Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Consultation

Yakima River Spring Chinook Salmon, Summer/Fall Chinook Salmon, and Coho Salmon Hatchery Programs.

NMFS Consultation Number: NWR-2011-06509

Action Agencies: Bonneville Power Administration and NMFS

Program Operators: Yakama Nation
Washington Department of Fish and Wildlife

Affected Species and Determinations:

ESA-Listed Species	**Status**	**Is Action Likely to Adversely Affect Species or Critical Habitat?**	**Is Action Likely To Jeopardize the Species?**	**Is Action Likely To Destroy or Adversely Modify Critical Habitat?**
Middle Columbia River steelhead (*Oncorhynchus mykiss*)	Threatened	Yes	No	No

Fishery Management Plan That Describes EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes

Consultation Conducted By: National Marine Fisheries Service, West Coast Region

Issued By: Robert Turner for
William W. Stelle, Jr.
Regional Administrator

Date: November 25, 2013

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Table of Contents

1. INTRODUCTION

This introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3.

The Proposed Action is primarily funded by the Bonneville Power Administration (BPA), with a small portion of funding by NMFS through the Mitchell Act. The BPA proposes to continue to fund three on-going hatchery programs that release non ESA-listed spring Chinook salmon, summer/fall Chinook salmon, and coho salmon into the Yakima River Basin (Table 1). The programs will be operated by the Yakama Nation (YN) and the Washington Department of Fish and Wildlife (WDFW). The hatchery programs are described in Section 1.8 of their respective Hatchery and Genetic Management Plans (HGMPs): for the Upper Yakima Spring Chinook/Cle Elum Supplementation and Research Facility (CESRF) (here after referred to as the Yakima spring Chinook salmon program (YN 2010b)); the Yakima River Summer and Fall Run Chinook Production Program (here-after referred to as the Yakima summer/fall Chinook salmon program (YN 2010d)); and the Yakima Basin Coho Reintroduction Project (here-after referred to as the Yakima coho salmon program (YN 2010c)) (Table 1). NOAA's National Marine Fisheries Service (NMFS) partially funds the Yakima summer/fall Chinook salmon program and the Yakima coho salmon program through the Mitchell Act, and is included as an action agency in this consultation. The U.S. Army Corps of Engineers (COE) indirectly funds the summer/fall Chinook salmon program by providing funds for feed through a contract with the U.S. Fish and Wildlife Service (USFWS). This funding will not be included in this consultation, but will be included as part of the ESA consultation for the COE's funding and operation of the proposed I-182 acclimation and adult collection facility in the lower Yakima River.

The purpose of the proposed spring Chinook salmon and the fall Chinook salmon hatchery programs is to increase the viability of the natural populations and to provide returning adult fish for harvest. The purpose of the proposed coho salmon hatchery program is to reestablish a locally adapted natural population and to provide returning adult fish for harvest. Fish from these programs are intended to spawn naturally. Four populations of threatened ESA-listed Middle-Columbia River steelhead are found in the Yakima River and these populations will be affected by the proposed programs.

Table 1. Yakima River Basin HGMPs, program operators and funding agencies.

Hatchery and Genetics Management Plan	Program Operator	Funding Agency
Upper Yakima River Spring Chinook/Cle Elum Supplementation and Research Facility (CESRF)	YN and WDFW	BPA
Yakima River Summer and Fall Run Chinook Production Program	YN and WDFW	BPA, and NMFS
Yakima River Coho Reintroduction Project	YN and WDFW	BPA and NMFS

1.1. Background

NMFS prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the ESA of 1973, as amended (16 U.S.C. 1531, *et seq*.), and implementing regulations at 50 CFR 402.

The NMFS also completed an Essential Fish Habitat (EFH) consultation. It was prepared in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801, *et seq*.) and implementing regulations at 50 CFR 600.

The opinion, ITS, and EFH conservation recommendations are in compliance with section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-5444) ("Data Quality Act") and underwent pre-dissemination review. The project files for both consultations are located at the Sustainable Fisheries Division (SFD) in Portland, Oregon.

1.2. Consultation History

The first hatchery consultations in the Columbia River Basin followed the first listings of Columbia River Basin salmon under the ESA. Snake River sockeye salmon were listed as an endangered species on November 20, 1991, Snake River spring/summer Chinook salmon and Snake River fall Chinook salmon were listed as threatened species on April 22, 1992, and the first hatchery consultation and opinion was completed on April 7, 1994 (NMFS 1994; 2008f). The 1994 opinion was superseded by "Endangered Species Act Section 7 Biological Opinion on 1995-1998 Hatchery Operations in the Columbia River Basin, Consultation Number 383" completed on April 5, 1995 (NMFS 1995). This opinion determined that hatchery actions jeopardize listed Snake River salmon and required implementation of reasonable and prudent alternatives (RPAs) to avoid jeopardy.

A new opinion was completed on March 29, 1999, after UCR steelhead were listed under the ESA (62 FR 43937, August 18, 1997) and following the expiration of the previous opinion on December 31, 1998 (NMFS 1999). That opinion concluded that Federal and non-Federal hatchery programs jeopardize Lower Columbia River (LCR) steelhead and Snake River steelhead protected under the ESA and described RPAs necessary to avoid jeopardy. Those measures and conditions included restricting the use of non-endemic steelhead for hatchery broodstock and limiting stray rates of non-endemic salmon and steelhead to less than 5% of the annual natural population in the receiving stream. Soon after, NMFS reinitiated consultation when LCR Chinook salmon, UCR spring Chinook salmon, Upper Willamette Chinook salmon, Upper Willamette steelhead, Columbia River chum salmon, and Middle Columbia steelhead were added to the list of endangered and threatened species (Smith 1999).

Between 1991 and the summer of 1999, the number of distinct groups of Columbia River Basin salmon and steelhead listed under the ESA increased from 3 to 12, and this prompted NMFS to reassess its approach to hatchery consultations. In July 1999, NMFS announced that it intended to conduct five consultations and issue five opinions "instead of writing one biological opinion on all hatchery programs in the Columbia River Basin." Opinions would be issued for hatchery programs in the, (1) Upper Willamette, (2) Middle Columbia River (MCR), (3) LCR, (4) Snake River, and (5) UCR, with the UCR NMFS' first priority (Smith 1999). Between August 2002 and October 2003, NMFS completed consultations under the ESA for approximately twenty hatchery programs in the UCR. For the MCR, NMFS completed a draft opinion and distributed it to hatchery operators and to funding agencies for review on January 4, 2001, but completion of consultation was put on hold pending several important basin-wide review and planning processes.

The increase in ESA listings during the mid to late 1990s triggered a period of investigation, planning, and reporting across multiple jurisdictions and this served to complicate, at least from a resources and scheduling standpoint, hatchery consultations. A review of Federal funded hatchery programs ordered by Congress was underway at about the same time that the 2000 Federal Columbia River Power System (FCRPS) opinion was issued by NMFS (NMFS 2000a). The Northwest Power and Conservation Council (Council) was asked to develop a set of coordinated policies to guide the future use of artificial propagation, and Reasonable and Prudent Alternative (RPA) 169 of the FCRPS opinion called for the completion of NMFS-approved hatchery operating plans (i.e., HGMPs) by the end of 2003. The RPA required the Action Agencies to facilitate this process, first by assisting in the development of HGMPs, and then by helping to implement identified hatchery reforms (NMFS 2001). Also at this time, a new *U.S. v. Oregon* Columbia River Fisheries Management Plan (CRFMP), which included goals for hatchery management, was under negotiation and new information and science on the status and recovery goals for salmon and steelhead was emerging from Technical Recovery Teams (TRTs). Work on HGMPs under the FCRPS opinion was undertaken in cooperation with the Council's Artificial Production Review and Evaluation process, with CRFMP negotiations, and with ESA recovery planning (Jones 2002; Foster 2004). HGMPs were submitted to NMFS under RPA 169; however, many were incomplete and, therefore, were not found to be sufficient[1] for ESA consultation.

ESA consultations and an opinion were completed in 2007 for nine hatchery programs that produce a substantial proportion of the total number of salmon and steelhead released into the Columbia River annually. These programs are located in the LCR and MCR and are operated by the FWS and by the Washington Department of Fish and Wildlife (WDFW). NMFS' opinion (NMFS 2007b) determined that operation of the programs would not jeopardize salmon and steelhead protected under the ESA.

On May 5, 2008, NMFS published a Supplemental Comprehensive Analysis (SCA) (NMFS 2008f) and an opinion and RPAs for the FCRPS to avoid jeopardizing ESA-listed salmon and steelhead in the Columbia River Basin (NMFS 2008d). The SCA environmental baseline included "the past effects of hatchery operations in the Columbia River Basin. Where hatchery consultations have expired or where hatchery operations have yet to undergo ESA section 7consultation, the effects of future operations cannot be included in the baseline. In some

[1] "Sufficient" means that an HGMP meets the criteria listed at 50 CFR 223.203(b)(5)(i), which include (1) the purpose of the hatchery program is described in meaningful and measureable terms, (2) available scientific and commercial information and data are included, (3) the Proposed Action, including any research, monitoring, and evaluation, is clearly described both spatially and temporally, (4) application materials provide an analysis of effects on ESA-listed species, and (5) preliminary review suggests that the program has addressed criteria for issuance of ESA authorization such that public review of the application materials would be meaningful.

instances, effects are ongoing (e.g., returning adults from past hatchery practices) and included in this analysis despite the fact that future operations cannot be included in the baseline. The Proposed Action does not encompass hatchery operations per se, and therefore no incidental take coverage is offered through this biological opinion to hatcheries operating in the region. Instead, we expect the operators of each hatchery to address its obligations under the ESA in separate consultations, as required." (see NMFS 2008f, p. 5-40; 2008b)

Because it was aware of the scope and complexity of ESA consultations facing the co-managers and hatchery operators, NMFS offered substantial advice and guidance to help with the consultations. In September 2008, NMFS announced its intent to conduct a series of ESA consultations and that "from a scientific perspective, it is advisable to review all hatchery programs (i.e., Federal and non-Federal) in the UCR affecting ESA-listed salmon and steelhead concurrently" (Walton 2008). In November 2008, NMFS expressed again, the need for re-evaluation of UCR hatchery programs and provided a "framework for ensuring that these hatchery programs are in compliance with the Federal Endangered Species Act" (Jones 2008). NMFS also "promised to share key considerations in analyzing HGMPs" and provided those materials to interested parties in February 2009 (Jones 2009).

On April 28, 2010 (Walton 2010), NMFS issued a letter to "co-managers, hatchery operators, and hatchery funding agencies" that described how NMFS "has been working with co-managers throughout the Northwest on the development and submittal of fishery and hatchery plans in compliance with the Federal Endangered Species Act (ESA)." NMFS stated, "In order to facilitate the evaluation of hatchery and fishery plans, we want to clarify the process, including consistency with *U.S. v. Oregon*, habitat conservation plans and other agreements…." With respect to "Development of Hatchery and Harvest Plans for Submittal under the ESA," NMFS clarified: "The development of fishery and hatchery plans for review under the ESA should consider existing agreements and be based on best available science; any applicable multiparty agreements should be considered, and the submittal package should explicitly reference how such agreements were considered. In the Columbia River, for example, the *U.S. v. Oregon* agreement is the starting place for developing hatchery and harvest plans for ESA review…."

NMFS has been corresponding with the YN since 2005 regarding the development of draft HGMPs for the three programs (Table 1). NMFS reviewed revised drafts for the three programs (YN 2007; 2009a; 2009b) and responded that the three HGMPs were now sufficient for formal ESA review pending several modifications (Turner 2009). In a letter dated January 20, 2011, the BPA "determined that its funding of the activities under these artificial propagation production programs may affect, and is likely to adversely affect listed Middle Columbia River steelhead and its critical habitat" and requested formal consultation under Section 7 of the ESA (Weintraub 2011a). The letter included updated HGMPs (YN 2010b; 2010d; 2010c) and an attachment addressing the action area and critical habitat. NMFS reviewed this material and responded that the proposed actions, HGMPs, and the associated critical habitat analysis were sufficient to initiate formal section 7 consultation under the ESA upon BPA concurrence that NMFS has accurately and appropriately characterized each proposed action (i.e., HGMP) and its effects on salmon and steelhead listed under the ESA (Jones 2011b). NMFS subsequently received BPA concurrence (Weintraub 2011b) that included minor corrections/updates to NMFS' description of the proposed actions.

Subsequent to the initiation of formal ESA consultation, the YN published an updated Yakima Subbasin Summer- and Fall-run Chinook and Coho Salmon Hatchery Master Plan (YN 2012a) that described, in more detail, future plans for the summer/fall Chinook salmon and coho salmon programs, including the proposed construction of a hatchery facility at Holmes Ranch, an upgrade and expansion of the Prosser Hatchery, improvements at Marian Drain Hatchery, and the construction of a fish trap at the Sunnyside Dam fish ladder. Construction on the Holmes Ranch Facility is not expected to occur until 2014 at the earliest. Funding for improvements at Prosser Hatchery and at Marion Drain Hatchery and for improvements to the Sunnyside Dam fish ladder have not been appropriated. However, this opinion will consider the effects of all of the facilities once construction is complete and the facilities are operational.

The Master Plan also included updated summer and fall-run Chinook salmon and coho salmon program HGMPs (YN 2012b). Coincident with the development of the Master Plan, the COE has been negotiating with the parties to *U.S. v Oregon* regarding JDM. The COE has identified the need for additional production to meet its JDM goals. The COE currently partially funds a release of 1.7M subyearling fall Chinook salmon at Prosser Hatchery. The COE would expand this release to up to 4.0M subyearlings (or an adult production equivalent of subyearling and yearling production). This production would be acclimated and released from a new facility built on COE owned land adjacent to and including the I-182 pond near the mouth of the Yakima River. Additional engineering evaluations of this site are ongoing and construction would begin in 2016 if funding becomes available.

Monitoring, evaluation, and research (ME&R) activities are included as part of the Proposed Action. Descriptions of the monitoring and evaluation activities associated with the hatchery programs were provided in statements of work (SOWs). These SOWs included the Yakima River Monitoring and Evaluation-Yakima/Klickitat Fish Project (Project# 1995-063-25) operated by both the YN (BPA 2012d) and WDFW (BPA 2012c), and the Project to provide VSP Estimates for the Yakima Steelhead MGP (Project#2010-030-00) operated by the YN (BPA 2012a) and WDFW (BPA 2012b).

1.3. Proposed Action

"Action" means all activities, of any kind, authorized, funded, or carried out, in whole or in part, by Federal agencies. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration.

NMFS describes a hatchery program as a group of fish that have a separate purpose and that may have independent spawning, rearing, marking and release strategies (NMFS 2008d). The operation and management of every hatchery program is unique in time, and specific to an identifiable stock and its native habitat (Flagg et al. 2004). In this case, the Proposed Action is represented by the three HGMPs determined to be sufficient for formal consultation, including those updated by the Master Plan (YN 2012a), as well as the associated ME&R activities (BPA 2012d; 2012c; 2012a; 2012b).

The purpose of the proposed spring Chinook salmon program is to increase the viability of the naturally produced spring Chinook salmon population in the Yakima River and to provide returning adults for harvest.

The summer/fall Chinook salmon hatchery program has two goals: the first is to establish a locally adapted, naturally spawning population of summer/fall Chinook salmon in the Yakima River above Prosser Dam; the second is to increase the contribution of the Up-River Bright (URB) fall Chinook salmon to fisheries below Prosser Dam.

Similarly, the purpose of the coho salmon hatchery program has two goals: the first is to reestablish a locally adapted, naturally spawning population coho salmon in the Upper Yakima River; the second is to operate a segregated program to provide returning adult fish for harvest.

The three programs do not preserve any ESA-listed species, spring and summer/fall Chinook salmon and coho salmon in the Yakima River are not protected under the ESA and none of the hatchery programs use ESA-listed fish for broodstock. The hatchery programs are mitigation for losses of salmon caused by construction and operation of the FCRPS. Yakima River spring Chinook salmon abundance was depressed in the 1980s and 1990s, and BPA was requested by the Northwest Power and Conservation Council (NPCC) to “fund the design, construction, operation, and maintenance of a hatchery to enhance the fishery for the Yakama Indian Nation as well as other harvesters” (NPPC 1982). The CESRF was later incorporated into the program “to test the assumption that new artificial production can be used to increase harvest and natural production while maintaining the long-term fitness for the fish population being supplemented and keeping adverse genetic and ecological interactions with non-target species or stocks within acceptable limits” (BPA 1996).

Yakima River summer/fall Chinook salmon and coho salmon were also similarly depressed, or extirpated in the case of coho salmon, and hatchery programs were established to produce salmon to support fisheries and to increase natural production in areas of the Yakima River that salmon used historically. The hatchery production from these programs is intended to be consistent with the ESA Recovery Plan for the Middle Columbia River (MCR) Steelhead Distinct Population Segment (DPS) (NMFS 2009b) and the 2008-2017 *U.S. v. Oregon* Management Agreement (*U.S. v. Oregon* 2008) as modified in the January 23, 2009, submittal to the U.S. District Court (*U.S. v. Oregon* 2009).

The individual programs listed in Table 1 will be described in the following section. Descriptions will be by program and will include the purpose for the program, production goals, program history, a profile of the facilities, broodstock collection activities, juvenile release strategies, and marking protocols. ME&R activities described in the HGMPs and supporting documents will be evaluated as part of this consultation.

The review of the three Yakima River hatchery programs under consideration here is consistent with the FCRPS opinion. The site-specific actions described herein are consistent with the programmatic best management practices and guidance criteria required under RPA 39 in the FCRPS opinion (NMFS 2008d).

The BPA funds the programs included in the proposed action through the NPCC's Fish and Wildlife Program. The BPA funds the co-managers, YN and WDFW, to operate the programs, and can ensure that the hatchery programs are operated as proposed through binding language within the contracts issued to fund the programs. The direct and indirect effects of this action and related activities are considered in this consultation.

NMFS has identified several actions that are interrelated and/or interdependent with the proposed action. These include monitoring and evaluation of the effects of hatchery operations in the Yakima River, monitoring the status of the steelhead populations in the Yakima River, and limited aspects of the operation of the Little White Salmon Nation Fish Hatchery (NFH), and Eagle Creek NFH. The operation of these facilities are interrelated to three Yakima River hatchery programs because they provide broodstock or produce fish that are released as part of the programs, but the operation of these facilities also supports numerous other hatchery programs and thus are not interdependent on the Proposed Action. The overall operations of these facilities are separate Federal authorizations and will not be included in the Proposed Action.

NMFS, through the Mitchell Act, provides funds to USFWS to spawn and rear coho salmon at the Eagle Creek NFH and to spawn and rear URB fall Chinook salmon at the Little White Salmon (LWS) NFH. The COE provides funds for small amount of feed for this program through their contract with the USFWS. A proportion of the production at these facilities is released into the Yakima River as part of the proposed hatchery programs. Consequently, the relevant portions of both of these funding actions are included as part of the proposed action and this consultation will evaluate the effects of these releases on ESA-listed steelhead populations in the Yakima River. An analysis of the effects of the operation of Eagle Creek NFH and Little White Salmon NFH was part of a larger USFWS hatchery consultation (see NMFS 2007b).

Fisheries are not part of the Proposed Action and there are no fisheries that exist because of the hatchery program, i.e., the "but for" test does not apply and therefore there are no interrelated or interdependent fishery actions. To the extent that fisheries have been developed to specifically target salmon produced by the Proposed Action, they will be subject to future section 7 consultations. To the extent that there are existing fisheries that may catch fish produced by the Proposed Action, they are mixed-stock fisheries and would exist with or without these programs (and have previously been evaluated in a separate biological opinion (NMFS 2008e).

Production from the three Yakima River hatchery programs also support fisheries in the ocean and Columbia River Basin; the impacts of those fisheries have already been evaluated (NMFS 2008e).

1.3.1. Yakima Spring Chinook Salmon Program

The Yakima spring Chinook salmon program is an on-going program that provides returning adults for harvest, for natural spawning, and for hatchery broodstock (YN 2010b). The fish used for the spring Chinook salmon program are collected as adults at Roza Dam, spawned and reared at the CESRF, and are released at the Clark Flat, Easton, and Jack Creek acclimation facilities. The program also includes a large research element that was authorized in 1996 under the NPCC's Fish and Wildlife Program "to test the assumption that new artificial production can be used to increase harvest and natural production while maintaining the long-term genetic fitness of the fish population being supplemented and keeping adverse genetic and ecological interactions with non-target species or stocks within acceptable limits." The research includes the maintenance of a "hatchery control (HC)" group and evaluation of a wild control (WC, baseline) in the Naches River. The HC group will be maintained by collecting hatchery-origin broodstock at Roza Dam to produce approximately 90,000 smolts annually for release at the Clark Flat acclimation site. All HC fish are differentially marked and all adult returns will be removed at Roza Dam and are either used for broodstock, research, or for tribal subsistence; no HC fish are allowed to spawn naturally. The WC group is maintained by collecting a small subsample of wild spring Chinook from the natural spawning grounds in the Naches River and rearing their eggs to the fry stage for juvenile trait evaluation (Busack et al. 2006).

The short-term goal for the program is to return 3,014 natural-origin spring Chinook salmon to the Upper Yakima River from an annual release of 720,000 smolts. The escapement to the Upper Yakima River is after a Columbia River mainstem harvest of 2,590 fish (hatchery and natural-origin) and a Yakima River Basin harvest of 1,854 fish (hatchery and natural-origin). These goals would increase over time as habitat improves within the basin. If properly functioning conditions within the basin reach 100%, then annual natural escapement could reach 47,377 adults (YN 2010b).

Fisheries targeting spring Chinook salmon in the Yakima River may also take listed steelhead. Regulations that are currently in place require the release of all steelhead in all non-tribal fisheries. A Fisheries Management and Evaluation Plan (FMEP) for recreational fisheries within the Yakima River Basin has been submitted to NMFS for concurrence under limit 4 of the 4(d) rule. Monitoring of the Tribal fisheries and sport fisheries show that harvest of steelhead does not occur but some sport catch record cards show harvest of steelhead in the Yakima River. The steelhead harvest level is very low, fewer than 15 fish annually, with the majority of these assumed to be reporting errors.

Spring Chinook salmon broodstock are collected from mid-April through September at the Roza adult monitoring facility located on the Yakima River (RM 127.9) (Figure 1). All returning CESRF fish are sampled for biological characteristics and marks and returned to the river with the exception of fish collected for experimental sampling, supplementation group broodstock, and for the HC line broodstock. Beginning in 2007, the project has been attempting to DNA sample every spring Chinook salmon passing upstream through the Roza adult monitoring facility for a long-term parent-progeny pedigree analysis. Due to logistical constraints at the facility, this may not be possible in all years. Adult steelhead run timing at Roza Dam is generally February through early May.

The program uses natural-origin spring Chinook salmon for broodstock collected at Roza Dam. During the adult spring Chinook salmon operations at Roza Dam, fewer than 25 steelhead are encountered annually. The Roza Facility is operated from mid-December to mid-September. All steelhead and spring Chinook salmon are sent down a flume into an anesthetic tank. When anesthetized, bio-data is collected including sex, length (fork and POHP), and weight, then scale and tissue samples (small fin clip) are taken and finally the fish are PIT tagged. Those sampled fish not being collected for broodstock are then placed into a recovery tank and released back into the river.

The CESRF is operated year-round and uses a combination of surface and groundwater. The surface water requirement is 32.6 cubic feet per second (cfs) (14,640 gallons per minute), which is supplied from the Yakima River via a pump intake that is screened to NMFS criteria (NMFS 2008a). Groundwater wells supply water for incubation, to control temperatures within hatchery, and to limit the amount of surface water removed during periods of low river flows. Surface water and groundwater used in the hatchery for rearing and adult holding is released into Ox Bow Lakes. The Ox Bow Lakes are a connected side channel to the Yakima River that was created when an oxbow of the Yakima River was cut off by the construction of the Burlington Northern Railroad. Water from the Ox Bow Lakes returns to the Yakima River approximately 7,000 feet below the hatchery intake. The hatchery intake is used to provide minimum flows in Ox Bow Lakes to maintain fish and wildlife habitat and the pumping of groundwater for the hatchery supplements flows in the Ox Bow Lakes and the Yakima River. During cleaning

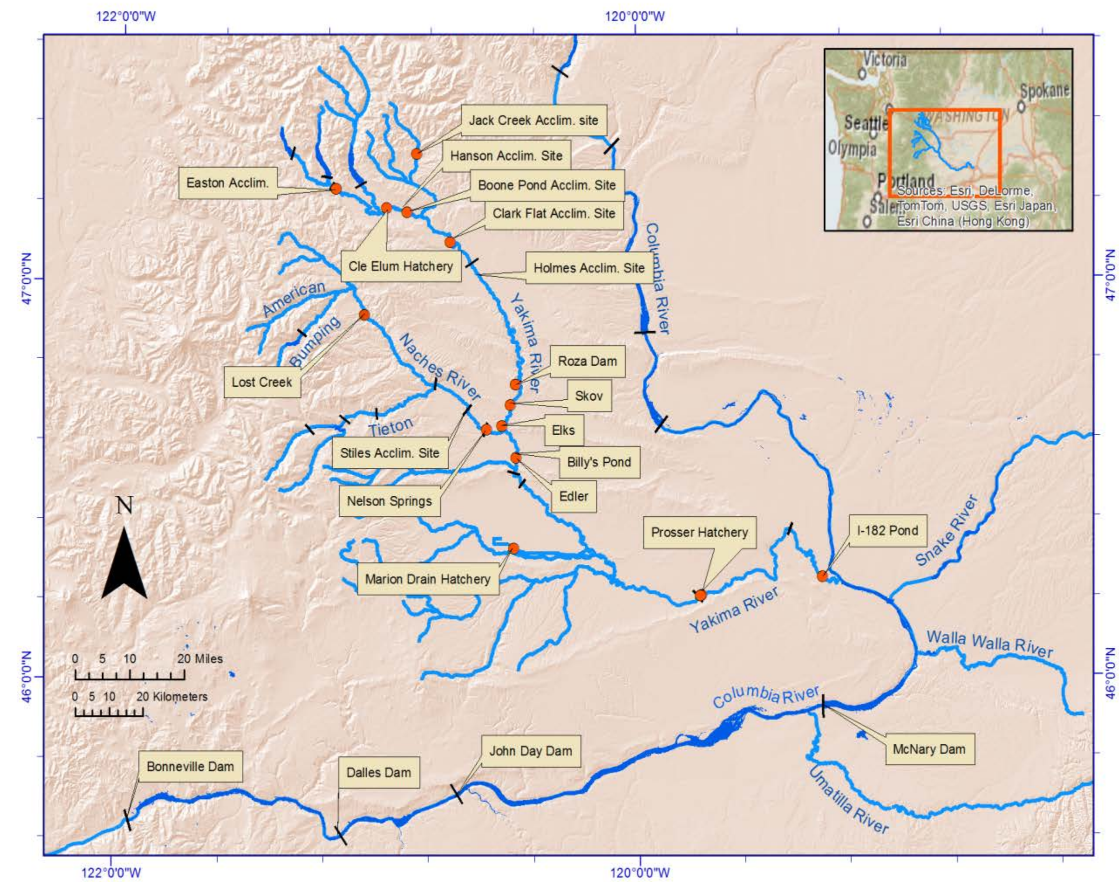

Figure 1. Yakima River Basin and Yakima/Klickitat Fisheries Program hatchery facilities.

operations, the rearing water is passed through the Cleaning Waste Ponds to settle out solids, before being released into the Ox Bow Lakes.

Green eggs are incubated and juveniles reared on station at the CESRF; however, smolts are not released from the CESRF. Juvenile spring Chinook salmon are transferred from the CESRF to three acclimation ponds throughout the Upper Yakima River Basin: Easton, Jack Creek, and Clark Flat (Figure 1). Each acclimation facility includes a screened river intake, six raceways, a cleaning waste basin, service building with office and storage, generators for primary or backup power, and a computerized system to monitor physical processes such as water flows and temperatures. Each facility uses up to 8.7 cfs of water during acclimation. Intake screens were upgraded in 2007 to fix icing and debris issues and to meet NMFS screening guidelines (NMFS 2008a). Fish are generally transferred to the acclimation facilities in mid-January to acclimate for 4-6 weeks prior to the beginning of volitional release around March 15. Spring Chinook salmon are volitionally released from March 15 until May 15 when the remaining fish are forced out of the ponds. Size at release averages 120 mm (Temple et al. 2011). Timing of release is based on YKFP on-going studies conducted since the early 1990s in the upper Yakima River Basin.

The Easton acclimation facility is located upstream of the CESRF at RM 198.6 on the Yakima River. The Easton acclimation facility pumps water from the Yakima River and returns the water approximately 30 feet downstream from the hatchery intake. The facility is operated beginning in January and must be shut down by the end of May per the water withdrawal permit (S4-32567).

The Jack Creek acclimation facility is located on the North Fork Teanaway River at RM 6.4. The facility is supplied by a gravity diversion system. A retractable weir system in the river raises the river level during periods of low flow to force water into the screened intake structure. A groundwater collector piped into the intake structure can be activated to provide a limited quantity of groundwater if the river water system is not producing enough water. Flows in Teanaway River are reduced over a distance of 300 ft, from the intake to the acclimation facility outfall. The river water is operated under water withdrawal permit S4-32572. The facility is generally used from January to May, but in recent years it has been used between March and May.

