD and other habitat restoration projects may incrementally improve conditions over baseline. No significant improvements expected.	Alternative flow management and habitat restoration actions expected to improve conditions over baseline but not significantly.
3	Substrates of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival.	Critical habitat in the action area does not support this bull trout PCE.	No effect	No effect
4	A natural hydrograph, including peak, high, low, and base flows or, if regulated, currently demonstrates the ability to support bull trout populations.	Generally degraded hydrograph in the McKenzie though current FOM conditions support the mainstem McKenzie local population of bull trout. Degraded hydrograph in the Middle Fork Willamette River – ability of this PCE to support bull trout FOM unknown.	Incremental improvements over baseline expected from implementation of mainstem and tributary flow targets, alternative flow strategies, and revised ramping criteria.	Proposed action not likely to appreciably improve conditions over baseline unless significant operational changes are made at one or more dams (e.g., run of river operation).

PCE#	Primary Constituent Element	Baseline Condition	Effect of the Action	
			Short-term	Long-term
5	Springs, seeps, groundwater sources, and subsurface water to contribute to water quality and quantity as a cold water source.	Critical habitat in the action area does not support this bull trout PCE.	No Effect	No Effect
6	Migratory corridors with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows.	Degraded baseline condition in both the McKenzie and Middle Fork Willamette rivers. Three of four bull trout local populations isolated above dams. Lack of access to historical FOM habitat. Lack of passage at numerous dams within and outside designated critical habitat.	Proposed operation of trap and haul facility at Cougar Dam will provide partial (upstream) passage for bull trout – significant improvement over baseline condition. Passage feasibility studies will inform long-term actions.	Known future construction of downstream passage at Cougar and Lookout Point dams will greatly improve conditions over baseline.
7	An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.	Significantly degraded baseline. Altered flow and temperature regimes below dams (and associated habitat effects) along with migratory blockage of anadromous fish at impassable dams have significantly impacted the productivity of stream reaches within bull trout critical habitat.	Proposed continuation of the Chinook salmon outplant program above Project dams will improve baseline condition by providing forage base and improved stream productivity by inputs of marine derived nutrients from salmon carcasses.	Assumed implementation of passage and water temperature control projects, along with alternative flow management would be expected to significantly improve conditions over baseline.

PCE#	Primary Constituent Element	Baseline Condition	Effect of the Action	
			Short-term	Long-term
8	Permanent water of sufficient quantity and quality such that normal reproduction, growth, and survival are not inhibited.	As note above in PCE# 1 & 4, the quantity and quality of flow is negatively affected by flood control management that has altered the natural flow and temperature regimes in the McKenzie and Middle Fork Willamette rivers.	Incremental improvements over baseline expected from implementation of mainstem and tributary flow targets, alternative flow strategies, and revised ramping criteria.	Proposed action not likely to appreciably improve conditions over baseline unless significant operational changes are made at one or more dams (e.g., run of river operation).

8.2.1 Summary of Effects of the Proposed Action on Designated Critical Habitat

The proposed action, as modified by the NMFS' RPA, is anticipated to maintain the majority of PCEs in their currently degraded condition, albeit with minor improvements to some in the short-term (0-5 years). However, over the full timeframe of the proposed action (15 years), interim and permanent measures to address fish passage, water temperature control, and alternative flow management will markedly improve many PCEs over baseline conditions.

8.3 Effects to Oregon Chub

As noted in the Environmental Baseline section above, the Oregon chub evolved in a dynamic network of slack water habitats in the floodplain of the Willamette River. Major alteration of the Willamette River for flood control and navigation improvements eliminated a large proportion of the River's historic floodplain. This alteration has also impaired or eliminated the environmental conditions in which the Oregon chub evolved. Many of the remaining suitable habitats have been invaded by non-native fish predators and competitors. Since non-native fishes out-compete Oregon chub, the recovery strategy has focused on managing Oregon chub habitats in isolation. This approach has been successful in the short-term but has potential long term genetic consequences (Scheerer et al. 2006).

The proposed action includes a number of conservation measures which, when implemented, are anticipated to better secure Oregon chub on USACE lands, minimize adverse affects to chub and chub habitat caused by flow management (i.e., high and low flows) below Willamette Project dams, minimize effects to populations impacted by reservoir management, and potentially restore habitat and habitat processes that would promote Oregon chub recovery in historic habitat throughout the Upper Willamette River mainstem and the five major subbasins where they are currently found. The proposed action also includes continued support of RM&E of Oregon chub populations on USACE lands.

Indirect effects of the proposed action include the alteration of habitat-forming processes. Reduction in the magnitude and frequency of floods alters the natural processes which create

backwater, slough and side channel habitats for Oregon chub. The change in flow regime also eliminates the natural mechanism for dispersal of Oregon chub to new sites within the Willamette Basin. Revetments eliminate habitat complexity within the channel which may have provided backwaters for Oregon chub. Reductions in riparian habitats and large wood in stream channels eliminate major sources of slow water habitats for Oregon chub.

The reservoirs behind the USACE dams may also provide habitat or a point of introduction for non-native fishes, which may either prey on or compete with Oregon chub. The introduction of non-native fishes in the Willamette Basin has complicated the effects of the natural process of flooding. Since the introduction of non-native fishes, floods have acted as a dispersal mechanism for non-native fishes as well as for Oregon chub (Scheerer and McDonald 2000). Thus, given the intractability of non-native fishes, flood control provided by the USACE dams may actually provide a benefit to Oregon chub by preventing floods which would disperse non-native fishes into isolated Oregon chub habitats.

The following section describes effects of the proposed action to Oregon chub and Oregon chub habitat by each major Recovery Area:

8.3.1 Mid-Willamette Recovery Area (Includes the McKenzie River Subbasin)

Continued operation of Cougar and Blue River dams and the maintenance of revetments have both negative and positive effects to Oregon chub in the McKenzie River Subbasin. The Big Island population occurs in side channels of the McKenzie River and may be directly affected by flow management at the dams. Project-related changes in water levels could affect the quality of the habitat for Oregon chub. Oregon chub may be adversely affected by the proposed flow management if such changes delay the onset of mating or affect growth rates. Eggs or juveniles could be stranded or killed if habitat is dewatered by rapid changes in release rates from the dams.

The operation of the Willamette Project and associated activities will have no effect on the two populations of Oregon chub at Russell Pond and Shetzline Pond in the Mohawk River drainage, a tributary of the lower McKenzie River. In addition, the proposed action will have no effect on the Display Pond and Gray Swamp populations at William L. Finley National Wildlife Refuge, and the Dunn Wetland population. These sites are isolated and occur on small tributaries to the mainstem Willamette River.

8.3.2 Santiam River Recovery Area

At present, five populations of Oregon chub are known to occur in the North Santiam Subbasin. All of the known populations are downstream of Detroit and Big Cliff Dams and occur in off-channel habitats. Most of the populations are hydrologically connected to the river, and are thus affected by flow management in the North Santiam River.

Releases from Big Cliff Dam into the North Santiam River directly affect water level and temperature in the North Pond at Geren Island, which harbors the largest population of Oregon chub in the North Santiam Subbasin. When the flow measured at Mehama (upstream of Geren

Island) falls below 2,000 cfs, water levels drop and temperatures rise, harming Oregon chub by increasing the suitability of the habitat for warm water non-native species that predate on Oregon chub.

All of the other known chub habitats in the North Santiam Subbasin are sloughs or backwater areas that have a connection to the river. Water releases from the dams may affect the quantity and quality of habitat, and in turn affect survival and spawning success in those habitats.

There is one population of Oregon chub in the South Santiam Subbasin, Foster Pullout Pond. It is above Foster Reservoir at a site not affected hydrologically by the operation of the USACE dams. The continued operation of the Willamette Project and associated activities are not likely to have any direct effects on Oregon chub in the South Santiam Subbasin.

Releases from Green Peter and Foster dams could have small, indirect effects on Oregon chub downstream in the mainstem Santiam at the Santiam I-5 Backwater population. Timing, amount, and temperature of releases from the dams may harm chub at these locations by impairing essential behavior patterns, including breeding, feeding, and sheltering, but the magnitude of these effects has not been investigated and is unknown.

8.3.3 Middle Fork Willamette River Recovery Area

There are 14 Oregon chub populations in the Middle Fork Willamette River recovery area. Four of the populations are unaffected by the operation of the USACE dams (i.e., East Fork Minnow Creek Pond, Shady Dell Pond, Buckhead Creek Enhancement Ponds, and Wicopee Pond). These populations occur on small tributaries, or are in isolated backwater or side channel habitats.

Three populations occur in habitats directly connected to Dexter and Lookout Point reservoirs. The operation of Dexter Reservoir affects Oregon chub found in two of the five alcoves on the south side of the Reservoir. The water level in Dexter Reservoir and the alcoves fluctuates daily by as much as five feet, with fluctuations averaging 1.5-3.5 feet during the chub's spawning season (Scheerer and McDonald 2000). As much as 50 percent of the vegetation in one of the alcoves is exposed when the reservoir drops (Scheerer and McDonald 2000). Oregon chub lay their eggs on vegetation in the shallow portions of the alcoves. As water level in the reservoir drops, the shallows are dewatered, and eggs may die; Oregon chub individuals in the shallows could be stranded and killed. Thus, operation of Dexter Reservoir has direct adverse effects on Oregon chub reproduction. In addition, Oregon chub may be adversely affected by predation from non-native fish present in Dexter Reservoir that can access the alcoves through the culverts that connect these habitats. The 2007 population estimate for these two Oregon chub populations was 4,020 (Dexter #3) and 1,130 (Pit #1) (Scheerer et al. 2007). Based on seasonal reservoir management, daily ramping, and potential predation and competition impacts from non-native fishes, we anticipate the proposed action, as modified by the NMFS' RPA, has the potential to harm all the Oregon chub that comprise these two populations.

Seasonal fluctuations in the level of Lookout Point Reservoir affect the Oregon chub population in Hospital Pond in a very different manner. Hospital Pond is a cold, spring-fed pond which is

connected to the reservoir by a culvert when the water level in the reservoir is above 917 feet (full pool is 926 feet) (P. Scheerer, Oregon Department of Fish and Wildlife, Corvallis, Oregon, pers. comm. August, 2000). When the reservoir is full, the pond area is at its greatest (about 4,400 m^2), and maximum depth is up to 5 m. When the reservoir drops below the level of the culvert (i.e., 917 feet), ponded area and depth are reduced. Temperature in the chub pond is also significantly affected by input from the reservoir. When the reservoir level is above 920 feet, shallow benches in Hospital Pond are flooded, which then warm up with exposure to solar radiation. Research during 1998 showed that Oregon chub only spawned successfully in Hospital Pond when the reservoir level exceeded 920 feet and when pond temperatures exceeded 15-16°C (Scheerer and McDonald 2000). This research also showed that Oregon chub growth rate in the pond was highest when water levels were warmer. Oregon chub population estimates at Hospital Pond were lowest in 1993 (n=690) and 1995 (n=780), the years following seasons when the reservoir did not fill (1992 and 1994), indicating that recruitment was poor or non-existent in those years (Scheerer and McDonald 2000).

Recent attempts to install a barrier which would allow the water level in Lookout Point Reservoir to be varied without effect to Hospital Pond have had limited success. In early 2003, the USACE undertook another project to increase spawning habitat in Hospital Pond by excavating a "spawning cove" on a bench in the pond; in April 2003, chub were observed in the new spawning cove (P. Scheerer, ODFW, pers. comm., 2003). In recent years, monitoring has shown that modifications to un-couple reservoir elevations in Lookout Point from water levels in Hospital Pond have been generally unsuccessful.

In years of abundant water, Lookout Point Reservoir may remain full long enough to warm the temperatures of Hospital Pond and promote strong recruitment of Oregon chub. However, considering the flow management objectives in the proposed action, as modified by the NMFS' RPA, and the need to balance water needs across the Willamette Basin to meet mainstem and tributary flow targets, we anticipate there will be few if any years under the term of this BO, that Lookout Point Reservoir is managed at full pool into the summer months. As a result, we expect the proposed action, as modified by the NMFS' RPA, will harm on an annual basis the entire Hospital Pond population of Oregon chub by significantly impacting habitat conditions that impair breeding, feeding and sheltering. We expect this harm to limit the productivity and perhaps ultimately the persistence of this Oregon chub population. The trade-off however, is that the Action Agencies will have greater flexibility to manage, and ultimately balance, tributary flows throughout the Willamette Project to the benefit of other Oregon chub populations, and other listed fish species.

The Oregon chub populations at Barnhard Slough, Berry Slough and North Slough at Elijah Bristow State Park are in backwater and side channel habitats that have connections to the Middle Fork Willamette River. Changes in flow regime caused by the operation of Willamette Project dams will have direct effects on habitat quantity and quality for the chub. Oregon chub or their eggs may be harmed or killed if water levels in the sloughs and backwaters fluctuate during the spawning season, resulting in desiccation or intolerable temperatures. The proposed action includes experimentation with seasonal pulse flows and other alternative flow management actions to mimic historic conditions and to promote channel disturbance and other habitat processes that create and maintain fish habitat. The effects of these flow actions on

Oregon chub populations below Dexter Dam are unknown. Depending on the magnitude and duration of the experimental flows, chub populations could be redistributed or connected, and/or they could be influenced by an invasion of non-native fishes. The magnitude of these potential effects to Oregon chub and chub habitat has not been investigated and is unknown and unpredictable. However, we expect the flow management actions under the proposed action, as modified by the NMFS' RPA, to be appropriately monitored via the flow RM&E program.

The Oregon chub population at the Fall Creek Spillway Ponds sits below the spillway of Fall Creek Dam. To date, the operation of Fall Creek Dam has not had an effect on the population, because the spillway has never been used. We do not anticipate any effects to chub from the continued operation of Fall Creek Dam, unless water is released over the spillway. If that were to occur, we could reasonably expect that the pond would be scoured out and all Oregon chub in the pond (estimated at 2,740 individuals in 2007) would be killed immediately or flushed down river, where they would be prey for exotic fish. In recent years, the drafting of Fall Creek Reservoir earlier in the year to meet downstream flow targets has resulted in less water percolating through the spillway and thus the lower Fall Creek Spillway Pond has dried up. The reduction in available habitat at this site has resulted in a decline in the population size of Oregon chub. The flow management component of the proposed action, as modified by the NFMS' RPA, and its emphasis on meeting tributary and mainstem flow targets and increasing early season flows, is expected to harm Oregon chub in the Fall Creek Spillway Ponds by limiting available habitat thus impacting the population size and stability of this population over the term of the proposed action.

8.3.4 Coast Fork Willamette River Subbasin

Habitat in the Coast Fork is highly degraded, and at present, Oregon chub are known to occur at only three sites in the subbasin, two of which are hydrologically connected to the Coast Fork Willamette River. The remaining site, Herman Pond, is isolated from the Coast Fork on USFS property. The two Oregon chub populations (approximately 82 individuals combined in 2007) that exist in side channels of the Coast Fork could be harmed by fluctuating water levels and temperatures caused by the operation of Dorena and Cottage Grove dams, although the extent to which this happens has not been investigated and the effects to Oregon chub, are unknown.

8.3.5 Oregon Chub Populations Most Likely to be Affected by High and Low Flows

Much of the concern regarding effects of the proposed action, as modified by the NMFS' RPA, on Oregon chub pertains to flow management and effects to chub populations from low and high water. Low water impacts will be most prevalent during years of insufficient or deficit water years (see Table 5.1 in the Proposed Action section above). During those years, the Action Agencies have proposed to utilize the Oregon chub drought contingency plan (Appendix A of this BO), a document developed by ODFW in 2001, to address the low water issues that were prevalent that year. While we believe much more RM&E should occur to inform management of Oregon chub and impacts from Willamette Project flow management, the drought contingency plan constitutes the best available information on the relationship between flow levels and Oregon chub populations.

The following sites (Table 8.1) are occupied by Oregon chub and are likely to be affected by low flow management during insufficient or deficit water years or by high flow "pulses" or other high flow management alternatives (P. Scheerer, fish biologist, ODFW, pers. comm., November, 2007):

Table 8.1. Oregon Chub Populations Susceptible to USACE Flow Management

Subbasin	Low Flow Conditions	High Flow Conditions
Santiam River	Gray Slough	all sites except Foster Pullout Pond
	Stayton Public Works Pond	
	Santiam I-5*	
	Green's Bridge	
McKenzie River	Big Island*	Big Island
	Green Island	Green Island
Middle Fork Willamette River	Elijah Bristow sites,* especially the Gravel Pits and Island Pond	Elijah Bristow sites*
	Dexter Alcoves	Haws Pond
	Fall Creek Spillway Ponds	Barnhard Slough
		Fall Creek Spillway Ponds (if spill occurs)

* shaded cells represent those populations most vulnerable to high and low flow management

In summary, the proposed action will continue to affect Oregon chub in both negative and positive ways. Flood control activities will continue, especially in the short-term, to suppress floodplain function and the complex channel forming processes that the species evolved under. At the same time, the impacts of non-native species will continue to be held in check by flood control operations that limit the expansion of non-natives caused by flooding. Reservoir operations will continue to negatively affect some Oregon chub populations by exposing them to predatory non-native species, and by ramping and/or seasonal flow management which limits habitat availability and productivity. It is expected that long-term floodplain restoration actions, along with alternative flow management, may create opportunities for the expansion of Oregon chub into additional habitats that more closely mimic those under which the species evolved. Under the proposed action, alternative flow management, in particular flood pulses to promote channel dynamics and the creation of new aquatic habitat, may cause a redistribution of some Oregon chub populations and non-native fishes. Whether these affects will be positive or negative are unpredictable at this time.

8.4 Effects of Interrelated or Interdependent Activities

As discussed in Section 7.4 above, the construction and operation of the Willamette Project, in combination with the construction and maintenance of revetements, has facilitated floodplain development, urbanization and rural development due to the annual protections against flooding. We cannot assume, however, that all floodplain development, urbanization, and rural development in the past, and into the future under the proposed action, as modified by the

NMFS' RPA, is due to the construction and operation of the Willamette Project since a great deal of development occurred before the Project was completed despite the known risk of flooding (USACE 2000). For purposes of this analysis we assume that some incremental increase in floodplain development, urbanization, and rural development within the floodplains of the action area would not occur but for the proposed action, as modified by the NMFS' RPA, because of its significant influence on controlling floods with dams and revetments. However, the magnitude of such effects cannot be quantified.

9. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Information on specific planned or foreseeable non-Federal activities was not provided in the BA, and the FWS is not aware of any significant future new (or changes to existing) State and private activities within the action area. The FWS assumes that management impacts from non-Federal activities which have degraded or hindered the conservation of listed species in the action area will continue in the short-term at similar intensities as in recent years. This assumption may be conservative in the long-term, given development of non-Federal conservation programs, such as the Oregon Plan for Salmon and Watersheds, and possible development of habitat conservation plans, safe-harbor agreements, or other conservation agreements with non-Federal entities to fulfill the requirements of section 10 of the Act.

State, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives. Non-federal government and private actions may include changes in land and water use patterns, including ownership and intensity, any of which could affect listed species or their habitats. Even actions that are already authorized are subject to political, legislative, and fiscal uncertainties. These realities, added to the geographic scope of the action area, which encompasses numerous government entities exercising various authorities and many private landholdings, make any analysis of cumulative effects difficult and speculative. This section identifies representative actions that, based on currently available information, are reasonably certain to occur. It also identifies goals, objectives and proposed plans by the State of Oregon. However, the FWS is unable to determine at this point in time whether such proposals will in fact result in specific actions, with specific impacts to bull trout or Oregon chub.

9.1 State Actions

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

- Oregon Department of Agriculture water quality management plans;
- Oregon Department of Environmental Quality development of total maximum daily loads (TMDLs) in targeted basins and implementation of water quality standards;
- Oregon Watershed Enhancement Board funding programs for watershed enhancement programs, and land and water acquisitions;
- ODFW and OWRD programs to enhance flow restoration;
- OWRD programs to reduce over-appropriation of water sources;
- ODFW and Oregon Department of Transportation programs to improve fish passage and

culvert improvements/replacements;

- Oregon Department of Forestry state forest habitat improvement policies and the Board of Forestry pending rules addressing forestry effects on water quality and riparian areas;
- Oregon Division of State Lands and Oregon State Parks Department programs to improve habitat health on state-owned lands;
- Department of Geology and Mineral Industries program to reduce sediment runoff from mines.

If these programs are implemented, they may improve habitat features considered important for Oregon chub and bull trout in the Willamette River Basin. The Oregon Plan also identifies private and public cooperative programs for improving the environment for listed aquatic species. The success and effects of such programs will depend on the continued interest and cooperation of the parties. One such cooperative program, the Willamette Restoration Initiative (WRI), was charged with developing the Willamette Basin section of the Oregon Plan.

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

Economic diversification has contributed to population growth and movement in the Willamette Valley, a trend likely to continue for the next few decades. Such population trends will: (1) result in greater overall and localized demands for electricity, water, and buildable land in the action area; (2) will affect water quality directly and indirectly; and (3) will increase the need for transportation, communication, and other infrastructure. The impacts associated with these economic and population demands will probably affect habitat features such as water quality and quantity, which are important to the survival and recovery of the bull trout, Oregon chub, and other listed species in the basin. The overall effect will be adverse, unless carefully planned for and mitigated.

Some of the state programs described above are designed to address these impacts. Oregon also has a statewide, land-use-planning program that sets goals for growth management and natural resource protection. These programs may help lessen the potential for the adverse effects discussed above.

9.2 Local Actions

Local governments will probably face similar and more direct pressures from population growth and movement. There will likely be demands for intensified development in rural areas, as well as increased demands for water, municipal infrastructure, and other resources. The reaction of local governments to growth and population pressure is difficult to assess without certainty in policy and funding. In the past, local governments in Oregon generally accommodated growth without regard for how such growth might effect listed fish habitat. Because there is little consistency among local governments regarding current ways of dealing with land use and

environmental issues, both positive and negative effects on Oregon chub, bull trout and their habitats are to be expected throughout the action area.

Local governments in Oregon are considering ordinances to address effects on aquatic and fish habitat from different land uses. Local governments may also participate in regional watershed health programs, although political will and funding will determine participation and, therefore, the effect of such actions on listed aquatic species. Overall, unless beneficial programs are comprehensive, cohesive, and sustained in their application, it is not likely that local actions will have measurable positive effects on listed aquatic species and their habitat and may even contribute to further degradation.

9.3 Private Actions

The effects of private actions on Oregon chub and bull trout are the most uncertain. Private landowners may convert their lands from current uses, or they may intensify or diminish those uses, provided their actions do not result in "take". Individual landowners may voluntarily initiate actions to improve environmental conditions, or they may abandon or resist any improvement efforts. Their actions may be compelled by new laws, or they may result from growth and economic pressures. Changes in ownership patterns will have unknown impacts. Whether any of these private actions will occur is highly unpredictable, and the effects are even more so.

9.4 Summary of Cumulative Effects

Non-Federal actions are likely to continue affecting listed species, including Oregon chub and bull trout, in the upper Willamette River fluvial ecosystem. The cumulative effects in the action area are difficult to analyze, considering the broad geographic landscape covered by this consultation, the geographic and political variation in the action area, the uncertainties associated with government and private actions, and ongoing changes to the region's economy. Whether those effects will increase or decrease in the future is a matter of speculation; however, based on the population and growth trends identified in this section, adverse cumulative effects are likely to increase. Although state, Tribal, and local governments have developed plans and initiatives to benefit listed aquatic species within the action area, they have yet to be implemented or have not been implemented to the point where it has measurably benefited the status of Oregon chub or bull trout.

10. CONCLUSIONS

10.1 Bull Trout

Jeopardy determinations for bull trout are made at the scale of the listed entity, which is the coterminous United States population (64 FR 58910). This follows the April 20, 2006, analytical framework guidance described in the FWS' memorandum to Ecological Services Project Leaders in Idaho, Oregon, and Washington from the Assistant Regional Director – Ecological Services, Region 1. The guidance indicates that a BO should concisely discuss all the effects and take into account how those effects are likely to influence the survival and recovery functions of the affected interim recovery units(s), which should be the basis for determining if the proposed action is "likely to appreciably reduce both survival and recovery of the coterminous United States population of bull trout in the wild."

As discussed earlier in the Status of the Species section of this BO, the approach to the jeopardy analysis in relation to the proposed action follows a hierarchal relationship between units of analysis (i.e., geographical subdivisions) that characterize effects at the lowest level or smallest scale (local population) toward the highest level or largest scale (coterminous listing) of analysis. Table 6.0 in the Status of the Species section shows the hierarchal relationship between units of analysis used to determine whether the proposed action is likely to jeopardize both the survival and recovery of the coterminous United States population of bull trout. As mentioned previously, should the adverse effects of the proposed action not rise to the level where it appreciably reduces both survival and recovery of the species at a lower scale, such as the local or core population, the proposed action could not jeopardize bull trout at the interim recovery unit or the coterminous United States (i.e., range-wide) scale. Therefore, the determination would result in a no-jeopardy finding. However, should a proposed action cause adverse effects that are determined to appreciably reduce both survival and recovery of the species at a lower scale of analysis, then further analysis is warranted at the next higher scale.

Our jeopardy analysis followed the organizational hierarchy depicted in Table 6.0, which identifies the South Fork McKenzie as one of the four local populations in the affected core area. The Upper Willamette Core Area is the only core area potentially affected by the proposed action, as modified by the NMFS' RPA, and is the only core area in the Willamette River Management Unit. The Upper Willamette Core Area is one of 97 core areas in the Columbia River Interim Recovery Unit and one of 121 Core areas identified in the coterminous United States population of bull trout. Three of the four local populations in the Upper Willamette Core Area were determined to be directly affected by the proposed action – the Mainstem McKenzie River and South Fork McKenzie River local populations in the McKenzie River Subbasin, and the Middle Fork Willamette River local population above Hill's Creek Dam in the Middle Fork Willamette River Subbasin. The local population above Trail Bridge Dam in the McKenzie River Subbasin, while not directly affected by the proposed action, is potentially indirectly affected by the continued implementation of the Resident Trout Mitigation Program that is funded by the USACE and implemented by ODFW.

Our analysis evaluated the potential impacts from the proposed action to bull trout and bull trout habitat in the action area beginning at the lowest level or scale in the hierarchy – Mainstem McKenzie, South Fork McKenzie, and Middle Fork Willamette local populations. We determined adverse effects to habitat and bull trout inhabiting these two subbasins are likely to occur, especially in the short-term, but that implementation of conservation measures, as modified by the NMFS' RPA, over the full term of the action (15-years) will significantly minimize adverse project effects and improve conditions over baseline. As a result, we do not believe that the proposed action will appreciably reduce the survival and recovery of bull trout at the scale of the Upper Willamette Core Area, and by extension not likely to appreciably reduce the survival and recovery of bull trout at the Willamette River Management Unit and the larger scale of the Columbia River Interim Recovery Unit. Subsequently, after reviewing the current status of bull trout, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the FWS' biological opinion that the proposed action, as modified by the NMFS' RPA, is not likely to jeopardize the continued existence of the coterminous United States population of bull trout.

Although we expect the Willamette Project will continue to cause adverse affects to bull trout and bull trout critical habitat, we believe implementation of the proposed conservation measures, as modified by the NMFS' RPA, over the 15-year term of the action will significantly improve conditions over baseline for three of the four affected bull trout local populations in the Upper Willamette Core Area. We acknowledge some significant conservation actions that would minimize project effects and contribute to bull trout recovery may not be implemented in the 15-year term of this action based on project scope, balancing priorities with other listed species (i.e., Chinook salmon and steelhead), and funding availability. However, we believe the proposed action, as modified by the NMFS' RPA, and the set of conservation measures it puts in motion represents major steps towards the survival and recovery of the bull trout in the Upper Willamette Core Area that will ultimately contribute to the recovery of the coterminous listed United States population of bull trout.

This non-jeopardy conclusion is further supported by the following:

- Given the current trends in abundance and the minimization measures in the proposed action, as modified by the NMFS' RPA, we believe the likelihood of persistence of bull trout in the Upper Willamette Core Area over the timeframe of the proposed action (15 years) is relatively high.

- The Upper Willamette Core Area is one of 97 core areas in the Columbia River Interim Recovery Unit and one of 121 Core areas identified in the coterminous United States population of bull trout.

- The minimization (i.e., conservation) measures in the proposed action, as modified by the NMFS' RPA, address to varying degrees, the major conservation needs of bull trout in the Willamette Basin which are:

    - <u>Connectivity between isolated bull trout populations:</u> addressed in the short-term by the proposed development and implementation of a genetic management plan,

the operation of an upstream trapping facility and downstream passage facility at Cougar Dam, and system wide fish passage feasibility and reconnaissance studies; and, in the long-term, construction of downstream fish passage at Lookout Point Dam and potential passage measures at Hill's Creek and Dexter dams in the Middle Fork Willamette River.

- Restoration of viable bull trout populations in current and historic habitat: addressed in part by the continued support and cooperation with the current efforts to rehabilitate bull trout in the Middle Fork Willamette River; continued support and cooperation with efforts to monitor bull trout in the South Fork McKenzie River; and, by proposing to inform future reintroduction efforts by conducting habitat suitability assessments in historical habitat.

- Restoration of anadromous fish to restore prey base: addressed in part by the proposal to continue the Chinook salmon outplanting program above Willamette Project dams, including above Cougar Dam in the South Fork McKenzie River, and Hill's Creek Dam in the Middle Fork Willamette River; and addressed in part by the proposed action's objective to increase productivity for anadromous salmonids below Willamette Project dams by operating Cougar Dam WTC and by investigating WTC and habitat restoration projects at and below other Willamette Project dams.

- Restoration (to the degree possible) of normative stream flow and temperature regimes below dams: addressed in part by the proposal to assess the feasibility of achieving interim and long-term water temperature control at priority Willamette Project dams. Also addressed by the proposal to design and implement monitoring and evaluation studies necessary to determine the effects of flow management on downstream habitat conditions, aquatic species and water quality conditions.

- Reduction in the effects caused by entrainment through dams: addressed in part by the proposed operation (beginning in 2010) of a trap and haul fish collection facility and operation of a downstream fish passage facility (2015) at Cougar Dam in the South Fork McKenzie (highest priority fish passage project for bull trout in the Willamette Basin), and operation of a downstream fish passage facility at Lookout Point Dam (2022). Entrainment also addressed by proposed studies investigating the feasibility of providing fish passage (up and downstream) at other high priority Willamette Project dams.

10.1.1 Bull Trout Critical Habitat

Based on the small amount of critical habitat affected (four percent – 111 stream miles) relative to the total amount present in the Columbia River interim recovery unit (3,096 stream miles), and the fact that the proposed action, as modified by the NMFS' RPA, will improve over the term of the action the condition of a number of PCEs over baseline conditions, it is our conclusion that the proposed action is not likely to destroy or adversely modify designated critical habitat.

10.2 Oregon Chub

The proposed action, as modified by NMFS RPA, will continue to affect Oregon chub in both negative and positive ways. Flood control activities will continue, especially in the short-term, to suppress floodplain function and the complex channel forming processes that the species evolved under. At the same time, the impacts of non-native species will continue to be held in check by flood control operations that limit the expansion of non-native fish species caused by flooding. Reservoir operations will continue to negatively affect some Oregon chub populations by exposing them to predatory non-native species, and by ramping and/or seasonal flow management which limits habitat availability and productivity. It is expected that long-term floodplain restoration actions, along with alternative flow management, may create opportunities for the expansion of Oregon chub into additional habitats that more closely mimic those under which the species evolved. Under the proposed action, alternative flow management, in particular flood pulses to promote channel dynamics and the creation of new aquatic habitat, may cause a redistribution of some Oregon chub populations and non-native fishes. Whether these affects will be positive or negative are unpredictable at this time. However, implementation of the Oregon chub conservation measures (Section 5.12.2) in the proposed action, along with implementation of the reasonable and prudent measures and terms and conditions (Section 11.3 below) are expected to provide significant conservation benefits and critical information to minimize adverse Project effects to Oregon chub over the 15-year term of this BO.

Although the proposed action, as modified by NMFS RPA, is expected to adversely affect some Oregon chub populations some years over the 15-year term of this biological opinion, the overall upward trajectory of the species is expected to continue. Recovery efforts to date have succeeded in increasing the number of populations from eight at the time of listing to 35 populations. The recently completed 5-year review (USFWS 2008) concluded that Oregon chub are no longer at risk of extinction and have recently met downlisting criteria outlined in the Oregon chub recovery plan (USFWS 1998).

After reviewing the current status of the Oregon chub, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the FWS' biological opinion that the proposed action, as modified by the NMFS' RPA, is not likely to jeopardize the continued existence of the Oregon chub.

10.3 Summary of Conclusions

It is the FWS' biological opinion that the proposed action, as modified by the NMFS' RPA, is not likely to jeopardize the continued existence of the coterminous United States population of bull trout, or Oregon chub, and will not adversely modify designated critical habitat for bull trout.

11. INCIDENTAL TAKE STATEMENT

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

The measures described below are nondiscretionary and must be implemented by the Action Agencies or applicants, as appropriate, in order for the exemption in section 7(o)(2) to apply. The Action Agencies have a continuing duty to regulate the activity that is covered by this incidental take statement. If the Action Agencies fail to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse. To monitor the impacts of incidental take, the Action Agencies must report the progress of the action and its impact on the species to the FWS as specified in this Incidental Take Statement [50 CFR§ 402.14(I)(3)].

11.1 Amount or Extent of Take Anticipated

The FWS anticipates that continued operation and maintenance of the Willamette Project, as proposed and as modified by NMFS' RPA, will result in take of bull trout and Oregon chub in the form mortality, capture, and forms of harm and harassment, including impairing essential behavioral patterns such as breeding, feeding, or sheltering. The expected incidental take will result from the Project's adverse influence on the following:

- Safe fish passage past Willamette Project dams, connectivity between isolated populations, access to historic and suitable habitat, and historic forage base.
- Natural flow and temperature regimes below Willamette Project dams that create and maintain suitable and productive habitat conditions for native aquatic species.
- Incidental take caused by sport angling, and predation and competition with non-native rainbow trout associated with the Resident Trout Mitigation Agreement.
- Non-native species proliferation and resulting predation impacts to native fish species in reservoir environments behind Willamette Project dams.
- Oregon chub populations vulnerable to seasonal flow management below dams and in Willamette Project reservoirs.

The amount of take expected is difficult to quantify because of the wide ranging distribution of bull trout and Oregon chub, numbers are unknown in any given stream reach at any given time, detection and identification of dead or injured aquatic species is unlikely, losses may be masked by seasonal fluctuations in numbers, and aquatic habitat modifications are difficult to ascribe to particular sources. In addition, the effects of management actions associated with large water projects are largely unquantifiable in the short-term and may only be measurable by assessing long-term effects to the species and habitats. Take of bull trout and Oregon chub caused by the direct and indirect effects to habitat cannot be accurately quantified as a number of fish because the relationship between habitat degrading effects and abundance of fish in the action area is imprecise. Therefore, a specific number of individuals taken cannot be predicted.

The reasonable and prudent measures and implementing terms and conditions below (Sections (11.3. and 11.4) are designed to minimize the impact of incidental take that might otherwise result from the proposed action, as modified by the NMFS RPA. Several of the terms and conditions direct the Action Agencies to conduct studies to help better understand the impacts (i.e., incidental take) from the proposed action on bull trout, Oregon chub, and their habitats. If the results from those studies suggest incidental take is occurring beyond that anticipated and described below in 11.1.1 and 11.1.2, then reinitiation of consultation and review of the reasonable and prudent measures will be necessary.

11.1.1 Bull Trout

Lethal take of bull trout is expected to be limited to entrainment through Cougar Dam in the McKenzie River Subbasin, Hill's Creek Dam in the Middle Fork Willamette River Subbasin, and potentially Lookout Point and Dexter dams if bull trout recolonize or are reintroduced to the Middle Fork Willamette River below Hill's Creek Dam over the timeframe of the proposed action.

Information on entrainment from Cougar Dam (from radio telemetry and PIT tagged individuals) indicates a small but significant number of adult and sub-adult bull trout are entrained through the dam on an annual basis and we expect this entrainment to continue in the short-term. Rates of injury and mortality at Cougar Dam are unknown because dead and injured bull trout are difficult to detect and no formal investigations of entrainment mortality of fish larger than Chinook salmon smolts has occurred. However, based on known adult abundance (41 spawning adults in 2006), PIT tag and telemetry data, and data collected on entrainment of Chinook smolts, we expect up to 10 percent of the adult and sub-adult population may be injured or killed annually from entrainment.

It is also evident that some bull trout survive entrainment through Cougar Dam, and in several cases have been captured and moved back above the dam multiple times. We expect in the short-term up to 10 percent of the adult and sub-adult population may be entrained, and survive, on an annual basis in the short-term. Although there is a temporary program in place to attempt to capture these individuals and move them back above the dam, the trapping and transport of these fish represents harassment that may disrupt normal behavior patterns such as feeding and breeding. Take of bull trout from entrainment at Cougar Dam is expected to continue in the short-term until the completion and operation of the downstream passage facility in 2015. The

downstream passage facility, combined with the proposed operation of an upstream trap and haul facility at Cougar Dam beginning in 2010, is expected to significantly minimize take of bull trout from the proposed action, as modified by the NMFS' RPA.

Based on the entrainment information from Cougar Reservoir, and documentation of adult and sub-adult use of Hill's Creek Reservoir, we assume a significant level of annual entrainment through Hill's Creek Dam will occur under the proposed action, as modified by the NMFS' RPA. High juvenile mortality of Chinook smolts entrained through Hill's Creek Dam (Taylor 2000) suggests injury and mortality of larger fish such as adult and sub-adult bull trout is likely high, and we expect this to continue for the term of the action. The current abundance of adults and sub-adults in this local population is approximately 20 to 30 individuals. We expect up to 20 percent of these individuals may be entrained through Hill's Creek Dam on an annual basis and that all individuals entrained will be subject to injury or death.

Lethal take of bull trout by entrainment at Hill's Creek Dam is expected to continue in the short-term and potentially for the full term of the action. The proposed action, as modified by NMFS' RPA, includes measures to assess the feasibility of constructing downstream passage facilities at Willamette Project dams, including Hill's Creek Dam, by 2015. Further, the NMFS' RPA stipulates that the Action Agencies will assess the feasibility of upstream passage at Willamette Project dams, including Hill's Creek Dam, by 2012, as part of the COP study. Although it is possible, but not probable, that these assessments will lead to construction of interim or permanent passage facilities at Hill's Creek Dam during the 15-year timeframe of this BO, we anticipate lethal take of adult and sub-adult bull trout will continue over the long-term.

We expect an unquantifiable amount of indirect lethal and sub-lethal take of bull trout is likely to occur in the short-term from the annual stocking of non-native rainbow trout (associated with the USACE's Resident Trout Mitigation Program) in areas occupied by bull trout. As discussed in Section 8.1.3.a, the annual stocking of non-native rainbow trout concentrates anglers in areas occupied by bull trout and likely results in increased incidental catch, misidentification, and poaching of bull trout. In addition, the non-native rainbow trout potentially compete and predate on young life stages of bull trout in areas such as the Middle Fork Willamette River above Hill's Creek Dam, and Trail Bridge Reservoir in the upper McKenzie River subbasin. We anticipate that reform of the Resident Trout Mitigation Program in the long-term, as proposed, will result in a reduction in take due to changes in stocking levels, alternative stocking locations, and potentially a redirection of a percentage of annual Resident Trout Mitigation Program funds to bull trout conservation actions.

Sub-lethal take of bull trout, in the form of harm from impairing feeding, breeding and sheltering patterns of bull trout is expected in areas of FMO habitat in the mainstem McKenzie River and the Middle Fork Willamette River below Hill's Creek Dam. As discussed in Section 8.1.1 above, these FMO habitats will continue, in the short-term, to be subject to altered flow and temperature regimes below Willamette Project dams that will continue to limit the productivity, and ultimately the carrying capacity, of these habitats for bull trout. The proposed action, as modified by NMFS' RPA, contains measures we expect will improve flow and temperature regimes in the long-term below dams in the Middle Fork and McKenzie rivers and thus reduce the sub-lethal take we expect will occur in the short-term.

11.1.2 Oregon Chub

In years of insufficient or deficit water years (see Table 5.1 above) it is likely that Oregon chub populations with connections to tributaries influenced by Willamette Project flow management will be subject to take from harm caused by desiccation of habitat. Oregon chub or their eggs may be harmed or killed if water levels in the sloughs and backwaters fluctuate during the spawning season, resulting in desiccation or intolerable temperatures. At least 10 of the 35 extant populations of Oregon chub are susceptible to low flow conditions. Conversely, many of these same habitats, and a few additional habitats (15 out of 35 populations - see Table 8.1 above) are susceptible to high flow conditions which may occur during years of abundant precipitation, seasonal flooding events, or through experimental "pulse-flow" actions to promote channel dynamics and the creation of new aquatic habitat. High flow conditions may cause a redistribution of some Oregon chub populations and non-native fishes. While these actions may ultimately provide additional habitat for Oregon chub, connect isolated populations, and allow for population expansion, there is likely to be some take associated with predation by non-native fishes. In recent years, the drafting of Fall Creek Reservoir earlier in the year to meet downstream flow targets has resulted in less water percolating through the spillway and thus the lower Fall Creek Spillway Pond has dried up. The reduction in available habitat at this site, expected to continue under the proposed action, constitutes take of Oregon chub through harm from impairing feeding, breeding and sheltering patterns.

Take of Oregon chub by harm is anticipated at several locations where they occupy habitats connected to Willamette Project reservoirs, such as at Lookout Point and Dexter reservoirs, or immediately below reservoirs such as at Fall Creek Dam spillway pond. The flow management component of the proposed action, as modified by NMFS' RPA, and its emphasis on meeting tributary and mainstem flow targets and increasing early season flows, will likely result in drafting of Project reservoirs earlier in the water year reducing the amount and quality of habitat available for Oregon chub. In some locations, such as Hospital Pond, Oregon chub recruitment will be limited and growth rates adversely affected, due to a lack of appropriate temperatures that are attained only when Lookout Point Reservoir is managed to remain near full pool through the early summer months.

In other locations, such as Dexter Reservoir, Oregon chub are subject to daily ramping of the reservoir during spawning season which is anticipated to cause take by desiccating eggs that are laid on shallow aquatic vegetation, and the potential to strand and kill individuals along shallow margins. In addition, Oregon chub are likely to be harmed and killed by predation from non-native fish present in Dexter Reservoir that can access the habitats occupied by Oregon chub through the culverts that connect these habitats to the reservoir.

11.2 Effect of the Take

In the accompanying BO, we determined that the level of anticipated take is not likely to result in jeopardy to bull trout or Oregon chub.

11.3 Reasonable and Prudent Measures

The FWS believes the following reasonable and prudent measure(s) are necessary and appropriate to minimize impacts of incidental take of bull trout and Oregon chub:

1. Minimize incidental take of bull trout as a result of isolating bull trout populations and fragmenting bull trout habitat with Willamette Project dams.

2. Minimize incidental take of bull trout resulting from the lack of upstream and downstream fish passage at Willamette Project dams.

3. Minimize incidental take of bull trout resulting from implementation of the USACE's Resident Fish Mitigation Agreement with ODFW.

4. Monitor the status of populations impacted by operation and maintenance of the Willamette Project to evaluate the success of efforts to minimize incidental take of Oregon chub.

5. Minimize incidental take of Oregon chub caused by Willamette Project reservoir fluctuations.

6. Minimize incidental take of Oregon chub from flow management and floodplain restoration actions below Willamette Project dams.

7. Minimize incidental take of bull trout and Oregon chub from construction projects implemented under the proposed action.

11.4 Terms and Conditions

To be exempt from the prohibitions of section 9 of the Act, the Action Agencies must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting and monitoring requirements. These terms and conditions are non-discretionary.

Implementation of the RPMs and TCs in this BO are expected to yield a significant amount of information regarding effects of large water developments on, and basic life history of, Oregon chub and bull trout, and their aquatic habitats in the Willamette Basin. Because there is limited information about the effects of large water developments on fish and fish habitat in general, information gained from implementation of the RPMs and TCs in this BO will likely have conservation utility outside the Willamette Basin. As a result, the FWS will facilitate the dissemination of information gained from implementation of this BO.

<u>To implement reasonable and prudent measure #1 (isolation and fragmentation), the Action Agencies must adhere to the following:</u>

1. a. The Action Agencies proposed the development of a Willamette bull trout genetic management plan (2007 Supplemental BA Addendum) but did not include a timeline or a specific level of funding available for development of the plan. To minimize take, the

Action Agencies shall dedicate funds and conduct the genetic analysis by December 31, 2008 and develop the management plan by June 1, 2009. The genetic management plan shall be developed and implemented in cooperation with ODFW, USFS and the FWS.

A genetic analysis and the development of a genetic management plan for bull trout in the Upper Willamette River will provide valuable information on current gene flow among bull trout populations (several of which are isolated by Willamette Project dams) and baseline information on the genetic health of each population. Most importantly, a genetic management plan will provide appropriate guidance towards stabilizing and possibly increasing the genetic diversity among these at-risk bull trout populations by potentially transferring individuals between isolated local populations above dams to provide artificial connectivity between populations in the absence of safe passage over Willamette Project dams.

1. b. The proposed action included the development of a comprehensive Willamette Basin RM&E program to be developed in coordination with the WATER RM&E Committee in FY 2008, and implemented beginning in FY 2009 (section 3.8, 2007 Supplemental BA). As part of the program, the Action Agencies proposed continued support towards RM&E of Willamette River bull trout (2007 Supplemental BA Addendum) but did not provide a timeline or a commitment of funding for the program. To minimize take, the Action Agencies shall dedicate funds beginning in FY 2009, to develop, and implement annually, a comprehensive RM&E plan for bull trout above and below USACE dams in the McKenzie and Middle Fork Willamette rivers.

In the proposed action (2007 Supplemental BA Addendum) the Action Agencies also committed to continued support of the Middle Fork Willamette River Bull Trout Rehabilitation Project (Middle Fork Project). As such, a portion of the annual bull trout RM&E funds shall be dedicated to supporting the continued implementation and associated monitoring of the Middle Fork Project. The Action Agencies, in coordination with the WATER RM&E Committee, will develop and begin implementing the plan in FY 2008, in cooperation with ODFW, FWS and other members of the Willamette Bull Trout Working Group.

The RM&E program, which includes RM&E of the Middle Fork Project, will minimize take by filling a critical information gap regarding how the Willamette Project's base operations, and measures implemented under the proposed action as modified by NMFS' RPA, will influence bull trout and bull trout habitat under the term of the action (15 years). RM&E information will feed into the COP study and be applied towards the development of revised Project operations and structural modifications that we anticipate will significantly reduce take of bull trout in the long-term.

1. c. The proposed action included the development of a comprehensive Willamette Basin RM&E program to be developed in FY 2008 and implemented beginning in FY 2009 (section 3.8, 2007 Supplemental BA). As part of the program, the Action Agencies proposed to conduct bull trout habitat suitability assessments in the Middle Fork Willamette River below Hills Creek Dam (2007 Supplemental BA Addendum). However, the proposed

action did not include a timeline or a commitment of funds for implementing the study. As a result, the following details are provided and must be adhered to as part of this term and condition:

To assist efforts to potentially reintroduce bull trout into the Middle Fork Willamette River below Hill's Creek Dam, the Action Agencies shall fund habitat suitability assessments (similar in scope to the habitat assessment portion of the 2007 *Clackamas River Bull Trout Reintroduction Feasibility Assessment*) in tributaries of the Middle Fork Willamette River below Hill's Creek Dam. The development of the study plan shall be coordinated by the WATER RM&E Committee in close cooperation with FWS, ODFW and USFS by 2010. The study and subsequent report shall be submitted to the FWS by December 31, 2012.

To implement reasonable and prudent measure #2 (fish passage), the Action Agencies must adhere to the following:

2.a. The Action Agencies proposed to conduct reconnaissance and feasibility studies (described under the COP study in NMFS' RPA) starting in 2008 (section 3.6.3, 2007 Supplemental BA) to determine the biological and technological feasibility of implementing upstream and downstream fish passage at priority Willamette Project dams. Following these studies, the Action Agencies committed to seek authorizations and appropriations to implement fish passage projects determined to be technologically feasible and biologically justified.

The NMFS RPA, which is additive to the proposed action, included the following non-discretionary fish passage related actions:

- Assess downstream juvenile fish passage through Project reservoirs (begin studies in 2008 with field investigations, reports, and NEPA completed by December 2015).
- Assess downstream juvenile fish passage through Project dams (begin studies in 2008 with field investigations, reports, and NEPA completed by December 2015).
- Head-of-reservoir juvenile collection prototype (design, build, and evaluate)
- Cougar Dam downstream passage (operational by 2015)
- Lookout Point Dam downstream passage (operational by 2022)
- Detroit Dam downstream passage (operational by 2024)
- Assessment of interim downstream passage at the above dams and others by April 2011, including seeking authorization (if necessary) and completing design or operational implementation plans for those operations that are deemed feasible. Begin to carry out operations that are feasible by May 2011.

In general, the intent of these assessments and structural and/or operational modifications is to provide safe downstream passage for juvenile salmon and steelhead past Willamette

Project reservoirs and dams. These assessments and structural and/or operational modifications may prove to minimize adverse Project effects to bull trout. However, behavioral and size differences between bull trout and anadromous salmonid juveniles warrant separate consideration. To reduce take on bull trout from entrainment through Project dams, the Action Agencies shall incorporate and fully consider bull trout in the above assessments and structural modifications. This term and condition shall coordinated through the WATER Fish Passage Committee in close coordination with FWS, NMFS, and ODFW.

To implement reasonable and prudent measure #3 (resident fish mitigation), the Action Agencies must ensure that:

3. a. Stocking of hatchery rainbow trout associated with the USACE's Resident Fish Mitigation Program may be adversely affecting bull trout in the McKenzie and Middle Fork Willamette rivers. The Action Agencies shall work cooperatively with ODFW and the FWS to modify the Resident Fish Mitigation Agreement to reduce potential adverse affects from the stocking of hatchery rainbow trout in areas inhabited by bull trout. This may include a reduction in the number of trout produced and/or a change in trout stocking locations. In addition, the USACE and ODFW, in cooperation with the FWS, shall investigate reallocating a portion of the USACE's Resident Fish Mitigation Program funds provided to raise non-native hatchery rainbow trout at Leaburg Hatchery in favor of bull trout conservation activities. This term and condition would be coordinated through the WATER Fish Passage and Hatchery Management Committee.

   Section 8.1.3.a above discusses the USACE's Resident Trout Mitigation Program and the associated annual stocking of non-native rainbow trout in areas occupied by bull trout. Implementing this term and condition will minimize take (incidental catch, misidentification, poaching) we expect occurs when anglers concentrate effort in these areas. We believe it will also minimize take by reducing the potential for predation and competition between stocked rainbow trout and young age classes of bull trout.

To implement reasonable and prudent measure #4 (monitoring), the Action Agencies must adhere to the following:

4. a. The proposed action included the development of a comprehensive Willamette Basin RM&E program to be developed by the WATER RM&E Committee in FY 2008 and implemented beginning in FY 2009 (section 3.8, 2007 Supplemental BA). As part of the program, the Action Agencies proposed continued support towards RM&E of Oregon chub (2007 Supplemental BA Addendum) but did not provide a timeline or a specific commitment to fund the program. As a result the following details are provided and must be adhered to as part of this term and condition:

   The Action Agencies shall provide funds annually to monitor the status of Oregon chub populations potentially influenced by Willamette Project dams. The Action Agencies, in coordination with the Water RM&E Committee, will develop and begin implementing the

plan in FY 2008, in cooperation with ODFW, FWS and other members of the Oregon Chub Working Group.

The RM&E program will minimize take by filling a critical information gap regarding how the Willamette Project's base operations, and measures implemented under the proposed action, as modified by NMFS' RPA, will influence Oregon chub and Oregon chub habitat under the term of the action (15 years). RM&E information will feed into the COP study and be applied towards the development of revised Willamette Project operations and structural modifications that we anticipate will significantly reduce take of Oregon chub in the long-term.

To implement reasonable and prudent measure #5 (secure Oregon chub on USACE lands), the Action Agencies must adhere to the following:

The Action Agencies proposed to better secure the status of Oregon chub on USACE managed property (USACE 2007b) but the proposal lacked specificity or timelines for implementation. As a result the following actions are described and must be adhered to as part of this term and condition:

5. a. The Action Agencies shall provide funds to investigate and implement, if feasible, actions to provide more permanent water to the Fall Creek Dam Spillway ponds (primary pond and lower pond) to maximize available habitat for Oregon chub that inhabit the site. Alternatives to provide more permanent water shall be developed in FY 2009, with implementation of a preferred alternative in FY 2010, in coordination with ODFW and the FWS. A final report shall be submitted to the FWS by December 31, 2010.

   Implementation of this measure is expected to reduce take of Oregon chub caused by seasonal reductions in habitat quality and quantity caused by management of Foster Reservoir.

5. b. The Action Agencies shall provide funds to investigate and implement, if feasible, actions to minimize Dexter Reservoir ramping effects on Oregon chub that inhabit the Dexter Alcove ponds. Alternatives to minimize ramping effects may include modifying culverts, installing stand-pipes, or excavating the ponds to a deeper depth. Associated with these actions, the Action Agencies shall investigate, and if feasible, install screens to minimize the potential of non-native fish movement from Dexter Reservoir to the Dexter Alcove ponds. Alternatives to minimize ramping and non-native species effects shall be developed in FY 2009, and implemented by FY 2010, in coordination with ODFW, FWS and other members of the Oregon Chub Working Group. A final report shall be submitted to the FWS by December 31, 2010.

5. c. To increase system-wide flexibility in seasonal flow management, and to address the unpredictability of maintaining Lookout Point Reservoir at full pool to promote maximum production of Oregon chub, the Action Agencies shall continue to investigate in FY 2009, alternatives for management of Oregon chub in Hospital Pond (alcove off of Lookout Point Reservoir). The study shall assess, in cooperation with FWS, ODFW and other members of

the Oregon chub working group, whether additional modification of the spawning terrace is feasible and warranted. If not feasible and warranted, the Action Agencies shall investigate other locations on USACE property in the Middle Fork Willamette Subbasin where new chub habitat could be created and translocation of individuals from Hospital Pond used to create additional population(s) not vulnerable to adverse affects from the proposed action (e.g., construction of additional ponds below Fall Creek Dam). This study shall be coordinated through the WATER RM&E committee, with a final report submitted to the FWS by March 15, 2010.

To implement reasonable and prudent measure #6 (flow management and floodplain restoration), the Action Agencies must adhere to the following:

The proposed action included the development of a comprehensive Willamette Basin RM&E program to be developed in coordination with the WATER RM&E Committee in FY 2008, and implemented beginning in FY 2009 (section 3.8, USACE 2007a). The comprehensive RM&E program lacked specificity. As a result the following research and enhancement actions are described and must be adhered to as part of this term and condition:

6. a. For those Oregon chub sites with surface or subsurface hydrologic connection to tributaries below or between Willamette Project dams, the Action Agencies shall fund a study aimed at identifying flow levels that may impact Oregon chub. In particular, the study should identify the various flow levels that desiccate, isolate, connect, or flood known chub habitat below or between Willamette Project dams. This work should complement and build upon the current Oregon chub drought contingency plan developed by ODFW (Appendix A of this BO). The development and implementation of the study plan shall be coordinated by the WATER RM&E Committee in cooperation with FWS and ODFW in FY 2009, with a final report submitted to the FWS by December 31, 2010.

   If feasible, this study shall be conducted in conjunction with flow related actions called for in NMFS RPA elements 2.4.2 (Tributary Instream Flow Studies), 2.7 (Environmental Flow/Pulse Flow Components), and 2.10 (Flow Related Research, Monitoring and Evaluation). See Appendix B for detailed descriptions of these RPA elements.

   This term and condition is expected to reduce Project related take by providing information that will inform water management decisions during years of high and low flows, or during experimental "pulse flows" that could impact Oregon chub by redistributing populations or by exposing them to non-native predators.

6. b. The Action Agencies shall fund a study investigating the potential effect of alternative tributary flow strategies on the potential distribution and abundance of non-native fishes below Willamette Project dams with an emphasis on potential impacts to Oregon chub populations. The study should also assess the potential influence of alternative flow strategies on the current distribution of Oregon chub. The development and implementation of the study plan shall be coordinated through the Water RM&E committee in cooperation with FWS and ODFW in FY 2009, with a final report submitted to the FWS by December 31, 2010.

If feasible, this study shall be conducted in conjunction with flow related actions called for in NMFS RPA elements 2.4.2 (Tributary Instream Flow Studies), 2.7 (Environmental Flow/Pulse Flow Components), and 2.10 (Flow Related Research, Monitoring and Evaluation). See Appendix B for detailed descriptions of these RPA elements.

Implementation of this term and condition is anticipated to reduce future take of Oregon chub by providing information that will allow for the Action Agencies to implement alternative flow management actions (with the ultimate goal of increasing system function to benefit all native species) while balancing risk to Oregon chub from the potential spread of non-native predacious fishes.

6. c. The Action Agencies shall fund a pilot study investigating the impact of floodplain restoration and reconnection (e.g., re-opening a side channel or re-connecting a slough to the river) on fish communities in river reaches below Willamette Project dams. Assess temperature regimes and fish species composition and abundance prior to and post restoration to determine whether more natural temperature regimes favor native fishes, including Oregon chub, over non-native fishes. Based on the results of the pilot study and future floodplain restoration actions, the Action Agencies shall cooperate and provide funding support towards efforts to introduce Oregon chub into restored habitats if fish community shifts occur that favor native fish and/or reduce suitability for non-native fish. The development and implementation of the pilot study shall be coordinated through the WATER RM&E Committee in cooperation with FWS, NMFS, ODFW, and other members of the Oregon Chub Working Group. This study shall be developed and implemented by FY 2010, with a final report issued to the FWS by March 15, 2012. If feasible, this study shall be conducted in conjunction with habitat actions called for in NMFS RPA elements 9.7.1 (Willamette River Basin Mitigation and Habitat Restoration) and 9.7.4 (Restoration of Habitat at Revetments) (see Appendix B).

<u>To implement reasonable and prudent measure #7 (construction), the Action Agencies must adhere to the following:</u>

7.a. Over the timeframe of the proposed action, we anticipate construction projects may occur for which we do not currently have enough information to assess the amount or extent of localized incidental take of bull trout and Oregon chub in this consultation. For major construction projects (e.g., the development of fish collection facilities, water temperature control, and large floodplain restoration projects) with the potential to effect bull trout and Oregon chub, or any other listed species under the jurisdiction of the FWS, the Action Agencies may need to complete project-specific section 7 consultation. The need for future consultation will be assessed on a project-by-project basis, by the Action Agencies and the FWS. These future project specific consultations will tier to this programmatic Willamette Project BO.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed

action, as modified by the NMFS RPA. With implementation of these measures, the FWS expects that the anticipated level of incidental take of bull trout and Oregon chub over the 15-year term of this biological opinion will be reduced from take levels that would otherwise result from the proposed action, as modified by the NMFS RPA. If the proposed action, as modified by the NMFS RPA, is not adhered to, the level of incidental take anticipated in this biological opinion may be exceeded. Such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Service retains the discretion to determine whether non-compliance with terms and conditions results in take exceeding that considered here, and whether consultation should be re-initiated. The Action Agencies must immediately provide an explanation of the causes of the taking and review with the FWS the need for possible modification of the reasonable and prudent measures.

11.5 Reporting Requirements

Upon locating a dead, injured, or sick bull trout or Oregon chub, initial notification must be made to the FWS, Wilsonville Law Enforcement Office. Care in handling dead specimens is advised to preserve biological material in the best possible state for later analysis of cause of death. The FWS is to be notified within three working days of the finding of any dead or injured bull trout or Oregon chub in the project area. Notification must include the date, time, and precise location of the injured or dead individual and any other pertinent information. The FWS contact for this notification is Chris Allen or Rollie White at the Oregon Fish and Wildlife Office at (503) 231-6179.

11.6 Conservation Recommendations

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

1. Future implementation of upstream and downstream fish passage facilities associated with the Willamette Project should consider the migratory needs of Pacific lamprey, native cutthroat and rainbow trout, and perhaps other native aquatic species.

   All flow and water quality related operations and structural modifications, whether experimental or standard, should fully take into account potential negative and positive effects on lamprey. The Action Agencies should use latest scientific information to predict how the operations or modifications are neutral or positive for meeting lamprey requirements at all life-history stages and should include measures to evaluate the effects of these operations and structural modifications on lamprey. The Action Agencies should identify existing or develop and implement new lamprey specific research and monitoring activities in consultation with appropriate Tribes and in potential partnerships with others in the basin.

Water withdrawal facilities operated with Reclamation water storage contracts at well as those associated with Willamette Project hatcheries and other Willamette Project facilities should employ structures and operations that avoid negative impacts on lamprey.

2. Provide annual transfer funding to the FWS, perhaps through the Fish and Wildlife Coordination Act, to support FWS workload associated with implementation of this BO. It is expected that implementation of this biological opinion over the term of the proposed action will require approximately one full time employee (FTE) of the FWS.

3. Fund a comprehensive bull trout reintroduction feasibility assessment in the North Santiam and North Fork Middle Fork Willamette rivers similar to the 2007 Bull Trout Reintroduction Feasibility Assessment conducted in the Clackamas River by FWS, USFS and ODFW.

4. Fund a biological position (one FTE) at USACE Portland District dedicated to assessing Willamette Project effects on, and implementing conservation measures for, resident fish species with an emphasis on bull trout, Oregon chub, coastal cutthroat trout, and Pacific lamprey.

5. Provide $90,000 in funds to the USFS, Middle Fork Willamette Ranger District, for Phase III of the Indigo Springs Bull Trout Passage and Habitat Restoration Project. Phase I was completed in 2007, and Phase II is expected to be completed, in part with FWS funding, in 2008. The final phase of the project (Phase III) is expected to occur in 2009, but is currently unfunded. When completed, this project is expected to add a significant amount of spawning and early juvenile rearing habitat for the critically small population of bull trout inhabiting the Middle Fork Willamette River above Hill's Creek Reservoir.

6. To further bull trout recovery in the Willamette Basin and to contribute to a project that would serve as a template for bull trout reintroduction elsewhere in the Willamette Basin, provide annual funding to FWS and/or ODFW towards implementation and monitoring of the Clackamas River Bull Trout Reintroduction Project. It is likely the FWS and ODFW will jointly propose in 2008 to implement the project beginning in 2009 or 2010.

7. Systems Operations Analysis: Review existing Project operating criteria and the information used to develop them. If the Action Agencies, with review by WATER and the Services, determine that currently available data and techniques might improve the USACE's ability to meet the flow objectives specified in this BO while meeting current flood control objectives, then the Action Agencies should undertake a detailed systems operations analysis, identify operating criteria that meet these objectives, and implement such changes as soon as possible.

   Willamette system water management objectives for listed salmonids should be analyzed in a Basin-wide assessment, which considers alternatives to improve the percentage of time that such objectives are attained. Such analysis should consider the effects of alternative flood control operations, improved forecasting procedures, climate change

scenarios, improved water quality and other water management strategies that specifically benefit anadromous fish. Beneficial changes from the review should be incorporated into modified management of the Willamette River projects.

Willamette Project seasonal drafting and refilling operations designed to provide storage space to control floods and to refill project reservoirs for summer recreation may at times limit the potential to operate the projects in a manner beneficial to listed fish. These operating criteria were developed several decades ago, before information on the flow needs for fish were developed and prior to recent improvements in weather and streamflow predictive capacity and climate change. It is likely that project operations could be modified in ways that would have negligible effects on flood risks while providing substantial benefits to fish. In order to identify such changes in project operations, it may be necessary to conduct a detailed systems operations analysis that would use up-to-date predictive modeling, climate change information, and fish flow needs.

8. Tribal Participation in Implementation Activities: The Action Agencies should invite appropriate Tribes to seek contracts to assist in performing activities related to investigating the feasibility of fish passage at Project dams. The Action Agencies, as well as other Federal agencies who will manage contracts for this work, should initiate a discussion with each appropriate Tribe to determine their desire to participate in the work and to identify mechanisms to provide funding for Tribal involvement where desired and appropriate.

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

11.7 Reinitiation Notice

This concludes formal consultation on the proposed action outlined in the Action Agencies April 24, 2000 BA, and June 1, 2007 Supplemental BA and associated Addendum as modified by the NMFS' RPA. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the proposed action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agencies' action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in this opinion or; (4) a new species is listed or critical habitat is designated that may be affected by the proposed action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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APPENDIX A. ODFW Drought Contingency Plan for Oregon Chub

Due to drought conditions forecast for 2005, ODFW has prepared a list of Oregon chub locations and the potential risk of drought to the continued survival of these populations. The potential risks to these populations were evaluated, based on existing information related to the stability of the water source, conditions observed in the past decade, the availability of alternate water sources (pumped or diverted water), and the presence of nonnative fish at the locations. Risks were classified as low (small probability of population being impacted), moderate (possible population impacts, but no indications of significant impacts from past observations), and high (population will likely be impacted, site should be closely monitored, some action may be needed). This table lists all locations where ODFW has collected Oregon chub since 1992. Sites where no Oregon chub were collected in 2004 were not evaluated. Site ownership is included in the table. The responsibility for monitoring these sites during 2005 will be shared by the agency that owns the site and ODFW research biologists. Monitoring of sites on private lands will be coordinated between ODFW and the landowners.

Five locations were classified at "high" risk of impact, if the drought conditions persist or worsen. These sites include: the Santiam I-5 Side Backwaters, Stayton Public Works Pond, Finley Gray Creek, Shady Dell Pond, and Herman Pond. The latter two sites do not contain non-native fish. Low water levels have been observed at all of these sites in the past. These sites should be very closely monitored this spring, summer, and fall.

There is no "rule of thumb" regarding when to take action. ODFW will take the lead and assist in making the decision to act. If a pond or creek is in imminent danger of desiccation and/or is dropping very quickly, some action will be taken.

The water levels at the Santiam I-5 site respond quickly to changes in Santiam River levels. Water levels in mid-March were quite low when the gage at Jefferson was ~1,600 cfs. Summer flows typically approach 1,100 cfs, although the pond had never been observed in the past to be as low as it was in mid-March. One proposed action is to pump water from an upstream borrow pit into the side channel. This may only be a temporary fix, because pond levels appear to respond quickly to river levels. If pumping does not work, the alternate action is to trap and move the Oregon chub to Stayton Ponds, an restoration project and future proposed introduction site in the N. Santiam drainage.

The Finley Gray Creek water levels have been quite low in the past, however usually some impounded water has existed in beaver ponds. If water levels get dangerously low, chub could be trapped and moved to Cheadle Pond.

Water levels at Shady Dell Pond have also been quite low in the past. A diversion pipe was installed in late-1980's to supply water into the pond from Dell Creek. This pipe requires maintenance to prevent the screen from plugging with debris. In the past, weekly visits to inspect and clean the screen on the pipe have been adequate to maintain water in the pond. If

water levels become dangerously low, despite these efforts, Oregon chub could be trapped and moved to an unoccupied pond in lower Buckhead Creek (upstream enhancement pond).

Herman Pond is a small spring fed pond in the Layng Creek drainage of the Row River (C. Fk. Willamette) that has also had low water levels in the past. There is no alternate source of water for this pond. If water levels become dangerously low, the chub would be trapped and moved to Fall Creek Spillway Ponds (source population for this introduced population). If water levels become dangerously low at one of the sites that was classified as having a "moderate" drought risk, similar actions would be taken. Almost all of these chub sites have staff gages installed and records of water levels will be kept to assist in making determination for when action might be necessary.

Oregon Chub Locations- 2005 drought risks

Site Name	Basin	2004 abundance	Nonnative Fish	Ownership	Drought risk	Comments
Geren Island North Channel	Santiam	2,290	no	City of Salem	low	intake from N. Santiam, controlled by U. Bennett dam
Foster Pullout Pond	Santiam	570	no	ACOE	high	spring fed, water levels have been low in past
Gray Slough	Santiam	340	yes	private	low	beaver are active and water level tied to N. Santiam levels
Santiam I-5 Backwaters	Santiam	320	yes	ODOT	high	site was very low in mid-March 2005
Santiam Conservation Easement	Santiam	**1**	yes	USFWS/private	low	beaver are active, fed by N. Santiam, several deep areas
Santiam Public Works Pond	Santiam	**1**	yes	City of Stayton	high	has nearly dried up in past
Pioneer Park Backwater	Santiam	**0**	no	City of Stayton		
Menear's Bend	Santiam	**0**	no	ACOE		
Green's Bridge	Santiam	**0**	yes	private		
Logan Slough	Santiam		no	ODFW		
Dunn Wetland	Mid-Willamette	25,810	no	private	moderate	spring fed, has maintained adequate levels in past
Finley Gray Creek Swamp	Mid-Willamette	520	yes	USFWS	high	water levels have been low, beaver maintained
Ankeny Willow Marsh	Mid-Willamette	500	no	USFWS	low	can pump water into pond if needed
Jampolsky Ponds	Mid-Willamette	500	no	private	moderate	water levels drop during summer, but have been adequate
Cheadle Pond	Mid-Willamette	220	no	USFWS	moderate	water levels drop during summer, but have been adequate
Finley Display Pond	Mid-Willamette	70	no	USFWS	moderate	water levels drop during summer, but have been adequate
Little Muddy Creek tributary	Mid-Willamette	5	yes	private	moderate	fed by irrigation water from McKenzie (Spores)
Dry Muddy Creek	Mid-Willamette	**1**	no	private	moderate	fed by irrigation water from McKenzie (Spores)
Camous Creek	Mid-Willamette		yes	private		
Fall Creek Spillway Ponds	M. Fk. Willamette	5,850	no	ACOE	moderate	fed by seepage from Fall Creek Reservoir, may be impacted if Reservoir is very low
Hospital Pond	M. Fk. Willamette	4,940	no	ACOE	low	spring fed, gated control structure
Wicopee Pond	M. Fk. Willamette	4,780	no	USFS	low	Salt Creek flows into pond through french drain
Shady Dell Pond	M. Fk. Willamette	4,210	no	USFS	high	has nearly dried up in past
Buckhead Creek	M. Fk. Willamette	3,600	no	USFS	moderate	beavers active, some areas may dry up
East Fork Minnow Creek Pond	M. Fk. Willamette	3,140	no	ODOT	low	beavers active, no problems in past
Elijah Bristow St. Park- Berry Slough	M. Fk. Willamette	2,950	no	OPRD	low	beavers active, no problems in past
Elijah Bristow St. Park- NE Backwater	M. Fk. Willamette	1,340	no	OPRD	low	beavers active, no problems in past
Dexter Reservoir Alcove- DEX3	M. Fk. Willamette	790	yes	ACOE	low	tied to Dexter Reservoir levels
Elijah Bristow Island Pond	M. Fk. Willamette	420	yes	OPRD	moderate	water levels low in early March 2005, but adequate
Dexter Reservoir Alcove- PIT1	M. Fk. Willamette	70	yes	ACOE	low	tied to Dexter Reservoir levels
Barnhard Slough	M. Fk. Willamette	**2**	no	ODOT	low	water levels tied to river levels, no problems in past
Oakridge Slough	M. Fk. Willamette	**1**	no	USFS	low	water levels tied to river levels, no problems in past
Rattlesnake Creek	M. Fk. Willamette	**0**	yes	private		
Elijah Bristow Large Gravel Pit	M. Fk. Willamette	**0**	yes	OPRD		
Elijah Bristow Small Gravel Pit	M. Fk. Willamette	**0**	no	OPRD		
Hospital Impoundment Pond	M. Fk. Willamette	**0**	yes	ACOE		
East Ferrin Pond	M. Fk. Willamette	**0**	yes	USFS		
Wallace Slough	M. Fk. Willamette	**0**	yes	private		
Dexter East Alcove	M. Fk. Willamette	**0**	no	ACOE		
Jasper Park Slough	M. Fk. Willamette	**0**	yes	OPRD		
Middle Fork Willamette Backwater	M. Fk. Willamette	**0**	yes	private		
West Ferrin Pond	M. Fk. Willamette		yes	USFS		
Shetzline Pond	McKenzie	1,050	no	private	low	fed by small tributary and springs
Russell Pond	McKenzie	720	no	private	moderate	site has spring delivery system and can pump from Mohawk if needed
Big Island	McKenzie	310	no	private	moderate	water levels were low in March 2005, beavers active, closely monitored
Herman Pond	C. Fk. Willamette	350	no	USFS	high	water levels have been low in past
Coast Fork Side Channels	C. Fk. Willamette	190	yes	ODOT	moderate	tied to water levels in CF Willamette
Camas Swale	C. Fk. Willamette	**0**	yes	private		

bold site names = chub reintroduction sites
bold abundance = number captured, otherwise abundance is a mark-recapture estimate

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9 REASONABLE & PRUDENT ALTERNATIVE

INTRODUCTION

In Section 8, NMFS concluded that the Proposed Action would jeopardize the continued existence of UWR Chinook salmon and UWR steelhead, and destroy or adversely modify their designated critical habitat. NMFS reached no jeopardy and no adverse modification conclusions for the 11 other listed salmonid species, and NLAAs for green sturgeon and southern resident killer whale. Therefore, NMFS is providing the Action Agencies with the following reasonable and prudent alternative (RPA) to avoid jeopardizing the continued existence of UWR Chinook salmon and UWR steelhead, and avoid destroying or adversely modifying their critical habitat, as required by ESA section 7(b)(3)(A).

An RPA is an action, identified during formal consultation, that can be carried out consistent with the purpose of the action, is within the scope of the action agency's legal authority, is economically and technologically feasible, and would avoid jeopardy to listed species and the destruction or adverse modification of designated critical habitats (50 CFR 402.02). The measures NMFS is providing in the RPA fit the regulatory requirements of an RPA. The measures fall into the general categories of substantive measures for fish passage, water quality, flows, water contracts, habitat, and hatcheries. There are also measures for coordination, studies, and monitoring related to the substantive measures. These measures have time frames for each action. The RPA measures are within the project purposes because fish and wildlife protection is a project purpose. The Action Agencies have legal authority to carry out these measures because the statutes that authorize the project include project purposes for fish and wildlife protection, and in some cases already include specific provisions for some of the measures.

These general categories of the measures in the RPA, fish passage, water quality, flow, water contracts, habitat, and hatcheries, are all measures in the PA that, when considered with the environmental baseline and cumulative effects and the rangewide status of UWR Chinook salmon and UWR steelhead, did not result in survival with an adequate potential for recovery for these species. In addition, they were inadequate to avoid the destruction or adverse modification of designated critical habitat. NMFS' RPA includes the measures in the PA, adds new measures, and modifies others in the PA. A general concept behind most of NMFS additional measures and modifications is to build on the studies in the PA by adding on-the-ground measures that the Action Agencies will complete to address Project effects on listed anadromous fish. Therefore, NMFS' RPA specifically lists measures that the Action Agencies will carry out after the necessary studies and designs are completed to verify feasibility. NMFS' assessment of effects regarding the RPA's avoidance of jeopardy and destruction or adverse modification of critical habitat is based on the benefits attributed to successful completion of these measures.

Structural and operational changes at Project dams and improvements in Action Agency programs that affect salmonid habitat downstream of the dams and that allow upstream and downstream fish passage are needed to address the effects of the Willamette Project, thereby increasing the viability of the affected populations and the functioning of the PCEs of their designated critical habitat. Specifically, construction and operation of new facilities for effective up- and downstream fish passage at Project dams, installation of water temperature control

(WTC) at Project dams, more normative discharge patterns downstream of these dams, mitigation of ongoing effects of the dams and continued existence and maintenance of revetments on the physical characteristics of downstream salmonid habitats, and hatchery programs more strongly focused on species conservation, are needed to address project effects on listed fish in multiple subbasins. The Action Agencies' proposed measures in the PA provide improvements to the existing system and operations, but do not adequately address project effects on listed fish and their habitat. Many of those measures lacked deadlines for beginning and completing work. This lack of certainty and specificity was one of the reasons that NMFS made the jeopardy and adverse modification of critical habitat determinations in Section 8. Another reason was that there were not enough specific on-the-ground measures to adequately address project effects and avoid jeopardy and destruction and adverse modification of critical habitat. In order to assure timely progress toward implementing critical on-the-ground actions, NMFS' RPA establishes deadlines for completing studies, structural and operational improvements at the dams and hatcheries, and for implementing habitat restoration programs. Specific projects are identified that must be completed in the short term, while other, larger projects must be completed during later years of the term of the Opinion. In the RPA, certain specific fish passage and temperature control measures will be completed by 2023, the end of the Opinion term. Additionally, significant progress will be made toward identifying future passage and temperature control measures that could be implemented after 2023 under a subsequent consultation.

A number of the RPA measures will provide benefits in the short-term, reducing each species' short-term risk of extinction, including measures to improve downstream habitat by changing flows and temperature, updating hatchery operations and facilities, improving irrigation diversions and water contracts, upgrading fish collection facilities and outplanting procedures, and conducting habitat improvement projects. These measures will immediately (during the first one-to-seven years of this Opinion) improve population viability and reduce the short-term risk of extinction. This is especially important for UWR Chinook salmon, for which the risk of extinction is "high."44 Project operations have had a key role in degrading habitat conditions downstream, which in the North and South Santiam, South Fork McKenzie, and Middle Fork Willamette are the only areas still accessible to Chinook for spawning, incubation, and early rearing. The Action Agencies began new reservoir operations in 2000 to meet mainstem and tributary flow objectives for both listed Chinook and steelhead. These, and operations that began in 2005 at the new Water Temperature Control facility at Cougar Dam, are already able to have a positive influence on adult Chinook returns. Under the RPA, interim temperature control operations at Detroit will improve water temperatures in the North Santiam, increasing the survival of eggs, juveniles, and pre-spawning adults of both species and thus population productivity. All of these measures will reduce extinction risk in the short term as well as contributing to long-term viability.

Decision-making for all of the final actions and implementation of measures included in the RPA must comply with all applicable statutes and regulations. Among those the Action Agencies must consider are NEPA, the Clean Water Act and the Northwest Power Planning Act. In so doing, the criteria the Action Agencies will apply are whether the action is: (1) biologically feasible and

44 The WLCTRT (McElhany et al. 2007) estimated the risk of extinction over 100 years for UWR Chinook ("high;" see Figure 3-5 in Section 3.2.1.3). The TRT did not estimate the species' short-term extinction risk.

beneficial; (2) technically feasible; and (3) cost effective. These criteria would not necessarily apply to interim decision points and to information gathering requirements. In addition, the Action Agencies' Configuration/Operation Planning (COP) study process will outline the costs of specific projects, their biological benefits, and a reasonable array of potential alternatives to achieve the desired results.

The measures in this RPA are additive to the Action Agencies' Proposed Action (USACE 2007a). That is, the two sets of measures combined create the complete RPA that NMFS will analyze. For the sake of brevity, the RPA measures provided below only include measures that are not in the PA, and PA measures that are changed in some way. In the event there are inconsistencies between the PA and RPA, this RPA will take precedence.

9.1 COORDINATION

The RPA measures in this section are based on Section 3.1 of the Supplemental BA (USACE 2007a). In that section, the Action Agencies propose to organize the WATER group, prepare a charter, and establish various subcommittees. In recent years, the USACE has informally coordinated flow management and project operation issues with other federal agencies, state agencies, local government, and other organizations, but there were no guidelines for how this coordination should take place or what would happen if technical participants could not agree. The Action Agencies proposed the WATER group to formalize this process and to ensure consistent coordination and decision-making. NMFS supports the Action Agencies' proposal, but we include it here with minor revisions to clarify the decision-making process and agency roles. This clarification is needed in the RPA because most of the actions that will be taken to avoid and minimize effects on listed salmonids and critical habitat rely on either in-season management (mainstem and tributary flows, response to emergency operations), review of RM&E studies (e.g., downstream fish passage measures) and review of engineering design alternatives (e.g., adult fish collection facilities, temperature control facilities. In order to ensure these ongoing decisions are implemented in a fashion consistent with the analysis in this Opinion, the following measures are needed:

RPA 1 Coordination

1.1 **<u>Charter of WATER</u>: By December, 2008, the Action Agencies, in coordination with the Services, other federal and state agencies with fisheries and water resource management responsibilities in the Willamette River Basin, and affected Tribes, will complete a Charter for a collaborative advisory body to be known as the Willamette Action Team for Ecosystem Restoration (WATER). Once the Charter is completed, the Action Agencies will coordinate with the WATER on operation of the Willamette Project consistent with the Charter. The WATER will be a formalized, collaborative body to advise the Action Agencies in the coordinated implementation of the environmental protection and conservation measures described in the Proposed Action, RPA, and other actions that may develop while operating the project.**

Rationale/Effect of RPA 1.1: This measure clarifies that the Action Agencies and the Services, other federal agencies, state agencies, and tribes will complete a charter for WATER by December, 2008, and will operate according to the charter. The Proposed Action had stated it would be done within one year of completion of the Supplemental BA (i.e., by June 2008), but that date has now passed.

The effect of this measure will be to improve and inform the Action Agencies' and Services' decision making, provide a forum for various points of view, share scientific and technical information, and coordinate actions by the parties. This coordination and sharing of information will ultimately reduce the time needed to address the effects of the Project on population viability and the functioning of PCEs of designated critical habitat.

1.2 **Technical Sub-Committees of WATER: The Action Agencies will establish technical coordinating committees as part of the WATER to provide review and recommendations of Action Agencies' products. Technical experts from applicable state agencies and the Tribes may participate on committees based on the subject matter of each committee and the scope of each organization's respective areas of responsibility and expertise. Other parties may participate on the subcommittees depending on the subject area and agreement by the Action Agencies and Services. The number, responsibilities, and scope of the technical committees formed will be determined by the Action Agencies and the Services through development of a charter for WATER. However, at a minimum, these will address flow management; fish passage and hatchery management; environmental coordination for construction projects; water quality/temperature control; habitat restoration; and research, monitoring, and evaluation.**

Rationale/Effect of RPA 1.2: NMFS adds this measure in place of the detailed description of each subcommittee proposed by the Action Agencies in Section 3.1 and Figure 3-1 of the Supplemental BA (USACE 2007a). The specific number, function, and membership of each subcommittee should be developed through development of the charter rather than pre-supposed in the Proposed Action. While NMFS encourages active participation by a variety of organizations and individuals on these issues, timely decisions on fish protection measures such as fish passage facilities and necessary RM&E to support those decisions need to be made by entities with fish management authority. The charter must be clear that the committees will play an advisory role only and will not replace the Action Agencies' responsibilities to carry out measures required by the Proposed Action and this RPA.

1.3 **WATER Decision-Making Process: The Action Agencies will ensure that the Charter for WATER and its technical coordinating committees describes a decision-making process that recognizes the unique role played by NMFS and USFWS in decisions related to measures covered in their respective Biological Opinions. In this process, the Action Agencies will prepare initial proposals for operations, studies, or structural changes and will seek review and comment by the applicable WATER subcommittee. Committee members, including NMFS and USFWS, will provide feedback to the Action Agencies within a maximum 60-day period, or less,**

depending on the magnitude and complexity of the proposal. The Action Agencies will then modify the proposal as they determine necessary to address committee members' comments and to meet their ESA responsibilities. NMFS or USFWS (or both, depending on the subject and what species might be affected) will review the final document and inform the Action Agencies whether they agree with it. If NMFS or USFWS disagrees with a proposal based on concerns that the proposal may adversely affect species within their respective authorities or be inconsistent with their respective Biological Opinions45, the Action Agencies will either modify the proposal to address the Services' concerns, elevate the decision following a process described in the Charter, or seek reinitiation of consultation.

Rationale/Effect of RPA 1.3: This measure specifies that the WATER process must use this decision-making process to ensure that measures required by this Opinion are carried out effectively and in a timely manner, with adequate opportunity for review and comment. The Action Agencies retain ultimate responsibility for completing required actions. Adaptive management decisions need to be made with written supporting documentation. NMFS and USFWS will inform the Action Agencies whether they agree or disagree with the decisions, or if specific decisions are inconsistent with their respective Opinions. If the NMFS or FWS disagree, the Action Agencies must either modify decisions, seek dispute resolution, or reinitiate consultation.

1.4 **Role of Services in decision-making (agreement with Action Agencies): The Action Agencies will provide NMFS, USFWS, or both, as appropriate depending on the action and species affected, with draft documents for comment. The Action Agencies will address comments received from NMFS and USFWS when finalizing a document. If the Services do not agree with the final document, then they will elevate the issues for resolution, if appropriate.**

Rationale/Effect of RPA 1.4: This new measure is needed to clarify that the Services play a unique role during the implementation phase of measures required by their respective Opinions. Unlike many other Section 7 ESA consultations that address specific, short-term projects and that require specific mitigation measures that are used during and directly after construction, this consultation involves many measures that are not clearly defined yet and are awaiting study results and design feasibility analyses before specific decisions can be made. For instance, in the fish passage measures below (section 9.4), NMFS requires that downstream fish passage be carried out at Cougar Dam by a specific year, but until field studies are completed and design alternatives analyzed, NMFS cannot predict what sort of system or set of operations this will be. NMFS anticipates that it will be closely involved in review of all facets of these studies and analyses to ensure that decisions made are consistent with the statement and intent of this Opinion. The effect of this dispute resolution provision will be to preserve both the Action Agencies' and Services' authorities.

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45 This measure does not broaden either of the Services authority to engage in issues outside of each agency's authority, except that it does provide for both agencies to engage in issues that affect species listed by both agencies.