The Clark Flat acclimation facility is located downstream from the CESRF on the Yakima River at RM 166.6 and is the only facility used for the HC spring Chinook salmon production, but also includes some supplementation production as well. The Clark Flat acclimation facility uses water from the Yakima River that passes through the intake screen into a sump where it is pumped to the raceways. A groundwater collector piped into the sump can be activated to provide a limited quantity of groundwater if the river water system is insufficient. The outfall for the facility is approximately 150 feet downstream from the intake structure. The Clark Flat facility is operated under water withdrawal permit S4-32568. Water removal at levels as low as expected at this site do not impair fish passage. The facility is generally used from January to May as described above.

All production is 100% marked using adipose fin-clips, coded-wire tags (CWT), passive integrated transponder (PIT) tags, and visual-implant elastomer tags in combination for monitoring and evaluation purposes. Marking schemes vary by brood year and are described in annual reports.

1.3.2. Yakima River Summer and Fall-Run Chinook Salmon Program

The purpose of the Yakima River Summer and Fall-run Chinook Salmon Program is to increase harvest and the natural spawning of Chinook salmon in the Yakima River with the ultimate goal of establishing a sustainable natural population of summer/fall Chinook salmon within a 25-year time frame (YN 2012a). Fish for the summer/fall Chinook salmon program come from a number of locations inside and outside the Yakima River Basin and are reared at the Prosser Hatchery and the Marion Drain Hatchery and released at multiple locations within the middle and lower Yakima River Basin. The Master Plan (YN 2012a) identifies goals for the summer/fall Chinook salmon program for the long-term and during the transition period as hatchery facilities are constructed and upgraded. The program will have two purposes: conservation and harvest. The goal of the conservation program is to re-establish a summer/fall run of Chinook salmon in the Yakima River upstream of Prosser Dam. The goal of the harvest program is to improve the performance of the URB fall Chinook salmon releases in the lower Yakima River downstream of Prosser Dam.

Currently, there are three parts to the program. These include fall Chinook salmon spawned and reared at Prosser and Marion Drain hatcheries, a part that releases summer Chinook salmon from broodstock collected at Wells Dam or Wells Hatchery, and a third part that currently receives 1.7 million URB fall Chinook salmon from LWS NFH for release at Prosser Hatchery. Total releases from all three parts are generally less than 2.7 million smolts. The COE, to meet JDM goals, would increase the 1.7 million segregated program releases up to 4.0 million that would be released at the proposed I-182 facility (Figure 1).

The locally-adapted fall Chinook salmon are collected at Prosser Dam (and in the future at Sunnyside Dam) and would continue to be reared at Prosser Hatchery and released at locations in the Yakima River above Sunnyside Dam. The release goal for this part of the program is 100,000 to 500,000 smolts annually. The summer Chinook salmon program would continue to use collections at Wells Dam and Wells Hatchery for broodstock and for eyed eggs that would be reared at Prosser Hatchery and Marion Drain Hatchery. The release goal for this part of the program is 100,000 to 500,000 smolts annually. After the upgrades to the Marion Drain Hatchery are completed, all of the summer Chinook salmon would be reared at that facility.

To develop a locally-adapted broodstock, fish will be collected in the following order: (1) natural-origin returns; (2) hatchery-origin returns; and (3) imported broodstock. The goal is to use only natural-origin returns for broodstock. The summer-run fish are expected to return as adults earlier in the year and spawn higher in the basin than the later arriving fall-run Chinook salmon. The hatchery program will not mix the summer-run and fall-run Chinook salmon; they will be incubated, and reared separately. However, it is expected that spawning by the two population components will overlap in the basin and will be managed as a single bimodal population.

In the past, broodstock for the 1.7 million URB fall Chinook salmon program was collected at the LWS NFH; to improve the performance of the segregated harvest portion of the program, broodstock would be collected from returns to Priest Rapids Hatchery and the Priest Rapids Dam fish ladder. Fish from these locations are more representative of the fish that return to this part of the Columbia River Basin. These will continue to be reared at LWS NFH until upgrades at Prosser Hatchery are completed (YN 2012a).

The Master Plan (YN 2012a) describes the harvest goal for the integrated summer/fall Chinook salmon program as temporally and spatially expanding fishing in the Yakima River to historical patterns. The long-term harvest goal for the segregated harvest program part is 18,000 adults to all fisheries, and the near-term goal is 6,000 adults to all fisheries. The level of out-of-basin harvest of fall Chinook salmon from the program has not been determined. Ocean and mainstem Columbia River harvest rates for URB fall Chinook salmon have ranged from 33% to 73% for the period 1989-1996. Tribal harvest in the Yakima River Basin is minimal. Sport harvest varies greatly. Sport harvest has ranged from 34 in 1998 to a high of 2,300 adults in 2002 – recent harvests have averaged around 500 adults.

Broodstock for the local fall Chinook salmon program are currently collected from several locations: (a) the Prosser Dam right-bank Denil ladder[2] and fish trapping facility; (b) from fish seined in Chandler Canal during maintenance operations; (c) from a Denil ladder at the Prosser Hatchery outlet stream; and (d) a fish wheel in Marion Drain. In the future, broodstock may also be collected at a new adult collection facility at Sunnyside Dam. It is anticipated that up to 600 Chinook salmon adults would be collected annually for the in-basin summer/fall part of the program, currently the goal is to collect 250 adults (125 females and 125 males (BPA 2012e) with the summer Chinook salmon adults being collected at Wells Hatchery or at Wells Dam. The collection and sampling of listed summer steelhead for monitoring purposes also occurs during the time that fall Chinook salmon broodstock are collected. The steelhead that will be sampled at the right-bank Denil ladder and trap represent a small portion of the steelhead passing over Prosser Dam (<15% of the total past Prosser Dam). These steelhead will be sampled for marks and biological data prior to returning to the river as part of the basin-wide monitoring program. Steelhead may also be handled as fall Chinook salmon are seined from the dewatered section of the Chandler Canal from the headgate to the screens during the maintenance period. In the past less than 5 steelhead have been handled annually during fall Chinook salmon broodstock seining in Chandler Canal.

Broodstock collection for the segregated program at the LWS NFH was analyzed in a separate ESA section 7 consultation (NMFS 2007b). As described above, broodstock source for this part of the program is transitioning to collection at Priest Rapids Dam fish ladder and from returns to the Priest Rapids Hatchery and will be a small part of the broodstock collected for the larger URB fall Chinook salmon program at Priest Rapids Hatchery. Impacts on ESA-listed species from operation of the fish ladder trap and broodstock collection facility at Priest Rapids Hatchery will be addressed in a separate consultation.

The Master Plan (YN 2012a) identified three potential acclimation, release, and adult trapping sites in the lower Yakima R. for the segregated program: Horn Rapids Park (RM 14.0), Barker Ranch (RM 9.5), and I-182 pond (Figure 1; RM 3.0). Appendix J of the Master Plan (YN 2012a) included a complete description and preliminary engineering evaluation of the three potential sites for a release of 1.7 to 3.0 million subyearling fall Chinook salmon. Coincident with the development of the Master Plan, the COE has been negotiating with the *U.S. v Oregon* parties regarding John Day Mitigation (JDM). As the COE owns the land adjacent to and including the I-182 pond (Figure 1), these negotiations have included additional engineering evaluation of this site for a release of up to 4.0 million fall Chinook salmon (an expansion of the existing 1.7 million subyearling release program to accommodate agreed-to production levels in the JDM negotiations), which could be a combination of sub-yearling or yearling smolts.

Water for the I-182 facility would come from well water and from water pumped from the Yakima River. Adult fall Chinook salmon would volunteer into the facility up a fish ladder, where they would be spawned and the eggs taken to Prosser Hatchery (in the near term, and Ringold Springs Hatchery in the future) for rearing. No steelhead are expected to be handled during broodstock collection because they are not expected to volunteer into the facility. The effects of the operation of the proposed site are included in the proposal.

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[2] A Denil fishway or ladder is a type of fishway design that used a series of baffles in a channel to redirect the flow of water so that fish swim around the baffle to ascend over the barrier.

Fall Chinook salmon brood are maintained and spawned on site at the Prosser Hatchery. Currently green eggs are incubated and reared on-station with a small proportion incubated and reared at the Marion Drain facility. Presently the program is rearing 350,000 fall Chinook salmon for release as subyearlings and 30,000 to be released as yearlings. Currently, all of the summer Chinook salmon are reared and released as subyearlings. After improvements to Prosser Hatchery and Marion Drain Hatchery, all production for the integrated harvest/conservation program would occur in the basin with the fall component of the summer/fall Chinook salmon program being reared at Prosser Hatchery and the summer component being reared at the Marion Drain facility. The lower river segregated URB fall Chinook salmon portion of the program would likely be reared at Prosser Hatchery in the near-term but will likely transition to Ringold Springs Hatchery in the mid-to-long term pending final outcome of negotiations with the COE and engineering specifications for expanded JDM production. The Master Plan (YN 2012a) describes a program for the early summer/fall Chinook salmon that would produce a total of 500,000 fall-run Chinook salmon (100% subyearlings) and 500,000 (250,000 subyearlings and 250,000 yearlings) or 1,000,000 (subyearling) summer-run smolts annually.

Water for Prosser Hatchery comes from Chandler Canal, downstream of the irrigation screens, and from wells on-site under water permits #G4-34946, and #G4-33055. The Master Plan (YN 2012a) includes as part of the upgrade to the Prosser Hatchery a proposal to install screens and a pump system to pump water from the Yakima River to provide water for the facility during 3 to 4 weeks in November – December when Chandler Canal is out of operation for maintenance. The intake for this surface water system would be immediately upstream of the hatchery outfall and would pump up to 7 cfs during the maintenance period.

The Marion Drain Hatchery is located on the Yakama Nation Reservation and is operated under Yakama Nation water withdrawal permits #2010-53 and #2010-06. The Marion Drain facility pumps water from the Marion Drain and gets water for incubation from two wells. The intake screen is located approximately 180 feet above the hatchery outfall. Impacts on listed steelhead would not be expected to occur because even though spawning occurs in Marion Drain, water quality is not adequate to support steelhead juvenile rearing. All screens currently meet NMFS criteria.

Summer/fall Chinook salmon would be released from a number of sites in the Naches and upper Yakima River including Prosser Hatchery and Marion Drain Hatchery. Currently, the goal is to release 350,000 fall Chinook salmon subyearling smolts on station at Prosser Hatchery. Up to 30,000 fall Chinook salmon yearling smolts will be acclimated and released from Stiles Pond (Figure 1). Stiles Acclimation Pond is located at RM 3.7 on the Naches River and is a ¾ acre pond supplied with water from the existing Chapman Nelson irrigation canal system. Flow is maintained at a minimum of 2.5 cfs. In addition to fall Chinook salmon, approximately 250,000 summer-run Chinook salmon could be acclimated at Stiles Pond. Acclimation would occur from February to April and the fish would be volitionally released beginning in early April. The actual number of smolts acclimated will vary due to production changes and evaluation needs but is not expected to exceed 250,000 smolts annually.

Nelson Springs Acclimation Pond located off the Naches River (RM 4), uses a standard mobile acclimation unit that is 20 feet long, 4 feet deep and 5 feet wide. The water is gravity fed from natural springs that are supplemented with irrigation return water. The outfall water from the pond along with the irrigation return flow travels a short distance to the Naches River (Fiander and Blodgett 2011).

Other acclimation ponds that may be used for acclimation of summer/fall Chinook salmon include Elks Pond, and Skov Pond (Figure 1). Elks Pond is located at RM 117 and Skov Pond is located at RM 112.5 on the mainstem Yakima River. These ponds are being investigated for use to acclimate summer-run Chinook salmon juveniles; however, other sites are being examined above Stiles Ponds in the Naches River Subbasin and above Selah in the Yakima River. Elks Pond empties into a creek that enters the Yakima River under the North 1st Bridge in Selah, Washington. A screen or net is placed near the top of the creek to prevent smolts from entering the Yakima River prematurely. Skov Pond is connected to the Yakima River by a six inch PVC underground pipe. Smolts in Skov Pond would be kept in a net-pen, and at the time of release a connection to the underground pipe would be made from the net-pen to allow access to the river. The fish would be acclimated from mid-March and volitionally released between mid-April and mid-May.

Beginning in 2012, a mobile acclimation pond was installed on top of Roza Dam to evaluate the survival of summer Chinook salmon acclimated and released from this location. Each vessel is 20 feet long, 4 feet deep and 5 feet wide. The water is pumped from above Roza Dam into the ponds cycles between 60 and 90 gpm (Fiander and Blodgett 2011). The pumps are operated using screens that meet NMFS criteria and return water to the Yakima River near the intake.

Another potential site for acclimating summer Chinook salmon is Billy's Pond. The pond is located adjacent to the Yakima River at RM 113. This five acre pond is fed by hyporheic flows (water from underground sources and from an adjacent streams that seeps into the pond though interstitial spaces in the gravel) and is connected to the Yakima River via a culvert under the Yakima Greenway Path. The pond and surrounding area is in the process of being rehabilitated and the culvert will be replaced to improve connectivity passage to the Yakima River.

A proportion of the juvenile fall and summer-run Chinook salmon released from all of these facilities would be given PIT tags to evaluate passage and survival from the different ponds. Currently fall Chinook salmon production for the harvest portion of the program is released on-station at Prosser Hatchery, the Master Plan (YN 2012a) proposes to develop an acclimation site in the lower Yakima River below Horn Rapids Dam to improve survival and contribution to the fisheries (see description above).

The program proposes to mark all 200,000-500,000 summer Chinook salmon with a CWT only; no other summer or fall Chinook salmon returning to the Yakima River Basin will have a CWT with an adipose fin present. The approximately 1.7 million harvest-group fall Chinook salmon production will 100% be adipose fin-clipped with 250,000 of these also given a CWT. Beginning in 2008, all of the in-basin fall Chinook salmon have been 100% marked either with a PIT tag or adipose fin-clip; this will continue and a portion will also be given a CWT.

1.3.3. Yakima River Coho Salmon Program

Coho salmon in the Yakima River were extirpated by the early 1980s. Beginning in the mid-1980s through the early 1990s, approximately 700,000 coho salmon smolts were transferred, from the lower Columbia River, and released annually into the Yakima River below the Wapato irrigation diversion. Coho salmon were also released above the Wapato Irrigation diversion in Wide Hollow Creek, and Cowiche Creek. In 1996, expansion of the program was included in the Yakima-Klickitat Fisheries Project with the goal of determining the feasibility of re-establishing a naturally self-sustaining spawning population and a substantial fall fishery for coho salmon in the Yakima River Basin. Phase I of the project moved release sites above the confluence of the Yakima and Naches rivers. Phase I was completed in 2003 and considered successful.

Phase II is currently ongoing, and the goal is to increase spawning in the tributaries and use fish reared from locally collected broodstock. Fish for the Yakima River coho salmon program would be collected at a number of locations, reared at Prosser Hatchery and at a proposed new facility at Holmes Ranch then released at a number of locations in the middle and upper Yakima River Basin as summer parr, smolts, and in some areas as adults. Some local broodstock has been collected at Prosser Dam since 1997, with the balance of the 1.0 million smolt production coming from Eagle Creek NFH and Washougal Fish Hatchery. A Master Plan for the coho salmon program has been released (YN 2012a) and describes the Phase III and Phase IV goals for the program. The current operation of the program is described in (BPA 2012e).

Phase III, as proposed in the Master Plan (YN 2012a) has the primary goal to provide fish for harvest. The goal will be accomplished by implementing both segregated and integrated hatchery programs in the basin. The segregated program component will be located at Prosser Hatchery on the lower Yakima River and the integrated program will be located at the planned Holmes Ranch Hatchery on the upper Yakima River. The segregated program will release 500,000 smolts (at 15 fish per pound (fpp)) downstream of Prosser Dam using broodstock collected at Prosser Dam and Prosser Hatchery. The integrated program will support increasing the distribution of coho salmon in the tributaries by outplanting parr, releasing smolts that have been acclimated in temporary acclimation ponds, and by outplanting adults. The integrated program will rear and release 500,000 parr (at 100 fpp) and up to 300,000 smolts (at 20 fpp) in the upper Yakima and Naches rivers using broodstock collected at Roza or Sunnyside dams. The major changes in the program would be that (1) all fish culture activities will occur in-basin and (2) the program will transition to locally adapted broodstock at ever increasing rates as natural-origin fish become available. In 2010 and 2011, a portion of the eyed eggs (approximately 150,000) from the broodstock spawned at Prosser Hatchery were reared at Eagle Creek NFH. This is expected to continue until improvement at Prosser Hatchery and the construction of the Holmes Ranch Hatchery are completed. The rearing of coho salmon at Eagle Creek NFH has already completed ESA section 7 consultation (NMFS 2007b).

The Master Plan (YN 2012a) identifies harvest goals under Phase III and Phase IV. The Phase IV goal is to support an average annual harvest of 20,000 coho salmon adults in ocean and freshwater fisheries, with 8,000 of these harvested in Zone 6 and Yakima River fisheries. The first step, however, is to protect fish from harvest so that a locally-adapted broodstock can be developed as soon as possible. To help accomplish this, hatchery coho salmon originating from the localized broodstock will be given a CWT but not externally marked. Out-of-basin production from Eagle Creek NFH (and other sources) will be adipose fin-clipped. Marking regimes will be re-evaluated and specific numerical objectives for harvest may be established as part of the long-term Master Plan. The WDFW has monitored the recreational coho salmon fishery near the mouth of the Yakima River since 1998. The in-basin fishery is managed to not exceed 10% of the escapement to the mouth of the river, and the co-managers work to establish geographic boundaries and season length. WDFW also bio-samples coho salmon caught in the fishery.

Regulations that are currently in place require the release of all steelhead in all non-tribal fisheries. An FMEP for recreational fisheries within the Yakima River Basin has been submitted to NMFS for concurrence under limit 4 of the 4(d) rule. Monitoring of the Tribal fisheries and sport fisheries show that harvest of steelhead does not occur but some sport catch record cards show harvest of steelhead in the Yakima River. The level is very low, less than 15 fish annually, and is assumed to be due to reporting errors.

Broodstock collection for this program presently occurs at the Prosser Dam right-bank adult Denil ladder and trap and from the Denil fish ladder at the Prosser Hatchery outfall. These fish are supplemented with production from Eagle Creek NFH. As described above, broodstock collection for the segregated program is not expected to change, the integrated program will collect broodstock at Roza Dam on the upper Yakima River, at Sunnyside Dam upstream of Prosser, and possibly in the future at the Cowiche or Wapatox dams on the Naches River. The current goal is to collect 830 local-origin adults (415 females and 415 males) (BPA 2012e) to meet a production goal of 500,000 smolts. In addition, up to 500,000 smolts will come from the Eagle Creek NFH. In the future the broodstock goal would be to collect up to 1,000 adults to meet the 1.3 million production goal (500,000 smolts for the segregated program and 500,000 parr and 300,000 yearlings for the integrated program) (YN 2012a). Under Phase IV, total production all from in-basin broodstock would be 800,000 smolts (YN 2012a).

In addition to adult coho salmon collected for broodstock, the program also outplants adult coho salmon collected at Prosser Hatchery into a number of tributaries throughout the basin. The releases are part of research to determine egg-fry survival and to evaluate the success of naturally spawning hatchery-origin adults. The primary release location has been Taneum Creek where the goal was to outplant 50 female and 50 male coho salmon adults into each of three 100 meter sections (Newsome 2012). The actual numbers outplanted varied by year due to adult availability. In addition, 20 pair of adult coho salmon were outplanted in other tributaries including Nile Creek and the SF Cowiche Creek, tributaries to the Naches and Little Naches River, Wilson Creek in the upper Yakima River, and Ahtanum Creek a tributary to the middle Yakima River (Newsome 2012). Adults were only outplanted into Taneum Creek in 2010 and 2011due low adult abundance. The use of adult outplants will be expanded as appropriate habitat is identified and will primarily focus on tributaries where bull trout and steelhead are more abundant.

Phase III will initiate more wide spread adult coho salmon outplants. Adult in-basin coho salmon from Prosser Hatchery will be transported to select tributaries in both the Upper Yakima and Naches Rivers. The preliminary results of the Taneum Creek adult reintroduction have shown great spawning success and little to no impact on juvenile *O. mykiss* (Temple et al.). Adult coho salmon will be used to augment parr plants and reestablish runs in sensitive systems that may have bull trout and/or steelhead present.

Brood fish will be held and spawned at the Prosser Hatchery. In the future, adults will also be held and spawned at the Holmes Ranch Hatchery. Juveniles are reared to the presmolt stage at Prosser Hatchery and transferred to up-river acclimation sites for release.

Coho salmon parr from the locally-adapted broodstock have been scatter-planted at the end of July in a number of tributaries since 2007. Parr plants were initiated to measure the tributary conditions and to evaluate over-winter survival of the parr life stage. Up to 42,000 parr have been out-planted annually with 3,000 PIT tagged coho being released at each location. In Phase III up to 500,000 parr will be outplanted annually with up to 10,000 released at each location. Parr releases will focus on tributaries in tributaries throughout the Upper Yakima and Naches Rivers. Numbers of coho salmon released will depend on a number of factors that include, Phase II survivals, habitat conditions and sensitive species within the tributaries. Parr releases will focus on tributaries where bull trout and steelhead are not present or at low abundance. Tributaries in the upper Yakima River where parr could be released include Crystal Springs/Easton-Keechelus Reach, Big Creek, Upper Cle Elum River (above Lake Cle Elum), Reecer Creek, and Wilson Creek. Tributaries to the Naches River include North Fork Little Naches, Little Naches River, Quartz Creek (Naches River), Upper Bumping River (above Bumping Lake), Nile Creek, Little Rattlesnake Creek, Cowiche Creek and others as habitat becomes available (Newsome 2012).

Production from non-local broodstock and the remaining locally-adapted broodstock will be acclimated and released from a number of acclimation ponds. Currently, up to 100,000 of the locally adapted production will be released at Stiles Pond, up to 86,000 at Lost Creek Acclimation Pond, up to 50,000 at the Holmes Acclimation Pond, up to 50,000 at Easton Pond, and up to 100,000 at Prosser Hatchery (BPA 2012e). In addition Eagle Creek NFH coho salmon smolts have been acclimated at Boone Pond. The actual release numbers will vary depending on final production numbers from both Prosser Hatchery and Eagle Creek NFH (YN 2012a).

Stiles Pond is a ¾ acre pond is on private property about ½ mile from the Naches River (RM 9) and is supplied with water from the existing Chapman Nelson irrigation canal system. Flow is maintained at a minimum of 2.5 cfs.

Lost Creek Pond consists of two ponds adjacent to the Naches River (RM 39). These are privately owned earthen ponds that were constructed in the early 1980s. The ponds are divided into two sections connected by a cement fish ladder. Water is provided from a privately operated gravity flow intake in the river, the minimum flow of 5 cfs is maintained.

Nelson Springs Acclimation Pond and the mobile acclimation pond on the top of Roza Dam, as describe above in Section 1.3.2, are also used for the acclimation and release of coho salmon production.

Holmes Ponds are located near Ellensburg, WA, and are a series of large, deep ponds used for acclimating coho salmon, with two water-check structures that can be used to manipulate flows through the system, which is supplied with up to 10 cfs ground water. The ponds also supplemented with water from the New Cascade Canal fish by-pass. These ponds will be part of the proposed Holmes Ranch Hatchery facility.

Easton Ponds are two old gravel pits owned by the Washington Department of Transportation that are adjacent to the Yakima River, and are the uppermost acclimation sites in the basin. The water source is the Yakima River which flows through the ponds and reenters the river though an outlet channel. A barrier net divides the two ponds.

Boone Pond is a shallow side channel of the Yakima River downstream from the CESRF at RM 180. The side channel is netted off at both ends to hold coho salmon during acclimation.

In addition to smolts that are acclimated and released as described above, 5,000-10,000 coho smolts are annually released from mobile acclimation units into South Fork Cowiche Creek and Rattlesnake Creek (YN 2012a). These releases are designed to increase distribution and abundance of adult spawners and to evaluate smolt-to-smolt survival. Each vessel is 20 feet long, 4 feet deep and 5 feet wide. The water is pumped from the adjacent creek into the ponds that typically cycle 60-90 gpm (Fiander and Blodgett 2011). The pumps are operated using screens that meet NMFS criteria and return water to the creek immediately downstream from the intake. The Rattlesnake Creek unit is operated under a temporary water right (S4-35257, expires 2015), and the South Fork Cowiche Creek unit is operated under water right S4-35210 which expires in 2014. The Cowiche Creek site has had two years of operation whereas the Rattlesnake operation started in 2010 (Fiander and Blodgett 2011). Both sites begin acclimation in late February and fish are released in early to mid-April. The goal is to acclimate the fish for a minimum of 4 weeks. In addition to the two mobile acclimation ponds, 17,000 coho salmon summer parr will be raised at the LaSalle Hatchery on the LaSalle High School grounds in lieu of mobile rearing as part of a cooperative project with the school (YN 2012a). The LaSalle High School spawns adults collected by the YN in the fall, and rears and PIT tags the resulting offspring, which are scatter-planted in Ahtanum Creek in May as summer parr. The small facility uses well water and a recirculating system for rearing the coho salmon.

In the past, 100% of all the hatchery-origin coho salmon were adipose fin-clipped and given a CWT. Under the Proposed Action, 100% of the hatchery fish are marked so that they can be distinguished from natural-origin fish. Coho salmon produced for the integrated part of the program will be given a CWT only. Fish from the segregated program will be 100% adipose fin-clipped and a proportion will also be given a CWT.

1.3.4. Monitoring and Evaluation Activities

ME&R activities directly and indirectly take listed MCR steelhead and are described in Sections 11 and 12 of the HGMPs. The CESRF was authorized under the NPCC's Fish and Wildlife Program with the stated purpose being "to test the assumption that new artificial production can be used to increase harvest and natural production while maintaining the long-term genetic fitness of the fish population being supplemented and keeping adverse genetic and ecological interactions with non-target species or stocks within acceptable limits." In order to meet the project's stated purpose, ME&R is an integral component of the program. The take of adult and juvenile MCR steelhead in all ME&R activities is described in the Yakima Fisheries Project

M&E report (project #1995-06325) and in the Steelhead VSP Project report (project # 2010-030-00)(BPA 2012d; 2012c; 2012a; 2012b). These studies also monitor and evaluate the Performance Indicators identified in Section 1.10 of the HGMPs and are needed to monitor the status of the threatened Yakima River steelhead populations to determine if the proposed hatchery programs are adversely affecting the listed populations.

There are a number of activities that support ME&R of the hatchery programs and the status of the steelhead populations in the Yakima River.

Chandler Juvenile Monitoring Facility (CJMF)

The CJMF is operated annually from December to July and is used to collect baseline data, enumerating every salmonid species, rearing type, and for spring Chinook salmon, all marks and mark locations. Biological information is collected daily from a subsample of approximately 100 fish. Data collection will include, but is not limited to, length, weight, age, and DNA. These data are used to estimate out migration timing, and egg-to-smolt survival rates for all species. Up to 16,000 juvenile steelhead are estimated to pass though the facility annually and up to 100% may be sampled and tagged (Table 1).

Roza Dam Adult Trapping

The Roza Dam adult trap is operated from mid- December to mid-September and is used to enumerate the total number of spring Chinook salmon, coho salmon, and steelhead returning to the upper Yakima River annually. This facility is also used to collect broodstock for the spring Chinook salmon program and to remove HC group spring Chinook salmon from the river to evaluate the long-term effects from an integrated hatchery-origin program using 100% natural-origin broodstock. Biological information collected from adults trapped at the facility will include, but is not limited to, fork length (FL), post orbital-to-hypural length (POHL), weight, age (scales), sex, and DNA. Visual marks, fin-clips, elastomer marks and CWT placement are also recorded. It is estimate that up to 1,000 summer steelhead adults could be handled and of these up to 1,000 would be sampled and tagged (Table 2).

Roza Dam Juvenile Sampling

Juvenile out-migrants are sampled from the juvenile bypass at Roza Dam. The goal is to capture and PIT tag 7,800 hatchery and 4,200 natural-origin spring Chinook salmon smolts to estimate smolt-to-smolt survival to the CJMF and to lower Columbia River projects. Up to 3,000 coho smolts will also be captured and PIT tagged. The Roza Dam juvenile fish bypass trap is generally operated from mid-March to the end of April. During juvenile sampling, up to 400 juvenile *O. mykiss* will also be handled, and up to 400 will be PIT tagged.

Rotary Trapping for Juvenile Sampling

Rotary screw traps will be operated in Satus, Ahtanum, and Toppenish creeks annually from November 1 to June 30th to sample outmigrating juveniles. A box trap at the Wapatox Diversion Dam on the Naches River will be operated from April 1through May 31. Trapping is conducted to determine out migration timing and abundance and to monitor the ongoing status of populations in the subbasins where the rotary screw traps are operated. Electrofishing may also be used to collect juvenile *O. mykiss*. An estimated 8,000 juvenile *O. mykiss* could be handled and up to 7,000 would be sampled and tagged (Table 1).