9.2 FLOW MANAGEMENT

The measures in this section are based on Section 3.3 of the Supplemental BA (USACE 2007a). In that section, the Action Agencies propose to do the following: 1) organize a Flow Management Committee of the WATER group; 2) develop a protocol for notification when Project operations cause deviations from flow and ramping objectives; 3) operate to make every effort to meet or exceed minimum mainstem Willamette flow objectives; 4) operate to make every effort to meet or exceed minimum tributary flow objectives; 5) operate to follow hourly and daily ramp-down rates under normal operating conditions; 6) release spill at Foster Dam during spring for downstream fish passage; and 7) develop and carry out a comprehensive RM&E program to evaluate and monitor these flow management actions.

NMFS generally supports the Action Agencies' flow management proposals, but the following measures are needed to improve the decision-making process, increase the likelihood and frequency of meeting flow and ramping rate objectives, and define agency roles. This clarification is needed in the RPA because most of the actions that will be taken in the short-term to avoid and minimize effects on listed salmonids rely on either in-season management (mainstem and tributary flows, response to emergency operations), review of RM&E studies (e.g., downstream fish passage measures) and review of engineering design alternatives (e.g., adult fish collection facilities, temperature control facilities).

RPA 2 Flow Management

2.1 **<u>WATER Flow Management Committee</u>: The USACE will establish a Flow Management (FM) Committee under WATER to advise USACE on streamflow management issues related to operation and maintenance of the Willamette Project. The USACE will take a leadership role in the administration of this committee, providing for coordination, administration costs, and meeting space. The USACE, with review by the FM Committee, will develop and implement the annual Willamette Conservation Plan,46 and coordinate on all issues related to listed fish with the Services and with Federal and state agencies, Tribes, and entities throughout each flow management season.**

Rationale/Effect of RPA 2.1: This measure modifies a similar action described in section 3.3.3 of the Supplemental BA (USACE 2007a) by assigning responsibility for managing and funding the committee to the USACE. The role of the committee is advisory to the USACE. Coordination throughout the flow management season should maximize benefits to listed fish, consistent with authorized Project purposes and giving due consideration to the relative importance of each.

The effect of this measure will be to improve decision-making regarding flow management and ensure that the USACE will operate the Project to minimize adverse Project effects on listed fish, consistent with other authorized Project purposes.

46 The Annual Willamette Conservation Plan is reviewed and revised each year. It describes minimum and maximum mainstem and tributary flow objectives that guide the Action Agencies' operation of the 13-dam Willamette Project, and it includes specific operational priorities for the given year.

Indirectly, this measure will help improve survival of juvenile and adult fish during migration through the mainstem Willamette and Project-affected tributaries by ensuring that timely decisions regarding Project flow releases are made and issues quickly resolved during in-season management. Likewise, this measure will help improve productivity of UWR Chinook salmon and UWR steelhead that spawn below Project dams by ensuring that local biologists are queried to provide real-time data regarding fish presence and that timely decisions are made to reduce impacts to redds once adults have spawned.

2.2 **Protocol for Notification of Deviations: The Action Agencies will notify the Services when turbine units, regulating outlets, and spillway gates malfunction or are placed out of service for an emergency which results in an unscheduled outage that may have an impact on ESA-listed fish species. The Action Agencies will follow the notification protocol described in RPA measure 4.3 (Willamette Fish Operations Plan) below.**

Rationale/Effect of RPA 2.2: This measure is described in RPA measure 4.3 below.

2.3 **Minimum Mainstem Flow Objectives: The USACE will operate the system in a manner to meet or exceed minimum mainstem flow objectives listed in Table 9.2-1 as measured at Salem and Albany, Oregon, following the framework described in Appendix D and in collaboration with the Services and other entities as provided in RPA measures 1 and 2.1. Based on RM&E results (RPA measure 9 in section 9.9 below) and operational experience, and with the approval of the Services and review by the FM Committee, the USACE will amend mainstem flow objectives (Table 9.2-1) in its Annual Willamette Conservation Plan.**

Rationale/Effect of RPA 2.3: This measure is based on a similar action described in section 3.3.5 of the Supplemental BA (USACE 2007a). The minimum mainstem flow objectives are the same as in the Proposed Action, and NMFS adopts Appendix D, which recognizes that these flow objectives will likely not be met in water years that are not "adequate" or "abundant" as defined in Appendix D. The primary difference from the Proposed Action measure is that this measure requires approval by the Services of any changes in Table 9.2-1 flow objectives, while the Proposed Action simply required the Action Agencies to consider recommendations from NMFS and other FM Committee members.

The effect of this measure is that it will better ensure adequate flows for UWR Chinook salmon and UWR steelhead that migrate and rear in the mainstem Willamette River than provided by the Proposed Action. In the Mainstem Willamette Effects section 5.10, NMFS found that the proposed mainstem flow objectives were sufficient based on existing data. These flow objectives would be expected to aid downstream migration of juvenile steelhead by reducing the likelihood of disease outbreaks based on flow and water temperature relationships. Additionally, minimum flow objectives during summer months would provide water quality benefits to rearing juvenile Chinook and steelhead

and upstream migrating adult Chinook. However, NMFS noted that additional data are needed to better define fish flow needs in the mainstem Willamette. This measure gives the Services approval authority over any proposed changes in the flow objectives. In the event that the RM&E studies required by measure 9 in section 9.9 indicate that different flow objectives should be established, the Action Agencies and NMFS would work together to identify flow objectives that protect ESA-listed fish species and their critical habitats.

Table 9.2-1 Mainstem Willamette Flow Objectives for "Adequate" & "Abundant" Years.[1]

TIME PERIOD	7-DAY MOVING AVERAGE [2] MINIMUM FLOW AT SALEM (CFS) USGS 141910004	INSTANTANEOUS MINIMUM FLOW AT SALEM (CFS) USGS 14191000	MINIMUM FLOW AT ALBANY (CFS) [3] USGS 141740005
April 1 - 30	17,800	14,300	---
May 1 - 31	15,000	12,000	---
June 1 - 15	13,000	10,500	4,500 [3]
June 16 - 30	8,700	7,000	4,500 [3]
July 1 - 31	---	6,000 [3]	4,500 [3]
August 1 - 15	---	6,000 [3]	5,000 [3]
August 16 - 31	---	6,500 [3]	5,000 [3]
September 1 - 30	---	7,000 [3]	5,000 [3]
October 1 - 31	---	7,000	5,000

[1] Appendix D defines "Adequate" and "Abundant" water years, and also describes how flow objectives can be decreased in "Deficit" water years.
[2] An average of the mean daily flows in cubic feet per second (cfs) observed over the prior 7-day period.
[3] Congressionally authorized minimum flows (House Document 531). September flows were extended into October.
4 USGS gage 14191000 Willamette River at Salem, OR
[5] USGS gage 14174000 Willamette River at Albany, OR

2.4 **<u>Tributary Flow Objectives –Project Release Minimums:</u> The USACE will operate Willamette project dams as described in this subsection to meet or exceed minimum tributary flow objectives listed in Table 9.2-2 to ensure adult fish access to existing spawning habitat below USACE dams, protect eggs deposited during spawning, and provide juvenile rearing and adult holding habitat for listed salmonids and other fishes within system constraints described in Appendix D. If, during annual operations, the system of Willamette Projects is unable to meet both mainstem and tributary flow objectives, the Action Agencies will notify NMFS and will coordinate through WATER to determine a suitable course of action to protect priority fish habitat needs. Consistent with Appendix D, USACE will operate to meet interim draft limits.**

Rationale/Effect of RPA 2.4: This measure is based on a similar action described in section 3.3.6 of the Supplemental BA (USACE 2007a). The minimum and maximum tributary flow objectives are the same as in the Proposed Action. NMFS also recognizes that it will not be possible to meet these flow objectives under all hydrologic conditions.

However, NMFS does not agree with the Action Agencies that other project purposes (i.e. recreation), as expressed by the proposed drafting priority (Table 2-6, in Chapter 2), should take priority over meeting tributary and mainstem flow objectives. For this reason, we include RPA measure 2.4.4 to identify opportunities to manage available water resources in a manner that improves the likelihood of providing flows known to be protective of salmon and steelhead and their critical habitats (see Section 5.5.2.1). The primary difference from the Proposed Action measure is that this measure emphasizes the fisheries objectives for these flows. This measure also requires the Action Agencies to notify NMFS when they are unable to meet both mainstem and tributary flow objectives, and emphasizes that NMFS will provide guidance on fish protection priorities.

The effect of this measure is that it will better ensure adequate flows for UWR Chinook salmon and UWR steelhead that migrate and rear in Project-affected tributaries (Middle Fork Willamette, McKenzie, South Santiam, and North Santiam subbasins) than provided by the Proposed Action. In the various Effects sections for these subbasins (sections 5.2 through 5.6), NMFS found that the proposed tributary flow objectives were sufficient based on existing data. However, NMFS noted that flows released from Project dams for fish protection purposes should be protected throughout the tributary reaches where such flows are needed for spawning, rearing, holding or migration. The Proposed Action limits the Action Agencies' obligation to flow rates at the lowermost Project dam on each tributary, but does not establish flow requirements for reaches downstream from the dams to the mouth of the tributaries because the Action Agencies do not have enforcement authority over water diversions. NMFS adds sub-measures 2.4.1 through 2.4.4 below to address this issue for the lower tributary reaches. Studies required by RPA measure 2.10 below will guide decisions to modify these flow objectives to better protect ESA-listed fish species.

Table 9.2-2 Minimum & Maximum Tributary Flow Objectives below Willamette Dams (USACE 2007a; Donner 2008)

DAM	PERIOD	PRIMARY USE	MINIMUM FLOW (CFS) [1]	PERCENT OF TIME FLOW IS EQUALED OR EXCEEDED[4]	MAXIMUM FLOW (CFS) [2]	PERCENT OF TIME FLOW IS EQUALED OR EXCEEDED[4]
Hills Creek	Sep 1 - Jan 31	Migration & rearing	400	99.9		
	Feb 1 - Aug 31	Rearing	400	99.9		
Fall Creek	Sep 1 - Oct 15	Chinook spawning	200	95	400 through Sep 30, when possible	25
	Oct 16 - Jan 31	Chinook incubation	50 [3]	99.9		
	Feb 1 - Mar 31	Rearing	50	99.9		
	Apr 1 - May 31	Rearing	80	99.9		
	Jun 1 - Jun 30	Rearing/adult migration	80	99.9		
	Jul 1 - Aug 31	Rearing	80	95		
Dexter	Sep 1 - Oct 15	Chinook spawning	1200	99.9	3,500 through Sep 30, when possible	10

DAM	PERIOD	PRIMARY USE	MINIMUM FLOW (CFS) [1]	PERCENT OF TIME FLOW IS EQUALED OR EXCEEDED[4]	MAXIMUM FLOW (CFS) [2]	PERCENT OF TIME FLOW IS EQUALED OR EXCEEDED[4]
	Oct 16 - Jan 31	Chinook incubation	1200 [3]	99.9		
	Feb 1 - June 30	Rearing	1200	99.9		
	Jul 1 - Aug 31	Rearing	1200	99.9		
Big Cliff	Sep 1 - Oct 15	Chinook spawning	1500	95	3,000 through Sep 30, when possible	5
	Oct 16 - Jan 31	Chinook incubation	1200 [3]	98		
	Feb 1 - Mar 15	Rearing/adult migration	1000	99.9		
	Mar 16 - May	Steelhead spawning	1500	99.9	3,000	25
	Jun 1 – Jul 15	Steelhead incubation	1200 [3]	99.9		
	Jul 16 - Aug 31	Rearing	1000	99.9		
Foster	Sep 1 - Oct 15	Chinook spawning	1500	75	3,000 through Sep 30, when possible	1
	Oct 16 - Jan 31	Chinook incubation	1100 [3]	80		
	Feb 1 - Mar 15	Rearing	800	95		
	Mar 16 - May	Steelhead spawning	1500	80	3,000	30
	May 16 - Jun 30	Steelhead incubation	1100 [3]	95		
	Jul 1 - Aug 31	Rearing	800	99		
Blue River	Sep 1 - Oct 15	Chinook spawning	50	99.9		
	Oct 16 - Jan 31	Chinook incubation	50	99.9		
	Feb 1 - Aug 31	Rearing	50	99.9		
Cougar	Sep 1 - Oct 15	Chinook spawning	300	99.9	580 through Sep 30, when possible	60
	Oct 16 - Jan 31	Chinook incubation	300	99.9		
	Feb 1 - May 31	Rearing	300	99.9		
	Jun 1 - Jun 30	Rearing/adult migration	400	99.9		
	Jul 1 - Jul 31	Rearing	300	99.9		
	Aug 1 - Aug 31	Rearing	300	99.9		

[1] When a reservoir is at or below minimum conservation pool elevation, the minimum outflow will equal inflow or the congressionally authorized minimum flows, whichever is higher.
[2] Maximum flows are intended to minimize the potential for spawning to occur in stream areas that might subsequently be dewatered at the specified minimum flow during incubation.
[3] The USACE will attempt to avoid prolonged releases in excess of the recommended maximum spawning season discharge to avoid spawning in areas that would require high incubation flows that would be difficult to achieve and maintain throughout the incubation period. When maximum flow objectives are exceeded for a period of 72 hours or longer, the WATER Flow Management Committee will review available monitoring information (e.g., regarding redd deposition in relation to flow rates), projected runoff, and reservoir storage, and will formulate a recommendation for an appropriate and sustainable incubation flow rate prior to the initiation of the subsequent incubation period.
[4] Flow duration estimates are based on HEC-ResSim model output data for the Biop operation. Period of Record of model data is Water Years 1936-2004.

In order to improve the likelihood of meeting tributary minimum flow objectives, the Action Agencies will complete the following actions:

2.4.1 **Lower River Gages: The USACE will establish and operate gage stations at locations near the mouths of the tributaries listed below in this paragraph, by July 1, 2009, and will operate the stations through the term of this Opinion to develop relationships between release flows and gage flows. The plan will initially assess the adequacy of existing gages, if any, and need for new gages where none exist, in the lower reaches of the**

- **North Santiam River**
- **South Santiam River**
- **McKenzie River**
- **Middle Fork Willamette River below Dexter**
- **Middle Fork Willamette River below Hills Creek, and**
- **Fall Creek**

The need for each gage will be determined based on fish use of lower river habitat and number of consumptive water diversions in each tributary. The USACE will complete a plan identifying the number and specific location of existing and new gages that are needed, in coordination with and review by the Services,47 by January 1, 2009. At a minimum, river stage and water temperature will be measured at those sites where gages are needed. Stage-flow relationships will be developed and maintained for accuracy. Unless good cause is given, USACE will work with U.S. Geological Survey to ensure that these stations will be part of the USGS' water data program and maintained in USGS' Real-Time data system.

Rationale/Effect of RPA 2.4.1: This measure is not in the Proposed Action. NMFS includes it here as a first step in determining whether flows released from Project dams are available for fish habitat needs in downstream tributary reaches. Presently, minimum flow targets are set at the dam, but biologically, they are needed throughout the reach. For example, if Project release flows in a given tributary are only needed for adult fish spawning in the first mile below the dam, then it is likely that those release flows are available throughout that one mile reach. On the other hand, if Project release flows are intended to provide juvenile rearing habitat in the tributary from the dam all the way downstream to its confluence with the Willamette River, then it is possible that existing, proposed, and future consumptive water users may divert these flows, resulting in inadequate habitat for juvenile rearing (or other fish habitat needs, depending on the tributary, specific reach, and species and life stages present).

NMFS acknowledges that the Action Agencies are not authorized to enforce State water rights. However, if data obtained from stream gages indicates that flows

47 See RPA 1.3 & 1.4 for elaboration of decision making process.

are lower than needed in specific tributary reaches, then the Action Agencies could modify flow releases at dams in those tributaries to compensate consumptive water withdrawals. (See RPA 2.4.3 and 2.4.4 for this subsequent action).

The effect of this measure is that the lower river gages will allow the Action Agencies to correlate dam releases to downstream flows, such that in the future, dam releases could be adjusted, if necessary, to ensure sufficient flows are provided to the reaches where they are needed for fish spawning, rearing, passage, and holding.

2.4.2 **Tributary Instream Flow Studies: In coordination with the Services, the Action Agencies will develop a detailed study plan by December 2008 to conduct instream flow studies in 2009 and 2010. The primary goal of these studies will be to identify the relationships between river flow rates and habitat conditions for adult passage, holding, and spawning and juvenile rearing in the following tributaries: N. Santiam, S. Santiam, Fall Creek, Middle Fork Willamette, SF McKenzie, and McKenzie (listed in priority order).**

Rationale/Effect of RPA 2.4.2: As noted above in RPA 2.4 and 2.4.1, existing tributary minimum flow objectives are based on the best available data, but that in most of the tributaries, flow requirements are based on protecting a single life stage in a specific reach, such as steelhead spawning in a few miles below a Project dam. Incomplete information exists regarding fish flow needs for other life history stages when Chinook salmon and steelhead spend time in the tributaries, such as adult holding, juvenile rearing, and adult and juvenile migration. These studies need to take place in the first few years of the Opinion's term to determine fish flow needs for all life stages that use the tributaries. This information can then be used in Project operational modeling, as described in RPA 2.4.3 below, to determine if storage water is available in Project reservoirs to release needed fish flows, or if not, how reservoir operations could be optimized to best protect salmon and steelhead. Additionally, the study information would be used with gage data from RPA 2.4.1 to determine if Project release flow objectives are adequate to meet fish flow needs in lower tributary reaches.

The effect of this measure, when considered together with RPA measures 2.4.1, 2.4.3, and 2.4.4, will be to improve flow management for fish habitat needs based on current scientific analyses.

2.4.3 **Revise Minimum Flow Objectives Table: Following completion of the studies specified in RPA measure 2.4.2 above, the USACE, in coordination with the Services, will determine if the minimum and maximum flow objectives in Table 9.2-2 are appropriate. If the studies suggest that fish protection goals can be better met with different flow levels than those specified in Table 9.2-2, then USACE, consistent with 2.4.4 below, will recommend any changes in**

flow objectives in applicable tributaries to improve benefits to listed fish while continuing to meet Project purposes. The Services will inform the USACE whether they agree48 with the modified flow objectives. By January 2011, the USACE will revise its annual water management plan to include the revised flow objectives indicated by studies in RPA measure 2.4.2, provided these flows are acceptable to the Services and that the flows can be released from Project reservoirs within existing system constraints. By January 2011, the USACE will use these flow objectives in operating the Project to the extent possible.

Rationale/Effect of RPA 2.4.3: This measure is the logical progression from RPA measures 2.4.1 and 2.4.2, by using information collected from stream gauging and instream flow studies to revise Table 9.2-2 and the annual water management plan. NMFS recognizes, however, that the flow studies may indicate the need for flow levels that could drain reservoirs and create conflicts with other Project purposes and subsequent instream water needs. For this reason, NMFS does not expect that the Action Agencies will be able to carry out preferred fish flows throughout the basin by 2011. Instead, NMFS intends that this measure will require the Action Agencies to develop a revised plan that identifies fish flow objectives, while recognizing that these flows may not be met at all times in all hydrologic conditions.

The effect of this measure will be to provide improved flows by providing guidance for flow management for fish habitat needs.

2.4.4 **Modify Project Operations: Following completion of the studies specified in RPA measure 2.4.2 above and determination of revised minimum flow objectives as described in RPA measure 2.4.3 above, the USACE will complete system operational modeling and NEPA analyses, if appropriate, including consideration of all project purposes, to identify modified project operations that optimize dam operations to best meet tributary and mainstem minimum flows needed to protect fish. The USACE will conduct these analyses as high-priority element of the COP (RPA measure 4.13 below). The USACE will carry out alternatives deemed feasible, as selected by the COP analysis, by January 2012.**

Rationale/Effect of RPA 2.4.4: This measure completes the studies and management plan revisions that are required by RPA measures 2.4.1, 2.4.2, and 2.4.3. These analyses will be a high priority in the COP because the information is needed to ensure that existing flow objectives are providing the expected fish benefits and, if needed, to identify alternative operations that could more effectively achieve the same benefits. The cost of the outcomes of the analyses should not require large capital investments. The purpose of this measure is to direct the USACE to complete evaluations, such as system operational modeling

48 See RPA 1.3 & 1.4 for elaboration of decision making process.

and NEPA analyses, if necessary, to determine how to best meet revised tributary and mainstem flow objectives for fish, consistent with authorized Project purposes, and to revise system operations accordingly. By allowing an optimization routine to operate the system without arbitrary drafting priorities (see Table 2-6, in Chapter 2), the flow objectives would be met more frequently.

The effect of this analysis is to ensure that project operations are designed to manage available water resources in a manner that best protects anadromous fish and their critical habitats. This measure may require the completion of a NEPA analysis.

2.5 **Tributary Flows –Project Release Maximums: During winter steelhead and spring Chinook salmon spawning seasons, the USACE will maintain tributary flows below the specified maximum flow objectives listed in Table 9.2-2 to the extent practical when the reservoirs are below their respective rule curves. The USACE will notify the Services when maximum flow rates are exceeded according to the protocol described in measure 2.2 above.**

Rationale/Effect of RPA 2.5: This measure is similar to a related measure in section 3.3.6 of the Supplemental BA (USACE 2007a). The only difference is that this measure makes clear that the USACE will notify the Services when maximum flow objectives are exceeded. This notification is necessary to provide NMFS the opportunity to conduct a site evaluation to assess whether the high flows are causing adverse effects to listed fish and if so, to propose emergency measures to minimize these effects.

The effect of this measure is to avoid high tributary flows during spawning seasons to prevent fish from spawning at relatively high channel elevations that would likely be dewatered later in the season when flows drop. This measure will reduce the likelihood of redd desiccation and improve egg-to-fry survival.

2.6 **Ramping Rates: When project outflows are less than those in Table 9.2-3, the USACE will restrict down-ramping (the rate at which outflows are decreased) to the hourly and daily rates listed in Table 9.2-4 to minimize stranding of juvenile fish and aquatic invertebrates and desiccation of redds. NMFS' goal is for down-ramping rates not to exceed 0.1 ft/hour during nighttime hours and 0.2 ft/hour during daytime hours. Table 9.2-4 shows the increment of flow estimated to achieve a 0.1 ft/hour nighttime and 0.2 ft/hour daytime rampdown rates for a range of outflow rates.**

2.6.1 **When system operations or equipment limits prevent USACE from meeting rampdown rates at all projects, USACE will place priority on achieving ramping rates at those projects marked in Table 9.2-4 as high priority for fish protection.**

2.6.2 **The USACE will identify mechanical, operational, or equipment modifications needed to achieve these ramping rates. The Action Agencies**

will evaluate structural modifications in the COP49 study, where indicated, to improve their ability to meet ramping rates.

2.6.3 **During active flood damage reduction operations, the USACE may deviate from the ramping rates in Table 9.2-4. However, the USACE will comply again with these ramping rates as soon as the flood risk has abated. The USACE must follow the protocol for deviations from Table 9.2-4 described in RPA measures 2.2 and 4.3.**

2.6.4 **As noted in RPA measure 2.10 below, the Action Agencies will conduct research, monitoring and evaluation of ramping rate restrictions to determine if the Table 9.2-4 ramping rates are effectively protecting fish and macroinvertebrates from stranding and redds from dewatering. Additionally, these studies will assess the effect of higher ramping rates that are presently permitted at flows greater than those in Table 9.2-3, to determine if these higher ramping rates are causing harm to ESA-listed fish or the critical habitat on which they depend. The Action Agencies will recommend appropriate changes to applicable ramping rates in Table 9.2-4 if indicated by results of the studies and consistent with authorized Project purposes. The Services will inform the Action Agencies whether they agree50 with the modified ramping rates. The Action Agencies will implement modified ramping rates as soon as studies are completed, but no later than January 2011.**

Table 9.2-3 Project outflow rates: below these rates, down-ramping limits in Table 9.2-4 apply.

PROJECT	PROJECT OUTFLOW (CFS)
Hills Creek	1500
Dexter	3000
Fall Creek	700
Dorena	1000
Cottage Grove	800
Cougar	1200
Blue River	700
Fern Ridge	300
Foster	2000
Detroit	2000

49 (C)onfigurations (O)peration (P)lan is Action Agencies' study and feasibility process described in section 9.4.
50 See RPA 1.3 & 1.4 for elaboration of decision making process.

Table 9.2-4 Maximum Ramping Rates During Flow Level Changes below Upper Willamette Basin Dams (cfs)

Nighttime Rampdown Rates to Achieve 0.1 ft/hour [1, 2, 4, 5, 6]

HCR[5]		LOP[5]		FAL[5]		DOR		COT		CGR[5]		BLU[5]		FRN		FOS[5]		DET[5]	
Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change
400		1200		50				50		400		50		30		800		1000	
600	60 [3]	1500	125	100	20 [3]	100		300	30 [3]	500	80 [3]	250	30 [3]	80	20 [3]	900	100	1200	100
1000	75 [3]	2000	145	300	40 [3]	500	50 [3]	500	40 [3]	1200	100 [3]	500	50 [3]	150	30 [3]	1900	150	1500	110
1500	90 [3]	2500	150	500	50	1000	60 [3]	800	50	2400	150	700	60 [3]	300	40	2000	155	2000	130
1700	100	3000	170	700	60	3700	100					2300	100	1000	50				

Highlighted flows are higher than the minimum flows needed to protect ESA species, but are included to represent the lowest flow rate at which 0.1 ft/hr ramp rate is currently possible at these dams.

Daytime Rampdown Rates to Achieve 0.2 ft/hour [1, 2, 4, 5, 6]

HCR[5]		LOP[5]		FAL[5]		DOR		COT		CGR[5]		BLU[5]		FRN		FOS[5]		DET[5]	
Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change	Q	Flow diff for 0.1' change
400		1200		50				50		400		50		30		800		1000	
600	120	1500	250	100	40 [3]	100		300	60	500	160	250	60 [3]	80	40	900	200	1200	200
1000	150	2000	290	300	80	500	100	500	80	1200	200	500	100	150	60	1900	300	1500	220
1500	180	2500	300	500	100	1000	120	800	100			700	120	300	80	2000	310	2000	260
		3000	340	700	120									1000	100				

[1] Avoid a flow volume reduction of more than 50% per hour or the lesser of 1 foot or 50% per 24 hours. Ramping listed are decrements in release that approximately yield the resulting change in flow of 0.1 foot/hour or 0.2 foot/hour.
[2] Operations prevent USACE from meeting rampdown rates at all projects, USACE will place priority on achieving ramp rates at these projects noted as high priority for fish protection.
[3] USACE cannot achieve ramping rates at low flows due to adjustment limits of existing equipment.
[4] NMFS prefers using 0.1 ft/hour during all hours from January 1 through March 31 because mostly fry-aged fish are present then and are less able to avoid ramping effects.
[5] High priority because of the presence of ESA listed salmon and steelhead. Rates listed are for reservoir operation other than when reducing project outflow to manage for downstream flood damage reduction.
[6] Change in flow at flows higher than those listed are less critical for protecting ESA species because of proportionally smaller flow volume change.

Rationale/Effect of RPA 2.6: The objective of this measure is to minimize project effects of entrapment and stranding of juvenile salmon and steelhead in Project-affected tributaries, and to minimize the adverse effects of Project-caused discharge fluctuations on stream biota. Unregulated rivers rarely have drops in stage in excess of two inches per hour (except during floods) whereas regulated rivers can have greater and more frequent stage changes. Thus, aquatic life is not well adapted to stage drops in excess of one or two inches per hour. Fish stranding is one of the greatest negative impacts of excessive stage change. The incidence of stranding is affected by fish size, species, time of day, substrate type, channel contour, magnitude of flow change, and rate of flow change (Hunter 1992). Redd dewatering, reduced invertebrate productivity, fish emigration, and exclusion from spawning habitat can also occur. These are all adverse effects to critical habitat as well as to population numbers.

Measure 2.6.1 recognizes that equipment limits at some of the dams prevents the USACE from making fine adjustments to reservoir discharge, particularly at very low flows. This limits their ability to guarantee that they will meet ramping rate limits specified in Table 9.2-4 at all times. Despite these restrictions, the Action Agencies will to make every effort to meet the Table 9.2-4 ramping rates within existing equipment restrictions, as stated in the Proposed Action.

NMFS includes Measure 2.6.2 to require the Action Agencies to identify modifications that could be made to existing equipment and operations to enable them to meet Table 9.2-4 ramping rates at low flows. The list of modifications should be evaluated in the COP study to identify priorities for making such changes and to seek funding for this work.

Measure 2.6.3 is necessary because during high flow periods, the risk of floods increases, and the Action Agencies need more flexibility to quickly modify reservoir discharges to minimize flood risk. This extra flexibility will not harm UWR Chinook salmon and UWR steelhead because down-ramping at high flows is less likely to cause fish to strand and redds to be dewatered than downramping at lower flows. This reduced impact results from the general relationship that at high flows, large decreases in flows can result in relatively small changes in water depth, while at low flows, a change in flow can result in relatively large changes in water depth, increasing the risk of fish stranding. During flood damage reduction operations, the USACE will attempt to meet the Table 9.2-4 ramp rates, but will not be required to meet these rates.

Measure 2.6.4 references flow-related RM&E actions that are necessary as part of the RPA and Proposed Action. Project-specific ramping rate studies have not been done at Willamette Project dams, and the extent of stranding over a range of ramping rates has not been determined. These RM&Es are needed to assess whether the Table 9.2-4 ramping rates are effectively preventing fish stranding and other harm to stream biota, as well as to determine if assumptions regarding reduced risk at higher flow levels and during flood operations are valid. This

measure includes a process that the Action Agencies will use to modify ramping rates and flows at which they apply, if indicated by study results.

The effect of measure 2.6 and its subcategories, 2.6.1 through 2.6.4 is that these measures will minimize entrapment and stranding of UWR Chinook salmon and UWR steelhead juvenile fish and dewatering of their redds in Project-affected tributaries and will minimize the adverse effects of Project-caused discharge fluctuations on stream biota and critical habitat. Actions will be taken to correct existing equipment that prevents the Action Agencies from meeting Table 9.2-4 ramping rates at very low flows, and studies will evaluate the effectiveness of these ramping rates and may identify revised rates that will further reduce fish entrapment and stranding. Structural modifications and changes to ramping rates will be considered and carried out where feasible and necessary to minimize adverse effects on ESA-listed fish.

2.7 **Environmental Flow51/Pulse Flow Components: The Action Agencies will work through the WATER Flow Management Committee and with the Services, and other aquatic scientists with expertise in Willamette basin fish ecology and fluvial geomorphology, and stakeholders, to identify environmental flow improvement opportunities for the mainstem Willamette River and the lower reaches of tributaries with USACE dams. The Action Agencies will design, test, and carry out modifications to flow releases from USACE dams to improve channel morphology in a manner that would create and sustain new, and improve existing, fish habitat through changes in project operations, while still addressing other authorized Project purposes. For each tributary, the process will begin by identifying fluvial morphology components52 important to ESA-listed salmonids and other biota that are currently underrepresented in the watershed. Following identification of these morphological conditions, the Action Agencies will examine the potential for improving these conditions through modification of project operations, as the Sustainable Rivers Project has done for the Middle Fork Willamette River in an effort summarized by Gregory et al. (2007). The Action Agencies will identify weak or missing morphological characteristics and, where feasible, will incorporate remedies to these conditions into one or more flow modification proposals. The Action Agencies will then submit proposals to the Flow Management Committee of WATER, which will recommend adjustments, if appropriate. The Services will inform the Action Agencies if they agree with the proposals. The Action Agencies will then carry out these flow modification proposals, initially as pilot studies and then, if determined feasible, as part of its regular water management operations. The Action Agencies will monitor the effectiveness of each environmental flow operation at achieving specific ecological objectives beneficial to ESA-listed**

51 "Environmental flows" are used in this context to refer to a full range of pulses or high flows that accomplish various fish habitat maintenance and creation through mechanisms such as sediment distribution, channel forming processes, overbank flows, maintaining access to side or off-channel habitat.

52 Such components may include appropriate seasons, magnitudes, durations, or rates of change in specific components of the annual hydrograph, including fall transition flows, small fall pulses in flow, winter bankfull flow pulses, small or larger floods above bankfull river levels, spring pulse flows, spring-to-summer transitions in flow, and summer baseflows.

salmonids and/or other aquatic biota. The Action Agencies will complete appropriate NEPA evaluation for alternatives being considered

Flow changes that may result from this measure could fall into one of three implementation types: (1) flow volume and timing adjustments that are within the operational flexibility of the USACE under current project authorizations and water control manuals; (2) larger scale adjustments that may fall within current operational flexibility and authority but whose implementation requires detailed evaluation of tradeoffs; and (3) major changes in operation which are clearly outside of the USACE's operational discretion and would require a thorough feasibility evaluation and possible reauthorization action. The USACE will begin implementing proposals for Type 1 environmental flow modifications on the lower Middle Fork Willamette, below Dexter Dam, in FY 2009, and explore with the Services and the Flow Management Committee of WATER any needs and opportunities to implement Type 2 or 3 flow modifications there in subsequent years. The Action Agencies will develop and carry out proposals for environmental flow modifications below other USACE dams in the Willamette Basin during the term of this Biological Opinion, with priorities among rivers identified by the Flow Management Committee. Within this period, a full effort will be made to optimize USACE management of flows in the tributaries and mainstem so as to achieve improved fish habitat benefits that are not incompatible with other purposes of the dams.

Rationale/Effect of RPA 2.7: Natural patterns of variation in flow exert significant influence on the habitat and ecology of UWR Chinook, UWR steelhead, and other aquatic organisms native to the Willamette Basin. Flow alteration by the system of USACE dams in the Willamette Basin has contributed to profound changes in the freshwater habitat of UWR Chinook and UWR steelhead. Requirements elsewhere in this Biological Opinion for seasonal minimums and maximums in flow, and for limits on down-ramp rates, do not fully address historical changes to natural patterns of variation in flow or to channel forming flows that may at present constrain the abundance and productivity of these ESA-listed anadromous fish.

The effect of this measure is to initially make minor improvements to existing spawning and juvenile rearing habitat downstream of Dexter Dam in the Middle Fork Willamette and below Dorena and Cottage Grove in the Coast Fork Willamette River. As the Action Agencies begin to release Type 1 flow modifications in other Project-affected subbasins, there will also be minor improvements to existing spawning and juvenile rearing habitat due to increased flushing of sediments, cleaning out small particles and moving new gravels into usable habitat. Over the next 15 years, Type 2 and possibly Type 3 flow modifications that will be carried out in the Middle Fork Willamette and at Project dams in other subbasins will improve or create and sustain new juvenile rearing habitat in complex habitat, side channels, or other morphological features. These actions will increase available rearing habitat and make existing spawning and rearing habitat below Project dams more suitable, resulting in increased productivity and abundance. Adverse effects on critical habitat in reaches below dams will be reduced because this measure

will improve existing rearing and spawning habitat and may create and maintain new rearing habitat.

2.8 **Foster Spring Spill: The USACE will continue to spill at Foster Dam between 0.5 and 1.5 feet of water (approximately 92 to 238 cfs), depending upon inflow and forebay elevation fluctuations, over the spillway fish weir53. This operation will occur from 0600 through 2100 hours daily during the primary fish passage season, April 15 through May 15. The Action Agencies will evaluate the effectiveness of this operation on downstream fish passage as part of RM&E (RPA measure 2.10) and COP studies (RPA measure 4.13). Based on the results of these studies, the Action Agencies will recommend modifications to this spill operation or new downstream fish passage facilities or operations. If modified operations are warranted and can be carried out within existing physical and operational constraints, the Action Agencies will begin to carry out these operations consistent with RPA measure 4.8, Interim Downstream Fish Passage. If more extensive modifications are needed, the Action Agencies will follow the process described in the COP study, RPA measure 4.13.**

Rationale/Effect of RPA 2.8: This measure would continue an existing spill program that provides better downstream juvenile steelhead passage survival than turbine passage at Foster Dam (see South Santiam Baseline section 4.5.3.1). Although based on a similar action described in section 3.3.8 of the Supplemental BA (USACE 2007a), NMFS includes a requirement that this measure be evaluated as part of the RM&E (RPA measure 2.10) and COP studies (RPA measure 4.13), and that the Action Agencies will modify this measure if indicated by study results.

The effect of this spill operation will be improved survival of juvenile steelhead, and likely Chinook salmon, emigrating from above Foster Dam as a result of the outplanting program.

2.9 **Protecting Stored Water Released for Fish: In coordination with the OWRD and ODFW, the Action Agencies will facilitate conversion of stored water to an instream flow water right. Oregon adopted minimum perennial streamflows for Willamette tributaries in Oregon's Willamette Basin Program (Table 1 in ORS 690-502). After being converted to water rights under Oregon law, OWRD can protect the minimum perennial stream flows from illegal diversion. The State of Oregon is solely responsible for administering and enforcing state water rights.**

Additionally, the Action Agencies will identify stored water in addition to the minimum perennial streamflows that could be allocated from reservoirs to enhance salmon and steelhead survival. The Action Agencies will proceed with necessary actions to allocate and protect water for this purpose. In particular, USACE and

53 To provide a measure of downstream fish passage, Foster dam employs an overflow weir immediately upstream of one tainter gate (which is raised, out of service, when the fish weir is employed). This fish weir provides a surface oriented flow that better attracts and conveys fish than turbine flow.

Reclamation will coordinate with OWRD on several tasks to accomplish this measure: 1) identify current water storage at USACE reservoirs that could be allocated to instream flow for ESA listed fish; 2) determine how to legally transfer flow for instream purposes; and 3) proceed with the necessary analyses to implement the agreed upon transfers. The tasks necessary to accomplish this action may require approval from Congress. This effort will begin immediately. By the end of 2009, the Action Agencies will have coordinated with all appropriate agencies and determined the path forward in order to accomplish this action.

Rationale/Effect of RPA 2.9: Water use and development in the Willamette basin are expected to continue to grow, making it very important to preserve adequate water for fish, particularly in the tributaries. Although the Action Agencies have agreed to release minimum flows from Project dams to support fish life in tributary reaches, they cannot guarantee that these flows will be maintained throughout the reach because the State (OWRD), not the Action Agencies, has enforcement authority over water rights. Current Oregon water law allows holders of natural flow water rights in the Willamette basin to divert stored water released from Project dams when this water is not obligated by existing Reclamation contracts. Thus, even though the Action Agencies intend for some of the stored water that is released to provide fish benefits, OWRD is not authorized to protect these flows from diversion by water users because this water is not currently obligated by a contract. In early 2008, NMFS participated in staff-level meetings with OWRD, Reclamation, BPA, and USACE to identify available mechanisms for protecting these minimum flow releases for fish purposes. As a result of these meetings, the Action Agencies agreed to investigate and carry out steps to achieve this purpose of protecting a certain amount of stream flows for fish. The exact steps that the Action Agencies will take have yet to be determined, but they must first request from OWRD a transfer of portions of the existing irrigation storage water rights to another use, such as multi-purpose or fish protection.

The effect of this measure is that the flows released from Project dams for fish protection purposes will remain instream and provide intended biological benefits. Although the Action Agencies cannot guarantee what action the State of Oregon may take, this measure requires the Action Agencies to take steps within their authorities to protect these flows.

2.10 **<u>Flow Related Research, Monitoring and Evaluation</u>: As part of the RM&E plan described in RPA measure 9 below, the Action Agencies will plan and carry out studies and monitoring of mainstem and tributary flow rates and Project ramping rate restrictions necessary to protect fish and aquatic habitat, as well as other evaluations required by measures in this section. The flow and ramping rate studies will be considered high priority and field studies should begin in 2009, with initial results available to inform modified flows and ramping rates by January 2011.**

Rationale/Effect of RPA 2.10: This measure is needed to evaluate the effectiveness of mainstem and tributary flows, ramping rate restrictions, and other flow-related measures such as Foster Spring Spill (RPA measure 2.8). Flow and ramping rate evaluations are high priority studies because they will provide the information necessary to identify any

necessary changes in project operations to protect UWR Chinook salmon and UWR steelhead. If studies indicate that different flows or ramping rates would be more effective at protecting fish, then the Action Agencies could carry out such changes as quickly as possible to ensure fish protection during this interim period.

The effect of this measure is that study results will be used to modify project operations and flows to improve UWR Chinook salmon and UWR steelhead survival in the tributaries below Project dams and in the mainstem Willamette River. Life stages affected will be fry and juveniles from stranding, smolting juveniles during migration, adults during migration and holding, and eggs in redds from dewatering associated with Project ramping.

9.3 WATER CONTRACT PROGRAM

One of the authorized purposes of the Willamette Project is the distribution of stored water to users who have contracts with Reclamation for irrigation use. As described in Effects Section 5.1, diversion of water to serve these contracts can adversely affect UWR Chinook and UWR steelhead by reducing the amount of stream flow available for use by all life stages and by entraining juveniles into water diversions. These RPA measures are intended to minimize the effects of diverting water served by Reclamation contracts on listed species by limiting the volume of new contracts that can be issued, requiring existing contract diversions to install screens and other fish passage devices within specified timeframe, requiring screening of all new contract diversions, ensuring that water released to serve contracts does not diminish water available to meet minimum flow objectives, and reducing the volume of stored water diverted to contract holders in low water years to ensure minimum objectives are met. These measures will also minimize destruction and adverse modification of critical habitat due to water diversions because they limit the total amount of water that can be diverted and require fish protection measures at the diversions.

RPA 3 Bureau of Reclamation Water Contract Program

Reclamation and the USACE will continue the existing irrigation contract water marketing program for the Willamette Project. Reclamation will issue new contracts, except as specified in RPA measure 3.1 below regarding new contracts in the N. and S. Santiam subbasins, and provided that the total water marketing program, including existing contracts, does not exceed a total of 95,000 acre feet. In the event that future irrigation demand exceeds 95,000 acre-feet, Reclamation and the USACE will reevaluate the availability of water from conservation storage for the water marketing program and reinitiate consultation with the Services if they propose to issue additional contracts.

In addition, all contracts will be subject to the availability of water, as determined by USACE. Therefore water may not be available for some or all of each year in order to meet ESA requirements and other project obligations for instream flows (e.g. minimum flows to protect water quality). Reclamation

may issue notices, orders, rules, or regulations governing water service as necessary to comply with the requirements of the ESA, including appropriate biological opinions and Incidental Take Statements.

Rationale/Effect of RPA 3: This measure builds on a similar action described in section 3.9 of the Supplemental BA (USACE 2007a). NMFS describes the effects of the Action Agencies' Proposed Action in the General Effects Section 5.1. In that section, NMFS finds that in most years and in most of the Project-affected tributaries, sufficient water is available to meet fish flow needs and still supply a water marketing program of up to 95,000 acre-feet and that Reclamation's contract language affords it the ability to curtail irrigation water deliveries when insufficient water is available to meet both instream flow needs and irrigation demand. (Measure 3.1 addresses NMFS' finding that there is insufficient water available to meet both fish flow and contract needs in the North Santiam and South Santiam rivers in most years). This measure specifies that as new contracts are issued and existing ones are renewed, Reclamation must make sure that the total amount of contracted water stays at or below 95,000 acre-feet. If future demand is for more than the existing total, then Reclamation and USACE must reinitiate consultation prior to issuing contracts that would exceed the 95,000-acre-foot limit.

The effect of this measure is to ensure that adequate water is available for possible use for protection of listed fish in the tributaries and mainstem Willamette. This measure also minimizes adverse effects on critical habitat by providing enough water so that minimum flows needed for properly functioning habitat are not precluded by the contract program.

3.1 **<u>New Contract Issuance</u>: Reclamation will not issue irrigation water service contracts in the North Santiam River and the South Santiam River that would in total exceed the current total of 11,574 ac ft (85 cfs) and 1,096 ac ft (7 cfs) respectively.**

The USACE will update its flow exceedance models (similar to Appendix C of the Supplemental BA; USACE 2007a) every five years, and, together with results of fish flow studies, determine whether additional water is available during most years for new irrigation contracts based on this information. If, based on these analyses and other information, the USACE determines that additional water is available to serve irrigation demand (beyond the volumes specified above) without adversely affecting listed fish and their critical habitats, then the USACE will inform Reclamation and seek the written agreement of the Services. The Services will inform the USACE in writing whether they agree54 with the USACE's determination. If the result of this process is an affirmative determination that additional water is available, Reclamation may issue new contracts based on and limited by the USACE's determination.

Rationale/Effect of RPA 3.1: NMFS includes this measure to prevent further reductions in streamflow in the North and South Santiam rivers until and unless a showing is made

54 See RPA 1.3 & 1.4 for elaboration of decision making process.

that additional water is available. The North and Santiam rivers are core population areas for UWR Chinook and UWR steelhead. As described in RPA 2.4, tributary minimum flows are needed to provide adequate rearing, spawning, holding and migration habitat for UWR Chinook salmon and UWR steelhead. Analysis conducted by the USACE and summarized in tables 5.5-2 (South Santiam Effects section) and 5.6-1 (North Santiam Effects section) indicates that minimum tributary flows are not met during certain months of the year. In the South Santiam, USACE estimates a 25% chance of not meeting the 1500 cfs minimum flow for Chinook spawning from September 1 through October 15, a 20% chance of not meeting the 1100 cfs Chinook incubation flows from October 16 through January 31, and a 20% chance of not meeting the 1500 cfs steelhead spawning flows from March 16 through May 15. In the North Santiam, Chinook spawning flows of 1500 cfs are not likely to be met about 5% of the time.

Additionally, as described in the North Santiam Effects section 5.6.2.1 and in RPA measure 2.4 (tributary minimum flows), the Action Agencies release minimum flows at the dams, but have no authority to enforce these minimums through tributary reaches. In the North Santiam, although the chance of not meeting summer rearing flows of 1000 from July 16 through August 31 is less than or equal to 1% at Big Cliff Dam, the likelihood that this flow will be sustained through the reach downstream to the confluence with the South Santiam is low. OWRD has issued water rights for up to 2,730 cfs from the N. Santiam River between Big Cliff Dam and the South Santiam confluence (about half of which is used for hydroelectric power and affects a short stretch of river). While total diversions seldom if ever reach this total permitted amount, diminished flows have been identified as a limiting factor for UWR Chinook and UWR steelhead in the basin.

Based on this information, it is clear that permitting additional water to be diverted from the stream would further reduce the likelihood of meeting minimum flows and result in less habitat available for rearing, spawning, and incubation. Because OWRD has determined that natural flow is unavailable in the North Santiam River, this curtailment of further water service contract issuance effectively protects the river from further flow reduction.

The effect of this measure is that streamflow in the North and South Santiam rivers would not be further reduced by diversions permitted with new Reclamation contracts. This measure would not improve fish habitat, but it would prevent further degradation. The amount of rearing habitat available to juvenile UWR Chinook and steelhead would continue to be reduced from points of diversion serviced by contracts to the confluence of the mainstem Santiam River with the Willamette during July and August of each year.

3.2 **Existing Contracts: All existing contracted diversions will be required, as a condition of continuing to receive project water, to have fish protection devices that comply with NMFS design criteria, and are approved by NMFS.55 While this clause is primarily about fish screens, it is not limited to fish screening. Based on**

55 Projects that have had, within the last 15 years, site-specific ESA Section 7 consultations performed with respect to fish protection devices are deemed compliant.

the effect of the diversion on anadromous fish, fish protection devices could include upstream passage at dams, exclusion of fish from irrigation water return channels, and other fish hazards presented by water diversion practices. Contractors that do not comply with Reclamation's notice or otherwise fail to obtain certification by NMFS as having adequate fish protection devices will not be eligible to continue to receive irrigation water service from the Project and their contract may be subject to termination. The compliance deadline is April 1, 2010, unless a later date is authorized by NMFS.[56]

3. **By October 1, 2008, Reclamation will send written notification to all existing contractors notifying them that in order for them to continue receiving irrigation water service from the Project, their diversions must have fish protection devices that comply with current NMFS fish protection requirements,[57] and are approved by NMFS. Contractors will be required to request assessment by entities listed in the Bureau's written notification letter. Within the time frame specified by Reclamation in its notice, contractors will be required to provide Reclamation with written assessment58 that their diversions conform to NMFS criteria. Reclamation will assemble this information and provide it to NMFS. NMFS will then make a determination as to whether NMFS agrees that the fish protection measures are sufficient to protect ESA-listed fish, and will advise the water user and Reclamation of this determination. NMFS may ask for additional information, or may need to visit the diversions in order to make its determination. If NMFS requests a site visit, NMFS will inform Reclamation.59**

4. **While contractors proceed with the fish protection device installation or modification and approval process, they may continue to divert water under the terms and conditions of their existing contracts, as long as they meet the deadline provided to them by Reclamation.**

5. **As another condition of receiving water, every five to seven years, contractors must re-confirm that their diversions are still in conformance with NMFS design guidelines.**

Rationale/Effect of RPA 3.2: This measure requires screening or other appropriate fish passage devices at diversions with existing Reclamation contracts that will not be renewed for a number of years. In most cases, fish entrainment into a diversion is lethal. Measure 3.3 below ensures that these protections will be required at renewal, but does not require immediate screening of all existing diversions.

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56 Reasons for extending this date might include challenging design requirements, or atypically large and complicated projects.

57 See Anadromous Salmonid Passage Facility Design, National Marine Fisheries Service, Northwest Region, February 2008, NMFS 2008e

58 NMFS will accept assessments by ODFW, Reclamation, or others, based on a Memoranda of Understanding between these Agencies and NMFS with respect to technical acceptance criteria.

59 Initially, all diversions will require a site inspection by NMFS; ideally, however, Reclamation and NMFS will develop a protocol to avoid site visits for every pumped, diversion, particularly small ones.

The effect of this measure is that losses of juvenile Chinook and steelhead due to entrainment or ineffective passage at existing diversions will only continue until April 1, 2010.

3.3 **New & Renewed Contracts – Conditions: Reclamation will require renewed and new contracts to meet all of the following:**

1. **Compliance with NMFS fish protection criteria, as required for existing diversions in 3.2, above.**
2. **Surface water diversions must have lockable headgates that are capable of easily starting, adjusting and stopping[60] the flow of water.[61]**
3. **Diversions greater than 3 cfs must have devices to enable measurement of the instantaneous rate of water delivery, within 5% accuracy.[62] Diversions over 10 cfs must also have a flow totalizer that calculates total volume of water diverted.**
4. **Reclamation will include provisions to curtail or cease entirely all water deliveries in specific areas, if certain flows are necessary to protect listed species and their critical habitats.**

Rationale/Effect of RPA 3.3: This measure is included to ensure that new and renewed contracts include conditions to protect fish from entrainment into diversions and to ensure that rate and volume of water diverted can be easily and accurately controlled. In most cases, fish entrainment into a diversion is lethal. The OWRD now requires new surface water right permittees in the Willamette basin to screen their diversions to avoid entrainment; however, an unknown number of diversions using older federal water service contracts are unscreened.

This effect of this measure is to minimize loss of UWR Chinook salmon and steelhead at diversions that acquire a new or renewed Reclamation contract. During the 15-year term of this Opinion, about 48 of the 205 existing contracts will be eligible for renewal. Harm will be reduced by requiring screens to be installed and operated at contract diversions. Contract conditions requiring headgate flow controls, measurement, and water curtailment will reduce adverse effects on listed fish due to reduced river flow.

3.4 **Annual Availability of Contract Water for Irrigation: Contract fulfillment is subject to the USACE's annual operating plan for the Willamette Basin Project in which the USACE determines availability of water for Reclamation contracts. If USACE determines that a shortage will occur, or is forecasted to occur, USACE can designate this shortage to specific tributary subbasins,**

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60 To less than 1.0 cfs.

61 Pumped diversions are presumed to inherently possess this capability.

62 Any of the measurement methods described in the *Reclamation Water Measurement Manual* for measuring instantaneous flow rate shall be acceptable, but generally for surface water diversions, and pumps that discharge to canals, this will likely be a flume; for flows entirely within conduit, a pipeline flow meter is presumed. Indirect methods based upon pump(s) electrical power consumption require field calibration (USBR 2001a) and an engineer's certification of the correlation between electrical power consumption and flow.

certain reaches, or throughout the Willamette basin, limiting the availability of the contract water supply. Reclamation will notify contractees of storage water shortages as described below. Appendix D further describes how water years are designated and is hereby incorporated into this RPA by reference.

Each year on or before April 1, the USACE will determine availability of water for irrigation contracts based on the best information available at that time.

DEFICIT YEARS:

(a) In "deficit" water years (as defined in Appendix D), the USACE will inform Reclamation that either (1) a specified partial supply or (2) no supply is available for the upcoming irrigation season in specific tributaries and will include this determination in the annual operating plan. The April 1 determination will remain in effect until October 31. The USACE may revise its "deficit" water year determination after April 1 if forecasts change significantly toward a wet year, and may make additional stored water available to meet irrigation contracts.

(b) Reclamation will notify affected contractees that water deliveries will be ceased or curtailed under these circumstances. Reclamation may apply the curtailment or cessation of water deliveries to specific tributaries where it is needed, but not in others, depending on water availability and storage capacity in each basin's reservoirs. Reclamation will also inform the OWRD of such actions.

(c) If the USACE determines initially that a partial supply is available for contractees, but later forecasts indicate even less water is available, in order to protect fish habitat the USACE will release additional flow from the applicable dams to offset the amounts diverted by contractees, based on the partial use that had been permitted on April 1. This additional flow will not be released if, based on coordination through WATER, it is determined these additional flows would impact ability to meet Table 9.2-1 (mainstem) and 9.2-2 (tributary) minimum flows during other seasons.

INSUFFICIENT, ADEQUATE, & ABUNDANT YEARS:

(f) In these water years (as defined in Appendix D), the USACE will usually not make a determination that would curtail contractees' use of water.

(g) Instead, the USACE will release additional flow (over the Table 9.2-2 flow rates) to offset the amount of flow diverted by

contractees, as estimated in Table 3-26 of the Proposed Action (USACE 2007a) (or based on updated estimates by Reclamation of actual use). This measure does not apply to the Coast Fork or Long Tom subbasins.

(h) The schedule for when and if to begin and end additional flow releases will be annually determined through the WATER Flow Management Committee, which will consider fish flow needs, Reclamation's estimate of contract water usage, and reservoir storage available for meeting tributary and mainstem flow objectives throughout the water year.

(i) In tributaries and reaches where the sum total of existing and new contracts is less than 20 cfs or otherwise beyond adjustment capabilities at each project dam, the USACE will attempt to release these additional increments. However, downstream gage data may not detect relatively small increases in flow over Table 9.2-2 releases.

(j) The USACE will not be required to make RPA measure 2.2 deviation reports where contracted flow is less than 20 cfs; NMFS will consider requests to waive RPA measure 2.2 deviation reports in other situations, as well, on a case-by-case basis.

Rationale/Effect of RPA 3.4: Under the Proposed Action, USACE would not increase the discharge rate at individual projects to meet Reclamation contracts, reasoning that established project minimum discharge rates are sufficient to meet those needs and contract diversions take a *de minimus* volume of water. Because the tributary minimum flows established in RPA measure 2.4 are designed to protect listed fish throughout the stream reaches downstream from Project dams, diverting water under Reclamation contracts while Willamette Project dams are discharging to meet minimum flows could put listed fish at risk. This RPA measure requires Reclamation to curtail contract diversions in Deficit water years, and, in all other water years, it requires USACE to release additional water above the minimum flow levels to ensure that contract users do not take water intended for fish purposes.

As a means to reduce risk to contractors, USACE will identify the likelihood of curtailment by April 1, prior to the irrigation season through the development of the Willamette Conservation Plan. Such early notification would assist water users to plan appropriately for a water shortage. In the event that the USACE's forecast is incorrect, and a forecast that appeared adequate (not requiring any curtailments) on April 1st changes to one predicting a "deficit" water year, the USACE will release additional flow at its dams to make up for the contracted amounts. This would protect contractors from interrupted water service mid-season, when it could result in excessive crop damage, but would ensure that streamflows are not further reduced due to contract withdrawals in such flow years.

Curtailments under this measure could be for one or more individual tributaries or the entire basin and could be in force for only a few weeks or the entire irrigation season.

Innovative solutions to minimize impacts to water users, such as rotational diversion timing, may be proposed by Reclamation and OWRD and may be adopted by NMFS.

The effect of this RPA measure is that losses to listed fish species from low stream flows will be reduced while allowing the Action Agencies to continue serving other project purposes to the extent practical. Adverse effects on critical habitat will be reduced because this measure will provide for flows necessary to support listed fish.

9.4 FISH PASSAGE

The Proposed Action included studies to consider passage at Project dams, but did not include specific passage measures and time frames associated with the measures. As discussed in the Effects (Chapter 5) and Summary of Effects (Chapter 7) sections of this Opinion, for UWR Chinook salmon and UWR steelhead, lack of passage is one of the single most significant adverse effects on both the fish and their habitat. In its jeopardy and destruction and adverse modification of critical habitat analyses, NMFS identified the need for more specific measures with associated time frames. Specific passage measures are necessary to address the effects of the Project. Therefore, NMFS includes specific passage measures to be completed and operational by set deadlines. NMFS also includes a measure to ensure that the Action Agencies continue to work toward providing more specific passage measures, if appropriate, past the time frame of RPA.

RPA 4 Fish Passage

4.1 **<u>Adult Chinook Salmon Outplanting</u>: The Action Agencies will continue capturing spring Chinook salmon below USACE dams and transporting them into habitat above the following dams:**

- **Detroit Dam in the North Santiam River basin;**
- **Foster Dam in the South Santiam River basin;**
- **Cougar Dam in the South Fork McKenzie River basin;**
- **Lookout Point and Hills Creek dams in the upper Middle Fork Willamette River subbasin; and**
- **Fall Creek Dam in the Fall Creek River basin.**

Additionally, if NMFS, after coordination with the Fish Passage and Hatchery Management Committee (FPHM) of WATER, determines it is necessary to evaluate passage at Green Peter Dam, then the Action Agencies will also release Chinook salmon above that dam in the South Santiam.

The Outplant Program will provide upstream fish passage for adults via "trap and haul" facilities while USACE carries out studies to assess upstream and downstream fish passage alternatives at these dams and reservoirs (see RPA measures 4.10, 4.11, and 4.12 below). The interim operational guidelines and protocols for outplanting fish will be as described in section 3.4.5 of the Supplemental BA (USACE 2007a),

NMFS (2006f) and section 15 of each ODFW (2003, 2007a, 2008a, and 2008b).63 The Outplant Program will be carried out consistently with the guidelines, protocols, and criteria specified in the Willamette Fish Operations Plan (see RPA measure 4.3 below) and annual revisions to this plan (see RPA measure 4.4 below). (See also RPA measure 6.2.3 below, which references this same Outplant Program as part of the hatchery-related measures).

Rationale/Effect of RPA 4.1: This measure is generally consistent with section 3.4.5.3 of the Proposed Action (USACE 2007a), in which the Action Agencies propose to continue the Outplant Program consistent with a philosophy described in detail in section 3.4.4.5 of the Proposed Action. The outplant program is a first step to provide UWR Chinook salmon and UWR steelhead access to historical habitat above Project dams, but by itself won't be sufficient. The major distinction between the PA and RPA for the outplanting program is that harm to listed fish should be decreased by following guidelines developed to minimize effects on the fish.

As described in the Effects sections for the major subbasins (Middle Fork Willamette, section 5.2; McKenzie, section 5.3; South Santiam, section 5.5; and North Santiam, section 5.6), the outplanting measures in the PA do not provide safe passage. Therefore, improvements in fish trapping, handling, transport, and release are needed to minimize stress and injury to adult fish. The interim guidelines and protocols, as implemented by the Action Agencies, will help to reduce fish stress and injury.

The Outplant Program, as modified based on monitoring and evaluation and with improved trapping facilities described in RPA measure 4.6, will provide adequate temporary upstream passage to ensure fish access to historical habitat. In most situations where fish passage at a dam is needed, NMFS would consider volitional passage via a fish ladder or other fishway as its first choice alternative. However, for the Willamette Project dams, in this case, sufficient improvements in upstream passage can be achieved in the short term with improved fish trap and transport facilities while efforts are focused on achieving safe downstream fish passage through the dams and reservoirs. Once downstream fish passage facilities are completed and demonstrated to provide safe and timely passage, then NMFS will reconsider whether volitional upstream passage is needed at certain Project dams.

This measure requires the Action Agencies to transport listed fish to the described locations. Fish habitat above dams was historically preferred for spawning and rearing. Since dam construction, remaining fish habitat below dams has been degraded by dam and reservoir operations, as well as other actions such as land use and agricultural and industrial water pollution. Lack of access to good habitat is considered a major reason for the decline in productivity of UWR Chinook, and most of the good habitat, and hope for restoring productivity, lies above project dams.

63 Hatchery and Genetic Management Plans (ODFW 2003, 2004a, 2005, 2007a, 2008a, and 2008b) are described in the salmon and steelhead 4(d) rule as a mechanism for addressing "take" of ESA-listed species that may occur as a result of artificial propagation activities.

The effect of this measure will be to require efforts to restore productivity of listed fish. Restoration of productivity is key to adequately addressing the effects of the Project because the extremely low numbers of wild fish caused by lack of or inadequate access to historical habitat are the major factor contributing to the species' decline. Lack of access to good habitat above the dams, injury and mortality associated with inadequate passage facilities, and restriction to degraded habitat below the dams has caused steep declines in numbers and has reduced the functioning of PCEs of critical habitat.

4.2 **Winter Steelhead Passage: The Action Agencies will continue to trap adult winter steelhead at Foster Dam in the South Santiam River and transport them to release sites above Foster reservoir. If NMFS and the Action Agencies, in coordination with the FPHM of WATER, determine it necessary for evaluation of winter steelhead passage at Green Peter Dam, then the Action Agencies will release some portion of the winter steelhead captured at the Foster Dam trap above Green Peter reservoir in the South Santiam. Additionally, if NMFS and the Action Agencies, in coordination with the FPHM, determine it necessary for evaluation of steelhead passage at Detroit and Big Cliff dams, then the Action Agencies will trap winter steelhead at the Minto Trap or other locations in the North Santiam River below Big Cliff Dam and release them above Detroit and/or Big Cliff dams, as directed by NMFS.**

Rationale/Effect of RPA 4.2: The Outplant Program described above in RPA measure 4.1, has focused on upstream passage of UWR Chinook salmon, but UWR steelhead access to historical habitat in the South and North Santiam rivers is also needed. In the South Santiam subbasin, the Action Agencies have continued to pass UWR steelhead above Foster Dam since dam construction, relying on a surface spill program to flush juvenile steelhead from the reservoir during the peak migration period. As described in Section 4.5.3 (Baseline South Santiam), upstream passage at Green Peter Dam was discontinued in 1988 because adults were not attracted to the cold water from the ladder and a low percentage of downstream migrants were collected in the downstream fish collection facility. This measure requires the Action Agencies to continue to pass UWR steelhead above Foster Dam, and possibly, above Green Peter Dam.

In the North Santiam subbasin, steelhead passage to historical habitat above Big Cliff and Detroit dams was blocked in 1953, when construction of the dams without fish passage facilities was completed (see section 4.6.3, Baseline North Santiam). As described in Effects Section 5.6, UWR steelhead spawn in the North Santiam below Big Cliff Dam. Although water quality and sediment transport are degraded in this reach due to continued dam operation, this population is considered to be at "moderate" risk of extinction. (UWR Chinook salmon, on the other hand, are at a "very high" risk of extinction). Because there is not a hatchery component of winter steelhead, NMFS is reluctant to release winter steelhead above Big Cliff and Detroit until downstream fish passage is shown to be safe with existing structures or until new facilities are installed that provide safe passage. RM&E studies will evaluate potential benefits of steelhead passage at Big Cliff and Detroit. Based on the results of the studies, NMFS, after

coordination with the FPHM, may determine that passage of UWR steelhead is appropriate during the term of this Opinion.

The effect of this RPA will be to ensure that UWR steelhead are provided safe upstream passage in the North and South Santiam subbasins, if determined feasible and necessary based on RM&Es. Lack of passage was a significant factor in the species' decline, and assuming passage is determined effective at Detroit and Big Cliff on the North Santiam and at Foster and Green Peter on the South Santiam, these populations will likely increase in abundance and productivity by allowing steelhead to use good spawning and rearing habitat above the dams.

4.3 **Willamette Fish Operations Plan: The Action Agencies will complete a Willamette Fish Operations Plan (WFOP) by October 1, 2008. The Action Agencies will coordinate with the Services when preparing the WFOP. This Plan and its annual revisions will be consistent with this Opinion and incidental take statement, and will take into account and be coordinated with related biological opinions issued by the USFWS to the fullest extent practicable. The Action Agencies will carry out measures identified in the WFOP and in annual revisions to the WFOP. The WFOP will include, but not be limited to, the following:**

7. **Identify optimal operating criteria for Green Peter, Foster, Detroit, Big Cliff, Cougar, Fall Creek, Dexter, Lookout Point, and Hills Creek dams to minimize adult and juvenile fish injury and mortality to the extent possible with existing facilities and operational capabilities;**

8. **Identify protocols for optimal handling, sorting, and release conditions for ESA-listed fish collected at USACE-funded fish collection facilities, including but not limited to those at Minto fish facility, Foster Dam fish collection facility, McKenzie Hatchery, Fall Creek fish facility, Dexter Dam fish collection facility, and at the new facilities at Cougar and Leaburg dams, when they are constructed;**

9. **Identify the number, origin, and species of fish to be released into habitat upstream of USACE dams, incorporated into the hatchery broodstock, or taken to other destinations;**

10. **Describe scheduled and representative types of unscheduled maintenance of existing infrastructure (dams, transmission lines, fish facilities, etc) that could negatively impact listed fish, and describe measures to minimize these impacts;**

11. **Describe procedures for coordinating with federal and state resources agencies in the event of scheduled and unscheduled maintenance.**

12. **Describe protocols for emergency events and deviations:**

a) Protocol Development: The USACE will establish a formal, written procedure for taking actions to prevent or minimize adverse impacts to ESA-listed fish, including water quality impacts, during unusual events/conditions. These protocols will guide the actions of project personnel.

b) In the event of an emergency outage or malfunction, the Action Agencies will inform the Services of the emergency by phone or email, as soon as practical, but not later than 24 hours after the event. This process will also apply whenever the Action Agencies carry out flood reduction operations that result in deviations from the flow measures described in this section.

c) The Action Agencies may initiate work prior to notifying the Services, when delay of the work will result in an unsafe situation for people, property, or fish. For each occurrence of unscheduled maintenance and each flood damage reduction operation that results in a deviation from minimum mainstem flow objectives, minimum and maximum tributary flow objectives, ramping rates, spill at Foster Dam, or adverse TDG and water temperature conditions, the USACE will inform the Services in writing (or email) within 24 hours, and include a description of the problem, type of outage required, potential impact on ESA-listed fish, estimated length of time for repairs or flood damage reduction operation, and proposed measures to minimize effects on fish or their habitat. This approach will be taken only if it is not possible to coordinate with the Services prior to starting the maintenance event or flood damage reduction operation.

Rationale/Effect of RPA 4.3: The WFOP will replace the Action Agencies' proposed Willamette Fish Passage and Management Plan, identified in the Proposed Action, 2007 Supplemental BA at sections 3.2.2 (p. 3-18) and 3.4.5.3 (p. 3-48). All of the features of the Action Agencies' proposed plan will be included in the WFOP, but it will also include important operational requirements not directly related to fish passage such as outflow protocols during emergencies to protect fish spawning in habitat below Project dams. The WFOP is a critical link between measures required by the Proposed Action and this RPA and on-the-ground implementation activities. The WFOP will guide Project personnel, including contractors and other agencies responsible for carrying out fish hatchery and passage measures, and will help to ensure that fish facilities are operated based on best practices and consistent with the terms of this Opinion.

By including emergency operations within the WFOP, field staff will have a single manual to rely on for all fish-related protocols, including steps that should be taken in emergency situations to minimize adverse fish effects. The notification protocols measure (number 6 in the list above) adds reporting details to a similar action described in section 3.3.4 of the Supplemental BA (USACE 2007a), and requires the Action Agencies to notify the Services within 24 hours of an unscheduled event rather than the

48 hours required by the Proposed Action measure. NMFS requires timely notification and reporting of these events in order to initiate damage assessments and to advise the Action Agencies on a preferred course of action to minimize adverse fish impacts.

The effect of this measure will be to reduce stress, injury, and mortality to adult fish caused by the Outplant Program by ensuring field personnel have clear instructions for carrying out this Program. The Plan will also minimize fish injury and mortality caused by emergency operations by providing clear directions to field staff for dealing with emergencies in a manner that is protective for listed fish. Additionally, NMFS will be able to quickly assist the Action Agencies in defining measures they should take to minimize and avoid fish losses, and NMFS will be able to assess losses when needed.

4.4 **Annual Revision of Willamette Fish Operations Plan (WFOP): The Action Agencies will annually revise and update the WFOP, including the "Fish Disposition and Outplant Protocol" sections of each chapter to describe how and where outplanted fish will be collected, held, marked, sampled, transported, and released and to incorporate changes in operations needed to protect fish. The WFOP will be revised annually based on results of RM&E activities, construction of new facilities, recovery planning guidance, predicted annual run size, and changes in hatchery management. Annual revisions will be submitted to the Services by January 15 of each year for review and comment; the Services will inform the Action Agencies by February 15, whether they agree64 with the revised WFOP. The Action Agencies will release a final updated WFOP by March 14 of each year. Annual revisions will be considered an "Annual Milestone" as defined below in RPA measure 4.13.**

Rationale/Effect of RPA 4.4: As described above for RPA measure 4.3, the WFOP builds upon the Willamette Fish Passage and Management Plan that the Action Agencies proposed. This measure specifies dates by which the Action Agencies will release a draft plan for review by the Services, a process for review and comment on the draft plan, and a deadline for completion of the updated WFOP. This will ensure timely completion of this manual prior to the primary fish passage season each year. It will also require coordination with NMFS to ensure that proposed changes are consistent with the intent of this Opinion.

The effect of the measure is that the WFOP will be kept up-to-date with information learned from previous years' operations as well as results of RM&E studies. This new information will ensure that revised practices for handling, sorting, transporting, and releasing fish will be carried out within the next year, or sooner, after such changes are indicated by new information. As a result, UWR Chinook salmon and UWR steelhead that are collected and released above Project dams will experience less stress, injury, and mortality, and fish abundance and productivity will increase due to improved fish passage to historical habitat. Similarly, annual updates will ensure the latest information is

64 See RPA 1.3 & 1.4 for elaboration of decision making process.

incorporated in the WFOP, and will result in reduced fish injury and mortality caused by emergency operations.

4.5 **Employee Training for Fish Protection Operations at Project Dams and Fish Facilities: The Action Agencies will ensure that fish facility personnel, operators, and managers responsible for operating and maintaining fish facilities at each project complete an annual employee environmental awareness training program. The training will include a review of the status of ESA listed aquatic species, the WFOP, and each fish facility's standard operation procedures (SOPs). Prior to conducting the annual training, the Action Agencies will coordinate with the WATER and appropriate natural resource agencies to identify any specific resource issues that should be addressed or emphasized at that time. The Action Agencies will maintain records of the training including agendas, attendance lists, and any handout materials.**

Rationale/Effect of RPA 4.5: The Proposed Action does not explicitly require staff training in how to operate fish facilities and how to handle emergencies to minimize harm to listed fish. Although hatchery personnel presently are trained to operate fish collection and transport facilities, other Project staff should be trained in emergency procedures for on-site fish facilities. If a water supply line to a fish holding pond broke and no hatchery personnel were able to respond quickly, simple directions could be given to an on-site Project operator or maintenance staff to open emergency water supply systems or otherwise provide temporary relief to trapped fish until hatchery personnel are available. The effect of this measure will be to ensure that all staff responsible for carrying out measures in the RPA and Proposed Action are well-trained in safe fish handling procedures and are able to knowledgeably and safely use mechanical equipment. The training will also ensure that fish facility personnel, as well as other Project staff, are able to quickly respond to emergencies to minimize effects on listed fish and fish habitat.

4.6 **Upgrade Existing Adult Fish Collection and Handling Facilities: The Action Agencies will design, construct, install, operate and maintain new or rebuilt adult fish collection, handling and transport facilities at the sites listed below. The Services will inform the Action Agencies whether they agree[65] with each facility's planned configuration and operation. The Action Agencies will design each facility with and incorporate NMFS' Anadromous Salmonid Passage Facility Design (NMFS 2008e) and the best available technology. During the design phase, the Action Agencies will coordinate[66] with the Services to determine if the design should accommodate possible later connection to a fish ladder, if determined necessary in future years beyond 2015.**

The Action Agencies will complete all necessary interim steps in a timely fashion to allow them to meet the following deadlines for completing construction and beginning operation of the facilities listed below. These steps may include completing a DDR and plans and specifications. The Action Agencies will give

65 See RPA 1.3 & 1.4 for elaboration of decision making process.
66 See RPA 1.3 & 1.4 for elaboration of decision making process.

NMFS periodic updates on their progress. The order in which these facilities are completed may be modified based on interim analyses and biological priorities, and with agreement67 of NMFS and USFWS.

1. **North Santiam Fish Facility (currently at Minto Pond) – complete construction no later than December 2012; begin operation no later than March 2013.**
2. **Foster Fish Facility – complete construction by December 2013; begin operation by March 2014.**
3. **Dexter Ponds Fish Facility – complete construction by December 2014; begin operation by March 2015.**
4. **Fall Creek Dam Trap – complete construction by December 2015; begin operation by March 2016.**

Rationale/Effect of RPA 4.6: The Action Agencies proposed to evaluate and modify these fish facilities in Section 3.6.3 of the Supplemental BA (USACE 2007a), but did not provide certainty in when the improvements would be made or whether funding would be available to do the work. NMFS makes clear that facility improvements or replacement are required, and establishes dates to complete work and begin operation. In some cases, work could be initiated sooner than listed above, and NMFS expects the Action Agencies to make these improvements as soon as possible.

Improvements in fish trapping are needed at each of the fish collection facilities to minimize stress and injury to adult fish, as described in the Effects sections for the major subbasins (Middle Fork Willamette, section 5.2; McKenzie, section 5.3; South Santiam, section 5.5; and North Santiam, section 5.6). Although there is no single known cause of pre-spawning mortality, stress induced during fish collection and handling is likely one component of this mortality that can be lessened by redesigning these trapping facilities using latest fish handling design criteria. Because these facilities will be used in lieu of volitional fish passage to provide access to historical habitat above the dams, this measure is an essential first step toward addressing low population numbers caused by decreased spatial distribution, which is a limiting factor for UWR Chinook salmon and UWR steelhead. This measure also addresses the critical habitat PCE factor of providing freshwater migration corridors free of obstruction, despite the fact that traps and transportation will be used to provide a migration corridor past some of the Project dams. The improvements to the fish facilities will also allow hatchery fish to be acclimated before release, a practice that will improve survival and reduce straying.

The effect of this measure is that improved collection and release of adult fish will minimize fish stress and injury, resulting in improved upstream fish passage to historical habitat. Upstream fish passage is the initial step toward restoring productivity of listed fish by using large reaches of good quality habitat above Project dams. Lack of access to good habitat above the dams, injury and mortality associated with inadequate passage facilities, and restriction to degraded habitat below the dams has caused steep declines in numbers and has reduced the functioning of PCEs of critical habitat.

67 See RPA 1.3 & 1.4 for elaboration of decision making process.

4.7 **Adult Fish Release Sites above Dams: The Action Agencies, working in coordination with the U.S. Forest Service (USFS) or other applicable landowners,68 will:**

- **Complete a site/concept study by February 28, 2009, that will identify at least four to six potential locations suitable for new adult fish release sites for Chinook salmon above Detroit, Foster, Lookout Point, Hills Creek, Fall Creek, and Cougar reservoirs. Sites located above Foster Reservoir will be suitable for releasing both Chinook salmon and winter steelhead; site(s) above Detroit and Green Peter dams should also be suitable for winter steelhead, should adult steelhead be released in these locations in future years.**
- **The Action Agencies will work with the USFS and the Services to prioritize and design each release site, which may include infrastructure to minimize stress and injury of adults (e.g., piping systems, vehicle ramps, etc). The release sites will be prioritized in the context of the Configuration Operation Plan (COP) (see RPA measure 4.13). The Services will inform the Action Agencies whether the sites as designed are consistent with the Opinion.**
- **The Action Agencies will complete construction of all selected sites by June 2012. If another entity, by December 2010, takes on the responsibility for constructing or improving these sites, the Action Agencies will not be responsible for construction of those sites completed by another entity. Additionally, if, based on results of the COP, additional sites are warranted, construction of additional sites will be completed as soon as possible after identified by the COP. Construction of the sites will be contingent upon availability of funds (which may include a non-federal cost-sharing requirement) and cooperation of landowners. Prior to construction, the Action Agencies will need to complete processes to ensure compliance with all applicable statutes and regulations not provided by this or other ESA consultations, as required by applicable law.**

Rationale/Effect of RPA 4.7: This measure builds upon one proposed by the Action Agencies in Section 3.4.5.3 of the Supplemental BA (USACE 2007a, p 3-51), but NMFS has added a minimum requirement of 4 to 6 sites, as well as dates for completion of construction and a requirement that sites above the Santiam dams be made compatible for steelhead as well as Chinook salmon release.

Improvements in release of outplanted adult fish are needed to minimize fish stress and injury, as described in the Effects sections for the major subbasins (Middle Fork Willamette, section 5.2; McKenzie, section 5.3; South Santiam, section 5.5; and North

68 NMFS acknowledges that establishment of release sites above reservoirs may be contingent upon securing funds and agreement with non-Action Agency landowners/land managers such as USFS and BLM. NMFS also understands that some entities such as USFS and BLM may elect to undertake work on the property they manage themselves, in which case Action Agencies would cooperate with them, including funding the work, if necessary. Environmental permitting not provided by this or other ESA consultations may also be required before this work can be accomplished.

Santiam, section 5.6). This is one more component (in addition to trapping facilities and handling and transport protocols described in RPA measures above) that is likely to help decrease the rate of pre-spawning mortality. Many of the existing release sites have relatively poor river access, forcing drivers to release fish using methods such as sliding fish on tarps or using collapsible hoses that elevate stress or cause direct or delayed injury or mortality. Some sites are located at river access points that experience heavy recreational pressure, leading to disturbance, harassment, or poaching of outplanted fish. New release sites will be chosen to allow safe transfer of fish from the truck, adequate recovery in pools without recreational pressure or poaching, and reasonable proximity to quality holding and spawning habitat.

The effect of this measure will be to reduce stress and associated pre-spawning mortality, ultimately increasing the percent of adult fish that successfully spawn, leading to increased productivity above the dams. This measure will also decrease adverse effects on critical habitat by providing a component of safe passage.

4.8 **Interim Downstream Fish Passage through Reservoirs and Dams: Until permanent downstream passage facilities are constructed or operations are established at Project dams and reservoirs in subbasins where outplanting of UWR Chinook salmon and steelhead is underway, the Action Agencies will carry out interim operational measures to pass downstream migrants as safely and efficiently as possible downstream through Project reservoirs and dams under current dam configurations and physical and operational constraints, and consistent with authorized Project purposes.**

Near-term operating alternatives will be identified, evaluated, and implemented if determined to be technically and economically feasible and biologically justified by the Action Agencies and Services, within the framework of the Annual Operating Plan updates and revisions and in coordination with the WATER Flow Management Committee.69

The Action Agencies will evaluate potential interim measures that require detailed environmental review, permits, or Congressional authorization as part of the COP (see RPA 4.13 below). The Action Agencies will complete this component of the COP by April 2011, including seeking authorization (if necessary) and completing design or operational implementation plans for those operations selected by the COP. The measures that will be considered in the COP include, but are not limited to, partial or full reservoir drawdown during juvenile outmigration period, modification of reservoir refill rates, and using outlets, sluiceways, and spillways that typically are not opened to pass outflow. The Services will inform the Action Agencies whether they agree70 with the interim downstream passage measures. The Action Agencies will begin to carry out measures selected by the COP by May 2011, contingent on funding, authorization, and compliance with all applicable

69See RPA 1.3 & 1.4 for elaboration of decision making process.

70 See RPA 1.3 & 1.4 for elaboration of decision making process.

statutes and regulations. One specific measure is listed below, and others may be developed in coordination with the WATER, if appropriate.

Rationale/Effect of RPA 4.8: The Proposed Action describes a formidable series of studies that would be required before the Action Agencies could construct downstream fish passage structures or make major operational changes to improve downstream fish passage at Project dams and reservoirs. Although it will take many years to investigate, design, and install structural downstream fish passage facilities at those Project dams where such facilities are determined necessary and feasible, there are some fish protective measures that can be carried out in the near future without requiring significant modification to existing structures or operations. Alternative interim measures that need to be considered include short-term operations such as reservoir drawdown, pulsing flow releases, opening various valves, or spill to safely pass fish downstream through a reservoir and dam.

The magnitude of effect of these interim measures is difficult to predict because insufficient data is available to determine where these measures would take place and how successful they would be in providing downstream fish passage for juvenile Chinook and juvenile and kelt steelhead. Such measures would likely be initiated for a short time period as part of an RM&E study to determine potential effectiveness of the measure before an annual or longer term commitment is made. Studies at some non-Project dams have shown that relatively large proportions of downstream migrants pass via spill or sluiceways (see discussion of Willamette Falls Hydroelectric Project in section 4.10, Mainstem Willamette Baseline). However, until interim measures are evaluated to assess fish passage effectiveness, NMFS can only assume that these measures will result in an unquantified improvement in fish survival. This increased survival would benefit the populations of UWR Chinook and UWR steelhead in the subbasins where interim measures are used (possible in any of the following: North Santiam, South Santiam, McKenzie, Fall Creek, and Middle Fork Willamette). Improved downstream survival would help to address the spatial access VSP parameter by increasing the likelihood that the Outplant Program will result in sustainable production above the dams. Sustainable production above the dams would also improve productivity and abundance of populations by increasing the total available habitat while limiting dam-related losses. This measure will also decrease adverse effects on critical habitat by providing a component of the PCE, "migration corridors free of obstruction," while more permanent passage options are being developed.

4.8.1 **<u>Fall Creek Drawdown</u>: Beginning in Water Year 2008, the Action Agencies will adjust timing of storage and release of flow at Fall Creek Reservoir to promote downstream passage of juvenile Chinook salmon through the reservoir and dam. Drawdown will be to at least elevation 714.0 by the end of November each year, and the Action Agencies will hold the reservoir at this elevation during all of December and January except during flood events, and possibly longer. The Action Agencies will conduct monitoring and evaluation studies to determine the effectiveness of the operation and to assist in deciding whether or not to continue the operation in future years.**

The depth and timing of the drawdown may be adjusted in subsequent years, based upon monitoring results, with NMFS' agreement.71 During this operation, when inflow is less than Project minimum flow objectives and the reservoir is at or below 714.0', then outflow will equal inflow and this will not be considered a deviation from flow objectives.

Rationale/Effect of RPA 4.8.1: Past studies have indicated that juvenile spring Chinook salmon migrate from Fall Creek Reservoir primarily during November, and that smolts passing through the regulating outlet under conditions of lower reservoir elevations survived at higher levels than when the reservoir was held high (see Section 4.2.3 Middle Fork Willamette Baseline). Also, smolts migrating late in the season under conditions of very low head appeared to sustain lower injury or mortality rates compared to passage under high reservoir levels. If the reservoir is drawn down to an elevation below minimum conservation pool, NMFS would expect increased survival of juvenile Chinook salmon emigrating during November.

The effect of this measure will be to improve downstream fish passage survival through Fall Creek dam and reservoir, increasing productivity of the Fall Creek Chinook salmon population and ultimately resulting in increased abundance and improved spatial distribution. Another effect of this measure will be to minimize adverse effects on critical habitat by providing a component of the PCE, "migration corridors free of obstruction."

4.9 **Head-of-Reservoir Juvenile Collection Prototype: The Action Agencies will plan, design, build, and evaluate a prototype head-of-reservoir juvenile collection facility above either Lookout Point or Foster reservoir. If Foster reservoir is chosen for testing the prototype, the Action Agencies will design for collecting both juvenile salmonids and steelhead kelt. The Action Agencies will complete construction by September 2014. As an interim step, the Action Agencies will complete feasibility studies as part of the COP (described in RPA measure 4.13) near the end of 2010. At that time, the Action Agencies will make a "go/no go" decision on the feasibility of the prototype facility(s) and the preferred location(s) and design(s) for construction of the prototype(s). The Action Agencies will make the go/no go decision in coordination with the FPHM, and after agreement by NMFS.**

After construction is completed, the Action Agencies will conduct biological and physical evaluations of the head-of-reservoir prototype collection facilities in 2015 and 2016, with opportunities for review and comment by the FPHM and RM&E committee of study proposals and draft reports. After receiving comments, including the Services' statements regarding whether they agree72 with the draft report, the Action Agencies will make necessary revisions to the draft report and issue a final report by December 31, 2016, on the effectiveness of the facilities, including recommendations for installing full-scale head-of-reservoir facilities at

71 See RPA 1.3 & 1.4 for elaboration of decision making process.
72 See RPA 1.3 & 1.4 for elaboration of decision making process.

this and other reservoirs. If the report concludes that head-of-reservoir facilities are technically feasible, capable of safely collecting downstream migrating fish, and capable of increasing the overall productivity of the upper basins, then the Action Agencies will include such facilities in the design alternatives that they consider in the COP studies described in RPA measure 4.13 below.

Rationale/Effect of RPA 4.9: This measure addresses the lack of effective downstream fish passage facilities described in the Effects sections for the major subbasins with Project dams (Middle Fork Willamette, section 5.2; McKenzie, section 5.3; South Santiam, section 5.5; and North Santiam, section 5.6). Past monitoring of downstream juvenile migration through the reservoirs and dams was minimal, although in some reservoirs (e.g., Green Peter, South Santiam, section 5.5) studies indicated that juvenile fish were not successfully migrating through the reservoir to collection facilities at the face of the dam. Regardless of whether this was caused by predation, lack of attraction to collection facilities, or another reason, these results support the notion that collecting fish near the head of a reservoir might be an effective means to achieve safe downstream passage.