Spawning Ground Surveys for Spring Chinook Salmon, Fall Chinook Salmon, Coho Salmon, and Steelhead

Regular foot and/or boat surveys are conducted within the established geographic range for each species (this is expanding for coho as acclimation sites are located upriver and the run increases in size). Redds are individually marked during each survey and carcasses are sampled to collect egg-retention, scale samples, sex, body length and to check for marks. Spring Chinook salmon surveys occur from July to October, summer/fall Chinook salmon surveys occur from September to November, coho salmon surveys occur from October to December, and steelhead surveys occur in the spring. Generally speaking, less than 2 adult steelhead are encountered during salmon spawning ground surveys. The number of steelhead observed during spring spawning surveys is variable and equates to approximately 20 percent of the redds observed. In recent years over 500 adult steelhead have been encountered annually (Table 2). No steelhead adults are handled during spawning ground surveys.

Table 2. Number of adult steelhead and juvenile *O. mykiss* encountered, sampled, and tagged, and anticipated mortality during monitoring and evaluation activities in the Yakima River Basin.

	Adult Steelhead				Juvenile *O. mykiss*				
Activity	Encountered	Sampled	Tagged	Mortality	Encountered	Sampled	Tagged	Mortality	Notes
Chandler Juvenile Monitoring					16,000	16,000	16,000	<500	
Roza Dam Adult Trapping	1,000	1,000	1,000	<5					
Roza Dam Juvenile Monitoring					400	400	400	<10	
Rotary Screw Traps					8,000	7,000	7,000	<140	
Spawning Ground Surveys									
Chinook and Coho (observed)	5								
Steelhead Surveys (observed)	500								
Prosser Dam Adult Trapping	1,000	1,000	1,000	<5					
Radio Tracking for VSP			500						1
Sunnyside Dam Broodstock Trapping	300			<5					
Coho Broodstock Collection (Cowiche or Wapatox dams)	10			<2					
Coho Snorkel Surveys (observed)					5,000				
Coho Presence Surveys									
Boat Electrofishing					2,000	1,700		<40	
Backpack Electrofishing					2,000	1,700	500	<40	
Piscivorous Fish Monitoring	10								
Spring Chinook Habitat Monitoring									
Backpack Electrofishing					50				
Snorkel Surveys (observed)					3,000				
Spring Chinook PIT tagging					4,000				2
Precocious Male Monitoring (observed)					40				
Ecological Interactions Monitoring					8,000	3,000	3,000	<30	
Domestication Selection					180	120	120	<3	
Steelhead VSP PIT Tagging									
Upper Yakima River					10,000	10,000	10,000	<100	

Naches River					10,000	10,000	10,000	<100	
Acclimation Pond Retention					30			<5	

Note 1: 500 radio-tagged adults from 1,000 collected at Prosser Dam.

Note 2: included in total for steelhead VSP PIT Tagging.

Prosser Dam Adult Trapping

Prosser Dam allows adult trapping at the right bank ladder only. Passage at the left, center, and right bank ladders will be monitored using video imaging (when not trapping), to allow counting of all adults that swim up the ladders. The adult trap is operated from early September to December for fall Chinook salmon and coho salmon monitoring and potentially for broodstock collection. To target steelhead, the trap will continue to be operated through June to sample across the migration period. Biological data that will be collected includes, but is not limited to, FL, POHL, weight, age (scales), sex, and DNA. The fish will also be examined for visual marks, fin clips, and CWT presence. It is estimated that up to 1,000 adult steelhead could be handled at the Prosser Dam right bank trap, and of these up to 1,000 would be sampled and up to 500 could be radio-tagged (see Radio-tagging Adult Steelhead below)(Table 2).

Coho Salmon Presence/Absence Snorkeling

Snorkeling surveys will be conducted to determine the presence or absence of juvenile coho salmon and to determine preferred rearing habitat (e.g., side channels and mainstem pools). In the Upper Yakima, 10 percent of the preferred habitat from Easton to Ellensburg will be systematically sampled. In the Naches River preferred habitat from the Little Naches River to the confluence will be sampled. Systematic sampling will also occur at all locations where juvenile coho salmon releases have occurred. All surveys will occur during summer lasting 3 days in each major subbasin and 1-2 days in each tributary. Potentially up to 5,000 juvenile *O. mykiss* could be observed/encountered during snorkel surveys (Table 2).

Coho Salmon Presence/Absence Electrofishing and Beach Seining

Backpack and/or boat electrofishing and beach seining are used to determine the presence or absence of coho salmon juveniles along with habitat utilization and to determine growth of parr coho salmon. In the mainstem Yakima River from Roza Dam (RM 128) downstream to Granger (RM 83), ten ½ mile reaches of preferred habitat are systematically sampled. One sample occurs in the summer and a second sample occurs in the fall. Backpack electrofishers will be used to sample backwater channel areas for over-wintering coho salmon juveniles. Areas that will be sampled include the Upper Yakima River mainstem (Easton Dam to Wilson Creek); Naches River mainstem (confluence to Little Naches River); Little Naches River (confluence to North Fork and the lower half mile of tributaries based on the presence of redds); and tributaries near adult and parr release areas. These surveys will be conducted 5 to 10 days per month from November to February with some areas not sampled every year. During these surveys it is estimated that between 25 and 100 *O. mykiss* juveniles per sample area would be handled and released. Potentially up to 4,000 juvenile *O. mykiss* could be encountered and up to 3,400 sampled (Table 2).

Habitat Monitoring – Sediment

The monitoring of sediment loads associated with operation of the dams and other anthropogenic factors (e.g., logging, agriculture, and road building), which can increase sediment loads in streams will occur on multiple reaches in Little Naches River, Bumping River, Naches River, and upper Yakima River drainages. During the collection of core samples, *O. mykiss* are not expected to be encountered.

Piscivorous Fish Monitoring

Piscivorous fish monitoring activities are designed to develop an index of predator response and predation on Yakima River spring Chinook salmon, coho salmon, and summer/fall Chinook salmon attributable to piscivorous fish in the lower Yakima River. Backpack and/or boat electrofishers will be used to capture and mark piscivorous fish to determine predator distribution and abundance. Small mouth bass will be captured and marked and the stomach contents will be removed and preserved. Monitoring will evaluate "hot spots" that included but are not limited to below Roza Dam, Wapato Dam, Sunnyside Dam, and Prosser Dam and Wanawish Dam juvenile bypass facilities. Typically 2-6 adult steelhead may be encountered by electric fields for a short period (Table 2). When adults are encountered shocking operations are halted. Adult steelhead are not handled during these activities. Juvenile *O. mykiss* are not encountered during these activities.

Spring Chinook Salmon Habitat Capacity

Backpack electrofishers will be used to estimate the abundance of rearing spring Chinook salmon fry in the Upper Yakima River Basin. Snorkel surveys will be conducted to measure feeding and agonistic strike distance and frequency of naturally produced spring Chinook salmon parr by parr length. An index of spring Chinook salmon juvenile habitat characteristics will be collected during snorkel surveys to estimate abundance. Up to 50 juvenile *O. mykiss* will be handled during electrofishing activities and up to 3,000 juvenile *O. mykiss* will be observed/encountered during snorkel surveys (Table 2).

Chinook Salmon Juvenile PIT tagging

Backpack electrofishers will be used to collect and PIT tag 2,500 juvenile spring Chinook salmon in the upper Yakima River Basin and 2,500 in the Naches River Subbasin. This data will be used to estimate overwinter survival, in basin passage survival and smolt to adult survival. Up to 4,000 juvenile *O. mykiss* will be handled and PIT tagged during these activities. These fish will be included as part of the targeted group of *O. mykiss* that are being PIT tagged as part of the Steelhead VSP Project described below.

Precocious Male Presence

Snorkel surveys will be conducted in areas where spring Chinook salmon spawn naturally to observe the presence of precocious male spring Chinook salmon and to determine the maximum upstream distribution of spring Chinook salmon in the North Fork Teanaway River. Up to 40 juvenile *O. mykiss* will be observed annually.

Ecological Interactions

This project looks at ecological interactions between native species not the target of supplementation (non-target taxa of concern) (NTTOC), which include *O. mykiss* and hatchery spring Chinook salmon and coho salmon. As part of this study, data are collected on the abundance of the NTTOC using backpack electrofishers in 29 tributary index sites, each 200m long. These sites include treatment and control areas in the Upper Yakima River (e.g., Taneum Creek – treatment; Swauk Creek – control), and in the Naches River (e.g., Nile Creek – treatment; Quartz Creek – control). A driftboat electrofisher will be used to capture NTTOC in 5 mainstem Yakima River index areas above Roza Dam. Length, weights, and condition of all fish sampled will be recorded and all fish will be checked for marks and tags. Up to 8,000 *O. mykiss* will be handled annually at all locations, and of these, 3,000 will be tagged. As described below, 1,000 will be PIT tagged in Taneum Creek, 1,000 in the Teanaway River, and approximately 1,000 known resident *O. mykiss* adults will be PIT tagged (Table 2).

In Taneum Creek, adult coho salmon spawning will be monitored inside and outside the three study sites. Backpack electrofishers will be used to capture coho salmon in 3 200m tributary index sites in Taneum Creek and these surveys will occur at the same time as the annual NTTOC surveys. Approximately 1,000 coho salmon juveniles and 1,000 *O. mykiss* will be PIT tagged in the fall for growth and spatial distribution monitoring.

In the North Fork Teanaway River approximately 600 *O. mykiss* will be PIT tagged along with 400 *O. mykiss* in the Middle Fork Teanaway River to test for differences in growth and spatial distribution between the treatment (North Fork Teanaway River with the Jack Creek release) and the Middle Fork Teanaway River as the control. Tagging will occur during the NTTOC sampling activities.

Hatchery Selection Research

At the CESRF an artificial spawning channel has been used to compare the behavior, spawning success, and juvenile production of natural-origin spring Chinook salmon, supplementation spring Chinook salmon, and spring Chinook from the HC group. These studies will be complete in the spring of 2014. Other studies are contemplated for the spawning channel beginning in 2014-2015, but these studies are still in the very preliminary proposal development stage. For the Naches River wild control evaluation, up to 10 pair of partially spawned natural-origin spring Chinook salmon are collected annually in late August to early September using 10 cm stretch or less gill nets, and landing nets. Snorklers are used to determine if steelhead and bull trout are present in the Naches River collection areas before sampling for natural-origin spring Chinook salmon occurs. No adult steelhead have been observed during these sampling activities. Juveniles from the three CESRF production groups will be exposed to natural predators to determine if there are differences between the three groups. Up to 120 juvenile *O. mykiss* are collected upstream of the Cle Elum hatchery intake and placed in net pens as part of a predation study. Juvenile *O. mykiss* are held for one week and then returned to the point of capture. Approximately 30-60 *O. mykiss* are encountered during sampling but are not captured (Table 2).

Steelhead VSP Project

As part of the VSP project, adult steelhead will be captured and radio tagged at Prosser Dam. The radio tagging will provide information on Upper Yakima and Naches spawning distributions; the extent, distribution, and contribution of mainstem spawning; estimate population specific adult escapement and spawner abundances in each population; and determine the efficacy of using GSI and PIT-tagging techniques for apportioning the total run at Prosser Dam. Radio tagging will also collect information on run-timing, pre-spawn migration and holding patterns, pre-spawning survival, spawn timing, number of redds per female, age structures, and surviving kelt rates. Up to 500 adult steelhead migrating past Prosser Dam will be collected from the right bank denil trap. Trapping will occur from early September to early May. The 500 adults are part of the approximately 1,000 adults that would be handled at the Prosser Dam right bank denil trap annually.

The other part of the VSP project is to PIT tag juvenile *O. mykiss* throughout the basin to estimate the proportion of anadromous and resident *O. mykiss* that are produced in tributaries. PIT tagging will occur in a number of tributaries and in the mainstem Yakima River. Tagging will occur in the spring when flow conditions permit and continue through early fall. Up to 10,000 juvenile *O. mykiss* from several tributaries to the Naches River will be PIT tagged. Backpack electrofishers will be used to capture and PIT tag *O. mykiss* juveniles: 1,000 in Swauk Creek; 1,000 in the West Fork Teanaway River; 1,000 in the Middle Fork Teanaway River; 1,000 in the mainstem Teanaway River; and 1,000 in Manatash Creek. Boat electrofishers will be used to capture and PIT tag juvenile *O. mykiss* in the mainstem Yakima River between river mile 132 and river mile 182 (upstream of Roza Dam). These fish will be tagged during the recapture sampling associated with mark-recapture population estimates. An additional 1,000 *O. mykiss* juveniles will be captured and PIT tagged upstream of Easton Dam river mile 203 to river mile 214.5. Bio-data will be collected from all juveniles sampled: location information, length and weight measurements, and a small fin clip for genetic sampling. Scales will be collected from 10% of the juvenile *O. mykiss* captured (approximately 500 from tributaries and 500 from the mainstem). In total, up to 12,500 juvenile *O. mykiss* juveniles will be sampled and PIT tagged annually in the tributaries, 10,000 in the upper Yakima River, and 2,500 in the Naches River (Table 2).

For all ME&R activities, best practices will be followed to reduce adverse impacts including the use of remote monitoring with PIT tags, modifying trapping times to intercept minimal numbers of non-target salmonids, and checking traps daily and more often during times of peak migration to minimize potential overcrowding and holding mortality. The operators will also follow NMFS guidelines for all electro-fishing and tagging activities. Fish that will be anesthetized during sampling will be provided additional aeration, and allowed time to recover prior to release.

1.4. Action Area

The "action area" means all areas to be affected directly or indirectly by the Proposed Action, in which the effects of the action can be meaningfully detected, measured, and evaluated (50 CFR 402.02). The threatened MCR Steelhead DPS would be affected by the Proposed Action, including the hatchery programs that are listed in Table 1. For the purposes of this analysis, the action area includes those areas of the Yakima River Basin that are accessible to fish released from the proposed hatchery programs, focusing on the vicinity of acclimation facilities, the Yakima River watershed below the hatchery facilities, release locations, and areas within the basin where ME&R activities occur.

NMFS looked at the potential effects of the Proposed Action on other areas and on other listed species. The progeny (both juvenile and adult) generated from the proposed hatchery programs will co-occur with ESA-listed fish, but co-occurrence will not result in measurable effects, based on available information. Hatchery fish can stray into other areas and spawn naturally. Hatchery fall Chinook salmon from the Yakima program are marked to determine contributions to fisheries and to spawning populations outside the Yakima River Basin. The closest ESA-listed fall Chinook salmon population is in the Snake River. One study (Bosch 2012) looked at recoveries of CWT-tagged fall Chinook salmon from Yakima River releases for broodyears 1997 to 2007 and observed only 3 CWT recoveries of Yakima River Chinook salmon in the Snake River Basin (two at Lyons Ferry Hatchery and one a Lower Granite Dam) all from the 1999 broodyear release. These 3 recoveries were expanded to represent 14 adults over 2 years in the Snake River from the Yakima River fall Chinook salmon release. No other recoveries have been observed since 2003. The one recovery at Lower Granite Dam represents less than 0.02 percent of all of the CWTs recovered that year (Milks 2012). Because the of the very low stray rate of Yakima hatchery program fall Chinook salmon releases the recovery information indicates, and because no recoveries have occurred since 2003, the likelihood of a discernible effect of the Proposed Action on ESA-listed Chinook salmon in the Snake River Basin is low and so the Snake River Basin is not included in the action area.

NMFS considered whether the mainstem Columbia River, the estuary, and the Pacific Ocean should be included in the action area. The potential concern is a relationship between hatchery production and density-dependent interactions affecting salmon growth and survival. The number of hatchery fish released annually by the proposed programs does not directly correspond to the number of juvenile hatchery fish that could co-occur with ESA-listed species in the mainstem Columbia River. As discussed in section 2.4, below, there is a high level of mortality immediately after release and before the hatchery fish even reach the mainstem Columbia River where they join more than 100 million juvenile salmon and steelhead emigrating to the ocean. (Neeley 2012) estimated juvenile survival from the acclimation and release locations in the Yakima River Basin to McNary Dam at less than 30% for spring Chinook salmon, coho salmon, summer Chinook salmon, and fall Chinook salmon (see section 2.4.2.4). This poor smolt migration survival leads to only a small number of juvenile hatchery fish entering the mainstem Columbia River. The number of hatchery fish from the Yakima River Basin that do reach the Columbia River would therefore only be a small fraction of the millions of juveniles present in the mainstem Columbia River, the estuary, and the Pacific Ocean; as a result, any discernible effects could not be meaningfully measured. NMFS has determined that due to the extremely small proportion of hatchery fish of the proposed programs in the Columbia River run at large, the mainstem Columbia River, the Columbia River estuary, and the Pacific Ocean are not included in the action area.

2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with the U.S. Fish and Wildlife Service (USFWS), NMFS, or both, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. Section 7(b)(3) requires that at the conclusion of consultation, NMFS provide an opinion stating how the agencies' actions will affect listed species or their critical habitat. If incidental take is expected, Section 7(b)(4) requires the provision of an incidental take statement specifying the impact of any incidental taking, and including reasonable and prudent measures to minimize such impacts.

2.1. Approach to the Analysis

Section 7(a)(2) of the ESA requires Federal agencies, in consultation with NMFS, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. The jeopardy analysis considers both survival and recovery of the species. The adverse modification analysis considers the impacts on the conservation value of the designated critical habitat.

"To jeopardize the continued existence of a listed species" means to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species or reduce the value of designated or proposed critical habitat (50 CFR 402.02).

This biological opinion does not rely on the regulatory definition of 'destruction or adverse modification' of critical habitat at 50 C.F.R. 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.[3]

We will use the following approach to determine whether the proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- First, the current status of the listed species and designated critical habitat, relative to the conditions needed for recovery, are described in Section 2.2.

- Next, the environmental baseline in the action area is described in Section 2.3.

- In Section 2.4, we consider how the Proposed Action would affect the species abundance, productivity, spatial structure, and diversity and the Proposed Action's effect on critical habitat features.

- Section 2.5 describes the cumulative effects in the action area, as defined in our implementing regulations at 50 CFR 402.02.

- In Section 2.6, the status of the species and critical habitat (Section 2.2), the environmental baseline (Section 2.3), the effects of the Proposed Action (Section 2.4), and cumulative effects (Section 2.5) are integrated and synthesized to assess the effects of the Proposed Action on the survival and recovery of the species in the wild and on the conservation value of designated or proposed critical habitat.

[3] Memorandum from William T. Hogarth to Regional Administrators, Office of Protected Resources, NMFS (Application of the "Destruction or Adverse Modification" Standard Under Section 7(a)(2) of the Endangered Species Act) (November 7, 2005).

- Our conclusions regarding jeopardy and the destruction or adverse modification of critical habitat are presented in Section 2.7.

- If our conclusion in Section 2.7 is that the Proposed Action is likely to jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitat, we will identify an RPA to the action in Section 2.8.

2.2. Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species and designated critical habitat that would be affected by the Proposed Action. The species and the designated critical habitat that are likely to be affected by the Proposed Action, and any existing protective regulations, are described in Table 3.[4] Status of the species is the level of risk that the listed species face based on parameters considered in documents such as recovery plans, status reviews, and ESA listing determinations. The species status section helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the status and conservation value of critical habitat in the action area and discusses the current function of the essential physical and biological features that help to form that conservation value.

Table 3. Federal Register notices for final rules that list threatened species, designate critical habitats, or apply protective regulations to listed species considered in this consultation.

Species	Listing Status	Critical Habitat	Protective Regulations
Steelhead (*Oncorhynchus mykiss*)			
Middle Columbia River	1/05/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160

"Species" Definition: The ESA of 1973, as amended, 16 U.S.C. 1531 *et seq.* defines "species" to include any "distinct population segment (DPS) of any species of vertebrate fish or wildlife which interbreeds when mature." To identify DPSs of salmon species, NMFS follows the "Policy on Applying the Definition of Species under the ESA to Pacific Salmon" (56 FR 58612, November 20, 1991). Under this policy, a group of Pacific salmon is considered a DPS and hence a "species" under the ESA if it represents an evolutionarily significant unit (ESU) of the biological species. The group must satisfy two criteria to be considered an ESU: (1) It must be substantially reproductively isolated from other con-specific population units; and (2) It must represent an important component in the evolutionary legacy of the species. To identify DPSs of steelhead, NMFS applies the joint FWS-NMFS DPS policy (61 FR 4722, February 7, 1996). Under this policy, a DPS of steelhead must be discrete from other populations, and it must be significant to its taxon. The MCR Steelhead constitute a DPS of the taxonomic species *Oncorhynchus mykiss*, and as such is considered a "species" under the ESA.

[4] ESA-listed bull trout (*Salvelinus confluentus*) are administered by the FWS and BPA is currently in consultation on the proposed hatchery programs.

2.2.1. Status of Listed Species

For Pacific salmon and steelhead, NMFS commonly uses four parameters to assess the viability of the populations that, together, constitute the species: abundance, productivity, spatial structure, and diversity (McElhany et al. 2000). These "viable salmonid population" (VSP) criteria therefore encompass the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. When these parameters are collectively at appropriate levels, they maintain a population's capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment. These parameters or attributes are substantially influenced by habitat and other environmental conditions.

"Abundance" generally refers to the number of naturally-produced adults (i.e., the progeny of naturally-spawning parents) in the natural environment.

Productivity," as applied to viability factors, refers to the entire life cycle; i.e., the number of naturally-spawning adults (i.e., progeny) produced per naturally spawning parental pair. When progeny replace or exceed the number of parents, a population is stable or increasing. When progeny fail to replace the number of parents, the population is declining. McElhany et al. (2000) use the terms "population growth rate" and "productivity" interchangeably when referring to production over the entire life cycle. They also refer to "trend in abundance," which is the manifestation of long-term population growth rate.

"Spatial structure" refers both to the spatial distributions of individuals in the population and the processes that generate that distribution. A population's spatial structure depends fundamentally on accessibility to the habitat, on habitat quality and spatial configuration, and on the dynamics and dispersal characteristics of individuals in the population.

"Diversity" refers to the distribution of traits within and among populations. These range in scale from DNA sequence variation at single genes to complex life history traits (McElhany et al. 2000).

In describing the range-wide status of listed species, we rely on viability assessments and criteria in TRT documents and recovery plans, when available, that describe VSP parameters at the population, major population group (MPG), and species scales (i.e., salmon ESUs and steelhead DPSs). For species with multiple populations, once the biological status of a species' populations and MPGs have been determined, NMFS assesses the status of the entire species. Considerations for species viability include having multiple populations that are viable, ensuring that populations with unique life histories and phenotypes are viable, and that some viable populations are both widespread to avoid concurrent extinctions from mass catastrophes and spatially close to allow functioning as meta-populations (McElhany et al. 2000).

2.2.1.1. **Life History and Current Rangewide Status of the MCR Steelhead DPS**

Steelhead in the Yakima River Basin are part of the MCR Steelhead DPS. The DPS includes all naturally produced steelhead in the Columbia River Basin upstream of the Wind River in

Washington and the Hood River in Oregon (exclusive) to the Yakima River in Washington. Excluded are steelhead from the Snake River Basin (Busby et al. 1996) (Figure 2).

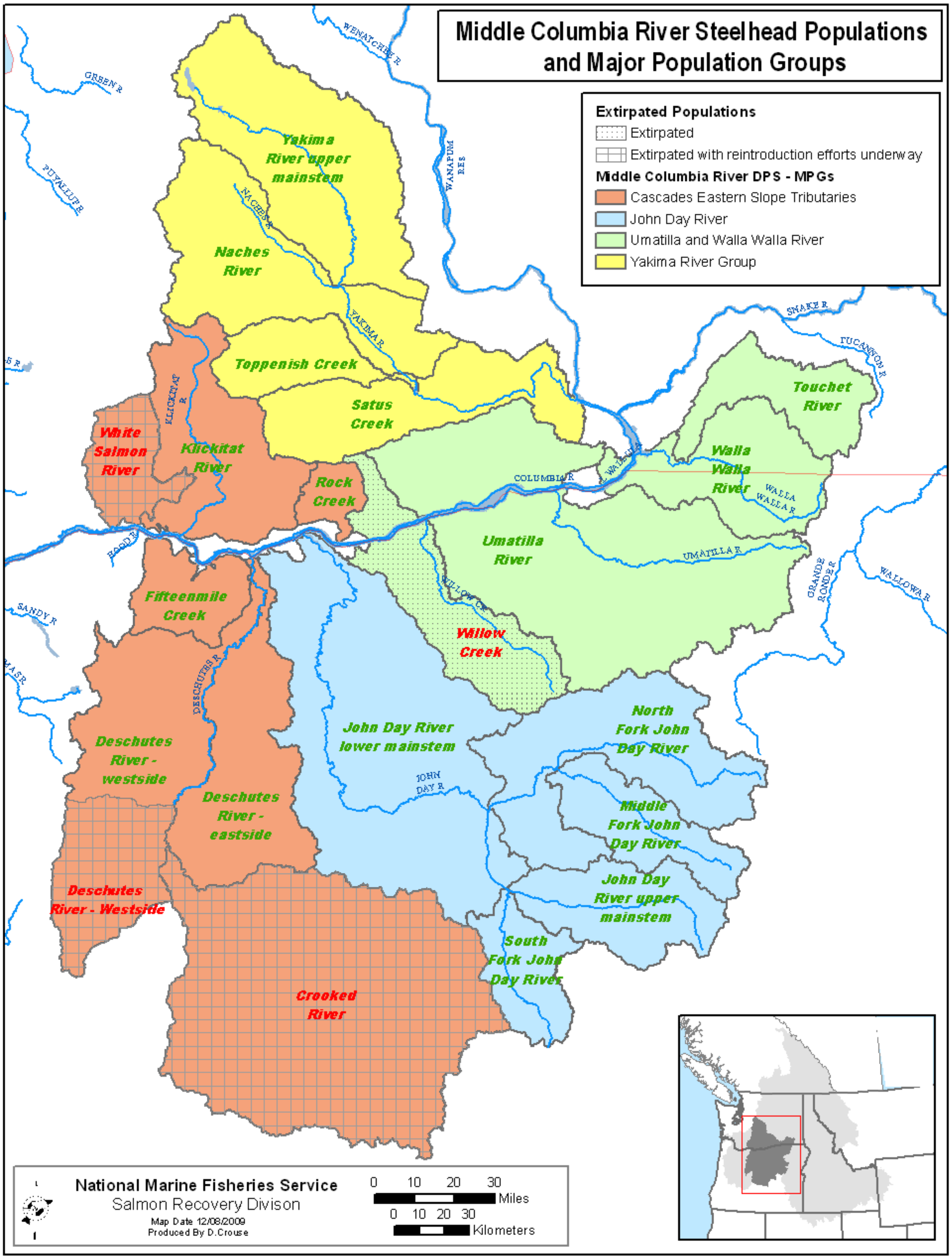

Figure 2. Historical summer and winter steelhead populations in the Middle Columbia River Steelhead DPS (NMFS 2009b).

The MCR Steelhead DPS includes the only populations of inland winter steelhead in the United States (in the Klickitat River, Rock Creek, White Salmon River, Washington, and Fifteenmile Creek, Oregon)(Figure 2). The summer-run populations generally enter freshwater from May through October (Busby *et al.* 1996) with peak entry occurring in July. The ICTRT identified 19 populations within the DPS (15 summer-run and 4 winter-run). In addition, the ICTRT identified the historical populations that have been extirpated due to dam construction in the Deschutes River Basin, and in Willow Creek (Figure 2; (ICTRT 2005). Within the DPS, the Klickitat and White Rivers are unusual in that they produced both summer and winter steelhead. The Round Butte Hatchery program (Deschutes River), the Umatilla River hatchery program, and the endemic summer steelhead program in the Touchet River are considered to be part of the MCR DPS (71 FR 834, January 5, 2006).

Most fish in the MCR Steelhead DPS smolt at two years and spend one to two years in saltwater before re-entering fresh water, where they may remain up to a year before spawning (Howell et al. 1985; Busby et al. 1996). Age-2-ocean steelhead dominate the summer steelhead run in the Klickitat River, whereas most other rivers with summer steelhead produce about equal numbers of age 1- and 2-ocean fish. Juvenile life stages (i.e., eggs, alevins, fry, and parr) inhabit freshwater/riverine areas throughout the range of the DPS. Parr usually undergo a smolt transformation as 2-year-olds, at which time they migrate to the ocean. A non-anadromous form of *O. mykiss* (redband trout, rainbow trout) co-occurs with the anadromous form in this DPS, and juvenile life stages of the two forms can be very difficult to differentiate.

In the Yakima River MPG, both anadromous and resident life histories are present. The anadromous form may smolt and migrate to the ocean after one, two, or three years of freshwater residency and return to its natal stream after spending between one and three years in the ocean. In contrast, the resident life history, spends its entire life in freshwater. Differences between the two life histories are further complicated by the fact that both forms can interbreed and produce offspring of the opposite type (Blankenship et al. 2007a; Pearsons et al. 2007) The anadromous form is part of the listed DPS while the resident form is not and is managed separately. The resident form is under the jurisdiction of the State of Washington and supports a popular sport fishery in the Yakima River. The relationship between the resident and anadromous forms was identified as a key uncertainty, particularly in the Upper Yakima River (YBFWRB 2009). There are concerns that the interactions between the two life histories could either contribute to, or limit the recovery of steelhead in the basin. Furthermore, the interactions between the two life histories could confound the evaluation of VSP parameters for the anadromous form. Monitoring of these interactions between the two life-histories is part of the Proposed Action (Section 1.3.4).