Because the head-of-reservoir fish collection concept is virtually untested, it would be imprudent to require such facilities without prior field studies, design, and prototype testing to validate the concept. For this measure, NMFS defines “prototype” to refer to temporary facilities intended for concept evaluation, not long-term operations. Further, “prototype” does not necessarily refer to a single concept; multiple concepts may be experimented with simultaneously. The FPHM subcommittee of the WATER group, comprised of fish biologists and engineers with experience in fish passage design, will be an appropriate forum in which to develop concepts. NMFS’ current thinking on possible means to accomplish this is 1) floating collectors in the reservoir near the mouths of tributaries and 2) fish collection facilities on tributaries above the reservoir pools. After several years of field monitoring and conceptual design review, the Action Agencies will identify a Major Milestone (MM2) (as described in RPA measure 4.13 below) near the end of 2010 in conjunction with completion of the DDR. The major decision associated with that milestone will be "go/no go" on the feasibility of the prototype facility(s), after coordination with the FPHM and agreement by NMFS. If the decision is to construct and evaluate the prototype(s), the focus of the decision will potentially be focused on alternative location(s) and design(s) for the prototype facility(s). Among the questions to be answered are whether such a device could capture enough fish to be biologically useful, and whether it could be operated during periods of high flow and debris loading.

The effects of this measure would be to initially demonstrate whether this concept is feasible, and if so, to use head-of-reservoir facilities in Project reservoirs where indicated to increase downstream fish survival. Safe and timely downstream passage of juvenile Chinook salmon and juvenile and kelt steelhead is a critical component to the success of the Outplant Program. In order to restore access to historical habitat above Project dams, and address the spatial distribution VSP parameter, the juvenile fish produced from adults released above the dams need to safely pass through reservoirs and dams on their

downstream migration. Sustainable production above the dams would improve productivity and abundance of populations by increasing the total available habitat while limiting dam-related losses. Providing access will also benefit critical habitat because lack of access was a limiting factor.

4.10 **Assess Downstream Juvenile[73] Fish Passage through Reservoirs: The Action Agencies will, in coordination with and review by the Services, assess juvenile fish passage through the following Project reservoirs:**

7. Cougar

8. Lookout Point and Dexter

9. Detroit and Big Cliff

10. Green Peter and Foster

11. Fall Creek

12. Hills Creek

These evaluations will be developed consistent with the RM&E process described below in RPA measure 9 (RM&E). The Action Agencies must seek NMFS' review of evaluation proposals. Comments submitted by NMFS on draft evaluation proposals must be reconciled by the Action Agencies in writing to NMFS' satisfaction prior to initiating any research-related activities anticipated in this RPA.[74] The proposals must identify annual anticipated incidental take levels by species, life stage, and origin[75] for each year. The Services will inform the Action Agencies whether they agree[76] with the proposed studies, reports, and NEPA alternatives. The Action Agencies will begin these studies in 2008; field investigations, study reports, and NEPA analyses, if necessary, will be completed by December 31, 2015.

Rationale/Effect of RPA 4.10: Juvenile fish (and kelts) need to emigrate through reservoirs, or be transported around them, in order to continue their downstream migration and complete their life cycles. Effects are unique at each reservoir: fish may pass satisfactorily through some reservoirs, but have problems, such as loss by predation or residualism (failure to continue migrating) at others. For instance, preliminary results at Fall Creek and Cougar indicated juvenile Chinook salmon were able to safely migrate through the reservoirs, yet studies at Green Peter in the 1980s showed few fish released near the head of the reservoir reached the dam.

There is little information on fish use, migration rates, and survival in the Willamette Project reservoirs.[77] Most of the information on Project reservoir fish passage has been

73 Include downstream steelhead kelt passage in Santiam studies through Detroit, Big Cliff, Green Peter, and Foster.
74 See RPA 1.3 & 1.4 for elaboration of decision making process.
75 That is, hatchery-origin or non-hatchery origin fish.
76 See RPA 1.3 & 1.4 for elaboration of decision making process.

77 This RPA does not include small reservoirs such as at Minto and those with the Long Tom dams.

inferred from fish traps placed below reservoirs. The kinds of studies that are needed would vary among reservoirs, depending on existing information and characteristics of each reservoir and the species that use it. If studies show that fry use a reservoir for rearing before migrating downstream as juveniles or smolts, then juvenile collection facilities at or near the face of the dam would be preferred over head-of-reservoir collection facilities. On the other hand, if juvenile fish are exposed to heavy predation while in the reservoir, then efforts would need to be directed at either head-of-reservoir collection, reducing predators or predator habitat, or reservoir operations that would encourage juvenile fish to quickly migrate downstream. In large reservoirs, currents may also be found to influence juvenile migration (vertical and horizontal distribution through the reservoir), and fish collection facilities would need to be located to take advantage of such currents. These examples show that downstream fish passage decisions regarding alternative operational and facility designs must be based on site-specific data regarding passage through reservoirs. Without this information, downstream passage facilities could be ineffective due to poorly located facilities or lack of understanding of reservoir use.

The effect of this measure will be to provide site-specific information regarding juvenile fish passage and use of Project reservoirs, informing key decisions related to downstream fish passage facilities and reservoir operations, and possibly predator management. Improved downstream fish passage will ultimately increase spatial distribution by providing safe access to and from historical habitat. This will, in turn, increase numbers of listed fish, which is needed to address the effects of the Project (depressed abundance and productivity).

4.11 **<u>Assess Downstream Juvenile Fish Passage through Dams:</u> At Cougar, Lookout Point and Dexter, Detroit and Big Cliff; Foster and Green Peter, Fall Creek, and Hills Creek dams, the Action Agencies will, in coordination with and review78 by the Services, do the following:**

5. **Assess passage survival and efficiency through all available downstream routes, including turbines, spillways, regulating outlets, hatchery water supplies, etc., noting injury and mortality through each route.**
6. **Identify and propose alternatives for reducing juvenile mortality passing through the routes noted above, including, but not limited to, operational and structural modifications.**
7. **The Action Agencies will begin these studies in 2008 and will complete all field investigations, study reports, and NEPA analyses, if necessary, by December 31, 2015 (except as noted below for Cougar, Lookout Point, and Detroit in RPA measure 4.12, which have earlier completion dates).**
8. **These evaluations will be developed consistent with the RM&E process described below in RPA measure 9. The Action Agencies must seek NMFS' review of evaluation proposals. Comments submitted by NMFS on draft**

78 See RPA 1.3 & 1.4 for elaboration of decision making process.

evaluation proposals must be reconciled by the Action Agencies in writing to NMFS' satisfaction prior to initiating any research-related activities anticipated in this RPA. The proposals must identify anticipated take levels of each species and life stage for each year. The Services will inform the Action Agencies whether they agree with the proposed studies, draft reports, and alternatives.

5. **The Action Agencies will conduct additional studies in anticipation of additional passage measures constructed and operated beyond 2023.**

Rationale/Effect of RPA 4.11: The effect of lack of effective downstream fish passage facilities is described in the Effects sections for the major subbasins with Project dams (Middle Fork Willamette, section 5.2; McKenzie, section 5.3; South Santiam, section 5.5; and North Santiam, section 5.6). However, there is little existing information on downstream fish passage through various routes at Project dams. Studies are needed to determine the proportion of fish moving through existing outlets (turbines, regulating outlets, spillways, sluiceways), and their survival and injury rates through each outlet. In order to determine the likely effectiveness of downstream fish passage alternatives, studies are needed to evaluate vertical and horizontal distribution of fish as they reach the face of the dam, and to evaluate biological, technical and engineering issues associated with design of passage facilities.

The information is key to designing effective passage facilities. The kinds of studies that are needed would vary among dams, depending on existing information and characteristics of each dam and the species that use it. The focus of studies would be to develop and evaluate alternative fish passage concepts that would guide site-specific decisions and identify priorities among Project dams on the most effective downstream passage methods at each dam where it is deemed feasible and likely to be effective. If studies show that fry use a reservoir for rearing before migrating downstream as juveniles or smolts, then juvenile collection facilities.

The effect of this RPA will be to provide site-specific information regarding downstream fish passage at Project dams, informing key decisions related to downstream fish passage facilities. This information is a necessary first step in fish passage design. Improved downstream fish passage will ultimately increase spatial distribution by providing safe access to and from historical habitat.

4.12 **<u>Long-Term Fish Passage Solutions</u>: Based on the best available scientific information at the time of development of this RPA, additional structural and operational modifications are needed to allow safe fish passage and access to habitat above and below Willamette project dams.**

The Action Agencies will complete this work as part of the COP described in RPA measure 4.13 below and according to the schedule in Figure 9.4-1. The dates for completing interim steps are guidance. However, the dates for completion and operation are fixed. Measures 4.12.1 through 4.12.3 identify dates for making

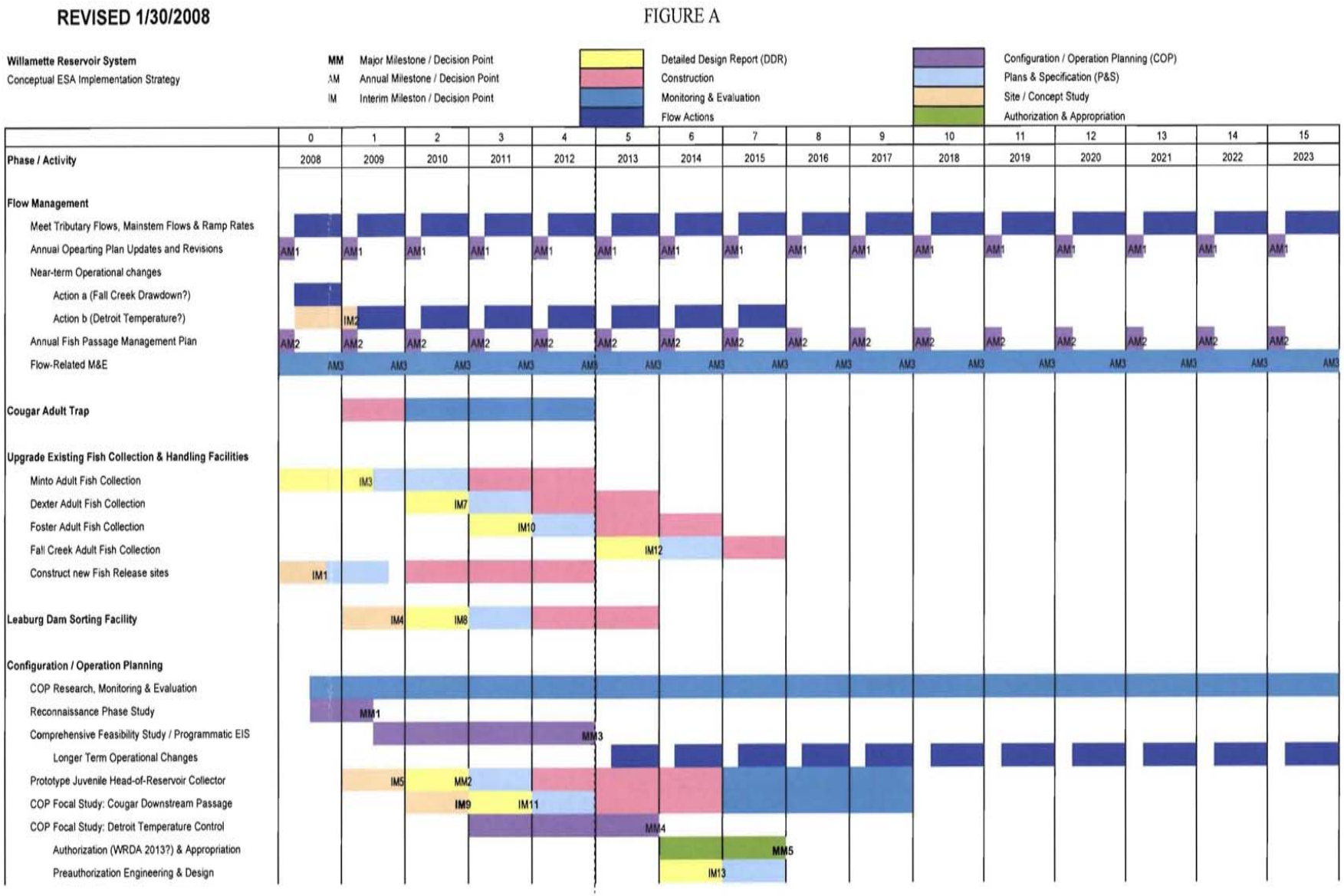
structural modifications (or biologically equivalent operational measures), based on the best available information at the time of development of the RPA.

These structural or operational modifications will be analyzed and developed as high priority measures in the Willamette Configuration Operation Plan (COP) (see RPA measure 4.13). The COP will evaluate a range of structural and operational alternatives for improving fish passage and water quality conditions associated with the Willamette dams. The three alternatives described below in RPA measures 4.12.1, 4.12.2 and 4.12 .3 will be priority actions evaluated in the COP to determine whether they are biologically and technically feasible. The Action Agencies, FWS, and NMFS will evaluate the information gathered through the COP, NEPA, RM&E measures, and any other sources of information such as ESA recovery planning (including life cycle modeling developed as part of the recovery planning process), university studies, local monitoring efforts and public comment, to determine whether the scheduled action, or an alternative, will provide the most cost-effective means to achieve benefits to ESA-listed fish. If the information gathered confirms that the scheduled action is best suited to addressing the effects of the Project, the Action Agencies will proceed with implementation. If the information shows that an alternative action would provide similar biological benefits, is technically feasible, and would be more cost-effective, then the Action Agencies will implement the alternative action.79 The Action Agencies may need to complete appropriate NEPA analyses and obtain authorization and appropriation before implementation. The Action Agencies will present specific implementation plans to NMFS, and NMFS will evaluate whether the actions proposed in the implementation plans meet the biological results NMFS relied on in its 2008 biological opinion. NMFS will notify the Action Agencies as to whether the proposal is consistent with the analysis in the biological opinion.

The Action Agencies will analyze additional structural and operational measures for downstream fish passage (beyond the three listed in measures 4.12.1 through 4.12.3 below) as part of the COP. The measures will be investigated in the same manner as for the three measures listed below. The time frame for construction and operation of these additional passage measures may extend beyond the time frame of this Opinion. However, the Action Agencies must begin certain actions, such as investigating feasibility, completing plans, conducting NEPA, if necessary, and requesting authorization, during the term of this Opinion. These studies will be included in the COP.

79 See RPA 1.3 & 1.4 for elaboration of decision making process.

Figure 9.4-1 Willamette Project Implementation Schedule. Revised Gantt chart from the Action Agencies (USACE 2008a).



REVISED 1/30/2008

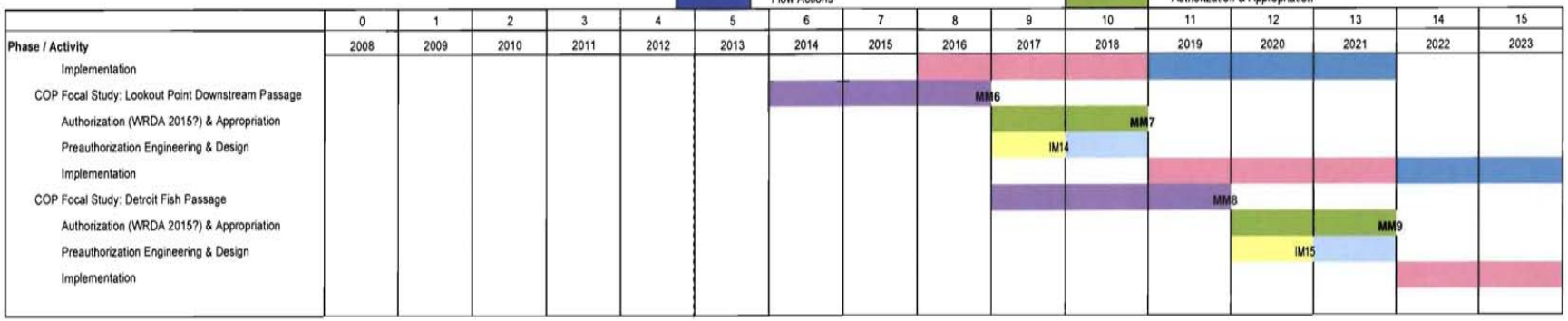
FIGURE A

Willamette Reservoir System
Conceptual ESA Implementation Strategy

MM Major Milestone / Decision Point
AM Annual Milestone / Decision Point
IM Interim Mileston / Decision Point

Detailed Design Report (DDR)
Construction
Monitoring & Evaluation
Flow Actions

Configuration / Operation Planning (COP)
Plans & Specification (P&S)
Site / Concept Study
Authorization & Appropriation



***Rationale/Effect of RPA 4.12*:** This measure ensures that three major fish passage actions will be taken by the Action Agencies by specified dates. As stated elsewhere in this Opinion, lack of passage is the most significant limiting factor to the viability of the affected populations of UWR Chinook salmon and UWR steelhead. This measure addresses that effect of the PA.

NMFS chose the three sites listed in the RPA for the first three passage facilities, based on the best available information at the time of this Opinion. The choice of location of the passage facility, as well as the method of passage may change based on additional information. If information shows a different location or passage method, then the Action Agencies must coordinate with the FPHM and receive NMFS' agreement on the proposed change. Also, passage methods may vary based on the specific requirements needed at each site, as well as how the fish behave at that location.

These three passage facilities are not all that the Action Agencies will ever need to construct to address access limitation, but are sufficient in the next 15 years to begin to address the effects of the Project. By improving downstream fish passage at Cougar, Lookout Point, and Detroit dams, survival will increase for three of the four UWR Chinook populations (McKenzie, Middle Fork, and N. Santiam) and one of the two UWR steelhead populations (N. Santiam) directly affected by Project dams. However, the Action Agencies need to continue studying the next location for passage during the next 15 years so they are ready to construct and operate the next facility soon after completion of the term of this Opinion, and possibly the next one after that. Additionally, measures in an RPA must be within the Action Agencies' ability to implement. The pace of completion of passage measures is as fast as the Action Agencies can proceed.

NMFS recognizes that where fish passage was not previously authorized, the Action Agencies may need to complete appropriate NEPA analyses and obtain congressional authorization before implementation. Further, regardless of whether fish passage was previously authorized, the Action Agencies will need to obtain appropriations before project construction activities can begin.

The effect of this measure will be to ensure that passage happens at three locations within the next 15 years. This will greatly help increase numbers of UWR Chinook salmon and steelhead because they will have access to upstream habitat, and the juveniles will have access downstream to the ocean for growth to maturity. With respect to critical habitat, this measure will address the Habitat Access pathway by improving access past physical barriers, and thereby improving the status of PCEs for spawning, rearing, and migration of UWR Chinook salmon and UWR steelhead populations.

Improved downstream fish passage with will also benefit critical habitat because lack of migration corridor access was a limiting factor.

4.12.1 **Cougar Dam Downstream Passage: The Action Agencies will investigate the feasibility of improving downstream fish passage at Cougar Dam through structural modifications as well as with operational alternatives, and if found feasible they will construct and operate the downstream fish passage facility.**

- **The Action Agencies will take necessary initial steps beginning no later than 2010, which may include a site/concept study, design report, plans and specifications, if appropriate.**
- **The Action Agencies will establish a Major Milestone (MM2) (described in measure 4.13 below) near the end of 2010, in conjunction with completion of the Cougar Site/Concept Study and DDR. The Action Agencies will make "go/no go" decisions on the feasibility of Cougar downstream passage facilities. In the case of the decision to move forward on implementation, the decision will potentially be focused on alternative locations and designs for downstream passage facilities and operations. (NMFS assumes that fish passage improvements at Cougar Dam will not require further authorization because passage was specifically authorized and constructed as part of the original Cougar Dam plans80; NMFS also assumes that the proposed Cougar trap will be used for upstream fish passage.)**
- **The Action Agencies will complete construction of any structural fish passage facilities by Dec. 2014; and by 2015, begin operating downstream fish passage facilities at Cougar Dam. Any necessary NEPA compliance required for implementation of the proposed facilities will occur in conjunction with development of the DDR.**

Rationale/Effect of RPA 4.12.1-Cougar Downstream: The Proposed Action identifies a series of field studies, alternatives analyses, and reports that will be completed, if funding is available, to assess the feasibility of downstream fish passage facilities at Cougar Dam and other Project dams, however, the Action Agencies provide no certainty that fish passage improvements will be made. As noted in Section 5.3, McKenzie Subbasin Effects, lack of access to historical spawning and rearing habitat above Cougar Dam is one of the limiting factors affecting population numbers and spatial distribution for the McKenzie Chinook salmon population. This population is at "moderate risk" of extinction and is considered a "core" and "genetic legacy" population (McElhany et al. 2007). Efforts to increase the viability of this population are essential, because it has the potential to be the stronghold for the ESU and is therefore likely to be targeted for "high" or "very high viability" in the recovery plan.

In addition to the population's status within the ESU, NMFS considers achieving safe fish passage at Cougar Dam a priority because this dam was originally authorized for fish passage, presumably making it easier for the Action Agencies to request and receive funding for this purpose. Cougar Dam originally incorporated fish passage measures, but these were abandoned due to the Project's effect on downstream water temperatures that

80 Due to temperature changes caused by construction of the reservoir, original passage efforts failed. Since 2005, however, temperature problems have been largely solved, and passage is once again feasible.

inhibited returning adults from reaching and entering a trap at the base of the dam. Cougar Dam was upgraded in 2005 with new temperature control facilities which now make, for the first time in 40 years, collection of adults feasible below the dam. USACE plans to construct a new adult fish trap at the base of Cougar Dam in 2009. Once adults are captured in the new trap and transported above the dam, their juvenile progeny will need to emigrate out to complete their life cycles, hence the need for downstream passage at Cougar.

The effect of this measure will be to provide improved downstream fish passage at Cougar Dam, increasing spatial distribution by providing safe access to and from historical habitat. By addressing the primary impediment to population growth and spatial distribution for the McKenzie Chinook salmon population, this measure will support increased abundance and productivity of this core population, reducing the likelihood that the Proposed Action will cause jeopardy.

With respect to critical habitat, this measure will address the Habitat Access pathway by improving access past a physical barrier, and thereby improve the status of PCEs for spawning, rearing, and migration of the McKenzie Chinook salmon population.

4.12.2 **<u>Lookout Point Dam Downstream Passage</u>: The Action Agencies will investigate the feasibility of improving downstream fish passage at Lookout Point Dam, and if found feasible, they will construct and operate downstream fish passage facilities there. The Action Agencies will take necessary initial steps, beginning no later than 2012, which may include feasibility studies, a design report, authorization and appropriation, and plans and specifications, if appropriate.**

- **The Action Agencies will complete construction of any structural fish passage facilities by December 2021.**
- **By March 2022, the Action Agencies will begin operating downstream fish passage facilities at Lookout Point that will enable collection and transport of fish from above Lookout Point to habitat downstream of Dexter.**
- **The Action Agencies will establish a Major Milestone (MM6) near the end of 2014 in conjunction with completion of the Lookout Point Feasibility Study. The major decision associated with that milestone will be "go/no go" decisions on the feasibility of Lookout Point fish passage facilities. Another Major Milestone (MM7) may be needed near the end of 2016 pending actions on authorization and appropriation of proposed facilities.**

Rationale/Effect of RPA 4.12.2: The Proposed Action identifies a series of field studies, alternatives analyses, and reports that would be completed, if funding is available, to assess the feasibility of downstream fish passage facilities at Lookout Point and Dexter dams, however, the Action Agencies provide no certainty that fish passage improvements will be made. As noted in Section 5.2, Middle Fork Willamette Subbasin Effects, lack of access to historical spawning and rearing habitat above Project dams restricts spatial distribution for the Middle Fork Willamette population to a few miles of habitat below

Dexter Dam that is unsuitable for spawning and juvenile fish production due to Project effects on downstream water temperature and habitat complexity. This restricted spatial distribution is likely the most important factor limiting abundance and productivity of the Middle Fork Willamette Chinook salmon population, and without significant improvements in spatial distribution this population may be lost. Improvements to the fish collection facility at Dexter will address the upstream component of habitat access, but safe downstream fish passage past Lookout Point and Dexter is essential to ensure that the Outplant Program can successfully reestablish fish production above these dams.

The effect of this measure will be to provide improved downstream fish passage past Lookout Point and Dexter dams, increasing spatial distribution by providing safe access to and from historical habitat. By addressing the primary impediment to spatial distribution for the Middle Fork Willamette Chinook salmon population, this RPA will support increased abundance and productivity of this population, increasing the likelihood that this population will trend toward a "viable" status rather than be lost. As a result, by protecting and restoring this population, there is reduced risk that the Proposed Action will cause jeopardy to the UWR Chinook salmon ESU.

With respect to critical habitat, this RPA will address the Habitat Access pathway by improving access past a physical barrier, and thereby improve the status of PCEs for spawning, rearing, and migration of the Middle Fork Willamette Chinook salmon population.

4.12.3 **<u>Detroit Dam Downstream Passage</u>: The Action Agencies will investigate the feasibility of improving downstream fish passage at Detroit Dam and if found feasible they will construct and operate downstream passage facilities. Temperature control will also be considered in designing the passage facility.**

- **The Action Agencies will take necessary initial steps beginning no later than 2015, which may include feasibility studies, a design report, authorization and appropriation, and plans and specifications, if appropriate.**
- **The Action Agencies will establish a Major Milestone (MM8) near the end of 2017 in conjunction with completion of the Feasibility Study. The major decision associated with that milestone will be "go/no go" on the feasibility of fish passage facilities at Detroit Dam. Another Major Milestone (MM9) may be needed near the end of 2019 pending actions on authorization and appropriation of proposed facilities.**
- **The Action Agencies will complete construction of any structural fish passage facilities by December 2023. (This measure may be completed earlier in conjunction with Detroit temperature control efforts, as described in RPA measure 5.2 below).**
- **By March 2024, the Action Agencies will begin operating downstream fish passage facilities at Detroit that would enable collection and transport of fish from above Detroit to habitat downstream of Big Cliff Dam. Any necessary NEPA**

Rationale/Effect of RPA 4.12.3: The Proposed Action identifies a series of field studies, alternatives analyses, and reports that would be completed, if funding is available, to assess the feasibility of downstream fish passage facilities at Detroit and Big Cliff dams, however, the Action Agencies provide no certainty that fish passage improvements will be made. As noted in Section 5.6, North Santiam Subbasin Effects, lack of access to historical spawning and rearing habitat above Project dams restricts spatial distribution for the North Santiam populations of Chinook salmon and steelhead to habitat below Big Cliff Dam. This downstream habitat is degraded by ongoing Project operations that continue to interrupt sediment transport, alter downstream water temperatures, and modify the rate and seasonality of downstream flows. Rebuilding the fish collection facility at Minto Dam below Big Cliff Dam will address the upstream component of habitat access, but downstream passage facilities are entirely lacking. Safe downstream fish passage past Detroit and Big Cliff is essential to ensure that the Outplant Program can successfully reestablish fish production above these dams.

Although NMFS has given a lower priority to this downstream passage facility than for similar facilities at Cougar and Lookout Point/Dexter dams, NMFS would prefer that this RPA be completed earlier than 2023. As described below in RPA measure 5.2, Water Quality, water temperature control facilities at Detroit Dam are scheduled to be constructed by 2018. These two measures should be evaluated and designed concurrently to ensure the design for temperature control does not preclude viable options for downstream passage. Moreover, the Action Agencies would likely achieve cost-savings and reduce operational and environmental adverse effects of construction by planning and constructing both facilities at the same time.

The effect of this measure will be to provide improved downstream fish passage past Detroit and Big Cliff dams, increasing spatial distribution by providing safe access to and from historical habitat. By addressing the primary impediment to spatial distribution for the North Santiam populations of Chinook salmon and steelhead, this RPA will support increased abundance and productivity, increasing the likelihood that these populations will trend toward a "viable" status. As a result, by protecting and restoring this population, there is reduced risk that the Proposed Action will cause jeopardy to the UWR Chinook salmon and UWR steelhead ESUs.

With respect to critical habitat, this RPA will address the Habitat Access pathway by improving access past a physical barrier, and thereby improve the status of PCEs for spawning, rearing, and migration of the North Santiam populations of Chinook salmon and steelhead.

4.13 **Willamette Configuration Operation Plan (COP): The Action Agencies will carry out the COP, a multi-year, multi-level study process, to evaluate a range of potentially beneficial actions for listed fish species at Project dams and reservoirs. Figure 9.4-1 identifies specific measures, studies, and milestones that will be accomplished**

through the COP. The interim steps will be completed in a timely manner; however, the dates shown in Figure 9.4-1 for interim steps are not firm. Regardless of the timing of interim steps, the Action Agencies will complete each Project measure no later than the final date listed for each measure. The Action Agencies will keep the Services appraised of their progress.

The Action Agencies will evaluate in the COP a variety of potential actions intended to benefit ESA-listed fish, including but not limited to, the following measures:

- **Upstream fish passage facilities, other than the collection facilities described in RPA measure 4.6, above;**
- **Adult fish release sites that require detailed study, as described in RPA measure 4.7, above;**
- **Interim operations for downstream fish passage that require detailed study, as described in RPA measure 4.8, above;**
- **Head-of-reservoir juvenile collection facilities that require detailed study, as described in RPA measure 4.9, above;**
- **Downstream passage facilities or operations, as described in RPA measure 4.12, above;**
- **Temperature control facilities or operations, described in RPA measure 5.2, below;**
- **Interim operations for temperature control that require detailed study, described in RPA measure 5.1, below; and**
- **System-wide operational changes, including "balancing" reservoir refill and release rates, to meet tributary and mainstem flow targets, as described in RPA measure 2.4, above.**

1. ***Definition of Milestones:*** **The COP and related actions will rely on a series of established milestones at key decision points at which the Action Agencies will coordinate and review key decisions with the Services. There will also be regular, continuous coordination between the Action Agencies, NMFS, USFWS, and other affected agencies and Tribes through the WATER process throughout implementation of proposed measures.**

There are three types of milestones identified in this RPA and defined below:

<u>Annual Milestones (AM)</u> for interagency coordination of annual and recurring activities associated with planning and implementation of ongoing ESA Measures related to operations, including completion of annual Willamette Fish Operations Plan (WFOP) revisions, and annual review of research, monitoring and evaluation (RM&E) results.

<u>Interim Milestones (IM)</u> for interim decision points in the planning and development of specific actions, including completion of site/concept studies, detailed design reports, and other key steps in the decision-making process. Interim

Milestones will include decision points on the scope, scale, and location of ESA measures under consideration with NMFS and USFWS review and comment.

Major Milestones (MM) are forecasted key points in the planning, design and implementation process involving decisions on the feasibility of major elements of the RPA and Proposed Action. They may include "go/no go" decisions on implementation of proposed major structural elements, such as fish passage or temperature control facilities, and/or significant operational changes. They may also involve decisions to shift efforts to different alternatives or priorities. Depending on decisions reached regarding the feasibility of proposed measures, it may be necessary to identify other alternatives or reinitiate ESA Section 7 consultation as a result of new information produced through the COP and related studies and coordinated through the Major Milestones.

2. ***Research, Monitoring and Evaluation:*** **RM&E will be a substantial component of the COP. The focus will be on collection and evaluation of biological and physical information required to determine the feasibility of alternative structural and operational measures under consideration in interim and major milestones. The COP RM&E program will be initiated in FY 08 and continue through the term of the Opinion. The Action Agencies will conduct an Annual Review of the Willamette COP and other related RM&E programs to review the results from previous years and revise RM&E program for upcoming years.**

3. ***Reconnaissance Phase Study:*** **The Action Agencies will initiate Phase I of the COP, the Reconnaissance Study (USACE 2007a, Section 3.6.4.3) by September 2008 and complete it by October 2009. The Reconnaissance Report will identify the range of structural and operational alternatives to be evaluated, establish preliminary basin priorities, define biological and other criteria to be used in evaluating alternatives, and provide the detailed Statement of Work for the COP Feasibility Phase. The Action Agencies will establish a Major Milestone (MM1) at the completion of the Reconnaissance Report. The primary purpose of this milestone will be to seek interagency review and concurrence on the scope and content of the subsequent Feasibility Phases. One of the key decision points at this milestone will be to review and possibly refine the priority of long term fish passage and water quality solutions for the COP (described in RPA measures 4.12 and 5.2, respectively).**

4. ***Comprehensive Feasibility Study:*** **The Action Agencies will initiate the Comprehensive Feasibility Study (USACE 2007a, Section 3.6.4.4) by October 2009 and will complete it by September 2012. The Comprehensive Feasibility Study will consider and incorporate relevant results of any life-cycle modeling developed as part of the Upper Willamette recovery planning process. If needed, the Action Agencies will complete appropriate NEPA coverage addressing the range of structural and operational alternatives addressed as part of the COP Comprehensive Study Phase. The Feasibility Report will reflect Action Agency preliminary determinations regarding the feasibility of fish passage, temperature control and other related structural and operational alternatives in the North Santiam, South Santiam, McKenzie, and Middle Fork Willamette basins. It is expected to provide specific recommendations for improvements to highest**

priority subbasins and/or features and to include recommendations for major operational changes. It will also evaluate the "high priority actions" (long term fish passage and water quality solutions described in RPA measures 4.12 and 5.2, respectively), and may suggest modifying the scope or timelines of these "high priority actions" based on the outcome of RM&E efforts.

The Action Agencies will establish a major milestone (MM3) at the completion of the COP Comprehensive Feasibility Study. At this point the Action Agencies will have completed initial studies and evaluations on a number of major alternatives, including prototype head-of-reservoir fish collection, downstream passage at Cougar Dam, and temperature control at Detroit Dam. The key decisions at this milestone are whether or not to continue toward fish passage and temperature control modifications of the dams as described in RPA measures 4.12 and 5.2, to evaluate whether or not the correct priorities were established for these measures 4.12 and 5.2, and whether other alternatives are determined more feasible. If the downstream fish passage improvements at Cougar Dam and other locations are determined not likely to be feasible at this milestone, then the Action Agencies may identify other alternatives that would be implemented within the same timelines as those identified in this RPA, or agree to reinitiate Section 7 consultation.

The Action Agencies will present specific implementation plans to NMFS, and NMFS will evaluate whether the actions proposed in the implementation plans are likely to have the biological results that NMFS relied on in this Opinion. NMFS will notify the Action Agencies as to whether the proposal is consistent with the analysis in this Opinion.

Rationale/Effect of RPA 4.13: Section 3.6.4 of the Supplemental BA (USACE 2007a) describes the Willamette System Review Study, the Action Agencies' proposal to undertake a series of studies to evaluate the feasibility and relative benefits of structural and related operational modifications to the Willamette dams designed to improve survival and productivity of ESA-listed aquatic species. The Action Agencies have changed the name of this study framework to "Willamette Configuration /Operation Planning" (COP). The Willamette System Review Study lacked certainty and commitment that fish passage, temperature control, and other improvements would be funded and completed during the term of this Opinion. As a result, the COP is significantly different than the Willamette System Review Study in that it adds certainty to the Action Agencies' proposed study by requiring firm dates for completion of specific measures.

The COP process, and NEPA when appropriate, will outline the costs of the projects, their biological benefits, technical feasibility, potential alternatives, and compliance with all applicable statutes and regulations. The analysis tool of cost effectiveness and incremental cost analysis will be used to assess the range of alternatives. An alternative plan is considered cost effective if it provides a given level of biological benefit for the least cost. Cost effectiveness analysis will be used to identify the least cost solution for each alternative that provides necessary environmental benefit. Incremental cost analysis compares the additional costs to the additional biological benefits of an alternative.

The effect of this RPA will be that the Action Agencies will complete evaluations that they state are needed to move forward on various fish passage, temperature control and other improvement projects and will then move forward with implementation of these measures. This will minimize time lost before fish protective measures are implemented and become effective at improving fish survival and habitat affected by Project facilities. With respect to critical habitat, this RPA will address the Habitat Access pathway by minimizing time lost before access is improved past physical barriers, and thereby will improve the status of PCEs for spawning, rearing, and migration of UWR Chinook salmon and UWR steelhead.

9.5 WATER QUALITY

The RPA measures in this section are based on sections 3.6 and 3.7 of the Supplemental BA (USACE 2007a). In section 3.6, the Action Agencies propose to evaluate the need and opportunities to achieve water temperature control at Project dams as part of the Willamette System Review Study. In section 3.7, the Action Agencies propose to do the following: 1) continue to operate the Cougar WTC to meet downstream water temperature targets; 2) conduct extended RM&E for Cougar WTC; and 3) carry out ongoing and new RM&E for water quality in Project-affected tributaries and the mainstem Willamette River.

NMFS agrees (in McKenzie Effects section 5.3) that continued operation of the Cougar WTC will provide more normative water temperatures in the South Fork McKenzie and mainstem McKenzie rivers, and will continue to support adult spawning, egg incubation, and fry and juvenile rearing for UWR Chinook salmon. While NMFS agrees that extensive RM&E studies are needed at Cougar to evaluate the effectiveness of the WTC and throughout the basin (General Effects, section 5.1) to monitor water quality and determine appropriate courses of action to achieve water quality standards, the Proposed Action does not provide sufficient certainty that these RM&E studies will be sufficient to provide necessary data and guide decision-making. Additionally, while NMFS agrees that further alternatives analysis is needed to identify priorities for implementing temperature control measures at Project dams (General Effects, section 5.1), the Proposed Action does not require any interim temperature control measures nor does it provide certainty that any permanent facilities will be constructed or operations will be carried out. RPA measure 5 is intended to address these issues.

The adverse effects of the Proposed Action on listed fish and critical habitat include unacceptable water temperature and TDG downstream of the Project dams where listed fish are forced to spawn because they have inadequate access to upstream habitat. The Proposed Action also causes adverse effects on critical habitat conditions downstream of the dam for the same reasons listed above. The water quality measures in the RPA will minimize these project-related adverse effects because they will make water temperatures and TDG more similar to natural conditions. The RPA measures will also provide for fish protection when there are emergencies causing the facilities to operate outside their normal procedures.

Some of the measures in this section of the RPA provide interim protection for listed fish and critical habitat by requiring the Action Agencies to implement certain temperature control measures in the next few years. These measures will address immediate needs of listed fish by providing more suitable habitat downstream of certain dams in areas used for spawning. In addition, the emergency protocols and actions will prevent further harm to listed fish and critical habitat by providing measures for listed fish protection the USACE can take immediately when emergencies arise.

RPA 5 Water Quality

5.1 **Interim Water Quality Measures: Until permanent temperature control facilities and water quality improvements are constructed or operations are established, the Action Agencies will evaluate and carry out, where feasible, interim operational measures and use existing conduits such as spillways, regulating outlets, and turbine outlets to achieve some measure of temperature control and reduced TDG exceedances below Project dams, including Detroit/Big Cliff, Green Peter/Foster, Hills Creek, Lookout Point/Dexter, Fall Creek, and Blue River.**

Rationale/Effect of RPA 5.1: Currently, listed fish are generally limited to inadequate habitat below the Project dams. Water quality problems are one of the major limiting factors in this habitat and prevent proper functioning of critical habitat directly below all of the Project dams listed above except Blue River. Therefore, until long term solutions for effective passage above the dams to properly functioning habitat are available, it is very important to make the habitat below the dams usable for listed fish.

This measure is necessary to ensure that short term actions are taken during the first 5 to 10 years of this Opinion until permanent facilities and operations are constructed and operational. Because permanent temperature control facilities such as the Cougar WTC are complex, large, and very expensive construction projects, the Action Agencies cannot build one or more in the initial years of this Opinion. However, because some of the UWR Chinook salmon populations are presently at such low abundance levels and at high risk of extinction, interim measures are needed as soon as possible to avoid further declines in abundance.

The effect of this measure will be that temperatures below one or more Project dams will more closely resemble normative conditions and TDG exceedances will be reduced, resulting in increased survival of juveniles, eggs, and adults over baseline conditions. This increased survival will help to maintain existing low populations of UWR Chinook salmon and UWR steelhead and will lead to increased productivity and abundance of those populations in affected tributaries. These interim measures will also minimize adverse project effects on critical habitat by increasing the value of critical habitat downstream of the dams by modifying temperature.

5.1.1 **Temperature Control at Detroit/Big Cliff Dams: By March 2009, the Action Agencies will complete an evaluation of the feasibility of modifying operations at Detroit/Big Cliff Dams to improve downstream temperature and TDG conditions, with the objective of achieving similar benefits to water temperature below the dams as was attained in 2007. This analysis will build on information developed during the summer 2007 emergency operation at Detroit Dam in which spill volumes were balanced with releases from the regulating outlets to achieve more desirable downstream temperatures during turbine outages.**

The Action Agencies will establish a Major Milestone (MM) to occur by March 2009, when the evaluation of feasibility is completed. If determined feasible, the Action Agencies will begin to implement the proposed operation beginning in Water Year 2009. If implemented, the Action Agencies will conduct monitoring and evaluation studies to determine the effectiveness of the operation and determine whether the operation should continue in future years. This operational alternative is considered a critical component of Configuration/Operation Planning (COP); effectiveness of using operations of existing facilities to achieve desired downstream water quality conditions will be important in future milestone decisions regarding whether or not to pursue structural water quality improvements.

Rationale/Effect of RPA 5.1.1: This measure identifies the initial location for carrying out interim temperature control measures that will address project-related adverse temperature effects on listed anadromous fish and critical habitat in the North Santiam River. Detroit Dam is a high priority for this action because interim temperature control was shown to be possible and effective in 2007, as described in North Santiam Effects section 5.6.

The effect of this measure is as described above in measure 5.1. Improved water temperatures will result in increased egg survival, as well as likely increased survival of adult and juvenile life stages, causing increases in abundance and productivity for both UWR Chinook salmon and steelhead in the North Santiam River. Another effect of this measure is to improve the value of critical habitat by improving temperature in spawning and rearing areas.

5.1.2 **Additional Interim Water Quality Measures: By March 2010, the Action Agencies will identify measures, in addition to those described in RPA measure 5.1.1 above, that they can start implementing in April 2010, if feasible. By April 2010, the Action Agencies will carry out those operational changes that will result in immediate downstream temperature and TDG benefits; and that do not require congressional authorization, detailed environmental review, extensive permitting, and that are within existing physical or structural limitations. Specific interim operational measures will be determined by the Action Agencies, with the advice of and review by the Services.**

Rationale/Effect of RPA 5.1.2: This measure provides for development of interim measures that can be easily identified and carried out at Project dams other than Detroit Dam without detailed analysis, structural modification, or additional authorization. The Action Agencies have not been able to identify such opportunities at other Project dams, but NMFS includes this measure to require the Action Agencies to assess existing gates, outlets, and operations at Project dams to determine if it is possible to mix outflow from turbines, regulating outlets or other valves with spillway flow to achieve improved downstream water temperatures while minimizing TDG exceedances. Lookout Point Dam is a priority for evaluation because monitoring shows extremely high egg mortality for UWR Chinook salmon in the very limited spawning habitat below Dexter Dam (see Middle Fork Willamette Effects section 5.2). Hills Creek Dam is another location that would likely provide immediate improvements in fish spawning and rearing habitat in the Middle Fork Willamette River below the dam downstream to the upper limit of Lookout Point reservoir.

The effect of this measure is that it may result in interim water quality improvements at more than the one or two dams listed in measure 5.1.1 above. This is an initial assessment that may or may not provide interim options, and thus, the effect on abundance and productivity of listed fish, as well as on critical habitat, is uncertain. However, it is included in this RPA because it has potential benefits to listed fish and critical habitat.

5.1.3 **<u>Complex Interim Water Quality Measures</u>: The Action Agencies will evaluate measures that require detailed environmental review, permits, and/or congressional authorization as part of the COP (see RPA measure 4.13 above). The Action Agencies will complete this component of the COP by April 2011, including seeking authorization and completing design or operational implementation plans for those operations that are determined feasible. The Action Agencies will carry out operations that are feasible by May 2011, contingent on funding, issuance of necessary permits and authorization. The Services will comment on the measures and inform the Action Agencies whether they agree81 with the interim water quality measures.**

Rationale/Effect of RPA 5.1.3: This measure recognizes that some interim water quality improvement alternatives may include facility or operational changes that would require detailed environmental review, permits, or congressional authorization, and therefore, should be evaluated as part of the COP study (measure 4.13). NMFS distinguishes this interim measure from that in measure 5.2 below, which involves more extensive design and cost, and would be considered a more permanent solution. NMFS expects the kinds of measures that would be included here would be proposals to replace valves on regulating outlets or to install automatic controls on spillway gates. These changes are neither

81 See RPA 1.3 & 1.4 for elaboration of decision making process.

structurally complex nor expensive, though they would likely require more detailed review than the measures contemplated in measure 5.1.2.

The effect of this measure is that interim water quality improvements may be carried out at more Project dams than contemplated in measure 5.1.2, resulting in more populations of UWR Chinook salmon and steelhead that could benefit from improved downstream temperatures and reduced TDG exceedances. However, NMFS cannot consider the effects of this measure on abundance and productivity of listed fish and critical habitat because there is no certainty that any complex interim alternatives will be carried out. However, it is included in this RPA because it has potential benefits to listed fish and critical habitat.

5.1.4 **Monitoring and reporting of interim water quality improvement measures*:* Each year from 2009 through the term of this Opinion, the USACE will monitor and evaluate the effectiveness of interim and permanent water quality improvement measures, and will produce an annual report, by March 1 of the following year, for review and comment by the Water Quality/Temperature committee. The report will include recommendations, if any, to modify project operations to further improve water quality. The Services will comment on the draft report and inform the Action Agencies if they agree82 with the recommendations.**

5.1.5 **Modifying interim water quality improvement measures: Each year from 2010 through the term of this Opinion, the USACE will carry out modified project operations proposed in the annual reports described above in RPA measure 5.1.4 unless such modifications require detailed analysis and authorization. If such additional analysis is needed, then the Action Agencies will analyze those proposed modifications as part of the COP (see RPA measure 4.13).**

Rationale/Effect of RPAs 5.1.4 & 5.1.5: Measure 5.1.4 ensures that the Action Agencies will monitor the effectiveness of interim water quality improvement measures carried out as a result of measures 5.1.1, 5.1.2, and 5.1.3, and that they will produce an annual report of their findings. Measure 5.1.5 requires the Action Agencies to use results of monitoring studies and annual report conclusions to modify interim water quality improvement measures, if indicated. NMFS recognizes in these measures that changes requiring detailed analysis, funding, or authorization will not be immediately implemented, but instead, must be considered through the COP study process.

The effect of these measures is that monitoring and reporting will give NMFS and the Action Agencies necessary information to modify water quality improvement measures to improve operations that will better protect UWR Chinook salmon and steelhead below Project dams. NMFS cannot consider effects on abundance and

82 See RPA 1.3 & 1.4 for elaboration of decision making process.

productivity of listed fish and critical habitat because NMFS cannot predict the results of monitoring and subsequent changes that might be determined beneficial for future interim water quality improvement measures. However, it is included in this RPA because it has potential benefits to listed fish and critical habitat.

5.2 **Water Temperature Control Facilities and Operations: During the term of this Opinion, the Action Agencies will make structural modifications or major operational changes for improved water quality to at least one of the Project dams. Based on the best available information at the time of development of the RPA, NMFS identifies Detroit as the highest priority dam for construction of a temperature control structure or operational changes to achieve temperature control.**

The Action Agencies will investigate the feasibility of improving downstream temperatures and reducing TDG exceedances in the North Santiam River for ESA-listed fish species. The Action Agencies will take necessary interim steps beginning no later than 2010, which may include feasibility studies, a design report, authorization and appropriation, and plans and specifications, if appropriate. As part of this effort, the Action Agencies will evaluate alternatives to achieve both temperature control and downstream fish passage. If feasible and more efficient to achieve both purposes through one construction project, the Action Agencies will include downstream fish passage in this effort, rather than delaying it until 2023, as stated in RPA measure 4.12.3, Detroit Dam downstream passage. The Action Agencies will complete construction of any structural temperature control facilities by December 2018. By March 2019, the Action Agencies will begin operation of permanent downstream temperature control at Detroit Dam.

The Action Agencies will establish a Major Milestone (MM4) near the end of 2011 in conjunction with completion of the Detroit Feasibility Study. The major decision associated with that milestone will be "go/no go" on the feasibility of temperature control facilities. Because temperature control was not included as part of the original project authorization, NMFS assumes that construction of temperature control facilities at Detroit Dam may require Congressional action. Another Major Milestone (MM5) may be needed near the end of 2012 pending congressional action on authorization and appropriation of proposed facilities.

Rationale/Effect of RPA 5.2: This measure builds on the Proposed Action (section 3.6 of the Supplemental BA [USACE 2007a]), in which the Action Agencies propose to evaluate water temperature control at Project dams as part of the Willamette System Review Study. However, the Proposed Action lacks certainty that any temperature control facilities or operations would be provided during the term of this Opinion. This measure provides needed specificity and certainty by identifying a location and date certain when construction will be complete and when improved downstream temperature conditions and reduced TDG exceedances will be achieved.

NMFS chose Detroit Dam as a highest priority for water quality improvements for several reasons. First, past studies by USACE indicate that temperature control is achievable with existing storage capacity at Detroit Dam (see North Santiam Effects section 5.6.3). Second, water quality improvements in the North Santiam would benefit both UWR Chinook salmon and steelhead. Third, UWR steelhead in the North Santiam River are especially dependent on spawning habitat just below Big Cliff Dam and are more likely to be harmed by adverse water temperature conditions and TDG exceedances than steelhead in the South Santiam, which are not as confined to spawning habitat below Foster Dam. Finally, interim operations at Detroit in 2007 confirmed that restoring a more normative water temperature regime caused beneficial effects on downstream fish populations.

The effect of this measure will be that temperatures below Detroit Dam will more closely resemble normative conditions and TDG exceedances will be reduced, resulting in increased survival of juveniles, eggs, and adults over baseline conditions. This increased survival will help to increase productivity and abundance of North Santiam populations of UWR Chinook salmon and UWR steelhead. These more normative temperatures and TDG will also benefit critical habitat because they will make it more useful for listed fish.

5.3 **Protecting Water Quality during Emergency and Unusual Events or Conditions: The Action Agencies will apply protocols developed under RPA measure 4.3 and take actions within existing operational and structural capabilities at all project dams and reservoirs to protect water quality during unusual events and conditions.**

5.3.1 Where the protocols described in RPA measure 4.3 above cannot ensure adequate protection of water quality and other impacts to ESA-listed fish during unusual events/conditions, the USACE will identify structural or mechanical changes that could be made at project facilities for this purpose. The USACE will produce a draft report by September 1, 2009, proposing to make structural or mechanical changes to protect water quality during anomalous events.

5.3.2 With review and comment by the WATER Water Quality/Temperature committee, the USACE will produce a final report by January 1, 2010. NMFS and FWS will inform the USACE if the report's recommendations are inconsistent with this RPA.

5.3.3 The Action Agencies will begin to carry out structural and mechanical changes that will protect water quality during anomalous events and that do not require congressional authorization, detailed environmental review, or extensive permitting by March 1, 2010. These minor changes include only those that meet all of the following criteria: no need to prepare an EIS pursuant to NEPA; no need to obtain additional congressional authorization; no need to submit to extensive permitting procedures; and within reasonable cost.

5.3.4 The Action Agencies will evaluate those measures that require detailed environmental review, permits, and congressional authorization as part of the COP (see measure 4.13). The Action Agencies will complete this component of the COP by April 2011, including seeking authorization and completing design for those structural measures that are determined feasible. The Action Agencies will begin to construct and operate those measures determined feasible by May 2011, contingent on funding and issuance of necessary permits. The Services will inform the Action Agencies whether they agree[83] with the structural measures.

5.3.5 As structural and mechanical changes are completed, the USACE will update the protocols described in measure 4.3 above to include any new instructions for operating the modified facilities.

5.3.6 Any structural or mechanical improvements that are carried out will be continued through the term of this Opinion unless the Action Agencies and the Services determine, as more information is obtained, that there is a better way (that is obviously feasible) to operate for water quality.

***Rationale/Effect of RPA 5.3*:** This measure requires the Action Agencies to prepare for emergency and unscheduled events that may alter water quality and cause harm to listed fish in Project reservoirs and downstream habitat. As described in North Santiam Baseline section 4.6 (and Effects section 5.6), a powerhouse fire at Detroit and Big Cliff in 2007 caused rapid increases in TDG below Big Cliff, potentially killing young steelhead alevins (the stage between hatching and leaving the gravel) as they prepared to emerge from redds below that dam. Had protocols been in place that described ways to avoid and minimize harmful effects of emergency conditions on water quality and fish, these actions could have been carried out immediately by Project staff, thereby reducing the number of steelhead alevins that would have been killed.

The effect of this measure will be that actions to minimize fish harm from emergency events will be identified in advance, and will then be carried out as soon as possible after such events occur, resulting in less injury and mortality to listed fish above and below Project dams. Additionally, because this measure requires the Action Agencies to investigate and carry out structural or mechanical changes determined feasible to protect water quality during emergency events, fish losses will be further reduced.

5.4 **<u>Cougar Dam RM&E</u>: The Action Agencies will fund and carry out an extended biological RM&E program associated with the Cougar Dam WTC. The RM&E program will begin in 2011, after completion of the RM&E program included in the previously authorized Cougar Trap project. The RM&E program will evaluate effects of the WTC operation on the downstream ecosystem (including TDG), fish passage through the reservoir, dam, and regulating outlet, and effectiveness of the trap-and-haul program. It will also quantitatively assess biological benefits realized**

83 See RPA 1.3 & 1.4 for elaboration of decision making process.

from these protective and restorative measures. By September 2010, the Action Agencies will prepare a revised Cougar Dam WTC Monitoring and Evaluation Plan, based on the original plan developed as part of a previous consultation, subject to review and comment by the Services, and consistent with the RM&E process described below in RPA measure 9 (RM&E). The Action Agencies must obtain NMFS' review of the plan prior to initiating any research-related activities anticipated in this RPA. The proposals must identify anticipated take levels of each species and life stage for each year. The Services will inform the Action Agencies whether they agree84 with the revised plan, proposed studies, draft reports, and NEPA alternatives. The Action Agencies will begin to carry out the extended RM&E program by March 1, 2011.

Rationale/Effect of RPA 5.4: This measure modifies a similar action described in section 3.7.1.2 of the Supplemental BA (USACE 2007a). The Proposed Action does not specify when this RM&E program would begin, or how it would mesh with ongoing monitoring at Cougar Dam. Monitoring the Cougar WTC and associated fish passage at that facility is already required thru at least 2010 as part of the Cougar Trap project, and NMFS completed consultation on that proposed action in 2007 (NMFS 2007a). In this measure, NMFS requires the Action Agencies to continue RM&E at Cougar Dam beginning in 2011 to ensure that studies include a sufficient number of years of data to represent a variety of water year conditions and to include adult return data.

The effect of this measure will be to ensure that decisions regarding temperature control and downstream passage at Cougar Dam and other Project dams are based on reliable biological information. As a result, existing structures will be operated to improve fish survival and new structures will be more likely to provide safe fish passage and favorable water quality conditions for listed fish below Project dams.

9.6 HATCHERIES

The following actions are included in the RPA for Hatcheries. These actions are necessary for reducing short- and long-term risks faced by the Chinook ESU and steelhead DPS, thereby increasing the viability of the affected populations.

RPA 6 Hatcheries

6.1 **The Action Agencies will work cooperatively with the State of Oregon to ensure that Willamette Project hatchery programs are not reducing the viability of listed ESUs/DPSs.**

6.1.1 **<u>Implementation of Hatchery and Genetic Management Plans (Willamette Basin-wide)</u>: The Action Agencies will implement the actions described in the Willamette Hatchery and Genetic Management Plans (ODFW 2003, 2004a, 2005a, 2007a, 2008a, 2008b) for spring Chinook, summer steelhead,**

84 See RPA 1.3 & 1.4 for elaboration of decision making process.

and rainbow trout, after NMFS approval of these plans. Implementation of these actions requires cooperation with the State of Oregon, who partially funds and operates many of the facilities associated with the Hatchery Mitigation Program.

***Rationale/Effect of RPA 6.1.1*:** The HGMPs provide the detailed management plan for each hatchery program throughout the entire life cycle of the fish. Adherence to the HGMP is necessary since the fine details of the hatchery programs are not (and should not be) included in the Supplemental BA.

The effect of this measure will be to reduce and minimize adverse effects of hatchery programs on UWR Chinook and steelhead. There are many specific protocols and guidelines for spawning, raising, and releasing hatchery fish that need to be implemented to be in accordance with best management practices for reducing impacts to ESA-listed stocks.

6.1.2 **Hatchery Facility Improvements (Willamette Basin-wide): The Action Agencies will improve fish collection facilities associated with the hatchery mitigation program; including salmonid ladders, traps, holding, and acclimation facilities associated with hatchery broodstock collection and the outplanting program. Facilities will be rebuilt according to the schedule described in RPA measures 4.6 and 4.7 above.**

Rationale/Effect of RPA 6.1.2: Improving the collection facilities associated with hatchery broodstock collection and the outplanting program of fish above the dams is necessary in order to reduce the handling impacts to listed fish associated with using the existing facilities. The existing facilities were not designed (nor originally intended) to capture and handle listed fish.

The effect of this measure will be to reduce handling stress and mortality to listed salmon and steelhead associated with the collection of fish associated with the outplanting program above the dams and hatchery broodstock collection.

6.1.3 **Mass-marking of Hatchery Releases (Willamette Basin-wide):- The Action Agencies will continue to mark all hatchery fish releases in the Willamette Basin with an adipose fin clip and otolith mark. The Action Agencies will ensure that coded wire tags (or blank tags if appropriate) will be inserted into all hatchery spring Chinook released into the McKenzie Basin, beginning with the 2008-09 smolt releases. The Action Agencies, with the cooperation of the ODFW, will phase in the tagging of all other Chinook releases according to the schedule described in RPA measure 4.13 above, so that the first year of the age-4 return can be detected at the rebuilt facilities. There is no need to wire tag Chinook releases unless infrastructure is in place to detect adult returns.**

***Rationale/Effect of RPA 6.1.3*:** It is necessary to continue to externally mark all hatchery fish releases so that (1) the status of natural-origin and hatchery-origin returns can be determined, (2) the percentage of hatchery fish spawning naturally in the wild can be determined, and (3) so that managers can incorporate natural-origin fish into hatchery broodstocks as appropriate.

The effect of this measure will be to ascertain effects of the hatchery program on the natural-origin population in terms of the percentage of natural-origin fish collected for broodstock and percentage of hatchery fish on the natural spawning grounds.

6.1.4 **Improvements at Leaburg Dam (McKenzie): The Action Agencies will fund the design, construction, and operation85 of a sorting facility at Leaburg Dam on the McKenzie River to reduce hatchery fish straying into core spring Chinook natural production areas upstream. Modification of the existing facilities, or construction of new ones, is contingent on agreement by the facility owner, Eugene Water & Electric Board (EWEB), and collaboration with EWEB and ODFW. The Action Agencies will establish a Working Group, comprised of representatives from BPA, USACE, NMFS, ODFW, and EWEB, to scope the design and implementation of the sorting facility. The design philosophy for this facility will be that it automatically separates hatchery-origin adults from other fish.86 If it is not feasible to design the facility with automatic sorting capability, the Action Agencies will seek NMFS' agreement87 to use an alternative facility design that minimizes harm to UWR Chinook salmon. The Action Agencies will complete construction of the sorting facilities by December 2013, and begin operation in time for the spring Chinook upstream migration beginning in 2014. If an acceptable sorting facility at this site is deemed infeasible by the Working Group and agreed to by NMFS, then the Action Agencies will take alternative actions to reduce hatchery fish straying to less than 10% of the total population spawning in the wild.**

***Rationale/Effect of RPA 6.1.4*:** The McKenzie run of Chinook is a stronghold population and currently produces the highest number of natural-origin fish in the ESU. Significant spawning by hatchery-origin fish (13-36%) in the wild presently occurs and represents substantial risks to population productivity and diversity. It is necessary to reduce the effects of hatchery fish on this population to the lowest extent possible (0-10%) in order to restore this population and to be able to evaluate its sustainability without the continual infusion of hatchery spawners.

85 Operation could be partially or completely funded by another entity.
86 Hatchery-origin fish have had small metal tags implanted in them. These tags may be electronically sensed and the resulting signal used to operate sorting devices. Non-hatchery origin fish do not have these tags and could theoretically be allowed to pass upstream without human intervention, reducing the injury and stress that they experience.
87 See RPA 1.3 & 1.4 for elaboration of decision making process.

The effect of this measure will be to reduce the natural spawning of hatchery fish in the wild, thereby reducing risks of genetic introgression.

6.1.5 **Management of Hatchery-origin Spring Chinook Upstream of Cougar Dam (McKenzie): The Action Agencies will discontinue releases of all hatchery spring Chinook salmon above Cougar Dam on the South Fork McKenzie River once sufficient numbers of wild fish can be safely collected at the rebuilt Cougar Dam trap and outplanted above the dam. The minimum number of wild fish needed for the outplanting program will be determined by the Fish Passage and Hatchery Management Committee. If insufficient numbers of wild fish (e.g., less than 100 wild fish) are collected at Cougar Dam, then hatchery fish may be used to supplement natural spawning above Cougar Dam, up to a maximum of 50% of the outplanted fish. The FPHM committee will annually update the Willamette Fish Operations Plan with the appropriate number of hatchery-origin fish to be released upstream of Cougar Dam.**

***Rationale/Effect of RPA 6.1.5*:** The continual outplanting of adult hatchery fish above Cougar Dam represents significant productivity and diversity risks to the McKenzie population because offspring from these outplanted fish (i.e. F1 hatchery fish) would be indistinguishable from natural-origin fish in the population. These fish would then spawn naturally in the population, thereby infusing hatchery genes into the wild population. The continual release of hatchery fish upstream of Cougar Dam is inconsistent with RPA measure 6.1.4 and continues to allow hatchery fish to influence the natural-origin population. This measure includes cooperation with the State of Oregon, who partially funds and operates many of the facilities associated with the Hatchery Mitigation Program.

The effect of this measure will be to manage genetic introgression of hatchery fish in the McKenzie population and facilitate local adaptation of a self-sustaining run of spring Chinook upstream of Cougar Dam in the South Fork of the McKenzie.

6.1.6 **Improve Summer Steelhead Release: The Action Agencies, in cooperation with ODFW, will improve the release of hatchery summer steelhead smolts by allowing volitional emigration from the point of release over an extended period of time (e.g., 2-4 weeks) with any non-migrants being removed and not released into free flowing waters below the Projects, to extent possible given constraints on the current infrastructure. When the facilities are reconstructed, the Action Agencies will ensure that any new acclimation facilities allow for this operation.**

***Rationale/Effect of RPA 6.1.6*:** Improving the release protocols for hatchery summer steelhead smolts should reduce the percentage of hatchery fish that residualize and thus interact with listed fish below the dams. Previously

management practices released all of the fish into the river and did not remove fish that were not ready to actively emigrate to the ocean.

The effect of this measure will be to reduce competition and predation of hatchery fish on natural-origin Chinook and steelhead downstream of the dams.

6.1.7 **Reduce Summer Steelhead Recycling in the Santiam Basin: The Action Agencies, in cooperation with ODFW, will stop recycling adult summer steelhead for fishery harvest purposes by September 1st of each year in the North Santiam and South Santiam rivers. The Action Agencies will continue to operate fish collection traps on a weekly basis through October 15th in order to maximize the collection of summer steelhead, to the extent possible with the current facilities. These fish will then be held at the hatchery for spawning, unless determined otherwise by the FPHM committee.**

***Rationale/Effect of RPA 6.1.7*:** Previously, summer steelhead were periodically recycled through the end of October for sport fisheries downstream of the dams. The practice of recycling fish later in the season (i.e. September through October) when fishery effort is low and the fish are nearing spawning time likely increases the number of summer steelhead that spawn in the wild during the fall and winter. Eliminating the recycling program later in the season and removing the summer steelhead that are captured in the traps will decrease the number of naturally-spawning summer steelhead.

The effect of this measure will be to reduce straying and spawning by summer steelhead in listed winter steelhead habitat and reduce competitive interactions between juvenile summer and winter steelhead.

6.1.8 **Adjust Releases of Summer Steelhead in the Santiam Basin: The Action Agencies, in cooperation with ODFW, will reduce the hatchery summer steelhead release in the North Santiam River to 125,000 smolts. To offset this reduction, summer steelhead releases may be increased in one or more of the following subbasins: South Santiam, McKenzie, and Middle Fork Willamette (up to a total of 36,000 fish) to maintain the existing hatchery mitigation in the Willamette Basin. The revised HGMP for summer steelhead will identify how these production changes will be allocated among the different rivers.**

***Rationale/Effect of RPA 6.1.8*:** Recent creel survey data shows the sport fishery in the South Santiam catches more summer steelhead than in the North Santiam (Schroeder et al. 2006). However, more hatchery fish are released in the North Santiam than the South Santiam. The combination of greater hatchery fish released and lower fishery harvest in the North Santiam is leading to widespread spawning by hatchery summer steelhead in the listed winter steelhead habitats. Adjusting the release numbers in the North and South Santiam to be more aligned with current fishery needs, and will allow greater harvest and reduce impacts to winter steelhead.

The effect of this measure will be to reduce spawning of summer steelhead in listed winter steelhead habitat of the North Santiam, thus reducing adverse effects of the hatchery program. More fish released in the South Santiam will provide more harvest in the sport fishery, where fishing effort is greater. Harvest of summer steelhead will likely increase, and thus straying and spawning by summer steelhead should not increase appreciably.

6.1.9 **Future Summer Steelhead Management Actions: The Action Agencies, in cooperation with ODFW, will implement future management actions aimed at reducing the impacts of the summer steelhead hatchery program on ESA-listed species. These actions will be developed according to the process described in section 3.4.10.2 of the Supplemental BA (USACE 2007a), which will incorporate the results of research, monitoring, and evaluation.**

Rationale/Effect of RPA 6.1.9: If RM&E in the near future continues to show unacceptable straying and spawning by summer steelhead in the DPS after recent management changes have been implemented, then further actions to reduce impacts will be developed and implemented as necessary.

The effect of this measure will be to adaptively manage the summer steelhead hatchery program and thus guide future management decisions that could reduce impacts on listed winter steelhead.

6.2 **The Action Agencies will preserve and rebuild genetic resources through conservation and supplementation objectives to reduce extinction risk and promote recovery. These actions rely in part on cooperation with the State of Oregon, which partially funds and operates many of the facilities associated with the Hatchery Mitigation Program.**

6.2.1 **Implementation of Hatchery and Genetic Management Plans (Willamette Basin-wide): When approved by NMFS, the Action Agencies, in cooperation with ODFW, will implement the actions described in the NMFS-approved Willamette HGMPs for spring Chinook, summer steelhead, and rainbow trout.**

***Rationale/Effect of RPA 6.2.1*:** This measure is identical to that described as RPA measure 6.1.1, but is included here because of the importance of HGMPs to practices that rebuild genetic resources.

6.2.2 **Genetically Integrated Management of Spring Chinook Programs (Willamette Basin-wide): For all Willamette spring Chinook hatchery mitigation programs, in each population area (Middle Fork, McKenzie, South Santiam, North Santiam), the Action Agencies, in cooperation with ODFW, will fund and implement conservation and supplementation programs that build genetic diversity using local broodstocks and manage the composition of natural spawners according to the sliding-scale matrices,**

as described in Section 3.4 of the Proposed Action, Supplemental BA (USACE 2007a, and ODFW 2003,2004a, 2005a, 2007a, 2008a, 2008b). The Action Agencies will monitor and evaluate implementation of actions through the end of the ESA take coverage period (term of this Opinion is 15 years).

Rationale/Effect of RPA 6.2.2: Since the hatchery Chinook programs are being used for reintroduction efforts above some of the impassable dams, based upon the best available science, it is necessary for the hatchery stock to be integrated with the natural-origin population to the extent possible at this time. Therefore natural origin fish must be incorporated into the hatchery broodstocks. In addition, hatchery fish will be managed on the spawning grounds to manage genetic risks to the wild population over the long-term.

The effect of this action will be to make the Chinook hatchery stocks as similar as possible to their respective natural-origin counterparts to the extent possible. This will reduce domestication and genetic risks of hatchery fish to the natural-origin population above and below the dams.

6.2.3 **<u>Continue Adult Chinook Outplanting Program (Willamette Basin-wide)</u>:- The Action Agencies will continue the existing Adult Chinook Salmon Outplanting program, capturing spring Chinook salmon below USACE projects and transporting them into habitat that is currently inaccessible above the following dams: in the North Santiam, above Detroit Dam; in the South Santiam, above Foster Dam; in the South Fork McKenzie, above Cougar Dam; and in the Middle Fork Willamette, above Lookout Point and Hills Creek dams; and carry out the operational and handling protocols described in the HGMP for each subbasin hatchery. The Action Agencies will use hatchery fish in each population area as described in the HGMP sliding scale matrices. See RPA measures 4.1 through 4.4 of this RPA for additional details.**

Rationale/Effects of RPA 6.2.3**:** For several Chinook populations (North Santiam, South Santiam, Middle Fork Willamette), it is necessary to use existing hatchery stocks for outplanting efforts above the impassable dams because of the lack of natural-origin fish available. Since the dams blocked most of the historical holding and spawning habitat in these populations and there are problems with water temperature below the Projects, it is necessary to regain production from the areas upstream of the dams, even though hatchery stock will be used for reestablishing the fish above the dams. This measure relies on the Action Agencies working in cooperation with ODFW.

The effect of this measure will be to re-establish natural production in historical habitat above impassable dams. Since the outplanting program has significant impediments at this time with the trapping facilities, prespawning mortality,

downstream passage of juvenile fish through the reservoirs and dams, the use of hatchery fish is more appropriate in many cases than using natural-origin fish.

6.2.4 **Adjust Spring Chinook Release Strategy (Willamette Basin-wide): The Action Agencies will use more natural (i.e. "wild-type") growth rates and size at release for all juvenile spring Chinook reared and released at hatcheries, as feasible. Actions shall be taken to release hatchery fish that are more similar to their natural-origin counterparts to the extent feasible. As proposed in the Supplemental BA, the Action Agencies will work with ODFW to develop a plan for an experimental release in 2009, with an associated RM&E program. The FPHM Committee will evaluate RM&E results, current science on release strategies, and additional information resulting from analysis of previous releases, to develop a plan for modifying future releases. These Chinook hatchery programs serve a dual purpose (fishery augmentation and population conservation), thus consideration shall be given to the survival effects of this hatchery reform action. Unacceptably low survival rates would prevent attainment of both conservation and fishery objectives.**

***Rationale/Effects of RPA 6.2.4*:** Since hatchery Chinook are being used for conservation purposes, it is necessary to align hatchery fish to the extent possible with the natural-origin population. The hatchery fish, when released as smolts, are larger than wild smolts, which has implications for survival, age at return, and reproductive potential. This RPA action will experiment with different release strategies to align hatchery smolts more with wild smolts with the intent of reducing hatchery effects on population viability.

The effect of this measure will be to make the hatchery Chinook more similar to their natural-origin counterparts, thus making them more appropriate for supplementation and reintroduction purposes.

6.2.5 **Molalla River Chinook Recovery: The Action Agencies will support ODFW efforts to eliminate the use of the non-local hatchery Chinook stock (South Santiam) released into the Molalla River. The Action Agencies will work with ODFW to identify potential funding and implementation mechanisms to develop a locally-adapted broodstock, using the conceptual approach described in the hatchery management strategy for the Molalla River Basin.**

***Rationale/Effects of RPA 6.2.5*:** The best available science suggests a locally-derived hatchery stock is better for supplementation purposes than an out-of-population and/or domesticated hatchery stock. The proposed action is to continue to release South Santiam hatchery stock into the Molalla River. Development of a locally derived Chinook broodstock would contribute to recovery efforts in the Molalla River by addressing the effects of the Project.

The effect of this measure will be to reduce impacts of the existing hatchery stock on the population. A locally-derived stock is likely to be more fit to local environmental conditions and more productive.

9.7 HABITAT

This section of the RPA is intended to build upon the measures described in Section 3.5, Habitat Restoration and Management Actions, of the Supplemental BA (USACE 2007a). For the most part, the Proposed Action measures involve assessment of habitat needs and studies to identify and prioritize possible restoration projects, if funding is available. In this Opinion, Section 5, Effects, NMFS describes adverse effects of continued operation of Project dams and maintenance of Project revetments on downstream physical habitat (See Middle Fork Willamette Section 5.2.4; McKenzie Section 5.3.4, etc). The Proposed Action would continue to degrade existing rearing, holding, and spawning habitat below Project dams, reducing abundance and productivity of UWR Chinook salmon and UWR steelhead. Additionally, as described in the Habitat Access and Fish Passage subsections within key tributary sections of Effects (Middle Fork Willamette Section 5.2.1, McKenzie Section 5.3.1, South Santiam Section 5.5.1, and North Santiam Section 5.6.1), the Proposed Action would continue to prevent safe access to historical habitat above the dams, restricting most of the fish to existing habitat below the dams. Thus, during the term of this Opinion, while fish passage solutions are being researched and installed at the highest priority Project dams, the Action Agencies must actively restore habitat downstream of the dams to offset continued degradation in this remaining habitat. Further, as described in Section 3, Rangewide Status, juvenile rearing habitat in the lower reaches of most tributaries is one of the key factors limiting productivity of most populations of UWR Chinook salmon. Even after other limiting factors are addressed that increase productivity (e.g., water temperature and/or fish passage), restoration of juvenile rearing habitat in reaches downstream of the dams will still be necessary to ensure adequate habitat is available for this life stage. Habitat restoration work will prevent further declines in abundance and productivity of UWR Chinook salmon and UWR steelhead associated with Project effects on downstream habitat, and will be necessary to ensure success of other actions required in this RPA by addressing limiting factors associated with other life stages.

7.1 **<u>Willamette River Basin Mitigation and Habitat Restoration</u>: The Action Agencies will plan and carry out habitat restoration programs on off-site lands. Existing programs will continue (7.1.1); a comprehensive program will be established (7.1.2); and additional projects will be done (7.1.3). The purpose of the program will be to protect and restore aquatic habitat to address limiting habitat factors for ESA-listed fish.**

7.1.1 The Action Agencies will continue to carry out the projects listed in Table 9.7-1 (below).

Table 9.7-1 Ongoing Habitat Restoration Projects in the Willamette Basin

Project/Program	Water Body	Description
Willamette Basin Mitigation (BPA 199206800)	Mainstem Willamette	Integrative mitigation program that protects, conserves, and restores areas containing diverse habitats that assist the life history needs and resources for multiple terrestrial and aquatic species in the Willamette Basin.
Delta Ponds (Section 206, USACE)	Mainstem Willamette near Eugene	Construction initiated in 2005 with the City of Eugene, and will continue. The project is providing floodplain and hydraulic connectivity to the Willamette River through a series of old gravel pits.
Springfield Millrace (Section 206, USACE)	Middle Fork Willamette near Springfield	Construction initiated 2008 with the City of Springfield. The project will restore historic millrace and mill pond and creation of wetlands, fish passage and water quality improvements.
North Santiam Gravel Study (Planning Assistance to States, USACE)	North Santiam River	This study was initiated in 2008 and will assess the need and potential locations for gravel placement in the North Santiam River.

7.1.2 The Action Agencies will develop and carry out a comprehensive habitat restoration program, in collaboration with the Services, which will include funding for carrying out habitat restoration projects during the term of this Opinion. The Action Agencies will work with the Services to pursue authorization, if necessary, and appropriations to carry out the habitat restoration program.

The Action Agencies will work closely with the Services to accomplish the following:

1. **Develop project selection criteria aimed specifically at addressing factors limiting the recovery of Willamette basin ESA-listed fish populations, focusing on, but not limited to, those factors caused at least partially by the Willamette Project. These criteria should be informed by regional plans including Willamette Basin Recovery Plans for anadromous salmonids (ODFW 2007b), Willamette Aquatic Habitat Assessment (unpublished, see RPA measure 7.5), Willamette Subbasin Plan (WRI 2004), Willamette River Basin Planning Atlas (Hulse et al. 2002), and the COP evaluation (measure 4.13).**
2. **Identify proposals for habitat restoration projects.**
3. **Forward those proposals that meet project selection criteria to NMFS for**

review and determination if they are consistent with improving survival and recovery.

4. **Fund priority projects, through applicable programs and processes (see Table 9.7-2), that NMFS and FWS determine to be consistent with recovery plans for their respective ESA-listed species.**

Table 9.7-2 Authorities/Programs to Facilitate Implementation of Habitat Restoration Projects in the Willamette Basin

Program	Water Body	Description
Columbia River Basin Fish and Wildlife Program	Columbia Basin (including Willamette)	The Northwest Power Act of 1980 directs the Council to develop a program to protect, mitigate and enhance fish and wildlife of the Columbia River Basin that have been impacted by hydropower dams, and make annual funding recommendations to the Bonneville Power Administration for projects to implement the program. The Bonneville Power Administration then decides which projects to fund and implements the selected projects.
Continuing Authorities Program (CAP); (USACE Sections 206 & 1135 Programs)	Oregon	Continuing Authorities Program funds small restoration projects that address a variety of water resource and land related problems. A description of the CAP program is provided in section 3.5.2.3 of the Supplemental BA (USACE 2007a)
General Investigation Program (GI); USACE)	Oregon	Authority to conduct complex, large-scale, multiple purpose water resource projects. Applicable existing GI studies are described in Section 3.5.2.2 of the Supplemental BA and include: the Willamette River Floodplain Restoration Study; Eugene-Springfield Metro Area Watershed Feasibility Study, Lower Willamette Ecosystem Restoration Feasibility Study
Planning Assistance to States (PAS); USACE)		Authority to work with non-Federal sponsor to study and evaluate water and related land resource problems. Current study of North Santiam Gravel under this authority
Upper Willamette Watershed Ecosystem Restoration Authority (USACE Sec 3138 program)	Willamette watershed upstream of Albany	New authority from WRDA 2007 to conduct ecosystem restoration studies for the upper Willamette basin to protect, monitor, and restore fish and wildlife habitat.
Ecosystem Restoration and Fish Passage Improvement Authority (USACE Sec 4073)	Oregon	New authority in WRDA 2007 to conduct studies for ecosystem restoration and fish passage improvement on rivers throughout Oregon. Emphasis on fish passage and restoration to benefit species that are ESA listed. In conjunction with study, pilot project to demonstrate effectiveness of actions is authorized.
Sustainable Rivers Partnership with The Nature Conservancy	Willamette Basin	Cooperative agreement between USACE and The Nature Conservancy to assess and implement dam operational changes to better mimic natural river flows in the Willamette basin

7.1.3 By 2010, the Action Agencies will complete at least two of the highest priority projects that should result in significant habitat improvement for listed fish species. The Action Agencies will complete additional habitat projects each year from 2011 through the term of this Opinion. Alternatively, larger projects that might require several years to complete could be funded over a

multi-year period instead of funding individual, smaller projects each year. NMFS will inform the Action Agencies whether they agree with the decision to fund and carry out these projects.

Rationale/Effect of RPA 7.1: This measure builds on the multiple studies and authorities the Action Agencies describe in the Proposed Action, section 3.5.2 through 3.5.4, of the Supplemental BA (USACE 2007a). It requires the Action Agencies to develop, fund, and carry out a comprehensive habitat restoration program for listed fish species in the Willamette basin.

Measure 7.1.1 acknowledges continued funding of existing projects in the Willamette watershed that provides some habitat improvements for UWR Chinook salmon and UWR steelhead. Although NMFS proposes to redirect project priorities to benefit these listed species, most of the funds for these projects have already been committed for other purposes, so only a small number of projects might be funded through this process. The Willamette Basin Mitigation project has some benefit, although limited, because it is directed primarily at terrestrial species. The Willamette Basin Mitigation projects will primarily benefit UWR Chinook salmon and UWR steelhead, and to a lesser degree, LCR Chinook salmon, LCR steelhead, and LCR coho salmon.

The priority for the new program and restoration projects described in RPA measures 7.1.2 and 7.1.3 is to maximize benefits for listed fish populations for which habitat degradation due to the Project is a major limiting factor. NMFS expects that most funded projects will have ecological benefits beyond helping listed fish species. Although specific projects are not identified, this measure provides enough certainty that the Action Agencies will establish a program, identify priority projects, acquire funding, and complete at least 2 projects by 2010, with additional projects funded and completed each year from 2011 through 2023, the term of this Opinion. This measure on its own would not be sufficient to offset continued population declines associated with degraded downstream habitat, but it does ensure an incremental improvement in downstream habitat, and would help to maintain populations at existing levels below the dams.

The effect of this measure is to offset adverse impacts of the Willamette Project on elements of critical habitat, such as degraded rearing and migration habitat in the mainstem Willamette and lower reaches of its tributaries caused by reduction in channel-forming flows and continued existence and maintenance of revetments. This measure will offset the effects by creating complex rearing habitat, adult holding habitat, and access to off-channel habitat, resulting in increased abundance and productivity of UWR Chinook salmon and UWR steelhead, and will improve the functioning of the PCEs for safe passage, spawning gravel, substrate, water quantity, water quality, cover/shelter, food, and riparian vegetation. If any projects are funded in the Willamette River below the falls, LCR Chinook salmon, LCR steelhead, and LCR coho salmon would also see small increases in abundance and productivity.

Some restoration projects will have negative effects during construction, but these are expected to be minor, occur only at the project scale, and persist for a short time (no more

and typically less than a few weeks). Examples include sediment plumes, localized and brief chemical contamination from machinery, and the destruction or disturbance of some existing riparian vegetation. These impacts will be limited by the use of the practices described in NMFS (2008e). The positive effects of these projects on population viability and PCEs will be long term.

7.2 **Habitat Restoration and Enhancement on USACE Lands at Project Dams and Reservoirs: The USACE will continue to use existing authorities and programs for land and water resource stewardship on the lands it administers at the 13 Willamette projects to carry out aquatic and riparian habitat projects to benefit terrestrial organisms and resident fish species, in ways that do not harm ESA-listed species. Additionally, the USACE may design projects on USACE lands to benefit ESA-listed anadromous species. These actions will be carried out consistent with the best management practices identified in the "SLOPES IV Restoration" (NMFS 2008f) or other applicable biological opinions.**

Rationale/Effect of RPA 7.2: In section 3.5.1 of the Proposed Action in the Supplemental BA (USACE 2007a), the Action Agencies propose to continue on-site habitat management activities aimed primarily at resident fish and wildlife species that use the reservoirs and adjacent lands. NMFS includes this measure to ensure that continued on-site activities are reviewed and modified, if necessary, to avoid adverse effects on listed UWR Chinook salmon and UWR steelhead. Further, on-site habitat projects that benefit UWR Chinook salmon and UWR steelhead should be funded through this program.

NMFS cannot quantify the effect of this measure on listed fish or critical habitat because the measure does not specify the number of projects or magnitude of benefit that should be directed at listed anadromous species. Insufficient information is available to assess the value of these reservoirs for rearing juvenile salmon and steelhead, and thus NMFS cannot determine how much, if any, habitat restoration work is needed in the reservoirs and adjacent aquatic habitat. However, this measure will provide benefit to listed anadromous fish because it will ensure that there are adequate protections for listed salmonids when the Action Agencies are conducting projects that benefit other species.

7.3 **Large Wood Collected at Project Dams: During annual maintenance operations, the Action Agencies will collect large wood that accumulates at Project dams and make it available for habitat restoration projects above and below Project dams.**

Rationale/Effect of RPA 7.3: This new measure that is not addressed in the Proposed Action is aimed at restoring large wood transport past Project dams. The continuing effects of Project dams on interruption of large wood transport were discussed in detail in each of the major tributary Effects sections (Middle Fork Willamette Section 5.2.4, McKenzie Section 5.3.4, South Santiam Section 5.5.4, and North Santiam Section 5.6.4).

Lack of large wood in downstream fish habitat continues to reduce available rearing and holding habitat for juvenile and adult UWR Chinook salmon and steelhead. This measure ensures that large wood that collects in the reservoirs will be made available for such projects.

The effect of this measure is generally positive for listed anadromous fish because it is a first step in the process of habitat restoration that provides large woody debris that is a benefit to the fish and habitat elements.

7.4 **Restoration of Habitat at Revetments: In coordination with the Services, the Action Agencies will undertake a comprehensive assessment of revetments placed or funded by the USACE Willamette River Bank Protection Program. The revetment assessment will be completed, including identifying sites with potential for modification, by December 31, 2010. The USACE will use applicable existing authorities and programs for funding habitat restoration identified in Table 9.7-2, as well as new programs that are applicable, to fund priority projects identified in this assessment.**

Rationale/Effect of RPA 7.4: This measure provides additional certainty to the Willamette River Bank Protection Program study described in section 3.5.4 of the Proposed Action (USACE 2007a). The Action Agencies indicated in that section that they had not identified funding sources or a timeline for conducting the study or follow-up actions. This RPA measure requires the USACE to secure funds for the study and complete it by December 31, 2010. Once completed, the Action Agencies would be required to seek funds to carry out projects at high priority sites.

The effect of this measure is that high priority sites for restoration or removal will be identified in the near term, and will be considered for funding through applicable authorities and programs. When projects are funded and carried out, the effect will be improved rearing and holding habitat, by opening access to off-channel rearing habitat and allowing establishment of complex habitat used for rearing and holding.

7.5 **Aquatic Habitat Assessment: By June 2008, the Action Agencies will complete surveys of spawning and holding habitat availability and condition in the major spawning tributaries with USACE dams (N. Santiam, S. Santiam, South Fork McKenzie, and Middle Fork Willamette rivers). The Action Agencies will distribute copies of the final report to the Services and will make the report available on the USACE's Portland District's website. Habitat survey data will also be available to the public in a GIS format. The Action Agencies will use the assessment to inform habitat restoration priorities for RPA measure 7.1.**

Rationale/Effect for RPA 7.5: The Action Agencies propose to complete this assessment by the end of FY 2008 (i.e., end of September 2008). These surveys will provide essential information for decision-makers regarding the availability of suitable habitat above and below Project dams for UWR Chinook salmon and steelhead.