The BRT concluded that the relatively abundant and widely distributed resident (non-anadromous) fish mitigated extinction risk in this DPS somewhat. However, due to significant threats to the anadromous component, the majority of BRT members concluded the MCR Steelhead DPS was likely to become endangered (i.e., threatened) (BRT 2003).

Abundance, Productivity, Spatial Structure, and Diversity

Status of the species is determined based on the abundance, productivity, spatial structure, and diversity of its constituent natural populations. Ford (2011) determined that there have been improvements in the viability ratings for some of the constituent populations, but the Mid-

Columbia Steelhead DPS as a whole is not meeting the viability criteria (adopted from the ICTRT) in the Mid-Columbia Steelhead Recovery Plan. In addition, several of the factors cited by the 2005 BRT (Good et al. 2005) remain as concerns or key uncertainties. Natural-origin spawning estimates are highly variable relative to minimum abundance thresholds across the populations in the DPS. Updated information indicates that stray levels into at least the Lower John Day River population are high. Natural-origin returns to the Yakima River Basin and to the Umatilla and Walla Walla Rivers have been higher over the most recent brood cycle while returns to the John Day River have decreased. Out-of-basin hatchery stray proportions, although reduced, remain very high in the Deschutes River Basin. Overall, the new information considered does not support a change in the biological risk category or improvement in DPS status since the last status review.

Steelhead in the Yakima River Basin are divided into four populations: the Satus Creek, Toppenish Creek, Naches River, and Upper Yakima River populations. These populations comprise the Yakima River Basin MPG. The (ICTRT 2007) identifies the Satus Creek population as steelhead that spawn in the Satus Creek drainage on the Yakama Nation Reservation, the mainstem Yakima River below Satus Creek, and tributaries to the lower mainstem. For management purposes under the Yakima Recovery Plan, local planners have subdivided the Satus population into the Satus block, which spawns in the Satus Creek drainage, and a mainstem block, whose current and historical status is uncertain (YBFWRB 2009). The Toppenish population consists of steelhead that spawn in Toppenish Creek, its tributaries and the short stretch of the mainstem between Toppenish and Satus creeks, and is entirely on the Yakama Reservation. The Naches population includes steelhead spawning in the Naches River and its tributaries (including the Tieton, Little Naches, American, and Bumping rivers and Cowiche, Rattlesnake and Nile creeks), the mainstem Yakima from the Naches confluence to the Toppenish Creek confluence and the tributaries to that reach of the Yakima, including Ahtanum Creek. The Upper Yakima population consists of all steelhead that spawn in the Yakima River and its tributaries upstream of the Naches confluence.

Ford (2011) summarized that natural-origin and total spawning escapements have increased in the most recent brood cycle, relative to the period associated with the 2005 BRT review, for all four populations in the Yakima River MPG (Table 4). Steelhead escapements into the Upper Yakima River, although increased relative to the previous review, remain very low relative to the total amount of habitat available. The proportion natural-origin natural spawners remained greater than 97% in the Yakima River Basin (estimated for aggregate run at Prosser Dam). The Satus Creek and Toppenish Creek populations need to exceed the minimum abundance threshold of 500 natural-origin natural spawners, and the Naches River and Upper Yakima populations need to exceed 1,500 natural-origin natural spawners (ICTRT 2007).

The ratings for individual populations in the Yakima MPG should be interpreted with caution given the basis for estimating population specific returns from Prosser Dam counts (Ford 2011). The overall viability ratings have increased from Maintained to Viable for the two basic sized populations, Satus Creek and Toppenish Creek, have remained stable, remaining at Maintained. The Naches River population and the Upper Yakima River population have remained at High

Table 4**.** Summary of abundance and hatchery proportions on the spawning grounds for Mid-Columbia Steelhead populations organized by MPG. Estimates for brood cycle prior to listing (1992-1996) and the 2005 BRT review included for comparison. Estimates for all series calculated using current data sets (Ford 2011)**.**

Population (organized by major population group)	**Natural Spawning Areas**								
	Total Spawners (5 year geometric mean, *range*)			**Natural Origin (5 year geometric mean)**			**% Natural Origin (5 year average)**		
	Listing (1992-1996)	***Prior (1997-2001)***	**Current (2005-2009)**	***Listing (1992-1996***	***Prior (1997-2001*)**	**Current (2005-2009)**	***Listing (1992-1996***	***Prior (1997-2001)***	**Current (2005-2009)**
Yakima River MPG									
Satus Creek	*347*	365 *(310–413)*	**831 *(524–1129)***	*317*	337 *(269–398)*	**809 *(519–1121)***	*91%*	92%	**97%**
Toppenish Creek	*131*	345 *(156-1229)*	**482 *(265-820)***	*119*	318 *(132-1208)*	**469 *(262-802)***	*91%*	92%	**97%**
Naches River	*278*	471 *(346–1000)*	**848 *(496–1199)***	*254*	435 *(304–983)*	**825 *(491–1190)***	*91%*	92%	**97%**
Upper Yakima	*53*	66 *(42-171)*	**158 *(80-226)***	*51*	65 *(42-162)*	**156 *(80-223)***	*91%*	99%	**99%**

Table 5. Summary of current status of populations using viability criteria incorporated into the Mid-Columbia Steelhead Recovery Plan for the Yakima River MPG (Ford 2011).

Yakima MPG	**Abundance/Productivity Metrics**				**Spatial Structure and Diversity Metrics**			**Overall Viability Rating**
Population	*ICTRT Minimum Threshold*	*Natural Spawning Abundance*	*ICTRT Productivity*	*Integrated A/P Risk*	*Natural Processes Risk*	*Diversity Risk*	*Integrated SS/D Risk*	
Satus Creek 2000-2009 1995-2004	**500**	**660** (347-1121) *379* (138-1032)	**1.79** (1.42-2.26) 1.73 (1.33-2.25)	Moderate Moderate	Low	Moderate	Moderate	Viable *(Maintained)*
Toppenish Creek 2000-2009 1995-2004	**500**	**599** (262-1252) *322* (57-1252)	**2.84** (1.81-4.45) 1.60 (0.94-2.71)	Moderate Moderate	Low	Moderate	Moderate	Viable *(Maintained)*
Naches River 2000-2009 1995-2004	**1,500**	**840** (491-1454) *472* (142-1454)	**1.59** (1.25-2.01) 1.12 **(0.75-1.65)**	High High	Low	Moderate	Moderate	High Risk
Upper Yakima 2000-2009 1995-2004	**1,500**	**151** (60-265) *85* (40-265)	**1.52** (1.17-1.98) 1.12 (0.76-1.64)	High High	Moderate	High	High	High Risk

Risk (Table 5). The changes in ratings reflect the relatively high annual returns in most years since 2001. Productivity estimates, based on the return series updated through 2009 (previously through 2005) have increased or remained at approximately the same levels as estimated in the recovery plan/ICTRT status assessments. The current ratings for spatial structure and diversity criteria reflect the assessments done for the 2008 ICTRT status assessments.

There are many factors that affect the abundance, productivity, spatial structure, and diversity of the MCR steelhead populations in the Yakima River MGP. The Yakima Recovery Plan (YBFWRB 2009) identified 5 major in-basin factors for decline:

1) Alteration of stream flows due to development of irrigation systems, including both the dewatering of lower reaches in many tributaries and the high and low flows in the mainstem Yakima and Naches rivers associated with water storage and delivery from upstream reservoirs.
2) Creation of passage barriers associated with both small and large diversion dams, road crossings, and Bureau of Reclamation (BOR) storage dams.
3) Reduction in floodplain function due to diking, channel simplification, and floodplain development for agricultural and urban uses.
4) Impacts on riparian areas and upland hydrology due to past and, to a lesser extent current, grazing and forestry practices.
5) Changed ecology dynamics, including reduction in beaver populations, reductions in delivery of oceanic nutrients to headwaters by salmon, introduction of exotic species, and increased predation by native species.

The recovery plan (NMFS 2009b) did not identify the release of spring Chinook salmon, fall Chinook salmon, or coho salmon as a factor limiting the productivity of the Yakima River MCR steelhead populations (NMFS 2009b). The Yakima Recovery Plan (YBFWRB 2009) supported the continued reintroduction of coho salmon, sockeye salmon, and summer Chinook salmon identifying these actions as potentially increasing the flow of marine-derived nutrients into salmon and steelhead rearing areas in the Yakima River Basin. They also identified the need to continue to monitor competitive interactions between salmon and listed steelhead. The Yakima Recovery Plan proposed to use artificial propagation techniques to restore steelhead into underutilized habitat and into habitat where passage has been restored.

2.2.2. Range-wide Status of Critical Habitat

This section of the opinion examines the range-wide status of designated critical habitat for the affected species. For the MCR Steelhead DPS, critical habitat was designated in 70 FR 52630 (September 2, 2005). Critical habitat for the MCR Steelhead DPS includes areas within the Yakima River Basin including habitat within the proposed action area. NMFS determines the range-wide status of critical habitat by examining the condition of its physical and biological features (also called “primary constituent elements,” or PCEs, in some designations) that were identified when critical habitat was designated. These features are essential to the conservation of the listed species because they support one or more of the species’ life stages (e.g., sites with conditions that support spawning, rearing, migration and foraging). These sites in turn contain physical or biological features essential to the conservation of the ESU. Specific types of sites and the features associated with them include:

(1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;
(2) Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks;
(3) Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival;
(4) Estuarine areas free of obstruction with water quality, water quantity and salinity conditions supporting juvenile and adult physiological transitions between fresh-and saltwater; natural cover, such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation;
(5) Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and
(6) Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation (Table 3).

For the MCR Steelhead populations that are affected by these programs, the watersheds that are within the action area (as described in section 2.2) have been designated as essential for spawning, rearing, juvenile migration, and adult migration. In the Yakima River Basin, the major factors affecting PCEs were described above under limiting factors and include: altered stream flows, passage barriers, altered floodplain function, riparian impacts, and altered ecological functions(YBFWRB 2009).

2.2.3. Climate Change

Climate change has negative implications for designated critical habitats in the Pacific Northwest (CIG 2004; Scheuerell and Williams 2005; Zabel et al. 2006; ISAB 2007). Average annual Northwest air temperatures have increased by approximately 1ºC since 1900, or about 50% more than the global average warming over the same period (ISAB 2007). The latest climate models project a warming of 0.1 ºC to 0.6 ºC per decade over the next century. According to the Independent Scientific Advisory Board (ISAB), these effects may have the following physical impacts within the next 40 or so years:

- Warmer air temperatures will result in diminished snowpacks and a shift to more winter/spring rain and runoff, rather than snow that is stored until the spring/summer melt season.
- With a smaller snowpack, these watersheds will see their runoff diminished earlier in the season, resulting in lower streamflows in the June through September period. River flows

in general and peak river flows are likely to increase during the winter due to more precipitation falling as rain rather than snow.

- Water temperatures are expected to rise, especially during the summer months, when lower streamflow co-occur with warmer air temperatures.

These changes will not be spatially homogeneous across the entire Pacific Northwest. Low-lying areas are likely to be more affected. Climate change may have long-term effects that include, but are not limited to, depletion important cold water habitat, variation in quality and quantity of tributary rearing habitat, alterations to migration patterns, accelerated embryo development, premature emergence of fry, and increased competition among species (ISAB 2007). In the Yakima River Basin, climate changes like those described above would be expected to change snowpack and runoff timing which would alter irrigation and reservoir management that would be expected to have long-term impacts on steelhead in the basin.

To mitigate for the effects of climate change on listed salmonids, the ISAB (2007) recommends planning now for future climate conditions by implementing protective tributary, mainstem, and estuarine habitat measures, as well as protective hydropower mitigation measures. In particular, the ISAB (2007) suggests: increased summer flow augmentation from cool/cold storage reservoirs to reduce water temperatures or to create cool water refugia in mainstem reservoirs and the estuary; the protection and restoration of riparian buffers, wetlands, and floodplains; removal of stream barriers; implementation of fish ladders; and assurance of high summer and autumn flows. All of these proposed actions are consistent with recovery actions in the MCR Steelhead Recovery Plan (NMFS 2009b).

2.3. Environmental Baseline

Under the Environmental Baseline, NMFS describes what is affecting listed species and designated critical habitat before including any effects resulting from the Proposed Action. The 'Environmental Baseline' includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area and the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation (50 CFR 402.02).

In order to understand what is affecting a species, it is first necessary to understand the biological requirements of the species. Each stage in a species' life-history has its own biological requirements (Groot and Margolis 1991; NRC 1996; Spence et al. 1996). Generally speaking, anadromous fish require clean water with cool temperatures and access to thermal refugia, dissolved oxygen near 100 percent saturation, low turbidity, adequate flows and depths to allow passage over barriers to reach spawning sites, and sufficient holding and resting sites. Anadromous fish select spawning areas based on species-specific requirements of flow, water quality, substrate size, and groundwater upwelling. Embryo survival and fry emergence depend on substrate conditions (*e.g.*, gravel size, porosity, permeability, and oxygen concentrations), substrate stability during high flows, and, for most species, water temperatures of 13ºC or less. Habitat requirements for juvenile rearing include seasonally suitable microhabitats for holding, feeding, and resting. Migration of juveniles to rearing areas, whether the ocean, lakes, or other stream reaches, requires free access to these habitats.

Yakima River Basin

The Yakima River Basin once supported abundant and diverse runs of salmon and steelhead that now return in just a fraction of their historical numbers (ICTRT 2007). Threatened MCR steelhead are currently affected by a number of habitat modifications within the action area. The most prominent and deleterious modifications are the result of flow regulation and irrigation activities, as well as development in floodplain, riparian, and upland areas.

The headwaters of the Yakima River (fifth order) emerge from the crest of the Cascade Mountains above Keechelus Lake. From there, the Yakima River flows approximately 215 miles downstream to Richland, Washington where it enters the Columbia River at RM 335.2 (Figure 1). The total Yakima River drainage area is roughly 6,155 square miles, encompassing over 1,900 miles of perennial streams. As the Yakima River flows toward the Columbia River, it gathers the flow of the Cle Elum and Teanaway Rivers, and Swauk, Taneum, Naneum, Wilson, Manastash, and Umtanum Creeks above Roza Dam. Below Roza Dam, the Naches River joins the Yakima River after gathering the discharge of the Little Naches, American, Bumping, and Tieton Rivers, and Rattlesnake and Cowiche Creeks. Major tributaries to the Yakima River below the Naches River confluence include Ahtanum, Toppenish, and Satus Creeks. Few appreciable natural tributaries enter the Yakima River below Prosser Dam, although numerous large irrigation projects drain into the mainstem Yakima River.

Human Activities

A wide variety of human activities have affected MCR steelhead and PCEs in the action area (Section 1.4), and for evaluation purposes in this opinion, are considered to be part of the baseline. Generally, land management and water development activities have: (1) reduced connectivity (*i.e.*, the flow of energy, organisms, and materials) between streams, riparian areas, floodplains, and uplands; (2) elevated fine sediment yields, degrading spawning and rearing habitat; (3) reduced large woody material that traps sediment, stabilizes streambanks, and helps form pools; (4) reduced vegetative canopy that minimizes solar heating of streams; (5) caused streams to become straighter, wider, and shallower, thereby reducing rearing habitat and increasing water temperature fluctuations; (6) altered peak flow volume and timing, leading to channel changes and potentially altering fish migration behavior; and (7) altered floodplain function, water tables and base flows (YBFWRB 2009). Specifically, irrigation and development have had the following effects on the environmental baseline: (1) adversely affected water quality, (2) adversely affected instream flows, (3) degraded floodplain and channel morphology and function, and (4) detached portions of the Yakima River and its tributaries from their historical floodplains creating impaired floodplain function.

Water Management

Unscreened agricultural diversions and desiccated river reaches early in the development history of the Yakima River Basin contributed to pronounced stock depletions and extinctions (*e.g.*, summer Chinook salmon and coho salmon). The construction of BOR storage reservoirs without fish passage early in the twentieth century blocked off many miles of spawning and rearing habitat to salmon and steelhead, and led to the extinction of native stocks (*e.g.*, sockeye salmon (*O. nerka*)). More than 100 years of water development for irrigated agriculture has altered flow regimes to the disadvantage of these fish.

Water quality in the action area generally decreases in the downstream direction, owing to a gradual increase in irrigation effluents from agricultural lands, and a pronounced decrease in instream flows during the irrigation season below Sunnyside and Prosser Dams. Synoptic studies of water quality in the Yakima River Basin have identified a host of agricultural pollutants, and 72 water bodies have been placed on the 303(d) list of impaired waters (WDOE 1998a; 1998b; 1998c). Although water quality conditions are generally better in the Upper than Lower Yakima River, problems associated with agricultural effluents and flow regulation practices exist in the Upper Yakima, Naches, and Cle Elum Rivers, and a number of tributaries to the Yakima River draining the Kittitas Valley (*e.g.,* Taneum, Manastash, and Wilson/Cherry Creeks). In most years, beginning below Sunnyside and Prosser Dams, irrigation diversions diminish streamflow and contribute to high temperatures and poor water quality conditions that can negatively impact native fish populations. Further, altered water quality conditions in the Lower Yakima River have produced an environment where native and nonnative predators are able to prey heavily upon emigrating MCR steelhead and other native anadromous salmonid smolts (McMichael and Pearsons 1998). Throughout the late summer, a thermal barrier at the mouth of the Yakima River largely precludes adult MCR steelhead from migrating into the Yakima River Basin until after the end of the irrigation season (late October). Additionally, runoff and/or groundwater recharge from extensive gravel pits along the Yakima River throughout the action area may contribute warm water containing toxic constituents. Finally, land-use activities (roading, grazing, farming, and gravel mining) have altered sediment cycling and nutrient delivery pathways, contributing to a riverscape that differs, often significantly, from its undeveloped template condition.

Flow regulation practices, pursuant to water deliveries and diversions for irrigation demands, have adversely affected biotic and abiotic conditions in the Yakima River and its tributaries in the action area. Generally, instream flow problems stem from chronically low discharge levels during reservoir refill periods to inordinately high flows out of phase with the ecology of MCR steelhead when downstream demands are being met. Winter flows in regulated reaches below storage reservoirs are usually very low as inflow is captured and outflow is decreased. Large volumes of stored water are released from Keechelus, Cle Elum, and to some degree, Kachess Dams during the irrigation season, resulting in streamflows greater than three times the estimated unregulated amount in the Upper Yakima and Cle Elum Rivers. After flip-flop, streamflows in these rivers drops precipitously in less than a week as releases increase from Kachess, Rimrock, and Bumping Lakes to provide irrigation water until the end of the irrigation season. Flip-flop inflates streamflow in the Tieton and Bumping Rivers to levels well above estimated unregulated discharge, and rates of flow increase and decrease in the Tieton River especially do not approach natural conditions. Similarly, rates of flow decrease in the Upper Yakima and Cle Elum Rivers greatly exceed those that would be observed in an undeveloped, unregulated watershed. Below Sunnyside Dam, irrigation season streamflow remains well below the estimated unregulated amount until unregulated tributary input augments discharge in the late fall and early winter. Return flows during the irrigation season enter the Lower Yakima River at numerous points throughout the irrigation season, increasing discharge to values well above the estimated unregulated amount until diversions at Prosser Dam once again deplete flows to below estimated unregulated levels.

The operation of BOR storage reservoirs has a profound, controlling effect on the timing, magnitude, and frequency of streamflow throughout the Action area (YBFWRB 2009). Flow regulation practices produce streamflows of strikingly dissimilar timing, duration, magnitude, and rates of change than under pre-development conditions. The hydrographs of the Yakima River and its regulated tributaries throughout the Action area exhibit diminished precipitation-induced late fall and winter spates, truncated spring runoff peak flows, and unnaturally high late spring and summer flows. Altered flow regimes, the influences of storage and diversion dams, and imbalances in sediment transport dynamics have simplified channel habitats and created impaired MCR steelhead habitat throughout the Action area. High discharge levels during the summer months can produce rearing conditions that are energetically stressful to juvenile fish, stunting their growth and maturity to smoltification. Hydrograph simplification (*e.g.*, the removal of fall-winter flow spikes, attenuation of peak flows, stable, high, irrigation flows, and low winter flows), as well as flow regulation regimes that are asynchronous with the life-history requirements of native floodplain and aquatic species, has deleteriously altered MCR steelhead habitat throughout the Action area.

Floodplain Development

Development and revetments, agricultural diversion structures, floodplain roads, armored streambanks, and floodplain gravel mines throughout the Yakima River Basin and Action area have altered natural processes that served to (1) promote exchange of water and sediments between the rivers and their overbank habitats, (2) provide lateral habitat heterogeneity for MCR steelhead, and (3) maintain riparian habitat communities dependent on natural streamflow dynamics. As described in the preceding paragraph, flow management scenarios have served to exacerbate floodplain function problems.

Throughout the Action area, riparian habitat has been degraded through a variety of activities. Among them, road construction and maintenance, farming, channel armoring, grazing, urban development, and floodplain revetments have had the greatest effect. These activities have degraded riparian habitat by direct canopy removal, covering floodplain surfaces with materials that preclude plant growth, reducing the widths of riparian zones, and altering riparian species composition in favor of nonnative plants. Further, flow regulation practices adversely affect the establishment and growth of native riparian vegetation (Jamieson and Braatne 2001). For MCR steelhead, the lack of properly functioning riparian habitat contributes to instream temperatures that may seasonally exceed physiological tolerances and streambank erosion that increases sedimentation of spawning habitat. Additionally, degraded riparian zones contribute an inadequate amount of LWD, and subsequently prevent or inhibit habitat forming processes such as pool formation and the establishment of instream cover. A few reaches of the Yakima and Naches Rivers in the Action area exhibit intact floodplain riparian habitats, but flow management practices and floodplain infrastructure provide discharge out of phase with the natural hydrograph that is spatially and temporally incompatible with salmonid, riparian, and hyporheic species' requirements.

Floodplain development and resource extraction has reduced functional floodplain area and denuded and degraded river, floodplain, and riparian function and destroyed miles of formerly productive salmon and steelhead habitat. Valley floors near towns of Ellensburg, Selah, Yakima, and Wapato contain relict braided and revetment-simplified river channels. Floodplain development (urbanization, agriculture), gravel mines, and transportation infrastructure has transformed floodplains and riparian areas, destroying miles of formerly productive salmon and steelhead habitat. Floodplain river networks, once a complex assemblage of vast, braided channels covered by dense riparian forests, have been reduced to simplified conduits bracketed by transportation infrastructure and levees. Further, anthropogenic activities in the floodplains, rivers, and streams across the Action area, including railway and highway construction, have leveed, armored, realigned, and shortened the historical channel, severely diminishing natural river-floodplain interactions. Primary land uses in the Action area include irrigated agriculture, municipal and urban development, floodplain gravel mining, and transportation infrastructure. Secondary land uses include recreation and grazing.

Habitat Improvement Programs

NMFS funds several large-scale habitat improvement programs that will affect the future status of the species considered in this SCA/Opinion and their designated critical habitat. These programs, which have undergone Section 7 consultation, provide non-Federal partners with resources needed to accomplish statutory goals or, in the case of non-governmental organizations, to fulfill conservation objectives. Because projects often involve multiple parties using Federal funds, it can be difficult to distinguish between projects with a Federal nexus and those that can be properly described as Cumulative Effects. As a result, many of the projects submitted by the States of Washington, Oregon, and Idaho received funding through the Pacific Coast Salmon Recovery Fund (NMFS 2007a), the Restoration Center Programs (NMFS 2004a), or the Mitchell Act-funded Irrigation Diversion Screening Program (NMFS 2000c). The objectives of these programs are described below and considered further in Section 2.5.

The Pacific Coastal Salmon Recovery Fund (PCSRF) was established by Congress to help protect and recover salmon and steelhead populations and their habitats (NMFS 2007a). The states of Washington, Oregon, California, Idaho, and Alaska, and the Pacific Coastal and Columbia River tribes receive PCSRF appropriations from NMFS each year. The fund supplements existing state, tribal, and local programs to foster development of Federal-state-tribal-local partnerships in salmon and steelhead recovery. The PCSRF has made substantial progress in achieving program goals, as indicated in annual Reports to Congress, workshops, and independent reviews.

There are numerous restoration and passage improvement projects in the Yakima River Basin overseen by the YBFWRB and funded through the Salmon Restoration Funding Board (SFRB). Examples of restoration actions in the action area include improved fish passage in Cowiche Creek and in Taneum Creek – that will also restore channel complexity, refuge areas, and riparian habitats. In 2011, land was purchased to protect and restore fish habitat adjacent to the Naches River, in Reecer Creek, and along the Yakima River in Ellensburg, Washington (YBFWRB 2009). Similarly, numerous projects funded by BPA have occurred within the Yakima River Basin, including, bank stabilization, habitat complexity, levee set-back, riparian plantings and fencing, barrier removal, and side-channel restoration (e.g., (Nicolai 2005 ; YRWP 2012).

Hatcheries

Hatcheries have operated in Oregon and Washington for more than a century, providing fish for recreational and commercial fisheries. Hatcheries were originally built to compensate for declining wild fish populations. Later, they played a prominent role in enhancing the state’s salmon resources. Now, hatcheries are an important economic force statewide and are integral to North Pacific recreational and commercial fisheries, to meeting treaty-trust responsibilities, and restoring and supplementing natural populations of salmon and steelhead. Hatcheries also aid coast-wide management of Chinook and coho salmon by providing wild stock analogs for CWT programs. Salmon and steelhead marked with CWTs are used to evaluate stock-specific fishery harvest rates and incidental impacts on ESA-listed salmon.

Within the Yakima River Basin, in addition to the CESRF, and proposed Chinook salmon and coho salmon hatchery programs, the BPA also funds the Kelt Reconditioning program. This program collects steelhead kelts (post-spawned adult steelhead) from the Chandler Juvenile Fish Facility and holds a portion of those at the Prosser Hatchery to recondition them so that they can be released into the Yakima River to spawn again. The Kelt reconditioning program has proven to be successful in producing repeat spawners that have contributed to the natural spawning populations in the Yakima River Basin. The impacts from collection of steelhead for the Kelt Reconditioning program are covered as part of the FCRPS biological opinion (NMFS 2008d). Hatchery steelhead were released in the Yakima River basin to support fisheries in the basin. The program has ended with the last release occurring in 1993. In addition to these hatchery programs, the YN is reintroducing sockeye salmon into the Yakima River Basin. This program uses adult sockeye salmon collected at Priest Rapids Dam and outplants these adults into Lake Cle Elum. The program may eventually be expanded to include some of the other lakes in the upper Yakima and Naches River Basins where they were present historically.

Fisheries

The Yakima River Basin was closed to steelhead fishing in 1994. In 1990, WDFW incorporated catch-and-release and selective gear restrictions for trout fishing in important rainbow trout/steelhead spawning and rearing habitats in the Yakima River mainstem between Roza Dam and Easton Dam. Selective gear rules (no bait, lures or flies only with single barbless hooks) during trout fishing have been implemented in tributaries to reduce incidental impacts on listed steelhead. Fisheries for coho salmon and fall Chinook salmon occur during a proportion of the steelhead migration. The areas at the mouths of Satus Creek and Toppenish Creek are closed to fishing to protect steelhead staging prior to entering the tributaries to spawn. Spring Chinook salmon fisheries in the Yakima River are closed and only open by special rule changes. The spring Chinook salmon fisheries are limited to parts of the Yakima River below Prosser Dam and from Union Gap to below Roza Dam. In all of these fisheries, all steelhead must be immediately released unharmed and cannot be removed from the water prior to release. Tribal harvest has remained very low with fewer than 10 steelhead harvested annually. Harvest of steelhead in areas outside the Yakima River also occurs. Impacts from mainstem treaty and non-treaty fisheries have been estimated to be less than 10% of the Yakima River MPG natural-origin return (NMFS 2008c).

Information relevant to the environmental baseline is also discussed in detail in Chapter 5 of the Supplemental Comprehensive Analysis (SCA), which cross-reference back to the related 2008 FCRPS Biological Opinion (NMFS 2008d). Chapter 5 of the SCA and related portions of the FCRPS Opinion provide analysis of the effects of past and ongoing human and natural factors on the current status of the species, and their habitats and ecosystems, within the Action area for this opinion and within the entire Columbia River Basin. In addition, chapter 5 of the SCA evaluates the effects of those ongoing actions on designated critical habitat. Those portions of Chapter 5 of the SCA, and environmental baseline section of the FCRPS Opinion that deal with effects in the action area (described in Section 1.4) are hereby incorporated by reference.

2.4. Effects of the Action on the Species and its Designated Critical Habitat

This section describes the effects of the Proposed Action, independent of the Environmental Baseline and Cumulative Effects. The methodology and best scientific information NMFS follows for analyzing hatchery effects is summarized first in Section 2.4.1 and then application of the methodology and analysis of the Proposed Action itself follows in Section 2.4.2. The "effects of the action" means the direct and indirect effects of the action on the species and on designated critical habitat, together with the effects of other activities that are interrelated or interdependent, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the Proposed Action and are later in time, but still are reasonably certain to occur. Effects of the Proposed Action that are expected to occur later in time (i.e., after the 10-year timeframe of the Proposed Action) are included in the analysis in this opinion to the extent they can be meaningfully evaluated. In Section 2.6, the Proposed Action, the status of ESA-protected species and designated critical habitat, the Environmental Baseline, and the Cumulative Effects of future state and private activities within the action area that are reasonably certain to occur are analyzed comprehensively to determine whether the Proposed Action is likely to appreciably reduce the likelihood of survival and recovery of ESA protected species or result in the destruction or adverse modification of their designated critical habitat.

2.4.1. Factors That are Considered When Analyzing Hatchery Effects

The NMFS has substantial experience with hatchery programs and has developed and published a series of guidance documents for designing and evaluating hatchery programs following best available science. These documents are available upon request from the NMFS SFD in Portland, Oregon. "Pacific Salmon and Artificial Propagation under the Endangered Species Act" (Hard et al. 1992) was published shortly following the first ESA-listings of Pacific salmon on the West Coast and it includes information and guidance that is still relevant today. In 2000, NMFS published "Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units" (McElhany et al. 2000) and then followed that with a "Salmonid Hatchery Inventory and Effects Evaluation Report" for hatchery programs up and down the West Coast (NMFS 2004b). In 2005, NMFS published a policy that provided greater clarification and further direction on how it analyzes hatchery effects and conducts extinction risk assessments (NMFS 2005). NMFS then updated its inventory and effects evaluation report for hatchery programs on the West Coast (Jones 2006) and followed that with "Artificial Propagation for Pacific Salmon: Assessing Benefits and Risks & Recommendations for Operating Hatchery Programs Consistent with Conservation and Sustainable Fisheries Mandates" (NMFS 2008b). More recently, NMFS published its biological analysis and final determination for the harvest of Puget Sound Chinook salmon, which included discussion on the role and effects of hatchery programs (NMFS 2011).

A key factor in analyzing a hatchery program for its effects, positive and negative, on the status of salmon and steelhead are the genetic resources that reside in the program. Genetic resources that represent the ecological and genetic diversity of a species can reside in a hatchery program. "Hatchery programs with a level of genetic divergence relative to the local natural population(s) that is no more than what occurs within the ESU are considered part of the ESU and will be included in any listing of the ESU" (NMFS 2005). NMFS monitors hatchery practices for whether they promote the conservation of genetic resources included in an ESU or steelhead

DPS and updates the status of genetic resources residing in hatchery programs every five years. Jones (2011a) provides the most recent update of the relatedness of Pacific Northwest hatchery programs to 18 salmon ESUs and steelhead DPSs listed under the ESA. Generally speaking, hatchery programs that are reproductively connected or "integrated" with a natural population, if one still exists, and that promote natural selection over selection in the hatchery, contain genetic resources that represent the ecological and genetic diversity of a species and are included in an ESU or steelhead DPS.

When a hatchery program actively maintains distinctions or promotes differentiation between hatchery fish and fish from a native population, then NMFS refers to the program as "isolated". Generally speaking, isolated hatchery programs have a level of genetic divergence, relative to the local natural population(s), that is more than what occurs within the ESU and are not considered part of an ESU or steelhead DPS. They promote domestication or selection in the hatchery over selection in the wild and select for and culture a stock of fish with different phenotypes, for example different ocean migrations and spatial and temporal spawning distribution, compared to the native population (extant in the wild, in a hatchery, or both). For Pacific salmon, NMFS evaluates extinction processes and effects of the Proposed Action beginning at the population scale (McElhany et al. 2000). NMFS defines population performance measures in terms of natural-origin fish and four key parameters or attributes: abundance, productivity, spatial structure, and diversity and then relates effects of the Proposed Action at the population scale to the MPG level and ultimately to the survival and recovery of an entire ESU or DPS.

"Because of the potential for circumventing the high rates of early mortality typically experienced in the wild, artificial propagation may be useful in the recovery of listed salmon species. However, artificial propagation entails risks as well as opportunities for salmon conservation" (Hard et al. 1992). A Proposed Action is analyzed for effects, positive and negative, on the attributes that define population viability, including abundance, productivity, spatial structure, and diversity. The effects of a hatchery program on the status of an ESU or steelhead DPS "will depend on which of the four key attributes are currently limiting the ESU, and how the hatchery fish within the ESU affect each of the attributes" (70 FR 37215, June 28, 2005). The presence of hatchery fish within the ESU can positively affect the overall status of the ESU by increasing the number of natural spawners, by serving as a source population for repopulating unoccupied habitat and increasing spatial distribution, and by conserving genetic resources. "Conversely, a hatchery program managed without adequate consideration can affect a listing determination by reducing adaptive genetic diversity of the ESU, and by reducing the reproductive fitness and productivity of the ESU". NMFS also analyzes and takes into account the effects of hatchery facilities, for example, weirs and water diversions – on each VSP attribute and on designated critical habitat.

NMFS' analysis of the Proposed Action is in terms of effects it would be expected to have on ESA-listed species and on designated critical habitat, based on the best scientific information on the general type of effect of that aspect of hatchery operation in the context of the specific application in the Yakima River. This allows for quantification (wherever possible) of the various factors of hatchery operation to be applied to each applicable life-stage of the listed species at the population level (in Section 2.4.2), which in turn allows the combination of all such effects with other effects accruing to the species to determine the likelihood of posing jeopardy to the species as a whole (Section 2.6).

The effects, positive and negative, for two categories of hatchery programs are summarized in Table 6. Generally speaking, effects range from beneficial to negative for programs that use local fish[5] for hatchery broodstock and from negligible to negative when a program does not use local fish for broodstock[6]. Hatchery programs can benefit population viability but only if they use genetic resources that represent the ecological and genetic diversity of the target or affected natural population(s). When hatchery programs use genetic resources that do not represent the ecological and genetic diversity of the target or affected natural population(s), NMFS is particularly interested in how effective the program will be at isolating hatchery fish and avoiding co-occurrence and effects that potentially disadvantage fish from natural populations. The range in effects for a specific hatchery program are refined and narrowed after available scientific information and the circumstances and conditions that are unique to individual hatchery programs are accounted for.

Information that NMFS needs to analyze the effects of a hatchery program on ESA-listed species must be included in an HGMP. Draft HGMPs are reviewed by NMFS for their sufficiency before formal review and analysis of the Proposed Action can begin.

Analysis of an HGMP or Proposed Action for its effects on ESA-listed species and on designated critical habitat depends on seven factors. These factors are:

(1) the hatchery program does or does not promote the conservation of genetic resources that represent the ecological and genetic diversity of a salmon ESU or steelhead DPS,
(2) hatchery fish and the progeny of naturally spawning hatchery fish on spawning grounds and encounters with natural-origin and hatchery fish at adult collection facilities,
(3) hatchery fish and the progeny of naturally spawning hatchery fish in juvenile rearing areas,
(4) hatchery fish and the progeny of naturally spawning hatchery fish in the migration corridor, estuary, and ocean,
(5) ME&R that exists because of the hatchery program,
(6) the operation, maintenance, and construction of hatchery facilities that exist because of the hatchery program, and
(7) fisheries that exist because of the hatchery program, including terminal fisheries intended to reduce the escapement of hatchery-origin fish to spawning grounds.

[5] The term “local fish” is defined to mean fish with a level of genetic divergence relative to the local natural population(s) that is no more than what occurs within the ESU or steelhead DPS (70 FR 37215, June 28, 2005).
[6] Exceptions include restoring extirpated populations and gene banks.

Table 6. Overview of the range in effects on natural population viability parameters from two categories of hatchery programs. The range in effects are refined and narrowed after the circumstances and conditions that are unique to individual hatchery programs are accounted for.

Natural population viability parameter	Hatchery broodstock originate from the local population and are included in the ESU or DPS	Hatchery broodstock originate from a non-local population or from fish that are not included in the same ESU or DPS
Productivity	**Positive to negative effect** Hatcheries are unlikely to benefit productivity except in cases where the natural population's small size is, in itself, a predominant factor limiting population growth (i.e., productivity) (NMFS 2004b).	**Negligible to negative effect** This is dependent on differences between hatchery fish and the local natural population (i.e., the more distant the origin of the hatchery fish the greater the threat), the duration and strength of selection in the hatchery, and the level of isolation achieved by the hatchery program (i.e., the greater the isolation the closer to a negligible affect).
Diversity	**Positive to negative effect** Hatcheries can temporarily support natural populations that might otherwise be extirpated or suffer severe bottlenecks and have the potential to increase the effective size of small natural populations. Broodstock collection that homogenizes population structure is a threat to population diversity.	**Negligible to negative effect** This is dependent on the differences between hatchery fish and the local natural population (i.e., the more distant the origin of the hatchery fish the greater the threat) and the level of isolation achieved by the hatchery program (i.e., the greater the isolation the closer to a negligible affect).
Abundance	**Positive to negative effect** Hatchery-origin fish can positively affect the status of an ESU by contributing to the abundance and productivity of the natural populations in the ESU (70 FR 37204, June 28, 2005, at 37215).	**Negligible to negative effect** This is dependent on the level of isolation achieved by the hatchery program (i.e., the greater the isolation the closer to a negligible affect), handling, ME&R[7] and facility operation, maintenance and construction effects.
Spatial Structure	**Positive to negative effect** Hatcheries can accelerate re-colonization and increase population spatial structure, but only in conjunction with remediation of the factor(s) that limited spatial structure in the first place. "Any benefits to spatial structure over the long term depend on the degree to which the hatchery stock(s) add to (rather than replace) natural populations" (70 FR 37204, June 28, 2005 at 37213).	**Negligible to negative effect** This is dependent on facility operation, maintenance, and construction effects and the level of isolation achieved by the hatchery program (i.e., the greater the isolation the closer to a negligible affect).

[7] Monitoring, Evaluation and Research

The analysis assigns an effect for each factor from the following categories. The categories are:

(1) positive or beneficial effect on population viability,
(2) negligible effect on population viability, and
(3) negative effect on population viability.

"The effects of hatchery fish on the status of an ESU will depend on which of the four key attributes are currently limiting the ESU, and how the hatchery within the ESU affect each of the attributes" (NMFS 2005). The category of affect assigned is based on an analysis of each factor weighed against the affected population(s) current risk level for abundance, productivity, spatial structure and diversity, the role or importance of the affected natural population(s) in ESU or steelhead DPS recovery, the target viability for the affected natural population(s), and the Environmental Baseline including the factors currently limiting population viability.

2.4.1.1. **Factor 1. The hatchery program does or does not promote the conservation of genetic resources that represent the ecological and genetic diversity of a salmon ESU or steelhead DPS**

This factor considers broodstock practices and whether they promote the conservation of genetic resources that represent the ecological and genetic diversity of a salmon ESU or steelhead DPS.

A primary consideration in analyzing and assigning effects for broodstock collection is the origin and number of fish collected. The analysis considers whether broodstock are of local origin and the biological pros and the biological cons of using ESA-listed fish (natural or hatchery-origin) for hatchery broodstock. It considers the maximum number of fish proposed for collection and the proportion of the donor population tapped to provide hatchery broodstock. "Mining" a natural population to supply hatchery broodstock can reduce population abundance and spatial structure. Also considered here is whether the program "backfills" with fish from outside the local or immediate area.

2.4.1.2. **Factor 2. Hatchery fish and the progeny of naturally spawning hatchery fish on spawning grounds and encounters with natural-origin and hatchery fish at adult collection facilities**

NMFS also analyzes the effects of hatchery fish and the progeny of naturally spawning hatchery fish on the spawning grounds. There are two aspects to this part of the analysis: genetic effects and ecological effects. NMFS generally views genetic effects as detrimental because at this time, based on the weight of available scientific information, we believe that artificial breeding and rearing is likely to result in some degree of genetic change and fitness reduction in hatchery fish and in the progeny of naturally spawning hatchery fish relative to desired levels of diversity and productivity for natural populations. Hatchery fish thus pose a threat to natural population rebuilding and recovery when they interbreed with fish from natural populations.

However, NMFS recognizes that there are benefits as well, and that the risks just mentioned may be outweighed under circumstances where demographic or short-term extinction risk to the population is greater than risks to population diversity and productivity. Conservation hatchery programs may accelerate recovery of a target population by increasing abundance faster than may occur naturally (Waples 1999). Hatchery programs can also be used to create genetic reserves for a population to prevent the loss of its unique traits due to catastrophes (Ford 2011). Furthermore, NMFS also recognizes there is considerable uncertainty regarding genetic risk. The extent and duration of genetic change and fitness loss and the short and long-term implications and consequences for different species, for species with multiple life-history types, and for species subjected to different hatchery practices and protocols remains unclear and should be the subject of further scientific investigation. As a result, NMFS believes that hatchery intervention is a legitimate and useful tool to alleviate short-term extinction risk, but otherwise managers should seek to limit interactions between hatchery and natural-origin fish and implement hatchery practices that harmonize conservation with the implementation of treaty Indian fishing rights and other applicable laws and policies (NMFS 2011).

Hatchery fish can have a variety of genetic effects on natural population productivity and diversity when they interbreed with natural-origin fish. Although there is biological interdependence between them, NMFS considers three major areas of genetic effects of hatchery programs: within-population diversity, outbreeding effects, and hatchery-induced selection. As we have stated above, in most cases, the effects are viewed as risks, but in small populations these effects can sometimes be beneficial, reducing extinction risk.

Within-population genetic diversity is a general term for the quantity, variety and combinations of genetic material in a population (Busack and Currens 1995). Within-population diversity is gained through mutations or gene flow from other populations (described below under outbreeding effects) and is lost primarily due to genetic drift, a random loss of diversity due to population size. The rate of loss is determined by the population's effective population size (N_e), which can be considerably smaller than its census size. For a population to maintain genetic diversity reasonably well, the effective size should be in the hundreds (e.g., Lande and Barrowclough 1987), and diversity loss can be severe if N_e drops to a few dozen.

Hatchery programs, simply by virtue of creating more fish, can increase N_e. In very small populations this can be a benefit, making selection more effective and reducing other small-population risks (e.g., Lacy 1987; Whitlock 2000; Willi et al. 2006). Conservation hatchery programs can thus serve to protect genetic diversity; several, such as the Snake River sockeye salmon program are important genetic reserves. However, hatchery programs can also directly depress N_e by two principal methods. One is by the simple removal of fish from the population so that they can be used in the hatchery. If a substantial portion of the population is taken into a hatchery, the hatchery becomes responsible for that portion of the effective size, and if the operation fails, the effective size of the population will be reduced (Waples and Do 1994). N_e can also be reduced considerably below the census number of broodstock by using a skewed sex ratio, spawning males multiple times (Busack 2007), and by pooling gametes. Pooling semen is especially problematic because when semen of several males is mixed and applied to eggs, a large portion of the eggs may be fertilized by a single male (Gharrett and Shirley 1985; Withler 1988). Factorial mating schemes, in which fish are systematically mated multiple times, can be used to increase N_e (Fiumera et al. 2004; Busack and Knudsen 2007). An extreme form of N_e reduction is the Ryman-Laikre effect (Ryman and Laikre 1991; Ryman et al. 1995), when N_e is reduced through the return to the spawning grounds of large numbers of hatchery fish from very few parents.

Inbreeding depression, another N_e-related phenomenon, is caused by the mating of closely related individuals (e.g., sibs, half-sibs, cousins). The smaller the population, the more likely spawners will be related. Related individuals are likely to contain similar genetic material, and the resulting offspring may then have reduced survival because they are less variable genetically or have double doses of deleterious mutations. The lowered fitness of fish due to inbreeding depression accentuates the genetic risk problem, helping to push a small population toward extinction.

Outbreeding effects are caused by gene flow from other populations. Gene flow occurs naturally among salmon and steelhead populations, a process referred to as straying (Quinn 1993; 1997). Natural straying serves a valuable function in preserving diversity that would otherwise be lost through genetic drift and in re-colonizing vacant habitat, and straying is considered a risk only when it occurs at unnatural levels or from unnatural sources. Hatchery programs can result in straying outside natural patterns for two reasons. First, hatchery fish may exhibit reduced homing fidelity relative to natural-origin fish (Grant 1997; Quinn 1997; Jonsson et al. 2003; Goodman 2005), resulting in unnatural levels of gene flow into recipient populations, either in terms of sources or rates. Second, even if hatchery fish home at the same level of fidelity as natural-origin fish, their higher abundance can cause unnatural straying levels into recipient populations. One goal for hatchery programs should be to ensure that hatchery practices do not lead to higher rates of genetic exchange with fish from natural populations than would occur naturally (Ryman 1991). Rearing and release practices and ancestral origin of the hatchery fish can all play a role in straying (Quinn 1997).

Gene flow from other populations can have two effects. It can increase genetic diversity (e.g., Ayllon et al. 2006) (which can be a benefit in small populations) but it can also alter established allele frequencies (and co-adapted gene complexes) and reduce the population's level of adaptation, a phenomenon called outbreeding depression (Edmands 2007; McClelland and Naish 2007). In general, the greater the geographic separation between the source or origin of hatchery fish and the recipient natural population, the greater the genetic difference between the two populations (ICTRT 2007), and the greater potential for outbreeding depression. For this reason, NMFS advises hatchery action agencies to develop locally derived hatchery broodstocks. Additionally, unusual rates of straying into other populations within or beyond the population's MPG or ESU or a steelhead DPS can have an homogenizing effect, decreasing intra-population genetic variability (e.g., Vasemagi et al. 2005), and increasing risk to population diversity, one of the four attributes measured to determine population viability. Reduction of within-population and among-population diversity can reduce adaptive potential.

The proportion of hatchery fish among natural spawners is often used as a surrogate measure of gene flow. Appropriate cautions and qualifications should be considered when using this proportion to analyze hatchery affects. Adult salmon may wander on their return migration, entering and then leaving tributary streams before finally spawning (Pastor 2004). These "dip-in" fish may be detected and counted as strays, but may eventually spawn in other areas, resulting in an overestimate of the number of strays that potentially interbreed with the natural population (Keefer et al. 2008). Caution must also be taken in assuming that strays contribute genetically in proportion to their abundance. Several studies demonstrate little genetic impact from straying despite a considerable presence of strays in the spawning population (Saisa et al. 2003; Blankenship et al. 2007b). The causative factors for poorer breeding success of strays are likely similar to those identified as responsible for reduced productivity of hatchery-origin fish in general, e.g., differences in run and spawn timing, spawning in less productive habitats, and reduced survival of their progeny (Reisenbichler and McIntyre 1977; Leider et al. 1990; McLean et al. 2004; Williamson et al. 2010).

Hatchery-induced selection (often called domestication) occurs when selection pressures imposed by hatchery spawning and rearing differ greatly from those imposed by the natural environment and causes genetic change that is passed on to natural populations through interbreeding with hatchery-origin fish, typically from the same population. These differing selection pressures can be a result of differences in environments or a consequence of protocols and practices used by a hatchery program. Hatchery selection can range from relaxation of selection, that would normally occur in nature, to selection for different characteristics in the hatchery and natural environments, to intentional selection for desired characteristics (Waples 1999).

Genetic change and fitness reduction resulting from hatchery-induced selection depends on: (1) the difference in selection pressures; (2) the exposure or amount of time the fish spends in the hatchery environment; and, (3) the duration of hatchery program operation (i.e., the number of generations that fish are propagated by the program). On an individual level, exposure time in large part equates to fish culture, both the environment experienced by the fish in the hatchery and natural selection pressures, independent of the hatchery environment. On a population basis, exposure is determined by the proportion of natural-origin fish being used as hatchery broodstock and the proportion of hatchery-origin fish spawning in the wild (Lynch and O'Hely 2001; Ford 2002), and then by the number of years the exposure takes place. In assessing risk or determining impact, all three levels must be considered. Strong selective fish culture with low hatchery-wild interbreeding can pose less risk than relatively weaker selective fish culture with high levels of interbreeding.

Most of the empirical evidence of fitness depression due to hatchery-induced selection comes from studies of species that are reared in the hatchery environment for an extended period – one to two years – prior to release (Berejikian and Ford 2004). Exposure time in the hatchery for fall and summer Chinook salmon and Chum salmon is much shorter, just a few months. One especially well-publicized steelhead study (Araki et al. 2007; Araki et al. 2008), showed dramatic fitness declines in the progeny of naturally spawning hatchery steelhead. Researchers and managers alike have wondered if these results could be considered a potential outcome applicable to all salmonid species, life-history types, and hatchery rearing strategies.

Critical information for analysis of hatchery-induced selection includes the number, location and timing of naturally spawning hatchery fish, the estimated level of interbreeding between hatchery-origin and natural-origin fish, the origin of the hatchery stock (the more distant the origin compared to the affected natural population, the greater the threat), the level and intensity of hatchery selection and the number of years the operation has been run in this way.

Ecological effects for this factor (i.e., hatchery fish and the progeny of naturally spawning hatchery fish on the spawning grounds) refer effects from competition for spawning sites and redd superimposition, contributions to marine-derived nutrients, and the removal of fine sediments from spawning gravels. Ecological effects on the spawning grounds may be positive or negative. To the extent that hatcheries contribute added fish to the ecosystem, there can be positive effects. For example, when anadromous salmonids return to spawn, hatchery-origin and natural-origin alike, they transport marine-derived nutrients stored in their bodies to freshwater and terrestrial ecosystems. Their carcasses provide a direct food source for juvenile salmonids and other fish, aquatic invertebrates, and terrestrial animals, and their decomposition supplies nutrients that may increase primary and secondary production (Kline et al. 1990; Piorkowski 1995; Larkin and Slaney 1996; Gresh et al. 2000; Murota 2003; Quamme and Slaney 2003; Wipfli et al. 2003). As a result, the growth and survival of juvenile salmonids may increase (Hager and Noble 1976; Bilton et al. 1982; Holtby 1988; Ward and Slaney 1988; Hartman and Scrivener 1990; Johnston et al. 1990; Larkin and Slaney 1996; Quinn and Peterson 1996; Bradford et al. 2000; Bell 2001; Brakensiek 2002).

Additionally, studies have demonstrated that perturbation of spawning gravels by spawning salmonids loosens cemented (compacted) gravel areas used by spawning salmon (e.g., Montgomery et al. 1996). The act of spawning also coarsens gravel in spawning reaches, removing fine material that blocks interstitial gravel flow and reduces the survival of incubating eggs in egg pockets of redds.

The added spawner density resulting from hatchery-origin fish spawning in the wild can have negative consequences in that to the extent there is spatial overlap between hatchery and natural spawners, the potential exists for hatchery-derived fish to superimpose or destroy the eggs and embryos of ESA listed species. Redd superimposition has been shown to be a cause of egg loss in pink salmon and other species (e.g., Fukushima et al. 1998).

The analysis also considers the effects from encounters with natural-origin that are incidental to the conduct of broodstock collection. Here, NMFS analyzes effects from sorting, holding, and handling natural-origin fish in the course of broodstock collection. Some programs collect their broodstock from fish volunteering into the hatchery itself, typically into a ladder and holding pond, while others sort through the run at large, usually at a weir, ladder, or sampling facility. Generally speaking, the more a hatchery program accesses the run at large for hatchery broodstock – that is, the more fish that are handled or delayed during migration – the greater the negative effect on natural-origin and hatchery-origin fish that are intended to spawn naturally and to ESA-listed species. The information NMFS uses for this analysis includes a description of the facilities, practices, and protocols for collecting broodstock, the environmental conditions under which broodstock collection is conducted, and the encounter rate for ESA-listed fish.

NMFS also analyzes the effects of structures, either temporary or permanent, that are used to collect hatchery broodstock. NMFS analyzes effects on fish, juveniles and adults, from encounters with these structures and effects on habitat conditions that support and promote viable salmonid populations. NMFS wants to know, for example, if the spatial structure, productivity, or abundance of a natural population is affected when fish encounter a structure used for broodstock collection, usually a weir or ladder. NMFS also analyzes changes to riparian habitat, channel morphology and habitat complexity, water flows, and in-stream substrates attributable to the construction/installation, operation, and maintenance of these structures. NMFS also analyzes the effects of structures, either temporary or permanent, that are used to remove hatchery fish from the river or stream and prevent them from spawning naturally, effects on fish, juveniles and adults, from encounters with these structures and effects on habitat conditions that support and promote viable salmonid populations.

2.4.1.3. **Factor 3. Hatchery fish and the progeny of naturally spawning hatchery fish in juvenile rearing areas**

NMFS also analyzes the potential for competition, predation, and premature emigration when the progeny of naturally spawning hatchery fish and hatchery releases share juvenile rearing areas. Generally speaking, competition and a corresponding reduction in productivity and survival may result from direct interactions when hatchery-origin fish interfere with the accessibility to limited resources by natural-origin fish or through indirect means, when the utilization of a limited resource by hatchery fish reduces the amount available for fish from the natural population (SIWG 1984). Naturally produced fish may be competitively displaced by hatchery fish early in life, especially when hatchery fish are more numerous, are of equal or greater size, when hatchery fish take up residency before naturally produced fry emerge from redds, and if hatchery fish residualize. Hatchery fish might alter naturally produced salmon behavioral patterns and habitat use, making them more susceptible to predators (Hillman and Mullan 1989; Steward and Bjornn 1990). Hatchery-origin fish may also alter naturally produced salmonid migratory responses or movement patterns, leading to a decrease in foraging success (Hillman and Mullan 1989; Steward and Bjornn 1990). Actual impacts on naturally produced fish would thus depend on the degree of dietary overlap, food availability, size-related differences in prey selection, foraging tactics, and differences in microhabitat use (Steward and Bjornn 1990).

Competition may result from direct interactions, or through indirect means, as when utilization of a limited resource by hatchery fish reduces the amount available for naturally produced fish (SIWG 1984). Specific hazards associated with competitive impacts of hatchery salmonids on listed naturally produced salmonids may include competition for food and rearing sites (NMFS 2012). In an assessment of the potential ecological impacts of hatchery fish production on naturally produced salmonids, the Species Interaction Work Group (SIWG 1984) concluded that naturally produced coho and Chinook salmon and steelhead are all potentially at “high risk” due to competition (both interspecific and intraspecific) from hatchery fish of any of these three species. In contrast, the risk to naturally produced pink, chum, and sockeye salmon due to competition from hatchery salmon and steelhead was judged to be low.

Several factors influence the risk of competition posed by hatchery releases: whether competition is intra- or interspecific; the duration of freshwater co-occurrence of hatchery and natural-origin fish; relative body sizes of the two groups; prior residence of shared habitat; environmentally induced developmental differences; and, density in shared habitat (Tatara and Berejikian 2012). Intraspecific competition would be expected to be greater than interspecific, and competition would be expected to increase with prolonged freshwater co-occurrence. Although newly released hatchery smolts are commonly larger than natural-origin fish, and larger fish usually are superior competitors, natural-origin fish have the competitive advantage of prior residence when defending territories and resources in shared natural freshwater habitat. Tatara and Berejikian (2012) further reported that hatchery-induced developmental differences from co-occurring natural-origin fish life stages are variable and can favor both hatchery- and natural-origin fish. They concluded that of all factors, fish density of the composite population in relation to habitat carrying capacity likely exerts the greatest influence.

En masse hatchery salmon smolt releases may cause displacement of rearing naturally produced juvenile salmonids from occupied stream areas, leading to abandonment of advantageous feeding stations, or premature out-migration (Pearsons et al. 1994). Pearsons et al. (1994) reported small-scale displacement of juvenile naturally produced rainbow trout from stream sections by hatchery steelhead. Small-scale displacements and agonistic interactions observed between hatchery steelhead and naturally produced juvenile trout were most likely a result of size differences and not something inherently different about hatchery fish.

A proportion of the smolts released from a hatchery may not migrate to the ocean but rather reside for a period of time in the vicinity of the release point. These non-migratory smolts (residuals) may directly compete for food and space with natural-origin juvenile salmonids of similar age. They also may prey on younger, smaller-sized juvenile salmonids. Although this behavior has been studied and observed, most frequently in the case of hatchery steelhead, residualism has been reported as a potential issue for hatchery coho and Chinook salmon as well. Adverse impacts from residual Chinook and coho hatchery salmon on naturally produced salmonids is definitely a consideration, especially given that the number of smolts per release is generally higher; however the issue of residualism for these species has not been as widely investigated compared to steelhead. Therefore, for all species, monitoring of natural stream areas in the vicinity of hatchery release points may be necessary to determine the potential effects of hatchery smolt residualism on natural-origin juvenile salmonids.

The risk of adverse competitive interactions between hatchery-origin and natural-origin fish can be minimized by:

- Releasing hatchery smolts that are physiologically ready to migrate. Hatchery fish released as smolts emigrate seaward soon after liberation, minimizing the potential for competition with juvenile naturally produced fish in freshwater (Steward and Bjornn 1990; California HSRG 2012).

- Operating hatcheries such that hatchery fish are reared to sufficient size that smoltification occurs in nearly the entire population.

- Releasing hatchery smolts in lower river areas, below areas used for stream-rearing naturally produced juveniles.

- Monitoring the incidence of non-migratory smolts (residuals) after release and adjusting rearing strategies, release location and timing if substantial competition with naturally rearing juveniles is determined likely.

Critical to analyzing competition risk is information on the quality and quantity of spawning and rearing habitat in the action area,[8] including the distribution of spawning and rearing habitat by quality and best estimates for spawning and rearing habitat capacity. Additional important information includes the abundance, distribution, and timing for naturally spawning hatchery fish and natural-origin fish; the timing of emergence; the distribution and estimated abundance for progeny from both hatchery and natural-origin natural spawners; the abundance, size, distribution, and timing for juvenile hatchery fish in the action area; and the size of hatchery fish relative to co-occurring natural-origin fish.