9.8 ESA COMPLIANCE & COORDINATION

These measures are based on similar Proposed Action measures in section 3.6.5 of the Supplemental BA (USACE 2007a). Additionally, the coordination process described in these measures is encompassed within RPA measure 1, Coordination, of this Chapter 9. However, the following measures add specificity to those measures with regard to design review and construction implementation. Specificity is necessary to ensure that needed reviews will happen and that construction will be accomplished in a way that minimizes impacts on listed fish.

RPA 8 ESA Compliance, Maintenance, and Construction Projects Environmental Coordination and Management

8.1 **Review of Design and Construction Reports: The Action Agencies will collaborate with the Services on the design, construction and operation of all potential structural modifications to the dams and associated facilities, including fish collection and handling facilities, fish passage improvements, and water temperature control facilities. The Action Agencies will obtain the Services' review88 of design reports and will address their recommendations in subsequent design reports. The Action Agencies will provide final design reports and drawings to the Services at least 30 days in advance of making the final design decision to allow time for their review and comment.**

Rationale/Effect of RPA 8.1: This measure is needed to ensure constructive collaboration between the Services and the Action Agencies to ensure facilities will be designed and constructed to be as benign to fish as possible. This review will take place as part of one of the technical subcommittee of the WATER group, as described in measure 1.2, and that decisions will be made according to the processes described in measures 1.3 and 1.4.

The effect of this measure is that facilities will be designed and constructed to minimize injury, mortality, and delay of listed fish, resulting in improved abundance and productivity, and in certain cases such as for fish passage facilities, increased spatial distribution of UWR Chinook salmon and steelhead.

88 See RPA 1.3 and 1.4 for elaboration of the decision making process.

8.2 **Construction Practices: Construction and operation will be carried out according to Best Management Practices (BMPs) and design specifications agreed89 to by the Services. The Action Agencies will follow BMPs provided in Section 12, Incidental Take Statement. If these are updated, the Services will provide the updates to the Action Agencies, and the Action Agencies should follow the updated BMPs.**

Rationale/Effect of RPA 8.2: This measure builds on the Action Agencies' Proposed Action in section 3.6.5 of the Supplemental BA (USACE 2007a), in which the Action Agencies agreed to adopt and follow BMPs for construction of all potential structural modifications to the dams and associated facilities. In their Proposed Action, the Action Agencies agreed to use the BMPs outlined in NMFS' Biological Opinion concerning construction of the Cougar adult fish collection facilities (NMFS 2007a) as a starting point, and proposed to use a technical subcommittee of the WATER group to further refine BMPs. NMFS provides this modified measure to require BMPs consistent with those identified in the Incidental Take Statement for this Opinion, included as chapter 11. Additionally, NMFS broadens the action to apply to all construction activities that may include in-water work or affect fish or fish habitat, rather than only for fish facility construction.

The effect of this measure is that construction projects carried out as part of the Proposed Action, including continued Project operation and maintenance, revetment maintenance, and fish and wildlife mitigation measures, will be done in a manner that minimizes harm to listed fish and avoid negative effects to critical habitat.

9.9 RESEARCH, MONITORING & EVALUATION (RM&E)

In their Proposed Action, the Action Agencies identify the need for developing a comprehensive research, monitoring, and evaluation (RM&E) program that will provide information necessary for making informed adaptive management decisions, in addition to tracking and documenting progress toward achievement of these RPA measures. They further identify the practicality of developing and managing this RM&E program under the auspices of the cooperative WATER subcommittee structure.

The Action Agencies provide certain guiding principles and strategic questions for consideration in developing a sound RM&E program. They also provide areas of concern where RM&E studies are needed. However, they generally do not make specific study recommendations.

The following RPA measures combine with portions of the PA and RPA measures described above to identify the broad outlines of an adaptive RM&E program. A comprehensive RM&E program is essential to guiding Action Agencies' decisions in carrying out PA and RPA measures and that will affect productivity, abundance, spatial

89 See RPA 1.3 and 1.4 for elaboration of the decision making process.

distribution, and genetic diversity of listed fish species. Additional and specific details of the RM&E program, study objectives, and methodologies will be developed and refined through the WATER process.

RPA 9 Research, Monitoring & Evaluation (RM&E)

9.1 **Comprehensive Program: The Action Agencies will, in consultation with the WATER RM&E subcommittee, established as a technical subcommittee as described in RPA measure 1.2, develop and manage the comprehensive Willamette Project RM&E program. In developing and conducting the RM&E studies, the Action Agencies will work closely with the Services to ensure that the studies will provide information useful to the Services and the Action Agencies in making decisions regarding the effectiveness of mitigation measures in the Proposed Action and the RPA, including alternatives for downstream flows and ramping, fish passage, water quality, hatchery program operations, habitat restoration and other measures. The Action Agencies will seek NMFS' review of draft study proposals and draft reports. Comments submitted by NMFS on draft evaluation proposals must be reconciled by the Action Agencies in writing to NMFS' satisfaction prior to initiating any research-related activities anticipated in this RPA.90 The proposals must identify annual anticipated incidental take levels by species, life stage, and origin91 for each year. The Services will inform the Action Agencies whether they agree92 with the proposed studies, reports, and NEPA alternatives. The Action Agencies will make modifications to operations and facilities based on the results of the RM&E information.**

Rationale/Effect of RPA 9.1: Research, monitoring, and evaluation studies comprise an essential and important component of the protective measures identified within the RPA. Often lacking within the basin is detailed information regarding geographically-specific environmental conditions (e.g., quantity and distribution of functional spawning and rearing habitat) and the extent to which ongoing Willamette Project operations are continuing to affect those conditions (e.g., flow variation and duration in relation to sediment transport dynamics, channel and habitat complexity, and related juvenile fish behavior and survival). In other instances, problems attributable to Willamette Project dams and operations (e.g., migration barriers and water temperature alteration) require additional information to assess the most prudent and effective means of overcoming these important limiting factors. Consequently, the functional effectiveness of RPA measures often depends upon the ability to make informed and timely decisions regarding the most effective and practical means of achieving protection and restoration objectives associated with each of the listed species. In studies aimed at obtaining this information, and in documenting tangible progress toward achieving protection and restoration objectives, the Services must discern whether the proposed studies are designed and

90 See RPA 1.3 & 1.4 for elaboration of decision making process.
91 That is, hatchery-origin or non-hatchery origin fish.
92 See RPA 1.3 & 1.4 for elaboration of decision making process.

conducted in a manner that is in keeping with the original intent of the RPA measures. They must also assure that the results of these studies are effectively applied.

Other kinds of RM&E include monitoring the existing and new mitigation measures. This is necessary to ensure that the measures are functioning properly and continue to do so. Also, the RM&E information can be the basis for making modifications to make them function effectively.

The effect of this measure is that the Action Agencies will have a basis for informed decisions about new mitigation measures, and will be able to ensure that current and new measures will be effective, and can modify them as needed.

9.2 **Mainstem Flow, Tributary Flow, and Ramping RM&E: The Action Agencies will develop and carry out RM&E to determine compliance with, and effectiveness of, flow and ramping measures and to better discern and evaluate the relationships between flow management operations and the resulting dynamics of ecosystem function and environmental conditions downstream of Willamette Project dams. Because flow releases and ramping rates are measures that can be implemented immediately, the Action Agencies should give high priority to studies to evaluate their effectiveness. The Action Agencies will begin flow and ramping rate studies by 2009. The Action Agencies will make modifications to Project operations and facilities that affect mainstem and tributary flows, ramping, and Reclamation water contract implementation, including RPA measures 2 and 3 listed above, no later than January 2011, as indicated by results of the monitoring and evaluation, and with NMFS' agreement.**

Rationale/Effect of RPA 9.2: The studies and monitoring of mainstem and tributary flow rates and of project ramping rate restrictions, as identified above in RPA2.10 (Flow-Related RM&E) of Section 9.2 (Flow Management), are necessary to acquire specific information about the functional relationship between rates of flow (e.g., flow stage), or change in flow, and resulting habitat conditions, fish behavior, and survival (e.g., winter steelhead spawning in the North and South Santiam rivers during spring; juvenile fish stranding during flow level changes). Information from physical habitat surveys and from hydrologic modeling will provide the data needed to make informed decisions regarding the adequacy and effectiveness of the mainstem and tributary flow measures.

The effect of this measure is that it will provide the basis for decisions on important mitigation measures, mainstem flow, tributary flows, and ramping rates that are adequate for listed fish protection. The measure includes interim measures for these flows and ramping, so it will help listed fish in the short term by improving their habitat downstream of the dams.

9.3 **Fish Passage RM&E: The Action Agencies will develop and carry out RM&E to determine the most effective and efficient means to accomplish safe fish passage at applicable Project dams. The studies will be used to determine 1) locations where it is feasible to re-establish self sustaining populations; 2) potential population size for each subbasin; 3) effectiveness of rebuilt trap-and-haul facilities; 4) downstream fish**

passage timing and survival through Project reservoirs; 5) downstream fish passage timing and survival through Project dams; 6) operational methods for higher juvenile and adult survival at Project facilities; 7) infrastructure needs to ensure long term viability of populations; and 8) selection of hatchery or natural-origin broodstock, as well as life stage, for release into habitat above Project dams.

These facilities must meet performance standards consistent with NMFS' Fish Passage Criteria and Guidelines (NMFS 2008e) or as determined through the FPHM committee of WATER and agreed to by the Services. The Action Agencies will monitor the effectiveness of the fish passage facilities. The Action Agencies will make modifications to Project operations and facilities that affect fish passage, including RPA 4 measures listed above, as indicated by results of the monitoring and evaluation, and with NMFS' agreement.

Rationale/Effect of RPA 9.3: Most historical production areas for UWR Chinook salmon and for UWR steelhead lie above federal dams in the Willamette River Basin. In general, the quality of the remaining habitat in these areas (e.g., on U.S. Forest Service lands) is also superior to that of the available habitat remaining below the dams. Re-accessing this habitat is a fundamentally important component of the strategy for protecting and restoring these listed species. Downstream fish passage through reservoirs and dams is influenced by unique characteristics at each site, such as dam configuration, reservoir length and depth, and life stage and physiological state of fish as they move downstream. In other words, what works at one project may not work at another, and thus, a study regarding the most effective and feasible means of re-accessing this habitat is essential.

This measure is needed to ensure that once passage facilities or operations are implemented at a Project dam, monitoring will take place to determine if facilities are performing as intended. If the facilities are not providing safe and effective passage, then they need to be modified accordingly. Performance standards are necessary to provide a quantitative measure of effectiveness.

The effect of this measure is to provide information to make decisions on passage measures that are one of the most important kinds of mitigation for project effects. It will also ensure that passage is working effectively.

9.4 **<u>Water Quality RM&E</u>: The Action Agencies will develop and carry out RM&E to monitor the effectiveness of measures in the RPA and Proposed Action to improve water quality, including but not limited to: 1) monitor operational performance and associated biological response of water temperature control in the McKenzie River Subbasin at Cougar Dam; 1a) quantify effects of USACE dams on water temperature; 2) evaluate biological effects of water temperature alteration caused by USACE dams on ESA listed fish species in the Santiam and Middle Fork Willamette rivers; 2a) quantify the effects of USACE dissolved gas and turbidity; 3) evaluate the effects of dissolved gas supersaturation and of turbidity alterations caused by USACE dams on ESA listed fish species in the Santiam, McKenzie, and**

Middle Fork Willamette rivers; and 4) conduct an aquatic macroinvertebrate species abundance and community structure study at USACE projects on the Santiam, McKenzie, and Middle Fork Willamette rivers to discern the extent to which project operations affect macroinvertebrate community composition, structure, and function. The Action Agencies will make modifications to Project operations and facilities that affect water quality, including RPA measure 5 (and its sub-measures) listed above as indicated by results of the monitoring and evaluation, and with NMFS' agreement.

Rationale/Effect of RPA 9.4: It is well documented that Willamette Basin projects have dramatically affected water temperatures below federal dams, and also affect other important water quality parameters, to the detriment of listed species. These studies are necessary to document geographically-specific effects, their relevance to protection and the water quality RPA measures 5, and the tangible options for addressing these concerns.

9.5 **Hatchery Programs RM&E: The Action Agencies will develop and carry out RM&E to monitor the effectiveness of hatchery measures in the RPA and Proposed Action to improve hatchery effectiveness and reduce adverse effects to listed fish species, including but not limited to the following:**

9.5.1 **Spring Chinook**

6. **Broodstock Management- Determine collection and spawning timing of broodstock, composition of hatchery and wild fish.**
7. **Composition of Hatchery Fish on the Spawning Grounds- Determine the abundance, distribution, and percent hatchery-origin Chinook on the spawning grounds of each population annually.**
8. **Survival of Adult Hatchery Fish Outplanted above Federal Dams- Determine the survival rate of outplanted fish and abundance of spawners above the dams.**
9. **Reproductive Success of Hatchery Fish in the Wild- Determine juvenile production by hatchery and wild spawners above the dams.**
10. **Use of Hatchery Fish to Evaluate Migration and Survival through Reservoirs and Dams- As hatchery program reforms are implemented to make hatchery fish more similar to wild fish, use hatchery fish as a surrogate for wild fish in the testing and evaluation of migration, behavior, and survival of fish through the reservoirs and dams. Wild fish may be used in the future if risks are deemed acceptable.**

9.5.2 **Summer Steelhead**

1. **Fund, design, and implement a study plan, in collaboration with ODFW, to determine the extent of summer steelhead reproduction in the wild. Collect tissue samples from juvenile steelhead for genetic analysis to determine if offspring are of winter- or summer-run origin. Sampling shall begin in 2009. Details to be worked out by the Research, Monitoring, and Evaluation Committee.**
2. **Fund and conduct a spawning survey for three years (i.e. 2010-2012) to determine the extent of summer steelhead spawning in the North Santiam River**

Basin. Survey shall be initiated after the reduction of the North Santiam hatchery summer steelhead release is implemented.

Rationale/Effect of RPA 9.5: The RM&E tasks identified above for the hatchery programs are essential in order to evaluate the effects of hatchery fish spawning in the wild and to determine how many natural-origin fish are being taken for broodstock. Information on both of these attributes helps inform and guide future management decisions on these hatchery programs and helps determine the status of listed populations. In addition, the Chinook hatchery programs are being used in many cases to reintroduce Chinook back into historical habitats above Project dams, thus it is necessary to evaluate the success of these outplanting programs.

9.6 **Habitat Restoration RM&E: The Action Agencies will develop and carry out RM&E for habitat restoration projects identified in the Proposed Action and this RPA to document changes in ecosystem function and biological response. The Action Agencies will make modifications to Project-related habitat restoration activities and structures, including RPA 7 measures listed above, as indicated by the results of the monitoring and evaluation and with NMFS' agreement.**

Rationale/Effect of RPA 9.6: The functional relationship between the characteristics and dynamics of habitat and related biological responses is poorly understood, in general. This is due, in part, to the complexity of those relationships and, in part, to the failure of restoration efforts to document their resulting biological effects. Careful planning of projects, with stated assumptions and objectives, in combination with post-construction physical and biological monitoring is required to document that intended benefits are realized. The information gained from this endeavor will provide the documentation required to make informed and adaptive management and planning decisions.

9.10 MAINTENANCE

These maintenance RPA measures are based on similar measures[93] described in the Proposed Action and apply to any constructed or fabricated features whose failure or improper function might affect ESA-listed fish and fish habitat such as, but not limited to, dams, gates, valves, pumps, access roads, fish hauling trucks, electrical power transmission grids, signal, control devices, and fish facilities.

These measures do not apply to the following:

- riverine components of the Willamette Project such as revetments, riprap, or riparian habitat improvements,

93 USACE 2007a including, but not limited to, pages 3-5, 6, 17, 18, 40, 41, 53, 54, 55, 56, 59, 68, 69, 71, 79-81, 91,136,137.

- re-configuration or rebuilding[94] of existing facilities (until they are placed in service.),
- items that are not likely to affect fish, such as building renovations, campground maintenance, recreational facilities, and
- preventative or routine maintenance.

The following measures add specificity to those maintenance measures in the Proposed Action:

RPA 10 Maintenance

10.1 **Identify fish protection maintenance needs. The USACE will develop and maintain a list of scheduled and unscheduled maintenance needs of existing infrastructure that could potentially negatively impact listed fish and will place high priority on maintaining performance of all such facilities. The scope of maintenance activities included encompasses all USACE dams, facilities, and appurtenances that *may significantly and adversely affect listed fish*, and includes not only "fisheries" facilities such as fish traps but all facilities required to meet the operations described in this Opinion (e.g. because forced spill can adversely affect downstream water quality, items such as turbines and generators may fall within this purview). This measure also affects those hatcheries raising listed fish, and all related hatchery facilities, including fish hauling trucks and related equipment used in fish transfers.**

The timeline for database modification and data entry:

1) All new items entered after 2008 shall include information noting whether they *may significantly and adversely affect listed fish,*[95]

2) All items, both new and pre-existing, shall be so notated by and after 2015[96].

Rationale/Effect of RPA 10.1: This RPA measure clarifies and makes uniform the maintenance reporting requirements for fish protection at all Project elements. USACE has a comprehensive maintenance program, including an associated database of maintenance needs. This RPA measure will enhance the USACE's database by

94 Defined as measures costing more than 25% of the replacement cost of the existing structure.
95 That is, this is not an immediate requirement to go through the existing database—at least for five years-- to determine whether the items in the existing backlog *may significantly and adversely affect listed fish.*
96 The intent here is to avoid an immediate requirement to research each of reportedly 30,000 items in the existing maintenance database for their impact on fish. During this five-year period any new deficiencies entered into the database will be annotated with respect to their possibility to affect fish. Presumably, many of the currently existing deficiencies will have been corrected within 5 years, so at the end of this period the task of assessing remaining deficiencies will not be great.

associating with each discrepancy or defect noted in the maintenance database whether the needed maintenance *may significantly and adversely affect listed fish.* This measure is needed to ensure that all facilities that might affect listed fish—not merely fish facilities—will be maintained to minimize adverse effects to listed fish and fish habitat caused by equipment malfunctions.

The effect of this measure is to clarify that all facilities will be maintained to minimize injury, mortality, and delay of listed fish and destruction of fish habitat, resulting in improved abundance and productivity, and in certain cases such as for fish passage facilities, increased spatial distribution of UWR Chinook salmon and steelhead.

10.2 **Inventory of Needed Maintenance: The USACE will provide the maintenance report described in the Proposed Action (USACE 2007a, p. 3-18 Item 2 in Section 3.2.297) in electronic98 database format to NMFS by February 1, 2009, and thereafter whenever requested in writing by NMFS. This report will include an inventory of current major deficiencies, (i.e., where facilities are in need of maintenance or replacement) and the anticipated date of correction, and for those previously identified maintenance items that have been corrected, the report will identify the date the deficiencies were corrected. To aid in the identification of repeated problems, all corrected deficiencies will be retained in the database.**

Rationale/Effect of RPA10.2: This measure builds on the Action Agencies' commitment to maintain project facilities included in the Proposed Action. The Action Agencies commit "to describe scheduled and unscheduled" maintenance, but do not commit to reporting or inventorying discovered discrepancies, or their correction. The effect of this measure will be to ensure that the Action Agencies will maintain an orderly and systematic record of maintenance deficiencies and problems that might affect listed fish and a record of when these deficiencies are corrected. Ultimately, in conjunction with the measure below, this will assist in minimizing harm to listed fish and avoiding degradation of designated critical habitat.

10.3 **Perform Timely Maintenance: The Action Agencies will correct the items noted in the inventories identified in RPA measures 10.1 and 10.2 above in a timely manner. All identified maintenance needs will be corrected, subject to congressional appropriation, or unless otherwise concurred with by NMFS. Notwithstanding, the USACE will correct deficiencies likely to cause substantial fish injury, mortality, or habitat degradation as soon as reasonably possible after discovery. The determination of whether injury, mortality, or loss of habitat function will occur in any particular instance will be collaboratively determined by NMFS and the Action Agencies.**

97 Now within the Willamette Fish Operations and Management Plan--WFOP
98 MS Access format or other mutually agreed upon format.

***Rationale/Effect of RPA 10.3*:** The Action Agencies have committed "to describe scheduled and unscheduled" maintenance (USACE 2007a), but have not actually committed to a timeline for correcting maintenance discrepancies.

The effect of this measure will be to minimize the likelihood of mortality and injury of adult and juvenile UWR Chinook and steelhead associated with malfunctioning equipment, unscheduled shutdowns, toxic substances, and other consequences of maintenance discrepancies. Additionally, this measure will reduce the likelihood of degradation of designated critical habitat for UWR Chinook and steelhead caused by malfunctioning equipment and other consequences of maintenance discrepancies.

9.11 CONCLUSION: EFFECTS OF THE REASONABLE & PRUDENT ALTERNATIVE

This section presents NMFS' rationale for concluding that with the adoption of this RPA, the Action Agencies would avoid jeopardizing listed species and adversely modifying their critical habitats while operating and maintaining Project facilities and revetments, funding the hatchery mitigation program, and administering the water service program. This rationale is presented for the species that NMFS concluded would be jeopardized by the proposed action (UWR Chinook salmon and UWR steelhead) and for the other species that would be affected by the RPA.

The Proposed Action would jeopardize the continued existence of UWR Chinook salmon and UWR steelhead, and would destroy or adversely modify critical habitat because it did not adequately address adverse effects of the dams, revetments and hatcheries on listed fish, factors that are suppressing the viability of both species and are contributing to the high risk of extinction for UWR Chinook.[99] NMFS' RPA provides a package of measures that will allow for the survival with an adequate potential for recovery for these two species. The main negative effects of the Proposed Action are lack of effective passage to important habitat, degradation of remaining habitat, adverse flows and temperature, and hatchery actions that have the potential to reduce the viability of the natural-origin populations. The RPA provides specific measures that will address project effects by improving the status of natural-origin UWR Chinook salmon and UWR steelhead. The RPA measures will improve spatial distribution (habitat access; geographic range), diversity (hatchery broodstock management), productivity (improved conditions below the dams), and abundance (reduced mortality rates), which are the four VSP parameters. Improvements in these four VSP parameters will increase viability and reduce the risk of extinction to the affected populations and to the UWR Chinook salmon ESU and UWR steelhead DPS as at the species level. The RPA provides increased certainty that Proposed Action measures intended to benefit listed species will be accomplished within reasonable time periods to prevent extinction in the short term and to support improvements in UWR Chinook salmon and UWR steelhead abundance. RPA measures also improve habitat PCEs, ensuring that critical habitat will be able to serve its conservation role.

9.11.1 UWR Chinook Salmon

99 The WLCTRT (McElhany et al. 2007) estimated the risk of extinction over 100 years for UWR Chinook ("high;" see Figure 3-5 in Section 3.2.1.3). The TRT did not estimate the species' short-term extinction risk.

9.11.1.1 Effects of the RPA

The RPA specifies many significant measures that will reduce the adverse effects of the Willamette Project on the UWR Chinook ESU and bring about the proper functioning of primary constituent elements (PCEs) of its critical habitat. Many of the RPA measures specifically address key limiting factors/threats facing each population and caused by the Willamette Project: lack of passage, the degraded quality of the remaining habitat downstream of the dams; and the risks of genetic introgression, competition, and predation from hatchery fish. Four core populations have been identified for this ESU (Middle Fork Willamette, McKenzie, South Santiam, and North Santiam; see Chapter 3), and each of these populations will benefit from major RPA measures in the form of access to historical habitat, and/or temperature control and flow measures within the first few years of implementation (Section 9.11.1.3.1). With full implementation of the RPA, NMFS expects that the status of the ESU, including the four VSP parameters, will improve significantly compared to their potential status under the Proposed Action.

As shown in Table 9.11-1, several major RPA measures will be completed between 2015 through 2024, including passage at dams in the Middle Fork and South Santiam, which will provide safe passage to and from historical upstream habitat, and temperature control to improve downstream habitat in the North Santiam. Most of these measures are major construction projects that take a significant amount of time to plan, fund, and execute. For a full description of the authorization and funding processes needed for these types of measures, see the Supplemental Biological Assessment (USACE 2007a). It is not economically and technically feasible to move the timelines for many of these measures forward significantly due to their magnitude and the time needed for studies, design, authorization and construction.

Given these constraints, the anticipated population status improvements will begin in the next 15 years and continue to increase over the 15-year term of this Opinion. It will take several generations of the Chinook life cycle to respond to the positive improvements in the operation of the Willamette Project and associated measures. Therefore, significant improvements in the status of the ESU will continue to accrue in the next 30 years (approximately six generations). While implementation of these RPA measures will occur during the term of this Opinion, their full effects on population metrics (e.g., abundance, productivity) will occur over a considerable period of time after implementation. Therefore, NMFS expects that substantial improvements to the ESU will result from the implementation of the Proposed Action and the RPA.

In addition to the major measures specified in Table 9.11-1, numerous other near-term measures such as changes to flow, screening irrigation diversions, hatchery program modifications, and habitat mitigation projects are included in the RPA. The “near-term” measures in Table 9.11-1 directly address project effects on listed fish and critical habitat without requiring as many years to plan and implement as the measures discussed above. A third group of measures, such as conducting RM&E studies, developing fish operations manuals, project planning, and implementing the WATER collaborative process, will begin in the near term. Although this third group of activities also has not been included in the summary table, these are essential tasks that will facilitate construction of the large structures as well as guide annual operations, all of which will benefit UWR Chinook.

Difference between the Proposed Action and RPA

The effect of the RPA measures on UWR Chinook is significantly different than the effect of the Proposed Action. The Proposed Action mainly provided for further studies to consider options such as passage facilities to historical upstream habitat, as well as a major downstream habitat improvement measure of temperature control. In addition, the RPA includes measures to improve degraded downstream habitat through changes to flows, screens at irrigation diversions, hatchery improvements, and other habitat improvement projects. These RPA measures are significant because UWR Chinook are currently limited to degraded downstream habitat in three important subbasins. The RPA measures both provide access to higher quality habitat and improve downstream habitat conditions, which together will provide significant enough improvements to allow the UWR Chinook ESU to increase in numbers, productivity, spatial structure, and diversity.

Table 9.11-1 Date of implementation of the RPA measures that will directly benefit UWR Chinook salmon and steelhead and their habitat.

Geographic Area	RPA #	pre-2008	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
		Timeline																	
Middle Fork Willamette																			
Adult outplant site(s)	4.7																		
Dexter collection facility rebuild	4.6.3																		
Fall Creek collection facility rebuild	4.6.4																		
Juvenile prototype (here or Green Peter (SS))	4.9																		
Lookout Point downstream facility	4.12.2																		
Interim temperature control (actions unspecified)	5.1.2																		
Water contract program	9.3																		
BOR compliance with fish protection criteria	3.2																		
Chinook outplanting above dams	4.1																		
Project-specific ramping rates	2.6																		
Project-specific min & max flows	2.4, 2.5																		
Fall Creek reservoir drawdown	4.8.1																		
Hatchery and Genetic Mgmt Plans (HGMPs)	6.1.1																		
McKenzie																			
Cougar collection facility																			
Adult outplant site(s)	4.7																		
Leaburg hatchery sorting	6.1.4																		
Cougar downstream facility	4.12.1																		
Water contract program	9.3																		
BOR compliance with fish protection criteria	3.2																		
Chinook outplanting above dams	4.1, 6.1.5																		
Project-specific ramping rates	2.6																		
Project-specific min & max flows	2.4, 2.5																		
Hatchery and Genetic Mgmt Plans (HGMPs)	6.1.1																		
South Santiam																			
Adult outplant site(s)	4.7																		
Foster collection facility rebuild	4.6.2																		
Juvenile prototype (here or Lookout Pt (MFW))	4.9																		
Water contract program	9.3																		
BOR compliance with fish protection criteria	3.2																		
Reduce hatchery steelhead residualism	6.1.6																		
Reduce hatchery steelhead recycling	6.1.7																		
Chinook outplanting above Foster Dam	4.1																		
Winter steelhead outplanting above Foster Dam	4.2																		
Project-specific ramping rates	2.6																		
Project-specific min & max flows	2.4, 2.5																		
Foster reservoir spring spill operations	2.7																		
Hatchery and Genetic Mgmt Plans (HGMPs)	6.1.1																		

End of Biological Opinion ESA Coverage

ongoing, continuing measures that have been in effect prior to the completion of this Biological Opinion

new measures that will be taken in the future (after this Biological Opinion is completed)

* This chart summarizes only a portion of the measures analyzed in this Opinion. Numerous other planning processes other planning processes, operational protocols and guidelines, research monitoring and evaluation, emergency operation plans are not included here.

Table continued on next page.

Table 9.11-1. ***(Continued)***

Geographic Area	RPA #	Timeline: pre-2008	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Calapooia																			
No RPA actions identified in this geographic area.																			
North Santiam																			
Adult outplant site(s)	4.7																		
Minto collection facility rebuild	4.6.1																		
Detroit Water Temperature Facility	5.2																		
Interim temperature control	5.1.1																		
Detroit downstream facility	4.12.3																		
Water contract program	9.3																		
BOR compliance with fish protection criteria	3.2																		
Reduce hatchery steelhead production	6.1.8																		
Reduce hatchery steelhead residualism	6.1.6																		
Reduce hatchery steelhead recycling	6.1.7																		
Chinook outplanting above dams	4.1																		
Project-specific ramping rates	2.6																		
Project-specific min & max flows	2.4, 2.5																		
Hatchery and Genetic Mgmt Plans (HGMPs)	6.1.1																		
Molalla																			
Hatchery Chinook reform	6.2.5	No date specified.																	
Hatchery and Genetic Mgmt Plan (HGMP)	6.1.1																		
Clackamas																			
No RPA actions identified in this geographic area.																			
Mainstem Willamette River																			
Mainstem flow targets	2.3																		
Habitat restoration projects					Two projects will be funded in 2010. Others unspecified.														
Water contract program	9.3																		
BOR compliance with fish protection criteria	3.2																		

End of Biological Opinion ESA Coverage

ongoing, continuing measures that have been in effect prior to the completion of this Biological Opinion

new measures that will be taken in the future (after this Biological Opinion is completed)

* This chart summarizes only a portion of the measures analyzed in this Opinion. Numerous other planning processes other planning processes, operational protocols and guidelines, research monitoring and evaluation, emergency operation plans are not included here.

9.11.1.2 UWR Chinook Populations—Summary of Effects of the RPA

The following is a population-by-population summary of the effects of the RPA. The RPA and the analysis in this section specifically address short-falls in the effects of the Proposed Action, which are identified in earlier sections of this Opinion (see especially Chapter 7, "Summary of Effects of the Proposed Action on UWR Chinook and Steelhead.")

Middle Fork Willamette Chinook

The primary reason for the poor status of the Middle Fork Willamette Chinook population (very high risk of extinction) is the loss of access to historical habitat due to the four Willamette Project dams and elevated temperatures in the reach below Dexter Dam and in lower Fall Creek. The risk of genetic introgression from hatchery-origin fish interbreeding with those of natural origin is also a key limiting factor.

- The RPA will improve upstream passage survival by rebuilding the collection facilities at Dexter and Fall Creek dams to reduce stress, injury, and mortality during capture and handling of Chinook salmon for outplanting (safe passage) above Project dams.

- *RPA 4.6: complete construction at Dexter by December 2014 and begin operations by March 2015; complete construction at Fall Creek by December 2015 and begin operations by March 2016*

- Construction and operation of new adult release sites above Lookout Point, Hills Creek, and Fall Creek dams will increase upstream passage survival and reduce pre-spawn mortality by minimizing stress and injury of adult Chinook salmon outplanted above the dams.

- *RPA 4.7: complete site/concept study by February 2009, establish priorities, and complete construction of all selected sites by June 2012*

- A downstream passage facility at Lookout Point reservoir/dam will allow higher survival of juvenile Chinook emigrants resulting from the adult outplanting program.

- *RPA 4.9: build prototype for head-of-reservoir juvenile collection facility at Lookout Point or Foster by 2014*

- *RPA 4.12.2: develop permanent downstream passage facility at Lookout Point—begin feasibility studies by 2012, construct by December 2021, and operate by March 2022 (if not feasible, make "no go" decision by end of 2014)*

- Drawdown to at least elevation 714.0 by the end of November each year will optimize downstream passage conditions at Fall Creek Dam during the juvenile outmigration.

- *RPA 4.8.1: reduce head by implementing Fall Creek drawdown beginning in Water Year 2008 (Nov-Jan, except during flood control operations), reducing injury and mortality of Chinook smolts*

- Interim operational measures at Lookout Point, Hills Creek, and Fall Creek dams will restore normative seasonal water temperatures.

- *RPA 5.1.2: Identify interim measures by March 2010*

- *RPA 5.1.3: Evaluate more complex measures (requiring detailed environmental review, permits, and/or congressional authorization) by April 2011*

- Address effects of the Willamette Project (specifically, reduced frequency of channel-forming flows, altered seasonal flow patterns below dams, and the maintenance of revetments) on downstream habitat

- *RPA 2.4.4: enabled by implementation of RPA measures 2.4.1-2.4.3, modify operations to optimize system's ability to meet improved flow objectives to the degree feasible, by January 2012.*

- *RPA 2.7: test pilot "environmental" or "pulse" flows below Project dams to achieve channel-forming and channel-maintenance flows; implement where feasible without compromising authorized Project purposes.*

- *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.100 Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*

- Screening diversions will remove impediments or barriers to juvenile Chinook migrants

- *RPAs 3.2 and 3.3: Reclamation will require that existing, new, and renewed contracts for stored water include conditions that protect fish from entrainment into diversions.*

- Adverse effects of the Chinook hatchery program will be minimized.

- *RPAs 6.1.2 and 6.2.2: cooperate with ODFW in the implementation of HGMPs, which include management plans for building genetic diversity using local broodstocks.*

- *RPA 4.6: improve fish collection facility at Dexter Ponds (begin construction by December 2014 and begin operations by March 2015) and at Fall Creek Dam (begin construction by December 2015 and begin operations by March 2016).*

- *RPA 6.1.3: continue to mark all hatchery Chinook released in the Willamette Basin with adipose fin clip and otolith mark, and insert coded wire tags into all hatchery Chinook prior to release*

- *RPA 6.2.4: cooperate with ODFW to release juvenile hatchery-origin Chinook that are more similar to natural-origin fish.*

The combined effect of these measures (especially the mechanisms for efficient sorting of hatchery fish for broodstock and to augment spawning above Dexter and Fall Creek dams, improvements in downstream passage survival in the Middle Fork Willamette and Fall Creek and in water temperatures in the Middle Fork) are expected to significantly improve the status of the Middle Fork Willamette population. Chinook will have access to high quality historical spawning and rearing habitat above the dams and the opportunity for successful spawning, incubation, and rearing in the lower reaches. Resulting juvenile production will emigrate downstream with reduced rates of injury and mortality. NMFS expects increases in the abundance, productivity, spatial structure, and diversity of natural-origin Chinook as these

100 Habitat restoration projects may be distributed in the lower reaches of the tributaries with spawning populations and in the mainstem Willamette.

measures become operational. These actions will improve the function of PCEs in designated critical habitat including:

- Freshwater spawning sites with water quantity and quality and substrate supporting spawning, incubation, and larval development (specifically RPA measures 2.4.4; 2.7; 5.1.2; 5.1.3; and 7.1.3).
- Freshwater rearing sites with water quantity and floodplain connectivity supporting juvenile development (RPA 2.4.4; 2.7; 5.1.2; 5.1.3; and 7.1.3).
- Freshwater migration corridors free of obstruction with water quality and quantity supporting juvenile and adult mobility and survival (RPA 2.7; 3.2; 3.3; 4.6; 4.7; 4.8.1; 4.9; 4.12.2; and 7.1.3).

McKenzie Chinook

The McKenzie Chinook population is at moderate risk of extinction. The risk of genetic introgression by hatchery fish and the loss of historical habitat due to blockage by Cougar Dam on the South Fork McKenzie River are two of the key limiting factors identified for this population. Under the Proposed Action, a new adult collection facility, to be completed by 2010, will allow fish to be collected and transported above Cougar Dam, restoring access to this high quality habitat with reduced rates of stress, injury, and mortality. In addition:

- The RPA will significantly reduce the risk of genetic introgression and competition by hatchery fish in the natural population by limiting hatchery fish straying above Leaburg Dam in the lower McKenzie River.

- *RPA 6.1.4: complete construction of the adult trap and sorting facility at Leaburg Dam by December 2013 and begin operations by spring 2014.*

- Construction and operation of an adult release site above Cougar Dam will increase upstream passage survival and reduce pre-spawning mortality by minimizing the stress and injury of adult Chinook salmon outplanted above the dam.

- *RPA 4.7: complete site/concept study by February 2009, establish priorities, and complete construction of all selected sites by June 2012*

- A downstream fish passage facility will be constructed at Cougar Dam to improve juvenile Chinook outmigrant survival

- *RPA 4.12.1: Initiate planning and make "go/no go" decision by end of 2010; complete construction by 2014, begin operations by 2015*

- The RPA will address the effects of the Willamette Project (specifically, reduced frequency of channel-forming flows, altered seasonal flows, and the maintenance of revetments) on downstream habitat

- *RPA 2.4.4: enabled by implementation of RPA measures 2.4.1-2.4.3, modify operations to optimize system's ability to meet improved flow objectives to the degree feasible, by January 2012.*

- *RPA 2.7: test pilot "environmental" or "pulse" flows below Project dams to achieve channel-forming and channel-maintenance flows; implement where feasible without compromising authorized Project purposes.*
- *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.*[57] *Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*

- Screening diversions will remove impediments or barriers to juvenile Chinook migrants

- *RPAs 3.2 and 3.3: Reclamation will require that existing, new, and renewed contracts for stored water include conditions that protect fish from entrainment into diversions.*

- Adverse effects of the Chinook hatchery program will be minimized.

- *RPAs 6.1.2 and 6.2.2: cooperate with ODFW in the implementation of HGMPs, which include management plans for building genetic diversity using local broodstocks.*
- *RPA 6.1.3: continue to mark all hatchery Chinook released in the Willamette Basin with adipose fin clip and otolith mark and insert coded wire tags into all hatchery Chinook prior to release.*
- *RPA 6.2.4: cooperate with ODFW to release juvenile hatchery-origin Chinook that are more similar to natural-origin fish.*

These measures (especially the mechanism for efficient removal of hatchery fish from the spawning population above Leaburg Dam, implementation of hatchery reforms per HGMPs, flow management, and improvements in upstream and downstream passage survival at Cougar Dam), are expected to significantly improve the status of the McKenzie River population. Natural-origin Chinook will have access to high quality historical spawning and rearing habitat above Cougar and the opportunity for successful spawning, incubation, and rearing. Juveniles produced above Cougar will emigrate downstream with reduced rates of injury and mortality. NMFS expects increases in the abundance, productivity, spatial structure, and diversity of natural-origin Chinook as these measures become operational. These actions will also improve the functioning of PCEs in designated critical habitat including:

- Freshwater spawning sites with water quantity and quality and substrate supporting spawning, incubation, and larval development (specifically RPA measures 2.4.4; 2.7; and 7.1.3).
- Freshwater rearing sites with water quantity and floodplain connectivity supporting juvenile development (RPA 2.4.4; 2.7; and 7.1.3).
- Freshwater migration corridors free of obstruction with water quality and quantity supporting juvenile and adult mobility and survival (RPA 2.7; 3.2; 3.3; 4.12.1; 6.1.4; and 7.1.3).

Calapooia Chinook

The risk of genetic introgression by hatchery fish interbreeding with those of natural origin and impaired physical habitat from past and/or present land uses are key limiting factors for the Calapooia population, which is at very high risk of extinction.

- Address effects of the Willamette Project (specifically, maintenance of revetments) on habitat in the mainstem and Willamette tributaries

- *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.*[57] *Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*

- Adverse effects of the Chinook hatchery program will be minimized.

- *RPAs 6.1.1 and 6.2.2: cooperate with ODFW in the implementation of HGMPs, which include management plans for building genetic diversity using local broodstocks.*

- *RPA 6.1.3: continue to mark all hatchery Chinook released in the Willamette Basin with adipose fin clip and otolith mark and insert coded wire tags into all hatchery Chinook prior to release.*

Implementation of the hatchery measures will increase the genetic diversity of Chinook spawning in the Calapooia River and will lead to increased abundance and productivity over time. Because the RPA does not require that habitat projects be located within the Calapooia subbasin, NMFS does not assume that this RPA measure will improve the status of this Chinook population or the functioning of PCEs in the Calapooia subbasin.

South Santiam Chinook

The loss of access to historical habitat above Foster and Green Peter dams and the risk of genetic introgression by hatchery fish interbreeding with those of natural origin, especially in the lower South Santiam below Foster Dam, are key limiting factors for this population, which is at very high risk of extinction.

- The RPA requires rebuilding of the collection facility at the base of Foster Dam to allow better capture and handling of Chinook for outplanting into historically accessible habitat above the dam.

- *RPA 4.6: complete construction of the new adult collection and handling facilities at Foster Dam by December 2013 and begin operations by March 2014.*

- Construction and operation of new adult release sites above Foster Dam will increase upstream passage survival and reduce pre-spawn mortality by minimizing stress and injury of adult Chinook salmon outplanted above the dams.

- *RPA 4.7: complete site/concept study by February 2009, establish priorities, and complete construction of all selected sites by June 2012*

- The RPA addresses the long-term need to improve reservoir and dam passage survival at Foster Dam for juvenile Chinook throughout the juvenile migration period.