Another potential ecological effect of hatchery releases is predation. Salmon and steelhead are piscivorous and can prey on other salmon and steelhead. Predation, either direct (direct consumption) or indirect (increases in predation by other predator species due to enhanced attraction), can result from hatchery fish released into the wild. Considered here is predation by hatchery-origin fish and by the progeny of naturally spawning hatchery fish and by avian and other predators attracted to the area by an abundance of hatchery fish. Hatchery fish originating from egg boxes and fish planted as non-migrant fry or fingerlings can prey upon fish from the local natural population during juvenile rearing. Hatchery fish released at a later stage, so they are more likely to emigrate quickly to the ocean, can prey on fry and fingerlings that are encountered during the downstream migration. Some of these hatchery fish do not emigrate and instead take up residence in the stream (residuals) where they can prey on stream-rearing juveniles over a more prolonged period. The progeny of naturally spawning hatchery fish also can prey on fish from a natural population and pose a threat. In general, the threat from predation is greatest when natural populations of salmon and steelhead are at low abundance and when spatial structure is already reduced, when habitat, particularly refuge habitat, is limited, and when environmental conditions favor high visibility.

SIWG (1984) rated most risks associated with predation as unknown, because there was relatively little documentation in the literature of predation interactions in either freshwater or marine areas. More studies are now available, but they are still too sparse to allow many generalizations to be made about risk. Newly released hatchery-origin yearling salmon and steelhead may prey on juvenile fall Chinook and steelhead, and other juvenile salmon in the freshwater and marine environments (Hargreaves and LeBrasseur 1986; Hawkins and Tipping 1999; Pearsons and Fritts 1999). Low predation rates have been reported for released steelhead juveniles (Hawkins and Tipping 1999; Naman and Sharpe 2012). Hatchery steelhead timing and release protocols used widely in the Pacific Northwest were shown to be associated with negligible predation by migrating hatchery steelhead on fall Chinook fry, which had already emigrated or had grown large enough to reduce or eliminate their susceptibility to predation when hatchery steelhead entered the rivers (Sharpe et al. 2008). Hawkins (1998) documented hatchery spring Chinook salmon yearling predation on naturally produced fall Chinook salmon juveniles in the Lewis River. Predation on smaller Chinook salmon was found to be much higher in naturally produced smolts (coho salmon and cutthroat, predominately) than their hatchery counterparts.

[8] "Action area" means all areas to be affected directly or indirectly by the action in which the effects of the action can be meaningfully detected and evaluated.

Predation may be greatest when large numbers of hatchery smolts encounter newly emerged fry or fingerlings, or when hatchery fish are large relative to naturally produced fish (SIWG 1984). Due to their location in the stream or river, size, and time of emergence, newly emerged salmonid fry are likely to be the most vulnerable to predation. Their vulnerability is believed to be greatest immediately upon emergence from the gravel and then their vulnerability decreases as they move into shallow, shoreline areas (USFWS 1994). Emigration out of important rearing areas and foraging inefficiency of newly released hatchery smolts may reduce the degree of predation on salmonid fry (USFWS 1994).

Some reports suggest that hatchery fish can prey on fish that are up to 1/2 their length (Pearsons and Fritts 1999; HSRG 2004) but other studies have concluded that salmonid predators prey on fish 1/3 or less their length (Horner 1978; Hillman and Mullan 1989; Beauchamp 1990; Cannamela 1992; CBFWA 1996). Hatchery fish may also be less efficient predators as compared to their natural-origin conspecifics, reducing the potential for predation impacts (Sosiak et al. 1979; Bachman 1984; Olla et al. 1998).

There are several steps that hatchery programs can implement to reduce or avoid the threat of predation:

- Releasing all hatchery fish as actively migrating smolts through volitional release practices so that the fish migrate quickly seaward, limiting the duration of interaction with any co-occurring natural-origin fish downstream of the release site.

- Ensuring that a high proportion of the population have physiologically achieved full smolt status. Juvenile salmon tend to migrate seaward rapidly when fully smolted, limiting the duration of interaction between hatchery fish and naturally produced fish present within, and downstream of, release areas.

- Releasing hatchery smolts in lower river areas near river mouths and below upstream areas used for stream-rearing young-of-the-year naturally produced salmon fry, thereby reducing the likelihood for interaction between the hatchery and naturally produced fish.

- Operating hatchery programs and releases to minimize the potential for residualism.

2.4.1.4. **Factor 4. Hatchery fish and the progeny of naturally spawning hatchery fish in the migration corridor, in the estuary, and in the ocean**

Based on a review of the scientific literature, NMFS' conclusion is that the influence of density-dependent interactions on the growth and survival of salmon and steelhead is likely small compared with the effects of large-scale and regional environmental conditions and, while there is evidence that large-scale hatchery production can effect salmon survival at sea, the degree of effect or level of influence is not yet well understood or predictable. The same thing is true for mainstem rivers and estuaries. NMFS will watch for new research to discern and to measure the frequency, the intensity, and the resulting effect of density-dependent interactions between hatchery and natural-origin fish. In the meantime, NMFS will monitor emerging science and information and will consider that re-initiation of section 7 consultation is required in the event that new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this consultation (50 CFR 402.16).

2.4.1.5. **Factor 5. Research, monitoring, and evaluation that exists because of the hatchery program**

NMFS also analyzes proposed ME&R for its effects on listed species and on designated critical habitat. Generally speaking, negative effects on the fish from ME&R are weighed against the value or benefit of new information, particularly information that tests key assumptions and that reduces critical uncertainties. ME&R actions including but not limited to collection and handling (purposeful or inadvertent), holding the fish in captivity, sampling (e.g., the removal of scales and tissues), tagging and fin-clipping, and observation (in-water or from the bank) can cause harmful changes in behavior and reduced survival. These effects should not be confused with handling effects analyzed under broodstock collection. In addition, NMFS also considers the overall effectiveness of the ME&R program. There are five factors that NMFS takes into account when it assesses the beneficial and negative effects of hatchery ME&R: (1) the status of the affected species and effects of the proposed ME&R on the species and on designated critical habitat, (2) critical uncertainties over effects of the Proposed Action on the species, (3) performance monitoring and determining the effectiveness of the hatchery program at achieving its goals and objectives, (4) identifying and quantifying collateral effects, and (5) tracking compliance of the hatchery program with the terms and conditions for implementing the program. After assessing the proposed hatchery ME&R and before it makes any recommendations to the action agencies, NMFS considers the benefit or usefulness of new or additional information, whether the desired information is available from another source, the effects on ESA-listed species, and cost.

Hatchery actions also must be assessed for masking effects. For these purposes, masking is when hatchery fish included in the Proposed Action mix with and are not identifiable from other fish. The effect of masking is that it undermines and confuses ME&R and status and trends monitoring. Both adult and juvenile hatchery fish can have masking effects. When presented with a proposed hatchery action, NMFS analyzes the nature and level of uncertainties caused by masking and whether and to what extent listed salmon and steelhead are at increased risk. The analysis also takes into account the role of the affected salmon and steelhead population(s) in recovery and whether unidentifiable hatchery fish compromise important ME&R.

2.4.1.6. **Factor 6. Construction, operation, and maintenance, of facilities that exist because of the hatchery program**

The construction/installation, operation, and maintenance of hatchery facilities can alter fish behavior and can injure or kill eggs, juveniles and adults. It can also degrade habitat function and reduce or block access to spawning and rearing habitats altogether. Here, NMFS analyzes changes to riparian habitat, channel morphology and habitat complexity, in-stream substrates, and water quantity and water quality attributable to operation, maintenance, and construction activities and confirms whether water diversions and fish passage facilities are constructed and operated consistent with NMFS criteria.

2.4.1.7. **Factor 7. Fisheries that exist because of the hatchery program**

There are two aspects of fisheries that are potentially relevant to NMFS' analysis of HGMP effects in a section 7 consultation. One is where there are fisheries that exist because of the HGMP (i.e. the fishery is an interrelated and interdependent action) and listed species are inadvertently and incidentally taken in those fisheries. The other is when fisheries are used as a tool to prevent the hatchery fish associated with the HGMP, including hatchery fish included in an ESA-listed ESU or steelhead DPS from spawning naturally. "Many hatchery programs are capable of producing more fish than are immediately useful in the conservation and recovery of an ESU and can play an important role in fulfilling trust and treaty obligations with regard to harvest of some Pacific salmon and steelhead populations. For ESUs listed as threatened, NMFS will, where appropriate, exercise its authority under section 4(d) of the ESA to allow the harvest of listed hatchery fish that are surplus to the conservation and recovery needs of the ESU, in accordance with approved harvest plans" (NMFS 2005). In any event, fisheries must be strictly regulated based on the take, including catch and release effects, of ESA-listed species.

2.4.2. Effects of the Proposed Action

Analysis of the Proposed Action identified that within the action area, ESA-listed species are likely to be negatively affected and take will occur from two of the seven factors described in Section 2.4.1. They are hatchery fish and progeny of naturally spawning hatchery fish in juvenile rearing areas (i.e., competition and predation) and ME&R that exists because of the hatchery program. No factors were found to benefit ESA-listed species (Table 7). An overview of the analysis is described below.

Table 7. A summary of the effects of the Yakima River hatchery programs on ESA-listed MCR Steelhead and on designated critical habitat. The framework NMFS followed for analyzing effects of the hatchery programs is described in Section 2.4.1 of this opinion.

		Analysis of Effects for each Factor by Program		
Factor	**Range in Potential Effects for this Factor**	**Yakima Spring Chinook Salmon Program**	**Yakima Summer/Fall Chinook Salmon Program**	**Yakima Coho Salmon Program**
The hatchery program does or does not promote the conservation of genetic resources that represent the ecological and genetic diversity of a listed salmon ESU or steelhead DPS	Negligible to negative effect	**Negligible** No ESA-listed fish are reared as part of this program.	**Negligible** No ESA-listed fish are reared as part of this program.	**Negligible** No ESA-listed fish are reared as part of this program.
Hatchery fish and the progeny of naturally spawning hatchery fish on spawning grounds and encounters with natural-origin and hatchery fish at adult collection facilities	Negligible to negative effect	**Negligible** Chinook salmon do not interbreed with steelhead. As described in Section 1.4, hatchery fish from this program do not stray into other populations outside the Yakima River. Spring Chinook salmon and summer steelhead spawn at different times and locations within the Yakima River and thus, there are no ecological interactions between the species (i.e., redd superimposition).	**Negligible**: Chinook salmon do not interbreed with steelhead. As described in Section 1.4, hatchery fish from this program do not stray into other populations outside the Yakima River. Summer/fall Chinook salmon and summer steelhead spawn at different times and locations within the Yakima River and thus, there are no ecological interactions between the species (i.e., redd	**Negligible** Coho salmon do not interbreed with steelhead. As described in Section 1.4, hatchery fish from this program do not stray into other populations outside the Yakima River. Coho salmon and summer steelhead tend to spawn at different times and locations within the Yakima River and thus, there are no ecological interactions between the species (i.e., redd superimposition).

		Broodstock for this program will be collected at Roza Dam. During broodstock collection, ESA-listed MCR steelhead will also be trapped and sampled as part of the ME&R activities (impacts of these activities are addressed below).	superimposition). Broodstock for this program will be collected at Prosser Dam, and Sunnyside Dam. During broodstock collection, ESA-listed MCR steelhead will also be trapped and sampled as part of the ME&R activities (impacts of these activities are addressed below).	Broodstock for this program will be collected at Prosser Dam, Sunnyside Dam, Roza Dam, and potentially at Cowiche Dam and Wapatox Dam. During broodstock collection, ESA-listed MCR steelhead will also be trapped and sampled as part of the ME&R activities (impacts of these activities are addressed below).

Hatchery fish and the progeny of naturally spawning hatchery fish occurring simultaneously in juvenile rearing areas	Negligible to negative effect	**Negligible effect** Competition may occur between listed juvenile steelhead and hatchery spring Chinook salmon juveniles from this program in the tributaries and mainstem Yakima River below the acclimation facilities where the two species co-occur. Predation by hatchery spring Chinook salmon juveniles on listed steelhead juveniles may occur in the tributaries and mainstem Yakima River below the acclimation facilities where the two species co-occur, but is expected to only impact a few individuals and would have a negligible effect on the listed populations.	**Negligible effect** Competition may occur between listed juvenile steelhead and hatchery summer/fall Chinook salmon juveniles from this program in the tributaries and mainstem Yakima River below acclimation facilities where the two species co-occur. Predation by hatchery fall Chinook salmon juveniles on listed steelhead juveniles may occur in the tributaries and mainstem Yakima River below acclimation facilities where the two species co-occur, but is expected to only impact a few individuals and would have a negligible effect on the listed populations.	**Negligible effect** Competition may occur between listed juvenile steelhead and hatchery coho salmon juveniles from this program in the tributaries and mainstem Yakima River below acclimation facilities, and at parr and adult release locations where the two species co-occur. Predation by hatchery coho salmon juveniles on listed steelhead juveniles may occur in the tributaries and mainstem Yakima River below acclimation facilities where the two species co-occur, but is expected to only impact a few individuals and would have a negligible effect on the listed populations.
Hatchery fish and the progeny of naturally spawning hatchery fish in the migration corridor, estuary, and ocean	Negligible to negative effect	**Negligible effect** Effects of the Proposed Action are not detectable. Available information does not show the level of hatchery production that leads to measureable competition, nor does it	**Negligible effect** Effects of the Proposed Action are not detectable. Available information does not show the level of hatchery production that leads to measureable competition, nor does it	**Negligible effect** Effects of the Proposed Action are not detectable. Available information does not show the level of hatchery production that leads to measureable competition, nor does it

		identify how and to what extent ESA-listed species would be disadvantaged. The conditions under which competitive interactions take place would not occur, and competitive advantages and disadvantages for different life-history stages, populations, ESUs and DPSs, and for hatchery and natural-origin fish are not detectable.	identify how and to what extent ESA-listed species would be disadvantaged. The conditions under which competitive interactions take place would not occur, and competitive advantages and disadvantages for different life-history stages, populations, ESUs and DPSs, and for hatchery and natural-origin fish are not detectable.	identify how and to what extent ESA-listed species would be disadvantaged. The conditions under which competitive interactions take place would not occur, and competitive advantages and disadvantages for different life-history stages, populations, ESUs and DPSs, and for hatchery and natural-origin fish are not detectable.
ME&R that exists because of the hatchery program	Beneficial to negative effect	**Negative effect** Proposed ME&R activities (i.e., the trapping, sampling, and tagging) may cause injury and death to listed steelhead. Data collected during these activities are needed to evaluate the hatchery program to determine if supplementation is working and impacts on non-target taxa are minimized. ME&R activities that measure steelhead VSP parameters are necessary to determine the status of the ESA-listed steelhead populations in the Yakima River MGP. The data collected will be used to	**Negative effect** Proposed ME&R activities (i.e., the trapping, sampling, and tagging) may cause injury and death to listed steelhead. Data collected during these activities are needed to evaluate the hatchery program to determine if the reintroduction is successful and to minimize impacts on ESA-listed species. ME&R activities that measure steelhead VSP parameters are necessary to determine the status of the ESA-listed steelhead populations in the Yakima River MGP. The data collected will be used to	**Negative effect** Proposed ME&R activities (i.e., the trapping, sampling, and tagging) may cause injury and death to listed steelhead. Data collected during these activities are needed to evaluate the hatchery program to determine if the reintroduction is successful and to minimize impacts on ESA-listed species. ME&R activities that measure steelhead VSP parameters are necessary to determine the status of the ESA-listed steelhead populations in the Yakima River MGP. The data collected will be used to

		determine if the hatchery program is affecting ESA-listed steelhead.	determine if the hatchery program is affecting ESA-listed steelhead.	determine if the hatchery program is affecting ESA-listed steelhead.
Construction, operation, and maintenance of facilities that exist because of the hatchery program	Beneficial to negative effect	**Negligible effect** Hatchery diversion screens protect juvenile fish from entrainment and injury and satisfy NMFS screen criteria. Operation of the facility is not expected to degrade water quality. Water is treated before it is returned to the river and the program has a current NPDES permit. Hatchery diversions may seasonally impact juvenile *O. mykiss* spatial distribution. Hatchery diversions for acclimation facilities are operated for a short period in the spring and can reduce flow in small sections of stream during that time but will not impact fish distribution.	**Negligible effect** Hatchery diversion screens protect juvenile fish from entrainment and injury and satisfy NMFS screen criteria. Operation of the facility is not expected to degrade water quality. Water is treated before it is returned to the river and the program has a current NPDES permit. Hatchery diversions may seasonally impact juvenile *O. mykiss* spatial distribution. Hatchery diversions for acclimation facilities are operated for a short period in the spring and can reduce flow in small sections of stream during that time but will not impact fish distribution.	**Negligible effect** Hatchery diversion screens protect juvenile fish from entrainment and injury and satisfy NMFS screen criteria. Operation of the facility is not expected to degrade water quality. Water is treated before it is returned to the river and the program has a current NPDES permit. Hatchery diversions may seasonally impact juvenile *O. mykiss* spatial distribution. Hatchery diversions for acclimation facilities are operated for a short period in the spring and can reduce flow in small sections of stream during that time but will not impact fish distribution.
Fisheries that exist because of the hatchery program	Beneficial to negative effect	**NA** Fisheries are not part of the Proposed Action. Management of the fisheries targeting spring Chinook salmon produced by this program and the effects on	**NA** Fisheries are not part of the Proposed Action. Management of the fisheries targeting summer/fall Chinook salmon produced by this program and the	**NA** Fisheries are not part of the Proposed Action. Management of the fisheries targeting coho salmon produced by this program and the effects on ESA-

		ESA-listed steelhead are included in a Fisheries Management and Evaluation Plan that has been submitted to NMFS.	effects on ESA-listed steelhead are included in a Fisheries Management and Evaluation Plan that has been submitted to NMFS.	listed steelhead are included in a Fisheries Management and Evaluation Plan that has been submitted to NMFS.

2.4.2.1. Factor 1. The hatchery program does or does not promote the conservation of genetic resources that represent the ecological and genetic diversity of a salmon ESU or steelhead DPS

Negligible effect: The proposed programs use spring Chinook salmon, summer/fall Chinook salmon, and coho salmon that are not listed under the ESA.

2.4.2.2. Factor 2. Hatchery fish and the progeny of naturally spawning hatchery fish on spawning grounds and encounters with natural-origin and hatchery fish at adult collection facilities

Negligible effect: Genetic effects on ESA-listed steelhead populations in the Yakima River would not be expected to occur because Chinook and coho salmon do not interbreed with steelhead. Impacts on other listed salmon populations outside the Yakima River Basin would not be expected to occur because fish from these programs do not tend to stray into ESA-listed salmon populations (see Section 1.4).

Ecological effects from hatchery Chinook salmon and coho salmon spawning naturally are expected to be negligible. Returning adults from the hatchery spring Chinook salmon, summer/fall Chinook salmon, and coho salmon programs spawn at times and in areas not used by the listed steelhead populations. One of the goals of the hatchery spring Chinook salmon programs is to supplement the naturally spawning spring Chinook salmon in the Upper Yakima River with hatchery-produced spring Chinook salmon. Similarly, one of the goals of the summer/fall Chinook salmon and coho salmon programs is to use hatchery fish to reestablish naturally self-sustaining populations in the Yakima River. All three of these programs are expected to increase in the number of hatchery fish spawning naturally but this would not be expected to lead to competition for spawning sites or redd superimposition because the hatchery-produced salmon would spawn at times and locations that do not overlap with the listed steelhead populations.

There may be a beneficial effect on juveniles from the Upper Yakima River and Naches River populations from an increase in marine-derived nutrients that result from hatchery salmon spawning naturally (see Section 2.4.1.2).

ESA-listed summer steelhead will be handled during broodstock collection activities for all three hatchery programs. Broodstock for the spring Chinook salmon program is collected at Roza Dam from mid-April to September and generally up to 25 steelhead are handled during the collection process. Steelhead passage at Roza Dam tends to be from February to early May. However, the Roza Dam adult trap is operated annually from mid-December to mid-September to monitor steelhead escapement. During monitoring activities, up to 1,000 steelhead could be sampled and tagged annually at the Roza Dam trap (see Section 1.3.4). However, the recent abundance of adult steelhead at Roza Dam has averaged less than 200 (Table 5, Upper Yakima population), though escapement over Roza Dam has been increasing in recent years (YN 2013). As a result, the actual number of adults sampled would be much less than the 1,000 adults proposed until the population begins to approach the minimum abundance goal of 1,500 (Table 5). Sampling mortalities have been very low and are expected to be fewer than 5 adults annually. The sampling at Roza Dam would only affect adults from the Upper Yakima River steelhead population.

Broodstock for the local fall Chinook salmon program is currently collected from several locations: (a) the Prosser Dam right-bank Denil ladder and fish trapping facility; (b) from fish seined in Chandler Canal during maintenance operations; (c) from a Denil ladder at the Prosser Hatchery outlet stream; and (d) a fish wheel in Marion Drain. In the future, broodstock may also be collected at a new adult collection facility at Sunnyside Dam. The collection and sampling of listed summer steelhead for monitoring purposes also occurs during the time that fall Chinook salmon broodstock are collected (from early September to December). Steelhead may also be handled as fall Chinook salmon are seined from the dewatered section of the Chandler Canal from the headgate to the screens during the maintenance period. Fewer than 5 steelhead have been handled annually during fall Chinook salmon broodstock seining in Chandler Canal (YN 2010d). Steelhead have not been observed entering the Denil ladder at the Prosser Hatchery or the fish wheel in Marion Drain (YN 2010a).

The Prosser Dam adult trap operation will be extended beyond the fall Chinook salmon broodstock collection period into June to sample returning adult steelhead. The steelhead that will be sampled at the right-bank Denil ladder and trap represent a small portion of the steelhead passing over Prosser Dam (<15% of the total past Prosser Dam). Passage at the left, center, and right bank ladders will be monitored using video imaging (when not trapping), to allow counting of all adults that swim up the ladders. Under the proposed monitoring and evaluation activities, up to 1,000 adult steelhead could be trapped annually (see Section 1.3.4). Sampling mortalities have been very low and expected to continue to be fewer than 5 adults annually. Adult steelhead sampled at the Prosser Dam adult trap would be from all four Yakima River populations.

The Sunnyside Dam does not have an adult trap to collect adult fall Chinook salmon, but one is proposed as part of the Master Plan (YN 2012a) and would be used as an alternative location to collect broodstock for the local fall Chinook salmon program. There are three existing fish ladders operating on the left and right banks and in the center of the river at the dam. The trap would be built on the right bank and would convert the fish ladder exit pool into a holding pool. A Denil steep pass would be used to attract fish out of the pool and into anesthetic tanks for sorting. Trapping for broodstock would occur from early September to December and would only impact those steelhead entering the right bank ladder. An estimated 300 adult steelhead could be handled at the Sunnyside Dam trap annually. The trapping would occur during broodstock collection activities for summer Chinook, fall Chinook, and coho salmon. Impacts from the trap operations would be considerably lower than at Prosser Dam because steelhead from the Satus Creek and Toppenish Creek populations do not migrate past Sunnyside Dam, but impacts on steelhead from the Naches and Upper Yakima River populations would occur. The mortality rate from handling is expected to be very low, less than 5 annually, similar to that observed at the Prosser Dam adult trap.

An adult ladder and trap at the proposed I-182 acclimation pond would be used to collect and remove returning adult fall Chinook salmon from the segregated harvest program. Natural-origin steelhead that do stray into the facility would be released back to the river. It is expected that few, if any, steelhead would volunteer up the ladder into the adult holding pond, similar to what has been observed at the Prosser Hatchery during fall Chinook salmon and coho salmon broodstock collection activities.

Broodstock collection for coho salmon program prior to 2009 was done at the Prosser Dam right-bank adult Denil ladder; since then broodstock has come from adults that volunteer up the Denil fish ladder at the Prosser Hatchery outfall. Collection occurs from September to mid-November. As described in Section 1.3.3, broodstock collection for the segregated program will be the same as what currently occurs using returns to Prosser Hatchery. As the integrated program develops, it would collect broodstock at Roza Dam on the upper Yakima River, at the proposed Sunnyside Dam trap, and possibly at the Cowiche or Wapatox dams on the Naches River. The potential for incidental interactions with adult steelhead during coho salmon broodstock collection for the integrated program at Roza, Cowiche, and/or Wapatox dams is low. Fewer than 5 steelhead would be encountered at each dam during the month of December when coho broodstock collection would occur. Broodstock collection at the proposed Sunnyside Dam trap would be expected to handle steelhead that are migrating upstream during the September-to-mid-November period. This is a peak passage time as measured at Prosser Dam; however, trapping at Sunnyside Dam would only handle steelhead from the Naches and Upper Yakima River populations and the actual number is expected to be low because only steelhead entering the right bank ladder would be handled. Upstream passage through the middle and left bank ladders at Sunnyside Dam would continue unimpeded.

2.4.2.3. **Factor 3. Hatchery fish and the progeny of naturally spawning hatchery fish in juvenile rearing areas**

Negligible effect: Hatchery smolts and juvenile progeny of naturally spawning hatchery Spring Chinook salmon, summer/fall Chinook salmon, and coho salmon are expected to have a minimal effect on juvenile *O. mykiss* from the Upper Yakima River, and Naches River populations. The effect on the Proposed Action on juvenile *O. mykiss* is used as a measure of impacts on ESA-listed steelhead juveniles because juvenile steelhead are indistinguishable from non-listed resident *O. mykiss* juveniles. Juvenile *O. mykiss* from the Satus Creek and Toppenish Creek populations are not expected to be affected by the hatchery releases because, under the proposed action, all releases would occur outside the primary spawning and rearing habitat of the Satus Creek and Toppenish Creek populations and the only interactions would be during out-migration in the lower Yakima River (see Section 2.4.2.4).

As described in Section 2.4.1.3, there are a number of actions that can be taken to minimize competitive interactions that are used for the spring Chinook salmon and the summer/fall Chinook salmon programs. These include releasing hatchery smolts that are physiologically ready to migrate; rearing fish to sufficient size that smoltification occurs in the entire population; volitionally releasing smolts from acclimation ponds; and monitoring the incidence of residuals. The coho salmon program also takes the same actions when releasing smolts; however, the program also releases summer parr, and outplants hatchery adults to increase the distribution of coho salmon in the basin, and to evaluate overwinter survival (YN 2012a). Coho salmon parr from the locally-adapted broodstock will be scatter-planted at the end of July in a number of tributaries to increase distribution and to evaluate over-winter survival. Up to 42,000 coho salmon parr will be out-planted annually with up to 3,000 being released at each location. To minimize competition, parr releases will focus on tributaries where bull trout and steelhead are not present or are at low abundance. Competitive interactions with juvenile *O. mykiss* from these releases of hatchery coho salmon summer parr would be expected to increase compared to what would result from the release of smolts. However, these impacts would be similar to impacts that what would result from interactions with the progeny of naturally spawning hatchery spring Chinook salmon, summer/fall Chinook salmon, and coho salmon.

Competitive interactions would occur where the distribution of hatchery salmon juveniles and the juvenile progeny of naturally spawning hatchery salmon overlap with *O. mykiss* juveniles. As described by the Species Interactions Working Group (SIWG 1984), competition between juveniles of the same species would be expected to be greater than competition between different species and the competition would be expected to increase with prolonged freshwater co-occurrence (overlap). All of the competitive interactions due to the Proposed Action will be between the different species, and the effect of this competition between the hatchery produced species and the juvenile *O. mykiss* is expected to be negligible because the different species tend to have different habitat preferences (SIWG 1984). WDFW and the YN have been evaluating the potential for salmon supplementation and reintroduction actions to negatively impact fish that are not the target of the enhancement – in this case, ESA-listed steelhead in the Yakima River Basin (Temple et al. 2012). These evaluations are on-going and are included as part of the Proposed Action (see Section 1.3.4).

To date, the evaluations have not found any detectable impacts on rainbow trout (the resident form of *O. mykiss*, used as an analog for juvenile ESA-listed steelhead) from the supplementation and reintroduction programs, even though the abundance of spring Chinook salmon and coho salmon has increased substantially in recent years (Temple et al. 2012). Similar results were obtained comparing impacts from coho salmon adult outplanting in a Taneum Creek (Temple et al. 2012). After four years of adult outplanting, natural production of coho salmon has been established in the study area and measurements of rainbow trout abundance, average size, and condition have not been negatively affected. These studies support the assertion that the juvenile *O. mykiss* in the Yakima River Basin are not being negatively impacted through competitive interactions with hatchery juveniles, and with the progeny of naturally spawning hatchery salmon.