- *RPA 4.13: The Action Agencies will evaluate a range of potentially beneficial actions for listed fish species at Project dams and reservoirs, including Foster, in their development of the Willamette Configuration and Operation Plan (COP). This will include facilities and operations that require detailed study including feasibility studies and environmental permitting such as long-term fish passage solutions at Foster Dam.*

- Interim operational measures at Green Peter and Foster dams will help to restore more normative seasonal water temperatures
  - *RPA 5.1: Identify interim measures by March 2010*
  - *RPA 5.1.3: Evaluate more complex measures (required detailed environmental review, permits, and/or congressional authorization) by April 2011*

- The RPA will address effects of the Willamette Project (specifically, reduced frequency of channel-forming flows, altered seasonal flow patterns, and the maintenance of revetments) on downstream habitat
  - *RPA 2.4.4: enabled by implementation of RPA measures 2.4.1-2.4.3, modify operations to optimize system's ability to meet improved flow objectives to the degree feasible, by January 2012.*
  - *RPA 2.7: test pilot "environmental" or "pulse" flows below Project dams to achieve channel-forming and channel-maintenance flows; implement where feasible without compromising authorized Project purposes.*
  - *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.*[57] *Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*

- Screening diversions will remove impediments or barriers to juvenile Chinook migrants
  - *RPAs 3.2 and 3.3: Reclamation will require that existing, new, and renewed contracts for stored water include conditions that protect fish from entrainment into diversions.*

- Adverse effects of the Chinook hatchery program will be minimized.
  - *RPAs 6.1.2 and 6.2.2: cooperate with ODFW in the implementation of HGMPs, which include management plans for building genetic diversity using local broodstocks.*
  - *RPA 4.6: improve fish collection facility at Foster Dam (begin construction by December 2013 and begin operations by March 2014).*
  - *RPA 6.1.3: continue to mark all hatchery Chinook released in the Willamette Basin with adipose fin clip and otolith mark, and insert coded wire tags into all hatchery Chinook prior to release*
  - *RPA 6.2.4: cooperate with ODFW to release juvenile hatchery-origin Chinook that are more similar to natural-origin fish.*

These measures (especially the mechanism for efficient removal of hatchery fish from the spawning population above Foster Dam, implementation of hatchery reforms per HGMPs, flow management, and improvements in downstream passage survival at Foster Dam) are expected to significantly improve the status of the South Santiam population. Natural-origin Chinook will

have the opportunity for successful spawning, incubation, and rearing in the reach above Foster and juveniles will emigrate downstream with reduced rates of injury and mortality. NMFS expects increases in the abundance, productivity, spatial structure, and diversity of natural-origin Chinook as these measures become operational. These actions will also improve the functioning of PCEs in designated critical habitat including:

- Freshwater spawning sites with water quantity and quality and substrate supporting spawning, incubation, and larval development (specifically RPA measures 2.4.4; 2.7; 5.1.2; 5.1.3; and 7.1.3).
- Freshwater rearing sites with water quantity and floodplain connectivity supporting juvenile development (RPA 2.4.4; 2.7; 5.1.2; 5.1.3; and 7.1.3).
- Freshwater migration corridors free of obstruction with water quality and quantity supporting juvenile and adult mobility and survival (RPA 2.7; 3.2; 3.3; 4.6; 4.7; 4.13; and 7.1.3).

North Santiam Chinook

The loss of access to historical habitat above Big Cliff and Detroit dams, poor natural production below the dams, and the risk of genetic introgression by hatchery fish interbreeding with those of natural origin are key limiting factors for this population, which is at very high risk of extinction.

- The RPA provides measures that will improve upstream passage survival by building a new adult collection facility to replace the trap at the Minto barrier dam, allowing the capture and handling of Chinook for outplanting above Big Cliff/Detroit dams with reduced levels of stress, injury, and mortality.

- *RPA 4.6: complete construction of the new adult collection and handling facilities in North Santiam by December 2012 and begin operations by March 2013.*

- Construction and operation of new adult release sites above Detroit Dam will increase upstream passage survival and reduce pre-spawn mortality by minimizing stress and injury of adult Chinook salmon outplanted above the dams.

- *RPA 4.7: complete site/concept study by February 2009, establish priorities, and complete construction of all selected sites by June 2012*

- Downstream passage improvements at Detroit Dam and Reservoir will increase juvenile Chinook survival and increase the number of smolts emigrating from the population. Combined with RPA 4.6, above, this measure is expected to increase the abundance, productivity, and spatial structure of the North Santiam Chinook population.

- *RPA 4.12.3: initiate planning by 2015, make "go/no go" decision by end of 2017; complete construction by end 2023, begin operations by March 2024.*

- The RPA requires implementation of interim temperature control using existing facilities. This action will provide immediate survival benefits, significantly reducing the problem with the altered water temperature regime in natural production areas downstream of Detroit/Big Cliff dams until a Water Temperature Control facility or alternative solution is implemented. Normative water temperatures, particularly during the critical egg incubation period in late fall, will improve the abundance and productivity of the population.

- *RPA 5.1.1: identify and evaluate interim operational measures at Detroit Dam and, if feasible, begin implementation in Water Year 2009.*
- *RPA 5.2: make structural modifications or major operational changes at Detroit Dam for improved water quality, initiating planning by 2010, completing construction by December 2018, and beginning operations by March 2019.*

- The RPA will address effects of the Willamette Project (specifically, reduced frequency of channel-forming flows, altered seasonal flow patterns, and the maintenance of revetments) on downstream habitat

- *RPA 2.4.4: enabled by implementation of RPA measures 2.4.1-2.4.3, modify operations to optimize system's ability to meet improved flow objectives to the degree feasible, by January 2012.*
- *RPA 2.7: test pilot "environmental" or "pulse" flows below Project dams to achieve channel-forming and channel-maintenance flows; implement where feasible without compromising authorized Project purposes.*
- *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.*[57] *Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*

- Screening diversions will remove impediments or barriers to juvenile Chinook migrants

- *RPAs 3.2 and 3.3: Reclamation will require that existing, new, and renewed contracts for stored water include conditions that protect fish from entrainment into diversions.*

- Adverse effects of the Chinook hatchery program will be minimized.

- *RPAs 6.1.1 and 6.2.2: cooperate with ODFW in the implementation of HGMPs, which include management plans for building genetic diversity using local broodstocks.*
- *RPA 4.6: build new fish collection facility in the North Santiam (begin construction by December 2012 and begin operations by March 2013).*
- *RPA 6.1.3: continue to mark all hatchery Chinook released in the Willamette Basin with adipose fin clip and otolith mark and insert coded wire tags into all hatchery Chinook prior to release.*
- *RPA 6.2.4: cooperate with ODFW to release juvenile hatchery-origin Chinook that are more similar to natural-origin fish.*

These measures (especially implementation of hatchery reforms per HGMPs, providing safe upstream and downstream passage at Big Cliff/Detroit dams, flow management, and improvements in water temperature below Big Cliff Dam) are expected to significantly improve the status of the North Santiam population. Natural-origin Chinook will have the opportunity for successful spawning, incubation, and rearing in the reach above Detroit and juveniles will emigrate downstream with reduced rates of injury and mortality. NMFS expects increases in the abundance, productivity, spatial structure, and diversity of natural-origin Chinook as these measures become operational. These actions will also improve the functioning of PCEs in designated critical habitat including:

- Freshwater spawning sites with water quantity and quality and substrate supporting spawning, incubation, and larval development (specifically RPA measures 2.4.4; 2.7; 5.1.1; 5.2; and 7.1.3).
- Freshwater rearing sites with water quantity and floodplain connectivity supporting juvenile development (RPA 2.4.4; 2.7; 5.2; and 7.1.3).
- Freshwater migration corridors free of obstruction with water quality and quantity supporting juvenile and adult mobility and survival (RPA 2.7; 3.2; 3.3; 4.7; 4.12.3; and 7.1.3).

Molalla Chinook

Genetic introgression of an out-of-basin hatchery stock and impaired physical habitat for past and/or present land uses are key limiting factors for this population, which is at very high risk of extinction.

- The RPA will address effects of the Willamette Project (specifically, maintenance of revetments) on habitat in the mainstem and Willamette tributaries

- *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.*[57] *Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*

- The RPA will eliminate use of the current out-of-basin hatchery stock and replacement over time with a locally-derived broodstock. This hatchery reform action will promote local adaptation within the population.

- *RPAs 6.1.1 and 6.2.2: cooperate with ODFW in the implementation of HGMPs, which include management plans for building genetic diversity using local broodstocks.*
- *RPA 6.1.3: continue to mark all hatchery Chinook released in the Willamette Basin with adipose fin clip and otolith mark and insert coded wire tags into all hatchery Chinook prior to release.*
- *RPA 6.2.5: support ODFW efforts to eliminate use of non-local Chinook stock and to develop locally-adapted broodstock.*

Implementation of the hatchery RPA measures will increase the genetic diversity of Chinook spawning in the Molalla River and will lead to increased abundance and productivity over time. Because the RPA does not require that habitat projects be located in the Molalla subbasin, NMFS does not assume that this RPA measure will improve the status of this Chinook population or the functioning of PCEs in the Molalla subbasin.

Clackamas Chinook

The risk of genetic introgression by hatchery fish interbreeding with those of natural origin and impaired physical habitat from past and/or present land uses are limiting factors for the Clackamas spring Chinook population, which is at moderate risk of extinction.

- Address effects of the Willamette Project (specifically, maintenance of revetments) on habitat in the mainstem and Willamette tributaries

- *RPA 7.1.3: implement at least tow habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.*[57] *Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*

- Adverse effects of the Chinook hatchery program will be minimized.

- *RPAs 6.1.1 and 6.2.2: cooperate with ODFW in the implementation of HGMPs, which include management plans for building genetic diversity using local broodstocks.*

- *RPA 6.1.3: continue to mark all hatchery Chinook released in the Willamette Basin with adipose fin clip and otolith mark and insert coded wire tags into all hatchery Chinook prior to release.*

Implementation of the hatchery measures will increase the genetic diversity of Chinook spawning in the Clackamas River and will lead to increased abundance and productivity over time. Because the RPA does not require that habitat projects be located within the Clackamas subbasin, NMFS does not assume that this RPA measure will improve the status of this Chinook population or the functioning of PCEs in the Clackamas subbasin.

All UWR Chinook Populations

The following RPA actions, located or affecting conditions within the mainstem Willamette, will affect all populations of UWR Chinook salmon.

- RPA 2.3: obtain NMFS' approval before changing mainstem Willamette (Albany and Salem) flow objectives, to ensure that flow-related habitat needs of UWR Chinook for rearing and juvenile and adult migrations are fully considered.

- Address effects of the Willamette Project (specifically, reduced frequency of channel-forming flows and the maintenance of revetments) on downstream habitat.

- *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.*[57] *Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*

- Ensure that the availability of adequate water for fish and habitat protection in the tributaries and in the mainstem Willamette is not precluded by the water contract program

- *RPA 3: Reevaluate the availability of water from conservation storage for the water contract program and reinitiate consultation if future irrigation demands exceed 95,000 acre-feet.*

These actions will improve the functioning of PCEs in designated critical habitat:

- Freshwater rearing sites with water quantity and floodplain connectivity supporting juvenile development (specifically RPA measures 2.3; 7.1.1; and 7.1.3).

- Freshwater migration corridors free of obstruction with water quality and quantity supporting juvenile and adult mobility and survival (RPA 2.3; 7.1.1, and 7.1.3).

9.11.1.3 Conclusions—UWR Chinook Salmon

9.11.1.3.1 Jeopardy Analysis

The beneficial effects of the RPA (see above), which includes the Proposed Action (Chapters 5 and 7), combined with recent improvements in project facilities and operations (Chapter 4), is expected to address the harm to UWR Chinook caused by the Project. The RPA is designed to increase the abundance, productivity, spatial structure and diversity of the natural-origin Middle Fork Willamette, McKenzie, and South and North Santiam Chinook populations and to increase the genetic diversity of the Calapooia, Molalla, and Clackamas populations. The loss of access to historical habitat will be ameliorated by the rebuilding of fish collection facilities below Fall Creek, Dexter, Foster, and Big Cliff dams to allow significantly safer capture, handling, and transport of Chinook for release above the Project dams. Downstream passage facilities will be constructed for three populations (Middle Fork, McKenzie, and North Santiam) to provide significantly higher survival of emigrating Chinook than under either current operations or the Proposed Action. Interim and long-term water temperature control operations in the North Santiam River will improve altered water temperatures that have depressed natural production in the habitat below the dams. Hatchery reform actions will limit the risk of genetic introgression into the natural-origin populations, promoting life-history diversity and increasing the abundance and productivity of each population. Increases in the viability of these populations will contribute to increases in the status, lowering the risk of extinction, of the ESU as a whole.

Although the RPA measures combined with the Proposed Action will be implemented over the 15-year term of the Opinion and some of the biological benefits will take even longer to accrue, a number of measures will provide benefits in the short-term, reducing the ESU's short-term risk of extinction. Specifically, project operations have had a key role in degrading habitat conditions downstream, which in the North and South Santiam, South Fork McKenzie, and Middle Fork Willamette are the only areas accessible to Chinook for spawning, incubation, and early rearing. The Action Agencies began new reservoir operations in 2000 to meet mainstem and tributary flow objectives for listed fish. These, and operations that began in 2005 at the new Water Temperature Control facility at Cougar Dam, are already able to have a positive influence on adult returns. By spring of 2009, interim temperature control operations at Detroit will improve water temperatures in the North Santiam, increasing the survival of eggs, juveniles, and prespawning adults and thus population productivity. All of these measures will reduce extinction risk in the short-term as well as contributing to long-term viability. The Action Agencies will adapt their operations to new information on physical habitat properties, including those related to climate change, as the information becomes available over the next 15 years (Section 5.1.7).

The hatchery program for UWR Chinook acts as a safety net for most of the affected populations, reducing the short-term risk of extinction. Under the RPA and Proposed Action, the Action Agencies will cooperate with ODFW in continuing the transition from the historical supplementation programs to conservation/supplementation programs that focus on building genetic diversity using local broodstocks. As part of this effort, the Action Agencies will complete construction of a new sorting facility at Leaburg Dam by 2013. ODFW will use the new facility to prevent hatchery-origin Chinook from interbreeding with natural-origin fish above Leaburg. This will preserve the genetic diversity of fish in an important natural production area, another buffer against short-term extinction.

Reclamation will immediately improve its water contracting program. All (existing, new, and renewed) contracts will be subject to the availability of water, and when there is not enough water to meet minimum flow targets and irrigation contracts, instream flows will be preserved. All contracts will require that irrigation intakes and diversion dams be screened to preclude entrainment and all existing water diversions served by existing water contracts will be screened by April 1, 2010. The headgate requirement will ensure that water diversions can be stopped when not needed, or when directed by OWRD. Particularly during deficit water conditions, this reform will preserve instream flows for fish habitat needs.

The Action Agencies will continue to outplant adult UWR Chinook salmon above Detroit (North Santiam); Foster (South Santiam); Cougar (McKenzie); and Lookout Point, Hills Creek, and Fall Creek dams (Middle Fork Willamette population), an operation that enhances spatial structure in the short term while long-term passage facilities are developed. The outplanting program will be managed according to an annual Fish Operations Plan, coordinated with the Services and ODFW, which will address how, where, and when outplanted fish will be collected, held, marked, sampled, transported, and released, and will incorporate changes needed to further protect these fish based on research and monitoring.

The Action Agencies will also begin to upgrade existing adult fish collection and handling facilities in the first half of the term of the Opinion. Dates for beginning operations at the new facilities are March 2013 in the North Santiam, 2014 at Foster Dam (South Santiam), 2015 at Dexter Ponds, and 2016 at Fall Creek Dam (Middle Fork Willamette). Once construction is complete, adult fish will experience reduced levels of stress and injury, which is expected to lessen pre-spawning mortality. Completion of these facilities will also help ensure that broodstock targets are met.

The Action Agencies will design and begin to use new adult release sites above the dams by 2012. These new sites, like the improved adult collection facilities, will reduce stress and injury and thus the risk of prespawning mortality.

In addition to these measures, which will immediately (during the first one-to-seven years of this Opinion) improve population viability and reduce the risk of extinction, the RPA requires that the Action Agencies complete various RM&E efforts, feasibility studies, and where needed, NEPA analysis. NMFS expects that these evaluations will lead to the construction of facilities and adjustments in operations during the second half of the term of this Opinion that will ensure that conditions are optimized for all affected life stages of UWR Chinook. These will include:

- Adjustments to mainstem and tributary flow objectives and ramping rates to meet the needs of the species over all affected life stages
- Operations for water quality (temperature and dissolved gas) and construction of new facilities
- Construction of additional juvenile passage facilities
- Full implementation of the habitat restoration program
- Adaptation of flow management and water quality measures to changing climatic conditions

The near- and longer-term RPA measures described above will address the effects of the Willamette Project that are detrimental to all life stages of UWR Chinook that occur within the

Willamette Basin: adult migration and holding, spawning and incubation, juvenile rearing, and emigration.

Other measures taken by the same Action Agencies under the environmental baseline (as required by the 2008 FCRPS RPA; NMFS 2008a) will improve the survival and condition of juvenile UWR Chinook in the lower Columbia River and estuary. The effects of the Willamette Project on habitat are very small in the lower Columbia and estuary, with slight to negligible adverse effects on viability (Section 5.11). However, the FCRPS RPA includes beneficial measures to reduce smolt predation by Caspian terns and Northern pikeminnows and a significant estuary habitat restoration program to ensure that biological requirements are met. These actions will benefit both yearling and subyearling Chinook from the Willamette Basin during the critical period prior to ocean entry.

After reviewing the effects of the RPA measures combined with the Proposed Action, which address significant adverse impacts of the Willamette Project (lack of effective passage, degraded water quality and physical habitat properties, and adverse effects of hatchery practices on population viability), the rangewide status of the species, the effects of the environmental baseline (UWR Chinook limited to significantly degraded habitat in several important subbasins), and cumulative effects (reasonably certain non-federal activities intended to benefit the status of the species mixed with those likely to have adverse effects), NMFS has determined that the UWR Chinook salmon ESU is expected to survive with an adequate potential for recovery. The actions that will be implemented in the first few years, including reforms to the Hatchery Mitigation Program, will protect the species against the short-term risk of extinction while longer-term measures are designed and constructed. NMFS therefore concludes that the RPA and Proposed Action, combined, are not likely to jeopardize the continued existence of the UWR Chinook salmon ESU.

9.11.1.3.2 Critical Habitat Analysis

The measures described in the RPA combined with the Proposed Action will also improve the functioning of primary constituent elements of habitat needed for the conservation of the species, restoring the ability of designated critical habitat affected by the Project to serve its conservation role. The actions described above will significantly improve the following PCEs over the term of the Opinion:

- Freshwater spawning sites with water quantity and quality and substrate supporting spawning, incubation, and larval development
- Freshwater rearing sites with water quantity and floodplain connectivity supporting juvenile development
- Freshwater migration corridors free of obstruction with water quality and quantity supporting juvenile and adult mobility and survival

In the first one-to-seven years, the Action Agencies will rebuild the adult Chinook collection facilities and will build new release sites above Project dams. These measures will provide safe passage to high quality freshwater spawning sites with water quantity and quality and substrate that support spawning, incubation, and larval development. A new downstream passage facility at Cougar will also become operational during this period, further improving passage conditions for juvenile Chinook. Ongoing operations to meet flow objectives in the Middle Fork

Willamette, McKenzie, and South and North Santiam rivers, and operations that preserve instream flows during deficit water conditions will ensure adequate water quantity in spawning, rearing, and early migration areas. The Action Agencies will implement interim temperature control operations at Detroit Dam in the North Santiam to provide water quality needed for adult migration, spawning and incubation, and juvenile and kelt downstream survival. All existing water diversions will be screened by April 1, 2010, also contributing to safe passage in the juvenile migration corridor.

The actions to be implemented in second half of the term of this Opinion will continue these trends, restoring the functioning of safe passage for juveniles and kelts in the North Santiam and of water quality in the South Santiam. Full implementation of the habitat restoration program will ensure that habitat affected by Project operations can serve its conservation role for the species.

After reviewing the effects of the RPA combined with the Proposed Action, the status of the species, the environmental baseline, and cumulative effects, NMFS has determined that the functioning of critical habitat is likely to improve and to remain functional. NMFS therefore concludes that the Proposed Action and the RPA, combined, are not likely to result in the destruction or adverse modification of designated critical habitat for UWR Chinook salmon.

9.11.2 UWR Winter Steelhead

9.11.2.1 Effects of the RPA

The RPA specifies many significant measures that will reduce the adverse effects of the Willamette Project on the UWR steelhead DPS and will bring about proper functioning of primary constituent elements (PCEs) of its critical habitat. Many of the RPA measures specifically address key limiting factors/threats facing each population and caused by the Willamette Project: lack of passage, the degraded quality of the remaining habitat downstream of the dams, and the risk of genetic introgression from out-of-ESU hatchery fish spawning in the wild. By implementing the RPA, it is very likely the status of the populations in the North and South Santiam rivers, designated core populations (see Chapter 3), will improve significantly. . With implementation of the RPA, NMFS expects that the status of the DPS, including the four VSP parameters, will improve significantly compared to their potential status under the Proposed Action.

As shown in Table 9.11-1, several major RPA measures will be completed between 2015 and 2024 including passage at Detroit Dam, which will provide access to and from historical habitat that is currently blocked and temperature control to improve downstream habitat in a different location. Most of these measures are major construction projects that take a significant amount of time to plan, fund, and execute. For a full description of the authorization and funding processes needed for these types of measures, see the Supplemental Biological Assessment (USACE 2007I). It is not economically and technically feasible to move the timelines for many of these measures forward significantly due to their magnitude and the time needed for studies, design, authorization and construction.

Given these constraints, the anticipated population status improvements will begin in the next 15 years and continue to increase over the 15-year term of this Opinion. It will take several generations of the steelhead life cycle to respond to the positive improvements in the operation

of the Willamette Project and associated measures. Therefore, significant improvements in the status of the DPS will continue to accrue in the next 30 years (approximately six generations). While implementation of these RPA measures will occur during the term of this Opinion, their full effects on population metrics (e.g., abundance, productivity) will occur over a considerable period of time after implementation. Therefore, NMFS expects that substantial improvements to the ESU will result from the implementation of the Proposed Action and the RPA.

In addition to the major measures specified in Table 9.11-1, there are numerous other near-term measures such as changes to flow, screening irrigation diversions, hatchery program modifications, and habitat mitigation projects that are included in the RPA. The near-term measures in Table 9.11-1 directly address project effects on listed fish and critical habitat without requiring as many years to implement as the measures discussed above. A third group of measures, such as conducting RM&E studies, developing fish operations manuals, project planning, and implementing the WATER collaborative process, will begin in the near term. Although this third group of activities also has not been included in the summary table, these are essential tasks that will facilitate construction of the large structures as well as guide annual operations, all of which will benefit UWR steelhead.

Difference between the Proposed Action and RPA

The effect of the RPA measures on UWR steelhead is significantly different than the effect of the Proposed Action. The Proposed Action mainly provided for further studies to consider options such as passage facilities to historical upstream habitat, as well as a major downstream habitat improvement measure of temperature control. In addition, the RPA includes measures to improve degraded downstream habitat through changes to flows, screens at irrigation diversions, hatchery improvements, and other habitat improvement projects. These RPA measures are significant because UWR steelhead are currently limited to degraded downstream habitat in one of the important subbasins (North Santiam). The RPA measures both provide access to higher quality habitat and improve downstream habitat conditions, which together will provide significant enough improvements to allow the UWR steelhead DPS to increase in numbers, productivity, spatial structure, and diversity.

9.11.2.2 UWR Steelhead Populations—Summary of Effects of the RPA

The following is a population-by-population summary of the benefits of the RPA on UWR steelhead populations. It is important that this section be read in the context of Chapter 7, "Summary of Effects of the Proposed Action on UWR Chinook and Steelhead."

Calapooia Steelhead

Impaired physical habitat from past and/or present land uses is a key limiting factor for the Calapooia population, which is at a moderate risk of extinction.

- Address effects of the Willamette Project (specifically, maintenance of revetments) on habitat in the mainstem and Willamette tributaries

- *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.*[57] *Use*

project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.

Because the RPA does not require that habitat projects be located within the Calapooia subbasin, NMFS does not assume that this RPA measure will improve the status of this steelhead population or the functioning of PCEs in the Calapooia subbasin.

South Santiam Steelhead

Competition with hatchery-origin summer steelhead smolts, inadequate passage facilities at Foster and Green Peter dams, and degraded habitat downstream of Foster Dam are key limiting factors for this population, which is at moderate risk of extinction.

- The RPA will reduce impacts associated with the summer steelhead hatchery program.
  - *RPA 6.1.6: reduces the risk of residualism by allowing the volitional emigration of hatchery summer steelhead from the point of release over an extended period of time and removing non-migrants from the system.*
  - *RPA 6.1.7: ends the recycling of hatchery-origin summer steelhead for harvest purposes by September 1st of each year to decrease the risk of straying and spawning in the wild.*
  - *RPA 6.1.8: adjusts the releases of summer steelhead in the Santiam basin. More summer steelhead are caught by recreational fishers in the South Santiam, but a disproportionate number of smolts are released in the North Santiam. Aligning releases with fishery needs will reduce the risk of competition with listed winter steelhead for spawning sites.*
  - *RPA 6.1.9: ensures that the Action Agencies will cooperate with ODFW to reduce the risks to winter steelhead of straying and spawning of summer steelhead based on information acquired through research and monitoring.*
- The RPA requires rebuilding of the adult collection facility at the base of Foster Dam to allow better capture and handling of winter steelhead for outplanting into historically accessible habitat above the dam.
  - *RPA 4.6: complete construction of adult fish collection and handling facilities at Foster by December 2013 and begin operations by March 2014.*
- Construction and operation of one or more new adult release sites above Foster Dam will increase upstream passage survival and reduce pre-spawn mortality by minimizing stress and injury of adult steelhead outplanted above the dam.
  - *RPA 4.7: complete site/concept study by February 2009, establish priorities, and complete construction of all selected sites by June 2012*
- The RPA addresses the long-term need to improve reservoir and dam passage survival at Foster Dam for juvenile steelhead and kelts.
  - *RPA 4.13: The Action Agencies will evaluate a range of potentially beneficial actions for listed fish species at Project dams and reservoirs, including Foster, in their development of the Willamette Configuration and Operation Plan (COP). This will include facilities and operations that require detailed study including feasibility studies and environmental permitting such as long-term fish passage solutions at Foster Dam.*

- The RPA requires continuation of the spill program for juvenile steelhead passage at Foster Dam, which provides better passage survival that turbine passage
  - *RPA 2.8: continuation of spill for juvenile steelhead passage at Foster from April 15 to May 15 each year*
- Interim operational measures at Green Peter and Foster dams will help to restore more normative seasonal water temperatures
  - *RPA 5.1: identify interim measures by March 2010*
  - *RPA 5.1.3: evaluate more complex measures (requiring detailed environmental review, permits, and/or congressional authorization) by April 2011.*
- The RPA will address effects of the Willamette Project (specifically, reduced frequency of channel-forming flows, altered seasonal flow patterns, and the maintenance of revetments) on downstream habitat.
  - *RPA 2.4.4: enabled by implementation of RPA measures 2.4.1-2.4.3, modify operations to optimize system's ability to meet improved flow objectives to the degree feasible, by January 2012.*
  - *RPA 2.7: test pilot "environmental" or "pulse" flows below Project dams to achieve channel-forming and channel-maintenance flows; implement where feasible without compromising authorized Project purposes.*
  - *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.*[57] *Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*
- Unscreened diversions create impediments or barriers to juvenile steelhead migrants.
  - *RPAs 3.2 and 3.3.: Reclamation will require that existing, new, and renewed contracts for stored water include conditions that protect fish from entrainment into diversions.*

These measures (especially the hatchery program improvements and increases in downstream passage survival at Foster Dam) are expected to significantly improve the status of the South Santiam steelhead population. Natural-origin winter steelhead are already collected at Foster and released upstream, but the RPA will ensure that these operations and juvenile and kelt movements downstream entail less injury, mortality, and stress. NMFS expects increases in the abundance, productivity, spatial structure, and diversity of natural-origin steelhead as these measures become operational. These actions will also improve the functioning of PCEs in designated critical habitat including:

- Freshwater spawning sites with water quantity and quality and substrate supporting spawning, incubation, and larval development (specifically RPA measures 2.4.4; 2.7; 5.1.2; 5.1.3; and 7.1.3).
- Freshwater rearing sites with water quantity and floodplain connectivity supporting juvenile development (RPA 2.4.4; 2.7; 5.1.2; 5.1.3; and 7.1.3).
- Freshwater migration corridors free of obstruction with water quality and quantity supporting juvenile and adult mobility and survival (RPA 2.7; 2.8; 3.2; 3.3; 4.6; 4.7; 4.13; and 7.1.3).

North Santiam Steelhead

Competition with hatchery-origin summer steelhead smolts, loss of access to historical habitat above Detroit Dam, and altered habitat downstream of Big Cliff Dam are key limiting factors for this population, which is at moderate risk of extinction.

- The RPA will reduce impacts associated with the summer steelhead hatchery program.
  - *RPA 6.1.6: reduces the risk of residualism by allowing the volitional emigration of hatchery fish from the point of release over an extended period of time and removing non-migrants from the system.*
  - *RPA 6.1.7: ends the recycling of hatchery-origin summer steelhead for harvest purposed after September 1st of each year to decrease the risk of straying and spawning in the wild.*
- The RPA will significantly reduce the problem with altered water temperatures released from Detroit/Big Cliff dams in natural production areas downstream by requiring the Action Agencies to construct a Water Temperature Control Facility, or alternative operational measures, at Detroit Dam.
  - *RPA 5.1.1: identify and evaluate interim operational measures at Detroit and if feasible, begin implementation in Water Year 2009.*
  - *RPA 5.2: make structural modifications or major operational changes at Detroit Dam for improved water quality, initiating planning by 2010, completing construction by December 2018, and beginning operations by March 2019.*
- The RPA addresses the potential need to provide upstream adult passage at Detroit and Big Cliff dams. Replacing Minto Trap will allow for capture and handling of steelhead for outplanting, if determined necessary, with reduced levels of stress, injury, and mortality.
  - *RPA 4.2: If determined necessary by NMFS, in coordination with the FPHM (WATER subcommittee), the Action Agencies will collect adult steelhead at the Minto trap and release them above Detroit and/or Big Cliff dams.*
- Construction and operation of new adult release sites above Detroit Dam will increase upstream passage survival and reduce pre-spawn mortality by minimizing stress and injury of adult Chinook salmon outplanted above the dams.
  - *RPA 4.7: complete site/concept study by February 2009, establish priorities, and complete construction of all selected sites by June 2012*
- The RPA addresses the potential need to provide downstream juvenile steelhead and kelt passage at Detroit and Big Cliff dams if NMFS determines that steelhead should be outplanted above Detroit Dam.
  - *RPA 4.12.3: initiate planning by 2015, make "go/no go" decision by end of 2017; complete construction by end of 2023, begin operations by March 2024.*
- The RPA will address effects of the Willamette Project (specifically, reduced frequency of channel-forming flows, altered seasonal flow patterns, and the maintenance of revetments) on downstream habitat

- *RPA 2.4.4: enabled by implementation of RPA measures 2.4.1-2.4.3, modify operations to optimize system's ability to meet improved flow objectives to the degree feasible, by January 2012.*
- *RPA 2.7: test pilot "environmental" or "pulse" flows below Project dams to achieve channel-forming and channel-maintenance flows; implement where feasible without compromising authorized Project purposes.*
- *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.*[57] *Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*

These measures, especially the hatchery program improvements, providing safe upstream/downstream passage at Big Cliff/Detroit dams, and improvements in water temperatures below Big Cliff Dam, are expected the significantly improve the status of the North Santiam population. Natural-origin steelhead will have the opportunity for successful spawning, incubation, and rearing in the reach above Detroit and juveniles will emigrate downstream with reduced rates of injury and mortality. NMFS expects increases in the abundance, productivity, spatial structure, and diversity of natural-origin winter steelhead as these measures become operational. These actions will also improve the functioning of PCEs in critical habitat:

- Freshwater spawning sites with water quantity and quality and substrate supporting spawning, incubation, and larval development (specifically RPA measures 2.4.4; 2.7; 5.1.1; 5.2; and 7.1.3).
- Freshwater rearing sites with water quantity and floodplain connectivity supporting juvenile development (RPA 2.4.4; 2.7; 5.1.1; 5.2; and 7.1.3).
- Freshwater migration corridors free of obstruction with water quality and quantity supporting juvenile and adult mobility and survival (RPA 3.2; 3.3; 4.2; 4.6; 4.7; 4.12.3; and 7.1.3).

Molalla Steelhead

Insufficient streamflows due to land use-related water withdrawals resulting in impaired water quality and reduced habitat availability and impaired physical habitat from past and/or present land use practices are secondary limiting factors for this population, which is at a moderate risk of extinction.

- The RPA will address effects of the Willamette Project (specifically, maintenance of revetments) on habitat in the mainstem Willamette and tributaries.
- *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.*[57] *Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*

Because the RPA does not require that habitat projects be located in the Molalla subbasin, NMFS does not assume that this RPA measure will improve the status of this steelhead population or the functioning of PCEs in the Molalla subbasin.

All UWR Steelhead Populations

The following RPA actions, located. or affecting conditions within the mainstem Willamette, will affect all populations of UWR steelhead.

- RPA 2.3: obtain NMFS' approval before changing mainstem Willamette (Albany and Salem) flow objectives, to ensure that flow-related habitat needs of UWR steelhead for rearing and juvenile and adult migration are fully considered.
- Address effects of the Willamette Project (specifically, reduced frequency of channel-forming flows and the maintenance of revetments) on downstream habitat
- *RPA 7.1.3: implement at least two habitat restoration projects by 2010; fund and complete additional projects each year from 2011 through 2023, the term of this Opinion.*[57] *Use project selection criteria developed through RPA 7.1.2 to identify priority projects for funding.*
- Ensure that the availability of adequate water for fish and habitat protection in the tributaries and in the mainstem Willamette is not precluded by the water contract program.
- *RPA 3: Reevaluate the availability of water from conservation storage for the water contract program and reinitiate consultation if future irrigation demands exceed 95,000 acre-feet.*

These actions will improve the functioning of PCEs in designated critical habitat:

- Freshwater rearing sites with water quantity and floodplain connectivity supporting juvenile development (specifically RPA measures 2.3; 7.1.1; and 7.1.3).
- Freshwater rearing corridors free of obstruction with water quality and quantity supporting juvenile and adult mobility and survival (RPA 2.3; 7.1.1, and 7.1.3).

9.11.2.3 Conclusions—UWR Steelhead

9.11.2.3.1 Jeopardy Analysis

The risk of extinction for the four UWR steelhead populations is moderate and the improvements in conditions that will result from the RPA and Proposed Action, combined with recent improvements in project facilities and operations (Chapter 4), will address limiting factors caused by the Project. The RPA is designed to increase the abundance and productivity of the South and North Santiam populations, to increase the spatial structure (geographic range) of the North Santiam population, and to improve the diversity (locally adapted genotypes) of all four populations (including the Calapooia and Molalla). The relationship between the RPA improvements, population viability, and the risk of extinction is similar to that described in Section 9.11.1.3 for UWR Chinook salmon, with a few differences. The Action Agencies are already passing winter steelhead upstream of Foster Dam, but the RPA requires that the adult collection facility be rebuilt to allow safer capture, handling, and transport to will increase the survival and therefore productivity of the outplanted fish. The downstream passage facilities, used by both juvenile steelheads and kelts, also will be improved to increase survival. Interim and long-term water temperature control operations in the North Santiam River and ongoing reservoir management to meet flow objectives will improve conditions that have depressed natural production below the dams and contributed to the populations' moderate risk of extinction. Hatchery reforms will reduce competitions for spawning sites with out-of-basin

summer steelhead and the risk of genetic introgression, promoting life history diversity and increasing the abundance and productivity of each population.

Measures implemented in the first half of the term of this Opinion will further reduce the species' risk of extinction. These include operations to meet mainstem and tributary flow objectives, which were initiated in 2000 and are beginning to positively influence adult returns. These will continue under the RPA and Proposed Action. The Action Agencies will conduct flow studies to ensure that the flow objectives are adequate, based on gauging stations they will establish or improve. By January 2011, the Action Agencies will have determined whether the Opinion's flow levels should be revised to better meet the species needs and will meet any revised flow objectives to the extent possible given all project purposes. Thus, the Action Agencies will improve their operations, reducing negative effects on the listed species and their critical habitat, and will adapt their operations to new information on physical habitat properties, including those related to climate change (Section 5.1.7).

Reclamation will immediately improve its water contracting program. All (existing, new, and renewed) contracts will be subject to the availability of water, and when there is not enough water to meet minimum flow targets and irrigation contracts, instream flows will be preserved. All contracts will require that irrigation intakes and diversion dams be screened to preclude entrainment (fish sucked into irrigation diversions) and the headgate requirement will ensure that water diversions can be stopped when not needed, or when directed by OWRD. These reforms will minimize fish entrainment and, particularly during "deficit" water conditions, preserve instream flows for fish habitat needs. In addition, all existing water diversions served by water contracts will be screened to prevent entrainment by April 1, 2010.

In the short-term, the Action Agencies will continue to pass adult UWR steelhead above Foster on the South Santiam to enhance spatial structure. Fish survival and productivity will be improved by the outplanting program, managed according to an annual Fish Operations Plan that are coordinated with the Services and ODFW and which will address how, where, and when outplanted fish will be collected, held, marked, sampled, transported, and released, and will incorporate changes needed to further protect these fish based on research and monitoring.

By spring of 2009, interim temperature control operations at Detroit will improve water temperatures in the North Santiam, increasing the survival of eggs, juveniles, and prespawning adults and thus population productivity. The Action Agencies will design and begin to use new adult release sites above the dams by 2012. These new sites, like the improved adult collection facilities, will reduce stress and injury and thus the risk of prespawning mortality.

The Action Agencies will also begin to upgrade existing adult fish collection and handling facilities in the first half of the term of the Opinion. Dates for beginning operations at the new facilities are March 2013 in the North Santiam and 2014 at Foster Dam (South Santiam. Once construction is complete, adult fish will experience reduced levels of stress and injury, which is expected to lessen pre-spawning mortality.

In addition to these measures, which will immediately (during the first one-to-seven years of this Opinion) improve population viability and reduce the risk of extinction, the RPA requires that the Action Agencies complete various RM&E efforts, feasibility studies, and where needed, NEPA analysis. NMFS expects that these evaluations will lead to the construction of facilities and adjustments in operations during the second half of the term of this Opinion that will ensure that conditions are optimized for all affected life stages of UWR steelhead. These will include:

- Adjustments to mainstem and tributary flow objectives and ramping rates to meet the needs of the species over all affected life stages
- Operations for water quality (temperature and dissolved gas) and construction of new facilities
- Construction of improved juvenile and kelt passage facilities
- Full implementation of the habitat restoration program
- Adaptation of flow management and water quality measures to changing climatic conditions

The near- and longer-term actions described above will address the effects of the Willamette Project on all life stages of UWR steelhead that occur within the Willamette Basin: adult migration, spawning and incubation, juvenile rearing, and juvenile and kelt downstream migrations.

Other measures taken by the Action Agencies under the environmental baseline (as required by the 2008 FCRPS RPA; NMFS 2008a) will improve the survival and condition of juvenile UWR Chinook in the lower Columbia River and estuary. The effects of the Willamette Project on habitat are very small in the lower Columbia and estuary, with slight to negligible adverse effects on viability (Section 5.11). However, the FCRPS RPA includes beneficial measures to reduce smolt predation by Caspian terns and Northern pikeminnows, and a significant estuary habitat restoration program to ensure that biological requirements are met. These actions will benefit yearling steelhead from the Willamette Basin during the critical period prior to ocean entry.

After reviewing the effects of the RPA measures combined with the Proposed Action, which address significant adverse impacts of the Willamette Project (lack of effective passage, degraded water quality and physical habitat properties, and adverse effects of hatchery practices on population viability), the rangewide status of the species, the effects of the environmental baseline (degraded spawning and rearing habitat in tributaries below Project dams), and cumulative effects (reasonably certain non-federal activities that are intended to benefit these status of the species mixed with those likely to have adverse effects), NMFS has determined that the UWR steelhead DPS is expected to survive with an adequate potential for recovery. The actions implemented in the first few years will protect the species against the short-term risk of extinction while longer-term measures are designed and constructed. NMFS therefore concludes that the RPA and Proposed Action, combined, are not likely to jeopardize the continued existence of the UWR steelhead DPS.

9.11.2.3.2 Critical Habitat Analysis

The measures described in the RPA combined with the Proposed Action will also improve the functioning of PCEs, restoring the ability of primary constituent elements of habitat needed for the conservation of the species. The actions described above will significantly improve the following PCEs over the term of the Opinion:

- Freshwater spawning sites with water quantity and quality and substrate supporting spawning, incubation, and larval development
- Freshwater rearing sites with water quantity and floodplain connectivity supporting juvenile development

- Freshwater migration corridors free of obstruction with water quality and quantity supporting juvenile and adult mobility and survival

In the first one to seven years, the Action Agencies will rebuild the adult steelhead collection facilities and will build new release sites above Project dams. These measures will improve safe passage to high quality freshwater spawning sites that have water quantity and quality and substrate that support spawning, incubation, and larval development. Ongoing operations to meet flow objectives in the South and North Santiam rivers, and operations that preserve instream flows during deficit water conditions will ensure adequate water quantity in spawning, rearing, and early migration areas below the dams. The Action Agencies will implement interim temperature control operations at Detroit Dam in the North Santiam to provide water quality needed for adult migration and holding, spawning and incubation, and juvenile survival. All existing water diversions will be screened by April 1, 2010, also contributing to safe passage in the juvenile migration corridor.

The actions to be implemented in second half of the term of this Opinion will continue these trends, restoring the functioning of safe passage for juveniles in three of the four tributaries with Project dams and of water quality in the Middle Fork and South Santiam. Full implementation of the habitat restoration program will ensure that habitat affected by Project operations can serve its conservation role for the species.

After reviewing the effects of the RPA combined with the Proposed Action, the status of the species, environmental baseline, and cumulative effects, NMFS has determined that the functioning of designated critical habitat is likely to improve and remain functional. NMFS therefore concludes that the Proposed Action and the RPA, combined, are not likely to result in the destruction or adverse modification of designated critical habitat for UWR steelhead.

9.11.3 Snake River, Upper Columbia River, Middle Columbia River, and Lower Columbia River Salmon and Steelhead

As described in Sections 8.3-8.7, NMFS has concluded that, taking into account the current status of 11 species of Interior and Lower Columbia Basin salmon and steelhead and of critical habitat designated for 10 of those species,101 the condition of the environmental baseline and cumulative effects within the action area, the Proposed Action is not likely to jeopardize the continued existence of any of these species or to destroy or adversely modify critical habitat. Adverse effects of the Proposed Action were limited to a very small decrease in average monthly flows in the lower Columbia River and estuary during February through June and very small reductions in the delivery of turbidity and large wood, trapped behind Project dams. These were expected to result in "slight to negligible" effects on habitat conditions, including the PCEs safe passage in the juvenile migration corridor and water quantity, turbidity, floodplain connectivity, large wood, and natural cover in freshwater/estuarine rearing areas, and on population viability. In addition, NMFS anticipates that habitat conditions in the lower Columbia River and estuary will improve over the term of this Opinion due to relocation of Caspian terns to sites outside Columbia Basin, ongoing control of Northern Pikeminnow predation, and implementation of a 10-year estuary habitat program under the 2008 FCRPS RPA (NMFS 2008a). These future improvements in baseline habitat conditions are expected to exceed the small to negligible

101 NMFS has not yet designated critical habitat for LCR coho salmon.

adverse effects of the RPA and Proposed Action. Thus, NMFS concludes that the Proposed Action and the RPA are not likely to jeopardize the continued existence of any of these species or to destroy or adversely modify critical habitat.

9.11.4 Southern Resident Killer Whales and Southern DPS of North American Green Sturgeon

After conducting the analyses included as Appendices A and B to this Opinion, NMFS determines that the Proposed Action and the RPA are not likely to adversely affect either species or critical habitat designated for the Southern Resident killer whale.