Temple et al. (2012) also evaluated the presence and abundance of residualized hatchery smolts in the North Fork Teanaway River, below the Jack Creek Acclimation pond, and in the mainstem Yakima River above Roza Dam, and found that many of the spring Chinook salmon smolts did not emigrate but very few coho smolts residualized. Since 1999, the number of spring Chinook salmon residuals observed in the mainstem Yakima River has ranged from 2 to 423, with only 30 observed in 2011 (Temple et al. 2012). No coho residuals have been observed since 2007. Johnson et al. (2012) estimate that the number of residualized hatchery spring Chinook salmon found on the spawning grounds ranged from 0 to 78 from 1999 to 2011, and were fewer in number than natural-origin residuals (0-92). Both of these estimates show that the only a small fraction, less than 1%, of the hatchery juvenile releases tend to residualize. Due to the low abundance of residualized hatchery salmon, impacts from competitive interactions are expected to be very low or negligible.

Summer/Fall Chinook salmon are released primarily as subyearlings, though a proportion of the summer Chinook program and a proportion of the segregated harvest program would be released as yearlings (YN 2010d). Subyearling summer/fall Chinook salmon do not tend to residualize, but if they do, survival in the lower Yakima River below the release locations is expected to be poor due to warm water temperatures and the presence of non-native predators (YKFP 2011). Yearling fall Chinook salmon releases have also been shown to produce precocious males that do not emigrate or do migrate out to the mainstem Columbia River but return only a few months later (Beckman and Larsen 2005). The proportion of the yearling summer/fall Chinook salmon from the local broodstock program that do not emigrate and remain as precocious males is expected to be small, less than 1% of the yearlings released (Beckman and Larsen 2005). The harvest fall Chinook salmon program proposes to release up to 4.0 million subyearlings annually from the I-182 acclimation pond near the mouth of the Yakima River. To improve survivals and contribution to fisheries, a proportion of these may be reared and released as yearlings, reducing the total number released but achieving the same adult harvest contribution. Because of the release location near the mouth of the Yakima River, the very low number of yearlings likely to residualize, and because this part of the river is not used by rearing *O. mykiss* due to high water temperatures during the summer and fall, competitive interactions are expected to be negligible.

As described in Section 2.4.1.3, predation by hatchery spring Chinook salmon and coho salmon on juvenile salmonids can negatively impact listed species, especially when hatchery releases coincide with emergence or the presence of new emergent fry. Spring Chinook salmon smolts, and coho salmon smolts are released in the spring prior to emergence of steelhead fry. Spring Chinook smolts average 120 mm FL, coho salmon smolts average 150 mm FL. Summer/fall Chinook salmon subyearlings of a target release size of 90 mm FL, yearling are released at sizes smaller than 160 mm. Using the assumption that salmonids tend to eat prey smaller than 1/3 their FL, *O. mykiss* juveniles smaller than 54 mm would be susceptible to predation by hatchery salmon smolts. Steelhead spawn timing in the tributaries varies by elevation and water temperatures, with spawning in the lower elevations beginning in March continuing into June, at higher elevations (YN 2012a). Based on the spawning timing, steelhead fry would not be expected to emerge from the gravel until after the majority of the hatchery salmon smolts have emigrated from the basin, thus reducing the potential for predation.

The low likelihood of predation of natural-origin salmonid fry by hatchery salmon smolts is supported by work that was done by Dunnigan (1999) who evaluated predation on spring Chinook salmon fry by hatchery coho salmon smolts. In two years, 2,854 coho smolts were sampled and out of these 7 had consumed fished and only two of the prey items were determined to be *Oncorhynchus spp.*, and these were consumed by one coho smolt (Dunnigan 1999). The mean coho smolt FL was 150.6 mm in 1998, and 132 mm in 1999. Temple et al. (2011) sampled juvenile *O. mykiss* in tributaries to the mainstem Yakima River during the spring and summer as part of the Steelhead VSP monitoring project. The length of the *O. mykiss* sampled ranged in size from 50 mm to over 200 mm FL, with the majority of the fish ranging between 110 and 130 mm Temple et al. (2011). In the mainstem rearing areas above Roza Dam, the mean FL ranged from 188 mm to 232 mm for age-1 *O. mykiss*. Juveniles at these sizes would not be susceptible to predation by Chinook or coho salmon yearling smolts.

2.4.2.4. **Factor 4. Hatchery fish and the progeny of naturally spawning hatchery fish in the migration corridor, estuary, and ocean**

Negligible effect: Best available information does not indicate that the release of hatchery fish from the Yakima River programs would exacerbate density-dependent effects on ESA-listed species in the mainstem Columbia River, in the estuary, or in the Pacific Ocean.

NMFS has been investigating this factor for some time. The Proposed Recovery Plan for Snake River Salmon (NMFS 1995) described the issue in this manner. There is intense debate over the issues of carrying capacity and density-dependent effects on natural populations of salmon. However, there is little definitive information available to directly address the effects of ecological factors on survival and growth in natural populations of Pacific salmon. Thus, many of the ecological consequences of releasing hatchery fish into the wild are poorly defined. The proposed recovery plan called on hatchery operators and funding entities to “limit annual releases of anadromous fishes from Columbia Basin hatcheries” and in fact, releases have declined substantially. Hatchery releases for the entire Columbia River Basin now vary between 130 and 145 million fish annually compared to a previous annual production of approximately 200 million fish.

More recently, NMFS has reviewed the literature for new and emerging scientific information on the role and the consequences of density-dependent interactions in estuarine and marine areas. While there is evidence of density-dependent effects effecting salmon survival, the currently available information does not support a meaningful causal link to a particular category of hatchery program. The SCA for the FCRPS opinion (NMFS 2008f) and the September 2009 FCRPS Adaptive Management Implementation Plan (AMIP) (NMFS 2009a) both concluded that available knowledge and research abilities are insufficient to discern any important role or contribution of hatchery fish in density-dependent interactions affecting salmon and steelhead growth and survival in the mainstem Columbia River, the Columbia River estuary, and the Pacific Ocean.

Furthermore, there is a high level of mortality immediately after release for the fish produced by these programs. Neeley (2012) estimated juvenile survival from the acclimation and release locations in the Yakima River Basin to McNary Dam: spring Chinook salmon, coho salmon, summer Chinook salmon, and fall Chinook salmon survival has been less than 30 percent over that distance. Our conclusion, based on available information, is that hatchery production on the scale proposed for the Yakima River Basin and considered in this opinion will have a negligible effect on the survival and recovery of the ESA-listed salmon and steelhead DPSs encountered in the mainstem Columbia River migration corridor, in the Columbia River estuary, and in the Pacific Ocean.

NMFS will continue to monitor emerging science and information and will reinitiate section 7 consultation in the event that new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this consultation (50 CFR 402.16).

2.4.2.5. Factor 5. Research, monitoring, and evaluation that exists because of the hatchery program

Negative effect: The HGMPs for the Proposed Action address the five factors that NMFS takes into account when it analyzes and weighs the beneficial and negative effects of hatchery ME&R (Section 2.4.1). The Proposed Action includes ME&R activities that will continue to monitor the Performance Indicators identified in Section 1.10 of the HGMPs, ensure compliance with this opinion, and inform future decisions over how the hatchery programs can be adjusted to meet their goals while further reducing impacts on ESA-listed steelhead. The activities will also monitor the status of the threatened Yakima River steelhead populations

As described in Section 1.3.4, all of the proposed hatchery programs include an intensive monitoring and evaluation component. For example, the spring Chinook salmon program was authorized under the NPCC's Fish and Wildlife Program with the stated purpose being "to test the assumption that new artificial production can be used to increase harvest and natural production while maintaining the long-term genetic fitness of the fish population being supplemented and keeping adverse genetic and ecological interactions with non-target species or stocks within acceptable limits." The initial phase of the coho salmon program was extensively monitored to evaluate the probability of success in reintroducing coho salmon back into the Yakima River and on the possible impacts on steelhead and other native populations (Dunnigan 1999). These monitoring activities will continue under the Propose Action.

The VSP proportion of the ME&R was developed to fill critical monitoring gaps identified in the 2009 Columbia River Basin monitoring strategy review and the FCRPS Opinion. Data from these activities will be used to evaluate population status and trends, determine impacts from the proposed hatchery programs, inform NMFS' status reviews, and address critical uncertainties (e.g., the relationship between resident and anadromous life histories in the Upper Yakima and Naches populations), consistent with the NMFS' mid-Columbia steelhead recovery plan (NMFS 2009b). The improved understanding of steelhead populations' performance produced by this project will directly inform efforts to recover the steelhead populations in the Yakima River Basin.

NMFS has developed general guidelines to reduce impacts when collecting listed adult and juvenile salmonids (NMFS 2000b; 2008a), which have been incorporated as terms and conditions into section 10 and section 7 permits for research and enhancement activities (e.g., NMFS 2007b). Though necessary to monitor and evaluate impacts on listed populations from hatchery programs, monitoring and evaluation programs should be designed and coordinated with other plans to maximize the data collection while minimizing take of listed fish. The ME&R activities in the Proposed Action will maximize the data collection by using *O. mykiss* juveniles that are collected and tagged for more than one project. The ME&R guidelines are currently being followed during ME&R activities and will be included as terms and conditions.

The proposed ME&R activities will directly and incidentally take ESA-listed steelhead adults and juveniles as described in Section 1.3.4 (Table 2), which will negatively affect the populations encountered. The level of take and its impact on steelhead adults depends on the activity. Adult steelhead observed during spawning ground surveys would not be negatively impacted because the effects would be negligible as the adults temporarily move away from the observers. Adult steelhead trapping and sampling activities at Prosser and Roza Dams will result in adult mortalities. The mortalities are expected to be low, fewer than five annually at each dam; adults trapped at Roza Dam would belong only to the Upper Yakima River population, while adults trapped at Prosser Dam would belong to all four populations in the MPG. The number of adult steelhead handled at Roza Dam is an estimate of the maximum number that could be encountered if the natural production reaches recovery. The proposed 1,000 adults that could be handled at Roza Dam currently exceeds the most recent 2006-07 to 2011-12 mean escapement of 293 adults.

The 1,000 adults sampling goal at Prosser Dam would handle only those adults that pass through the right bank fish ladder and would represent less than 20% of the recent annual escapement past Prosser Dam. The sampling of steelhead at these facilities would co-occur with broodstock collection activities for the proposed salmon programs, but would continue after broodstock collection to sub-sample the entire run. The radio-tagging of 500 adult steelhead at Prosser Dam is needed to address a number of uncertainties including run timing, timing of entrance into the spawning tributaries, survival to spawning, and spatial distribution within the tributaries. Radio tagging adult steelhead can increase mortalities due to extended handling, as compared to normal sampling, and due to the presence of the radio tag. These effects can be reduced by how the tags are attached and by using skilled personnel. Overall mortality (from handling, sampling, tagging – including delayed mortality) associated with adult trapping of the four ESA-listed populations in the Yakima River basin is expected to be very low.

The projected take of juvenile *O. mykiss* is listed in Table 2, and includes both resident and anadromous life-histories. Juvenile *O. mykiss* sampled at the CJMF are considered to be emigrating steelhead juveniles because they have the morphological and physiological indicators of a smolt and resident (non-migratory) trout do not rear below Prosser Dam due to poor water quality. The *O. mykiss* sampled at the CJMF belong to all four populations. The projected handling of 16,000 steelhead juveniles at the CJMF would allow for increased sampling and encounters as natural production increases in the future. The passage of juvenile steelhead at Prosser Dam, as estimated at the CJMF, has been highly variable over the past few years ranging from 28,754 in 2009 to 229,466 in 2011(D. Lind personal communication (email June 5, 2013). The actual number of juvenile steelhead that are handled at the CJMF has also been variable, ranging from 2,540 in 2012 to 5,743 in 2011. It should be noted that the juvenile steelhead passage estimates are based on canal survival estimates and flow-entrainment estimates for spring Chinook salmon juveniles and may not accurately estimate steelhead passage. Furthermore, the flow-entrainment model used to estimate passage at Prosser Dam is also affected by higher flows and low diversion rates which influence the high estimate for 2011. Increased PIT tagging of both spring Chinook salmon and steelhead juveniles will be used to develop a PIT tag based model that is expected to provide better estimates of juvenile salmonid passage at Prosser Dam.

Under the Proposed Action, all of the monitoring and evaluation activities in the tributaries and in the mainstem Upper Yakima River could encounter up to 40,270 *O. mykiss* juveniles annually (Table 2). Of these juveniles approximately 26,520 would be sampled and 23,620 would be tagged (Table 2). Within the 40,270 encountered annually, 8,000 of these would be from observations during snorkel surveys and any effects would be minor and transitory as the juveniles move away from the observers. As described in Section 2.2.1.1, both the resident and anadromous forms of *O. mykiss* are found in the Yakima River Basin and a principle objective of the VSP monitoring research is to evaluate interactions between the resident and anadromous life histories. Resident *O. mykiss* are not part of the ESA-listed DPS in the Yakima River and thus take prohibitions do not apply; however, visually distinguishing between resident and anadromous forms is impossible. To get an estimate of the number of anadromous *O. mykiss* that are handled and tagged, the proportion of those juveniles that are PIT tagged that are then detected emigrating from the basin can be used. For the Upper Yakima River and Naches River populations, where the majority of the PIT tagging is occurring, the estimated proportion of tagged *O. mykiss* detected at downstream locations was less than 5% (e.g., the mean proportion of the fish tagged in 2011 that were detected in 2012 was 3.28% (Temple 2013). The proportion detected downstream varied by the location where they were marked and ranged from 0.85% in the mainstem Yakima River (above Roza Dam), to 5.10% in the mainstem Teanaway River (Temple 2013). Using the 5% proportion, out of the 40,270 juvenile *O. mykiss* collected annually (calculated using the total less those that are just observed) an estimated 2,013 would be anadromous steelhead juveniles.

The majority of the 8,000 juvenile *O. mykiss* that are expected to be handled during the operation of rotary screw traps in Satus, Toppenish, and Ahtanum Creeks, and the 400 juveniles sampled at Roza Dam downstream migrant trap are considered to be juvenile steelhead. The juveniles are considered smolts because they show physiological and morphological traits used to identify smolts and they are actively migrating out of the rearing areas for the Pacific Ocean. Under the Proposed Action, the number of fish handled during the operation of the rotary screw traps, juvenile sampling at Roza Dam, and the CJMF could total up to 24,400 smolts annually. This number plus the anadromous juvenile *O. mykiss* handled during the VSP monitoring activities, (approximately 2,013 juveniles), would total up to 26,413 smolts annually that would be allowed to be handled under the Proposed Action. Using the 2010-2012 average estimated emigration at Prosser Dam, the 26,413 smolts would represent 17% of the total out-migrating ESA-listed steelhead smolts for the Yakima River Basin.

The actual number of juvenile steelhead smolts handled is considerably less than the 26,413 smolts that would be allowed under the Proposed Action. The number of smolts that are currently being handled during the ME&R activities include the 4,256 average (2010-2012) at the CJMF, the average 5,276, for the same period, handled in the rotary screw traps (Ressigue 2013), and the average 168 handled at the Roza Dam. These fish, along with those PIT tagged as part of the VSP project, currently average around 10,940 smolts, which is less than 7% of the estimated emigration at Prosser Dam. The larger number of juveniles that could be handled under the Proposed Action allows for increases in the overall production of steelhead smolts overtime as the populations recover.

Hatchery fish from the proposed production programs will not be confused with, or conceal the status of, any ESA-listed species or the effects of the hatchery production on any ESA-listed species. All of the hatchery origin fish are either externally marked with an adipose fin-clip or internally marked with a CWT. A proportion of each release group will also be PIT tagged to monitor survival and run timing. These marks will allow for identification of program salmon if they are recovered outside the basin. This will be important to monitor because straying into other basins could occur as a result of the proposed increases in number of fall Chinook salmon released at Prosser and/or at the proposed I-182 acclimation pond.

2.4.2.6. Factor 6. Construction, operation, and maintenance of facilities that exist because of the hatchery programs

Negligible effect: Operations, maintenance, and construction activities included in the Proposed Action are expect to have a negligible effect on ESA-listed steelhead and on designated critical habitat.

Spring Chinook Salmon Program

The rearing and release of spring Chinook salmon at the CESRF and the juvenile acclimation ponds may seasonally impact flows in the bypass reaches but are not expected to reduce the spatial distribution or productivity of listed steelhead in the Upper Yakima River basin.

The CESRF is operated under water withdrawal permits #G4-32414 and #G4-32504. As described in Section 1.3.1, the CESRF uses a combination of surface and groundwater to operate year-round. The surface water comes from a screened intake on the mainstem Yakima River, and the river water is supplemented by groundwater wells for incubation, to control temperature, and to limit the amount of surface water used during periods of low river flows. The surface water and ground water used in the hatchery is released into Ox Bow Lakes. These are part of a connected side channel that was isolated from the Yakima River by the construction of the Burlington Northern Railroad. The lakes are accessible to anadromous fish, where it returns to the Yakima River, 7,000 feet below the intake. Flows in the Yakima are lowest from October to December and during this period the CESRF removes approximately 6.5% of the river flow (31.2 cfs from an average Yakima River flow of 486 cfs). Removal of this amount of water will have a negligible effect on the quantity and quality of steelhead rearing habitat. Any impacts that may occur would be offset by the benefits of cooler water temperatures from groundwater pumping, and from the off-channel rearing habitat that occurs from the outfall of hatchery waters into the Ox Bow lakes. The facility operates within the limitations established by the NPDES permit.

The Easton acclimation facility pumps water from the Yakima River and returns the water approximately 30 feet downstream from the intake. The facility is operated beginning in January and must be shut down by the end of May per the water withdrawal permit (S4-32567). Impacts from the water removal at this facility are negligible because the facility reduces river flow 2.1% over a 30-foot section. Impacts at the Clark Flat acclimation facility are also negligible because the facility reduces flow by less than 1% over a 150-foot section of the mainstem Yakima River. The Clark Flat facility is operated under water withdrawal permit S4-32568. Water removal at levels as low as expected at both these sites does not impair fish passage.

The Jack Creek acclimation facility, located on the North Fork Teanaway River, uses a gravity diversion system with a retractable weir. The river water is operated under water withdrawal permit S4-32572, and is supplemented by ground water. The facility reduces flow over a 300-foot section of the river and can remove up to 13.4% of the average flows in February. The proposed operation of this facility is from January through May but in recent years the facility has only been used from March to May. When operated in March, the facility reduces flows by up to 11% over the 300 ft section, a level that is not expected to reduce fish passage or rearing habitat for steelhead.

Summer/Fall Chinook Salmon Program

The operation of facilities for rearing and release of summer/fall Chinook salmon at Prosser and Marion Drain hatcheries, along with their acclimation at remote sites may seasonally impact flows in the bypass reaches but are not expected to reduce the spatial distribution or productivity of ESA-listed steelhead. Prosser Hatchery water comes from the Chandler Canal downstream of the irrigation screens and thus will not affect steelhead. Prosser Hatchery is operated under water permits #G4-34946, and #G4-33055. Under the Master Plan (YN 2012a), an additional screen and pump system would be constructed to provide water to the hatchery during the 3 to 4 weeks that the Chandler Canal is out of operation for maintenance. The screened intake structure would be located adjacent to the mainstem Yakima River immediately above the hatchery outfall. The new screens and pump system would take up 7 cfs of river flow during the November to December time period when the Chandler Canal closed. The mean flow, above Prosser, during the months of November and December has been 2,477 cfs and 3,389 cfs, respectively. Therefore, the withdrawal represents less than 0.3% of the November flow and 0.1% of the December flow. The new screen intake would be designed to meet NMFS criteria, and would remove water from the river over a very short distance for only a 3 to 4 week period. Any effect of this level of water withdrawal on ESA-listed steelhead would be negligible.

The Marion Drain facility pumps water from the Marion Drain from a screened intake that is 180 feet upstream of the outfall. The screen currently meets NMFS criteria and effects from the operation of the hatchery intake would be negligible. Marion Drain is an irrigation return canal and because of water quality issues it does not support steelhead juvenile rearing. Improvements to the intake structure at Marion Drain that would change the configuration of the screens, improving efficiency, are proposed in the Master Plan (YN 2012a). The Marion Drain Hatchery is located on the Yakama Nation Reservation and is operated under Yakama Nation water withdrawal permits #2010-53 and #2010-06.

Summer/fall Chinook salmon will be released from a number of acclimation ponds in the Naches and Upper Yakima Rivers. The majority of the production would be acclimated and released from the Stiles Acclimation Pond. This facility is located at RM 3.7 on the Naches River and is supplied with water from the existing Chapman Nelson irrigation canal system (Figure 1). Flow through the ponds is maintained at 2.5 cfs during the acclimation period, generally from February through April. The withdrawal of water for rearing of summer and fall Chinook salmon at this facility would not be expected to reduce fish passage or rearing habitat because withdrawal occurs during the a period of high flow in the Naches River.

Summer/Fall Chinook salmon will also be released from the Nelson Springs Acclimation pond (Figure 1). Operation of the Nelson Springs acclimation pond would not be expected to impact ESA-listed steelhead, because the pond uses spring water and irrigation return water that is collected above areas accessible to steelhead.

Another location being considered for summer/fall Chinook acclimation is Billy's Pond (Figure 1). The pond is located around RM 109 on the Yakima River, and is currently going through rehabilitation to improve connectivity to the Yakima River. The pond is maintained by hyporeheic flows and fluctuates with changes in Yakima River flows. Currently, steelhead smolts do not use the off-channel pond, but impacts may occur in the future if steelhead use the pond for off-channel rearing and are prevented from exiting the pond when the summer/fall Chinook salmon are being acclimated. The effects would be negligible because steelhead smolts generally would emigrate from the pond prior to summer/fall Chinook salmon acclimation in April and May. The number of steelhead smolts that may be trapped would be small, <10 juveniles annually, because at the time that acclimation would be occurring, steelhead smolt passage at the CJMF is peaking (Sampson et al. 2012) and those that would be detained during the acclimation period are steelhead that would not have smolted.

Beginning in 2012, a mobile acclimation pond was installed on top of Roza Dam to evaluate the survival of summer Chinook salmon acclimated and released from this location. The pond uses up to 90 gpm (0.20 cfs) that is pumped from the above Roza Dam. The pump is operated from behind the fish screen at Roza Dam and water outfall is back into the bypass. No measureable impacts are expected on steelhead from the operation of the facility.

Other ponds that may be used to acclimate summer/fall Chinook salmon include Elks Pond and Skov Pond (Figure 1). Elks Pond and Skov Pond are off-channel ground water ponds that fluctuate with fluctuations in the Yakima River flows. Elks Pond enters a stream that enters the mainstem Yakima River and a net is used at the outlet of the pond to prevent fish from exiting prematurely. Skov Pond is connected to the Yakima River by a six-inch PVC underground pipe. Juveniles in this pond would be kept in a net-pen and, at time of release a connection would be made to the underground pipe. The fish in these ponds would be acclimated beginning in mid-March and volitionally released from mid-April to mid-May. There would be no impacts on ESA-listed steelhead because cannot access the pond through the outlet pipe.

The proposed I-182 acclimation pond would require improvements to groundwater sources at the site and the installation of a screened intake and pump system that would be operated from March through May for juvenile acclimation and in the fall to collect returning adults. Current designs in the Master Plan (YN 2012a) have the intake structure located immediately upstream of the hatchery ladder outfall and thus would not be expect to have any effect on ESA-listed steelhead.

All of the production at each of these facilities will be marked for identification at a level sufficient to evaluate the different rearing types, release locations, and straying to areas outside the Yakima River Basin.

Coho Salmon Program

The coho salmon hatchery program releases smolts from Prosser Hatchery as part of the segregated harvest program and from a number of other facilities to support reintroduction in the Yakima River Basin above Prosser Dam. Impacts from the operation of Prosser Hatchery are the same as described above for the Summer/Fall Chinook Salmon Program. Similarly, the Stiles Acclimation Pond, the Nelson Springs Acclimation Pond, and the Roza Dam mobile acclimation pond would also be used to acclimate and release hatchery coho smolts. Impacts from the acclimation of coho smolts at these facilities would the same as those described above for the acclimation of summer/fall Chinook salmon.

Lost Creek Pond, at RM 39 on the Naches River (Figure 1), will be used for acclimating hatchery coho salmon. The pond consists of two privately owned earthen ponds that are separated by a cement fish ladder. The water for the ponds comes from a privately operated gravity flow intake in the river and diverts up to 5 cfs, which would continue independent of the Proposed Action (for private recreational use of the pond). Coho salmon are acclimated from mid-March and volitionally released at the beginning of May. The acclimation of coho salmon at this facility is not expected to increase impacts on listed steelhead in the Naches River above those already occurring from the operation of the privately operated water diversion.

Holmes Ponds, located near Ellensburg, Washington (Figure 1), will be used to acclimate hatchery coho salmon. The ponds are located at the site of the proposed Holmes Ranch Hatchery facility. Bypass water from the New Cascade Canal supplements the 10 cfs of ground water flow that support a series of large, deep ponds. The operation of the New Cascade Canal diversion would continue independently of the Proposed Action. Juvenile coho salmon are acclimated at this facility beginning in mid-March and generally volitionally released in May at the start of irrigation bypass flows. Impacts may occur due to delay of outmigrating steelhead smolts that are bypassed into the ponds from the New Cascade Canal diversion. These fish would not be able to exit the ponds until the screens are removed. Smolt traps installed at this facility showed that very few spring Chinook salmon or juvenile *O. mykiss* use these ponds for rearing thus limiting impacts on ESA-listed steelhead to <10 juveniles annually. Impacts from the removal of water would not be expected to increase due to the acclimation of coho salmon at the Holmes Ponds, because those impacts are already occurring due to the operation of the irrigation diversion.

Easton Ponds are two old gravel pits adjacent to the Yakima River in the upper most part of the basin (Figure 1). Hatchery coho salmon would be acclimated and released here. The water source is the Yakima River that naturally flows through the ponds with additional ground-water seepage. The ponds reenter the river through an outlet channel. A barrier net separates the two ponds. Coho salmon smolts are acclimated at this site beginning in mid-March and volitionally released by the beginning of May. Juvenile steelhead that happen to be in the ponds when the barrier nets are installed would be trapped until the nets are removed. The actual number that could be trapped is expected to be very small, <10 juveniles annually, because the smolts that are emigrating from the system would not enter the off-channel ponds and the ponds are located high in the basin such that only a few emigrating smolts would potentially pass the off-channel habitat.

Boone Pond is a shallow side channel of the Yakima River downstream from the CESRF (Figure 1). The side channel is netted off at both ends to hold coho salmon during acclimation. Juvenile steelhead do not use the pond, it is very shallow and is poor natural rearing habitat; thus, effects on steelhead are not expected to occur because they would not use the pond for rearing.

The coho salmon hatchery program uses mobile acclimation units. These units use up to 90 gpm (0.20 cfs) of surface water and the pumps are screened to NMFS criteria. The water is returned to the tributary stream a short distance from the intake. Mobile acclimation ponds would be used to release coho salmon into Cowiche and Rattlesnake Creeks. Effects on steelhead would be negligible because only a small quantity of water would be removed over a very short distance and for a short duration. Juvenile and adult steelhead spatial distribution would not be affected. The Rattlesnake Creek unit is operated under a temporary water right (S4-35257, expires 2015), and the South Fork Cowiche Creek unit is operated under water right S4-35210 which expires in 2014.

Instead of using a mobile acclimation pond for release of coho salmon in Ahtanum Creek, the YN is working with the LaSalle High School to spawn and rear coho salmon at a small facility run by the High School. Juvenile salmon are reared and then PIT tagged before being scatter-planted in Ahtanum Creek in May as summer parr. The small hatchery uses well water and thus would not affect ESA-listed steelhead.

All of the production will be marked for identification at level sufficient to evaluate the different rearing types, release locations, and straying to areas outside the Yakima River Basin.

Pollution Abatement

The CESRF is operated under NPDES Permit # WAG 13-5016. The Prosser Hatchery is operated under NPDES Permit #WAG 13-5017. The Marion Drain Hatchery is located on Yakama Nation Reservation and is operated through the Yakama National Water Code Administration. Effluent from these facilities is monitored weekly to ensure compliance with permit requirements. The mobile acclimation ponds currently do not need NPDES permits because rearing levels in the ponds are below permit minimums. At the request of the Washington Department of Ecology, effluent samples were collected for two years at the Cowiche Creek mobile acclimation pond and for one year at the Rattlesnake Creek mobile acclimation pond and the results showed no impacts on water quality, so no effects on ESA-listed species is expected.

Construction Activities

The Master Plan (YN 2012a) describes improvements to the Prosser Hatchery and the Marion Drain Hatchery, along with new facilities: an adult fish trap at Sunnyside Dam and the new Holmes Ranch Hatchery. Improvements at the Prosser Hatchery, Marion Drain Hatchery, and the Sunnyside Dam fish trap have been delayed until at least 2018. Construction at the Holmes Ranch site could start as soon as 2014. The proposed Holmes Ranch Hatchery would be constructed at the location of a former cattle ranch. The facility is designed to have a small footprint to limit impacts on fish and wildlife habitat. As part of the proposed operation of the hatchery, during periods when the irrigation water withdrawals are shut off (from November through April), up to 8 cfs would continue to be diverted through the Yakima River side-channel to allow for hatchery operations, and to maintain flows through the side-channel habitat. The 8 cfs represents < 2% of the flows during the low flow period in February.

The proposed I-182 acclimation pond is currently part of a larger JDM proposal that includes a major upgrade to the Ringold Springs Hatchery facility. The COE is currently in the process of submitting the proposed construction activities at Ringold Springs and the I-182 acclimation pond for funding authorization for Fiscal Year 2016. Possible impacts from the construction of the I-182 acclimation pond would likely be transitory and minimal, but the project remains unfunded at this time and its effects are considered not reasonably certain to occur. Impacts on ESA-listed salmon and steelhead associated with the construction of the project will be reviewed prior to construction when more details of the construction process and mitigation actions are known, and thus these impacts are not included in this consultation.

After reviewing the timing of the operation of the acclimation ponds, their locations, their design, and the in-river conditions, NMFS has determined that the effects of the operation of these facilities with respect to water withdrawals and the water intake themselves, as operated under the Water Use Permits, would not be measurable and would not impact ESA-listed juvenile or adult steelhead in the Yakima River Basin or their critical habitat. NMFS is not currently considering potential effects of any future violations of the Water Use Permits on listed species; NMFS considers that any such violation would trigger reinitiation of consultation. The Permittees will notify NMFS in a timely manner of any proposed changes to the permits.

2.4.2.7. Factor 7. Fisheries that exist because of the hatchery program

Not Applicable. Fisheries in the Yakima River Basin and their management are not included as part of the Proposed Action. To the extent that fisheries have been developed to specifically target salmon produced by the Proposed Action, they will be subject to future section 7 consultations. To the extent that there are existing fisheries that may catch fish produced by the Proposed Action, they are mixed-stock fisheries and would exist with or without these programs (and have previously been evaluated in a separate biological opinion (NMFS 2008e). Management of the fisheries in the Yakima River Basin that target hatchery spring Chinook salmon, summer/fall Chinook salmon, and coho salmon produced by the hatchery programs are included in a Fisheries Management and Evaluation Plan that has been submitted to NMFS for ESA consultation.

2.4.2.8. Effects of the Action on Critical Habitat

Negligible effect: This consultation analyzed the Proposed Action for its effects on designated critical habitat and has determined that operation of the hatchery programs will have a negligible effect on PCEs in the action area.

The existing hatchery facilities have not led to altered channel morphology and stability, reduced and degraded floodplain connectivity, excessive sediment input, or the loss of habitat diversity. Except for ladder entrances and water diversions, the hatchery facilities are located away from the river and do not affect designated critical habitat.

As described above in Section 2.4.2.6, the proposed surface water diversions used for rearing fish in the hatcheries and for acclimation and release will not affect the spatial distribution of adult or juvenile ESA-listed steelhead. The Proposed Action includes strict criteria for diverting water from the mainstem Yakima River and its tributaries. Many of the acclimation facilities use water that has already been diverted for irrigation purposes and will not contribute to additional impacts on critical habitat. Some of the facilities may actually provide a benefit by increasing off-channel rearing habitat by supplementing with groundwater and maintaining minimum flows in the bypass sections. In no case will the amount of water withdrawn from streams be anywhere near levels that would interfere with usage of the stream for rearing or passage. In a few cases, the acclimation sites themselves may entrap a few ESA-listed steelhead that have not yet smolted – the numbers of such juveniles trapped would be low and are not expect to have any discernible effect on a given population.

Operation of the hatcheries and acclimation facilities are not expected to degrade water quality. Water will be treated at the hatcheries before it is returned to mainstem Yakima River under the current NPDES permits. Furthermore, production released from the acclimation ponds does not meet minimum poundage levels that would require NPDES permits. Evaluation of two of the mobile acclimation ponds has shown no effect on water quality parameters, and similarly low levels of effect on water quality are expected at the other acclimation sites.

2.5. Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). For the purpose of this analysis, the action area is that part of the Columbia River Basin described in the Section 1.4. To the extent ongoing activities have occurred in the past and are currently occurring, their effects are included in the baseline (whether they are federal, state, tribal, or private). To the extent those same activities are reasonably certain to occur in the future (and are tribal, state, or private), their future effects are included in the cumulative effects analysis. This is the case even if the ongoing, tribal, state, or private activities may become the subject of section 10(a)(1)(B) incidental take permits in the future. The effects of such activities are treated as cumulative effects unless and until an opinion has been issued.

Currently on-going non-Federal actions described in the Environmental Baseline (Section 2.3) are expected to continue to affect ESA-listed steelhead in the Yakima River at similar levels of intensity.

State, tribal, and local governments have developed plans and initiatives to benefit listed species and these plans must be implemented and sustained in a comprehensive manner for NMFS to consider them "reasonably foreseeable" in its analysis of cumulative effects. The Federally approved MCR Steelhead Recovery Plan (NMFS 2009b) is such a plan and it describes in detail the on-going and proposed state, tribal, and local government actions that are targeted to reduce known threats to listed MCR summer steelhead in the Yakima River Basin. Such future tribal, state, and local government actions will likely to be in the form of legislation, administrative rules, or policy initiatives, and land use and other types of permits. Government and private actions may include changes in land and water uses, including ownership and intensity, any of which could impact listed species or their habitat.

2.6. Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the benefits and risks posed to ESA-listed species and critical habitat as a result of implementing the Proposed Action. In this section, NMFS add the effects of the Proposed Action (Section 2.4.2) to the environmental baseline (Section 2.3) and the cumulative effects (Section 2.5) to formulate the agency's opinion as to whether the Proposed Action is likely to: (1) result in appreciable reductions in the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat. This assessment is made in full consideration of the status of the species and critical habitat and the status and role of the affected populations in recovery (Sections 2.2.1, 2.2.2, and 2.2.3).

In assessing the overall risk of the Proposed Action on each species, NMFS considers the benefits and risks of each factor discussed in Section 2.4.2, above, in combination, considering their potential additive effects with each other and with other actions in the area (environmental baseline and cumulative effects). This combination serves to translate the positive and negative effects posed by the Proposed Action into a determination as to whether the Proposed Action as a whole would appreciably reduce the likelihood of survival and recovery of the ESA-listed species and their designated critical habitat.

2.6.1. MCR Steelhead

Best available information indicates that the species, in this case the MCR Steelhead DPS, is at risk and remains at threatened status (Ford 2011). Ford (2011) determined that there have been improvements in the viability ratings for some of the component populations, but the MCR Steelhead DPS is not currently meeting viability criteria. Within the Yakima River MPG, two of the populations (Satus Creek and Toppenish Creek) are considered viable, but the Naches River and Upper Yakima River populations are at high risk due to low abundance and productivity.

As set out in the Environmental Baseline (Section 2.3), the Yakima River steelhead populations are affected by habitat modifications within the Action area. The most prominent and deleterious modifications are the result of flow regulation and irrigation activities, as well as, urban development in the floodplain, riparian, and upland areas. These activities have reduced connectivity; elevated fine sediments yields; reduced large woody debris; reduced vegetative canopy; caused streams to become straighter, wider, and shallower; altered peak flow volume and timing; and altered floodplain function. All of these have contributed to the current status of the populations within the Yakima River MPG.

NMFS analyzes seven factors to determine the effects of a hatchery program on ESA-listed species and on designated critical habitat (Section 2.4). Take of ESA-listed steelhead may occur as a result of the Proposed Action from broodstock collection, hatchery fish spawning naturally, interactions with juvenile hatchery fish, the operation of the hatchery facilities and acclimation ponds, and from ME&R activities. The amount and effect of the take on the ESA-listed steelhead, as detailed in Section 2.4, are summarized below; for the majority of the activities where take occurs, NMFS found that the effects are expected to be negligible, except for take associated with the ME&R activities (Table 2).

The primary source of effects on the ESA-listed steelhead that results from the Proposed Action is from those activities included as part of the large ME&R component that is necessary for the evaluation of all three hatchery programs (see Section 2.4.2.5). The Proposed Action also includes activities designed to monitor the status of the ESA-listed steelhead populations in the basin and to evaluate the interactions between the resident and anadromous forms of *O. mykiss*.

The Proposed Action includes numerous ME&R activities that will handle and sample ESA-listed steelhead (see Table 2). The ME&R results in some level of injury to and mortality of ESA-listed fish from handling, sampling, and marking both juveniles and adults. Adult steelhead will be trapped and sampled at Roza Dam and Prosser Dam, and these activities will overlap with hatchery broodstock collection for Chinook and coho salmon. Trapping will cause mortalities but the numbers will be low with less than 5 adults lost at each dam annually. The impacts at Prosser Dam would affect all four steelhead populations in the basin, while the impacts at Roza Dam would affect one, the Upper Yakima River population. Trapping and radio tagging of adults at Prosser Dam will provide needed status information on the run timing and spatial distribution of the four steelhead populations in the MPG and this is a beneficial effect that NMFS weighs against negative effects from handling and sampling.

The number of juvenile steelhead proposed to be sampled, and tagged, as described in Table 2, are intended to provide for adequate sampling levels to obtain necessary information as the steelhead abundance and viability increase. For example, the proposed number of juvenile steelhead that could be sampled and tagged at the CJMF is 16,000, while the number handled in recent years has ranged from 2,540 to 5,743, the difference allows for take to increase as the populations and habitat in the basin recover.

ME&R in the tributaries and in the mainstem Upper Yakima River (excluding downstream migrant sampling, see below), would encounter up to 40,270 juvenile *O. mykiss* annually, although not all of these will be ESA-listed steelhead and many would not be handled (e.g., only observed during snorkel surveys). Approximately 70% of the fish encountered would be sampled. As described in Section 2.2.1.1, both the resident and anadromous forms of *O. mykiss* are found in the Yakima River Basin. Resident *O. mykiss* are not part of the ESA-listed MCR Steelhead DPS and thus take prohibitions do not apply; however, distinguishing between the resident and ESA-listed steelhead, based on visual inspection only, is not possible. The best information available upon which to estimate the number of ESA-listed steelhead encountered during ME&R activities described in the Proposed Action is PIT tag data for juvenile *O. mykiss* that were detected emigrating from the basin. Based on this data, approximately 5% of the proposed 40,270 *O. mykiss* or 2,013 would be ESA-listed steelhead.

Juveniles sampled during the operation of rotary screw traps in Satus Creek, Toppenish Creek, and Ahtanum Creek, along with juveniles sampled at Roza Dam, are considered to be ESA-listed steelhead because they would be collected as actively migrating smolts. The total number of steelhead smolts that could potentially be handled annually under the Proposed Action is estimated to be 26,413 smolts representing all four steelhead populations in the Yakima River Basin roughly proportionate to their abundance. Collecting, sampling, and tagging would be expected to have a negative effect on the juveniles handled and could lead to mortalities. However, the number of juveniles killed is expected to be low, with less than 3% of all of the juveniles encountered being lost. The 26,413 smolts that could be handled represent about 17% of the current annual smolt passage at Prosser Dam. The negative effects are partially offset by the benefits gained from developing a better understanding of the status of the four populations in the Yakima River MPG, and of the interactions between the resident and anadromous forms of *O. mykiss* in the basin.

NMFS analyzed the remaining factors and determined that they would have negligible or inconsequential effects on ESA-listed steelhead. As described in Section 2.4.2, the proposed hatchery programs do not rear ESA-listed salmon or steelhead but do promote the conservation and reintroduction of salmon species that were historically present in the Yakima River Basin. Hatchery and naturally produced adult Chinook salmon and coho salmon are not expected to interact with ESA-listed steelhead on the spawning grounds due to differences in spawn timing and location. Broodstock collection activities that may occur at Cowiche, and/or Wapatox dams, and potentially in the future at Sunnyside Dam would handle adult steelhead (Table 2). Impacts at these locations are expected to be low with <7 adult mortalities annually. Impacts on ESA-listed steelhead that are encountered during broodstock collection activities at the Roza and Prosser dams are the same as those expected for adult steelhead monitoring because broodstock collection overlaps with adult steelhead monitoring activities.

The presence of hatchery fish and the progeny of naturally spawning hatchery fish in the juvenile rearing areas is likely to result in competition between rebuilding Chinook salmon and coho salmon and ESA-listed steelhead (see Section 2.4.2.3), but this competition is expected to have a negligible effect on ESA-listed steelhead. Spring Chinook salmon, summer/fall Chinook salmon, coho salmon, and steelhead all co-occurred and thrived, previously, in areas throughout the Yakima River Basin. The salmon species were extirpated or severely reduced in abundance due to many of the same factors that reduced steelhead to threatened status. As these factors are remedied and Chinook and coho salmon populations and steelhead populations rebuild, there will be a corresponding increase in interactions between these species, and monitoring and implementation of the Proposed Action will ensure that steelhead are not disadvantaged during the rebuilding process. For example, the out planting of coho salmon summer parr and coho salmon adults will increase competitive interactions, but implementation of the Proposed Action will release hatchery fish away from the primary steelhead rearing locations. The Proposed Action will also acclimate smolts prior to release, release hatchery smolts that are physiologically ready to migrate, rear fish to sufficient size so that smoltification occurs, and volitionally release smolts, such that they immediately begin moving downstream, all for the purpose of reducing interactions in rearing areas that disadvantage steelhead.

Interspecific interactions that would result from the release of hatchery Chinook and coho salmon are being evaluated as part of the ME&R activities included in the Proposed Action. To date, the evaluations have not found any detectable impacts on rainbow trout (the resident form of *O. mykiss* that is used as an analog for steelhead) from the release of hatchery Chinook and coho salmon, even though the abundance of naturally spawning spring Chinook salmon and coho salmon has increased (Temple et al. 2012) and so no such impacts on ESA-listed steelhead are expected. ME&R has shown that the number of spring Chinook salmon and summer/fall Chinook salmon residuals is low and decreasing, meaning any competition with steelhead that may occur is negligible.

Hatchery smolt predation on steelhead fry will be low because most spring Chinook salmon and coho salmon hatchery smolts are released and leave the system prior to the emergence of steelhead fry from the gravel redds. Dunnigan (1999) found that coho salmon smolt predation on steelhead is very low, and that juvenile *O. mykiss* are generally too large for coho salmon to prey upon in areas where the two species co-occur (see Section 2.4.1.3).

Take can occur from the operation of the hatchery facilities under the Proposed Action, however, the effect of the take is expected to be negligible. The CESRF, Prosser Hatchery, and Marion Drain Hatchery are operated to comply with water withdrawal permits, pollution abatement permits, design standards that have a proven track record for protecting both juvenile and adult steelhead. Take can also result from the operation of the acclimation ponds from water withdrawals, and possible entrapment of ESA-listed juvenile steelhead. The effects on ESA-listed steelhead rearing and passage from acclimation pond water withdrawals are negligible because withdrawals are constrained by permit limits, are temporary, and remove only a small proportion of the flow over a short distance. A few of the acclimation ponds use off-channel habitat for rearing and can entrap ESA-listed steelhead juveniles when the ponds are netted off to acclimate hatchery juveniles. The number of juvenile steelhead that could be entrapped is expected to be very low, <10 per pond annually, because the ponds occur high in the basin above the primary spawning and rearing areas, and netting off the ponds for acclimation would occur after the majority of the juvenile steelhead smolts have migrated downstream (see Section 2.4.2.6).

The management of fisheries in the Yakima River and elsewhere is not part of the Proposed Action. Management of the fisheries targeting salmon produced by these programs and the effects on ESA-listed steelhead are included in a Fisheries Management and Evaluation Plan that has been submitted to NMFS.

None of the actions that result from the Proposed Action, discussed above, and in more detail in Section 2.4.2, were considered to be factors limiting the recovery of ESA-listed steelhead in the Yakima River Basin by either the federally approved Recovery Plan for MCR Steelhead (NMFS 2009b) or the Yakima Subbasin Salmon and Steelhead Recovery Plan (YBFWRB 2009).

Added to the Environmental Baseline and effects of the Proposed Action are the effects of future state, private, or tribal activities, not involving Federal activities, within the action area. To the extent those same activities are reasonably certain to occur, their effects are included in the cumulative effects analysis. Many of the state, private, and tribal activities identified in the Environmental Baseline are anticipated to occur at similar levels of intensity into the future. The federally approved Recovery Plan for MCR Steelhead (NMFS 2009b) and the Yakima Subbasin Salmon and Steelhead Recovery Plans (YBFWRB 2009) describe, in detail, the on-going and proposed state, tribal, and local government actions that are targeted to reduce know threats to ESA-listed MCR steelhead in the Yakima River Basin. Such future state, tribal, and local government actions will likely be in the form or legislation, administrative rules, or policy initiatives, and land use and other types of permits and that government actions are subject to political, legislative, and fiscal uncertainties. As such, NMFS will not attempt to account for factors that are highly speculative.

This analysis has considered the potential effects of the Proposed Action (Section 1.3), combined with the environmental basin and cumulative effects, and determined that the Proposed Action will not appreciably reduce the likelihood of survival and recovery of MCR Steelhead in the wild by reducing the reproduction, number, or distribution of the DPS.

2.6.2. Critical Habitat

Critical habitat for the ESA-listed MCR Steelhead is described in section 2.2.2 of this opinion. After reviewing the Proposed Action and conducting the effects analysis, NMFS has determined that the Proposed Action will not impair PCEs designated as essential for spawning, rearing, juvenile migration, and adult migration purposes.

The hatchery diversions and their discharges pose only a negligible effect on designated critical habitat in the action area (Section 2.4.2). The existing facilities used for proposed hatchery programs have not contributed to altered channel morphology and stability, reduced and degraded floodplain connectivity, excessive sediment, or the loss of habitat diversity. These facilities are designed and used such that they do not reduce access to spawning and rearing habitat, or increase water temperatures. The Proposed Action includes strict criteria for diverting water from the Yakima River and its tributaries, such that the amount of water withdrawn would not impair PCEs associated with usage of migration corridors or rearing areas (Section 2.4.2 6). Steelhead do spawn in certain tributaries where acclimation facilities are located and they also rear in the vicinity of the CESRF and acclimation facilities on the mainstem Yakima River. The operation of these facilities, as described in the HGMPs, will not impair PCEs for migration and rearing, and may provide benefits by improving side channel and floodplain connectivity.

The federally approved Recovery Plan for MCR Steelhead (NMFS 2009b) did not identify hatchery programs as a factor limiting steelhead survival and recovery in the Yakima River. The plan identified a number of limiting factors and threats including altered steam flows due to irrigation; passage barriers from small and large diversions, road crossings and storage dams; reduced floodplain function due to diking, channel simplification, and floodplain development; and impacts on riparian and upland hydrology from development and past practices (Section 2.2). None of these factors will be affected in a measurable way by the Proposed Action, either by itself or in conjunction with other activities in the Action area, so the Proposed Action is unlikely to reduce the value of designated or proposed critical habitat for the conservation of the species.

2.7. Conclusion

After reviewing the current status of the listed species, the environmental baseline within the action area, the effects of the Proposed Action, including effects of the Proposed Action that are likely to persist following expiration of the Proposed Action, and cumulative effects, it is NMFS' biological opinion that the Proposed Action is not likely to jeopardize the continued existence of the MCR Steelhead DPS or to destroy or adversely modify their designated critical habitat.

2.8. Incidental Take Statement

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by regulation to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 CFR 17.3).

Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. For purposes of this consultation, we interpret "harass" to mean an intentional or negligent action that has the potential to injure an animal or disrupt its normal behaviors to a point where such behaviors are abandoned or significantly altered.[9] Section 7(b)(4) and Section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA, if that action is performed in compliance with the terms and conditions of this ITS.

2.8.1. Amount or Extent of Take

Take of ESA-listed steelhead would occur as a result of the Proposed Action from broodstock collection, hatchery fish spawning naturally, interactions with juvenile hatchery fish, the operation of the hatchery facilities and acclimation ponds, and from ME&R activities. The amount and effect of the take on the ESA-listed steelhead is detailed in Section 1.3 (Table 2); for the majority of the activities where take occurs, NMFS found that the amount of take would be small if not negligible.

Hatchery fish spawning naturally can cause take of ESA-listed steelhead through ecological interactions – competition for space and food where their presence overlaps. However, take associated with these ecological interactions cannot be directly measured in a reliable manner because the take does not directly result in mortality that can be quantified but results in changes in behavior that may reduce growth and productivity. NMFS will therefore rely on a surrogate take indicator that relates to the abundance of natural-origin steelhead returning to the Naches and Upper Yakima River steelhead populations (where impacts from naturally spawning hatchery spring Chinook salmon and coho salmon would occur) as compared with abundance of steelhead returning to the Toppenish and Satus Creek steelhead populations, which are not directly impacted by hatchery salmon. As the abundance of returning hatchery Chinook and coho salmon spawning naturally increases the level of ecological interactions with ESA-listed steelhead juveniles would also be expected to increase which may lead to take reflected by decreases in the abundance of the steelhead populations in the Naches River and Upper Yakima River due to reductions in productivity. Because this surrogate compares abundance in one situation not impacted by the hatchery programs with one impacted by the hatchery programs, it allows NMFS to measure those abundances impacts, and to know when they have gone beyond levels assumed in the effects analysis.

Specifically, the surrogate take indicator for interactions between ESA-listed steelhead and naturally spawning hatchery salmon is as follows: the trend of 5-year moving averages of abundance of the Naches and Upper Yakima River steelhead populations cannot decline greater than 20% relative to the Toppenish and Satus Creek populations. The decline of 20% in the abundance trend would be measured as the absolute difference between the two upper and two

[9] NMFS has not adopted a regulatory definition of harassment under the ESA. The World English Dictionary defines harass as "to trouble, torment, or confuse by continual persistent attacks, questions, etc." The U.S. Fish and Wildlife Service defines "harass" in its regulations as an intentional or negligent act or omission which creates the likelihood of injury to wildlife 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 (50 CFR 17.3). The interpretation we adopt in this consultation is consistent with our understanding of the dictionary definition of harass and is consistent with the U.S. Fish and Wildlife interpretation of the term.

lower Yakima River steelhead populations. For example, if the 5-year moving average for the Naches and Upper Yakima River populations decline by 30% and the Toppenish and Satus Creek populations decline by less than 10%, then this triggers the 20% relative decline standard and indicates an impact particular to the areas where ecological interactions are a unique potential risk caused by hatchery operations. The 20% relative measure was selected because it allows for some annual variation in abundance between the populations due to environmental factors that are unique to each population, and is at a level that when reached would require further evaluation.

Similarly, the take of ESA-listed natural-origin juvenile steelhead through interactions with juvenile hatchery fish cannot be directly measured. This form of take concerns interactions (such as predation or competition for food) between juvenile steelhead and hatchery smolts emigrating from the acclimation ponds. Such interactions cannot be reliably and comprehensively observed. NMFS will therefore rely on a surrogate take indicator that relates to the proportion of hatchery fish remaining in the rearing areas after release from the acclimation ponds. Specifically, the extent of take from interactions between hatchery smolts and natural-origin juvenile salmonids in rearing areas in the lower Yakima River is as follows: the proportion of juvenile hatchery salmonids (excluding juveniles from hatchery fry releases) in rearing areas in the Yakima River cannot exceed 10 percent on or after the 21st day following completion of hatchery releases. This surrogate has a rational relationship to the form of take, because the greater the proportion of hatchery smolts relative to natural-origin *O. mykiss* in the rearing areas below the acclimation facilities the greater the likelihood ecological interactions will occur. Monitoring this surrogate will take place as part of the current ME&R activities monitoring residualism from hatchery spring Chinook salmon and coho salmon releases as well as monitoring hatchery juvenile downstream migration.

The operation of the hatchery facilities and acclimation ponds can also cause take of ESA-listed steelhead through water withdrawals that can impact steelhead habitat, and by encounters of steelhead at the acclimation facilities. For the latter, up to 30 juvenile *O. mykiss* may be encountered at some acclimation facilities that use natural ponds accessible to juvenile steelhead. The take of ESA-listed steelhead that may occur from the water withdrawals cannot be directly measured because the take occurs when a reduction in total flow through a section of stream/river reduces the amount of habitat in that section but only at levels that do not prevent the use of the remaining habitat or prevents migration. NMFS will therefore rely on a surrogate take indicator that relates to the proportion of flow reduction in stream sections between the facility intake and facility outfall. Specifically, the surrogate take indicator is water withdrawals that exceed the maximum proportion of flow diversion for the source stream during the period that program fish are present as listed in Table 8. This is rationally related to the form of take, since the withdrawals directly cause the take at issue, and is measurable because the hatchery facilities will record and report its water usage as part of its permit.

Table 8. Facility specific maximums for flow diversion during operation of hatchery facilities and acclimation ponds.

Facility	Maximum Proportion of Source Stream Flow Diverted	Notes
CESRF	10%	
Easton Acclimation Pond	5%	
Clark Flat Acclimation Pond	5%	
Jack Creek Acclimation Pond	20%	
Prosser	2.0%	
Marion Drain	n/a	No suitable habitat present
Stiles Pond Acclimation Pond	3%	
Nelson Springs Acclimation Pond	n/a	Non-anadromous water source
Billys Pond	n/a	Underground water source
Rosa Dam Pond	n/a	Water returned to facility bypass
Elks Pond	n/a	Underground water source
Skov Pond	n/a	Underground water source
I-182	10%	Proposed Levels
Lost Creek	3%	
Holmes Pond	5%	Uses irrigation bypass flows
Easton Ponds	n/a	Side channel with natural flows
Boone Pond	n/a	Side channel with natural flows
Mobile Acclimation Ponds	10%	

Take of ESA-listed steelhead will also occur during broodstock collection activities that include the handling of adult steelhead at the proposed Sunnyside Dam trap and at Cowiche and/or Wapatox dams. The total number of steelhead handled during broodstock collection activities at these facilities would be up to 310 adults annually. Broodstock collection activities at Prosser and Roza dams will co-occur with sampling of adult summer steelhead as part of the ME&R program and the impacts from these activities are evaluated below. Annual mortalities that might result from broodstock collection are expected to be up to 7 adults

NMFS determined that there would be take associated with the ME&R activities (Table 2). As described in Section 2.4.2.5 and in Section 1.3.4, there is an extensive ME&R component designed to evaluate the spring Chinook salmon supplementation program and the programs to reintroduce summer/fall Chinook salmon and coho salmon into the basin. An important aspect of the proposed ME&R is evaluation of the hatchery programs for compliance with the HGMPs and for their effects, both beneficial and negative, on ESA-listed steelhead. In addition, the Proposed Action includes ME&R to monitor VSP parameters for the four listed steelhead populations in the Yakima River Basin and to better under the relationship between resident *O. mykiss* and steelhead. Up to 64,720 juvenile *O. mykiss* and up to 2,515 adult ESA-listed natural-origin summer steelhead could be encountered in the Yakima River Basin annually during ME&R activities (Table 2). Mortality caused by the ME&R is expected to be up to 10 adults, and 995 juvenile *O. mykiss* annually. NMFS will require annual reports so that it can monitor and evaluate whether the effects from ME&R contemplated in this opinion are being exceeded.

2.8.2. Effect of the Take

In Section 2.7, NMFS determined that the level of anticipated take, coupled with other effects of the Proposed Action, is not likely to jeopardize the MCR Steelhead DPS or destroy or adversely modify their designated critical habitat.

2.8.3. Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary measures to minimize the amount or extent of incidental take (50 CFR 402.02). "Terms and conditions" implement the reasonable and prudent measures (50 CFR 402.14). These must be carried out for the exemption in section 7(o)(2) to apply.

NMFS concludes that the following reasonable and prudent measures are necessary and appropriate to minimize incidental take. The BPA shall ensure that:

1. The YN and WDFW implement the hatchery programs and operate the hatchery facilities as described in the Proposed Action (Section 1.3) and in the submitted HGMPs.
2. The YN and WDFW follow criteria and guidelines specified in this opinion for their respective ME&R activities.
3. The YN and WDFW provide reports to SFD annually for all hatchery programs, and for all ME&R activities associated with the hatchery programs.

2.8.4. Terms and Conditions

The terms and conditions described below are non-discretionary, and Action Agencies must comply with them in order implement the reasonable and prudent measures (50 CFR 402.14) The Action Agencies have a continuing duty to monitor the impacts of the incidental take and must report progress of the action and its impacts on the species as specified in this incidental take statement (50 CFR 402.14). If the following terms and conditions are not complied with, the protective coverage of section 7(o)(2) will lapse. The BPA shall ensure that:

1a. YN and WDFW implement the hatchery programs as described in the Proposed Action (Section1.3) and in the submitted HGMPs. NMFS' SFD must be notified, in advance, of any change in hatchery program operation and implementation that potentially would result in increased take of ESA-listed species.

1b. YN and WDFW, in effectuating the take authorized by this ITS, are considered to have accepted the terms and conditions set forth herein and must be prepared to comply with the provisions of this incidental take statement, the applicable regulations, and the ESA.

2a. YN and WDFW take ESA-listed species while conducting ME&R only at the levels, by the means, in the areas, and for the purposes stated in the Section 1.3.4 of this opinion.

2b. YN and WDFW do not intentionally kill or cause to be killed any listed species while conducting ME&R unless the incidental take statement specifically allows intentional lethal take.

2c. YN and WDFW handle listed fish with extreme care and keep them in cold water to the maximum extent possible during sampling and processing procedures. When fish are transferred or held, a healthy environment must be provided; e.g., the holding units must contain adequate amounts of well-circulated water. When using gear that captures a mix of species, the permit holder must process listed fish first to minimize handling stress.

2d. If the YN and WDFW anesthetize listed fish to avoid injuring or killing them during handling, the fish must be allowed to recover before being released. Fish that are only counted must remain in water and not be anesthetized.

2e. YN and WDFW use a sterilized needle for each individual injection when passive integrated transponder tags (PIT-tags) are inserted into listed fish.

2f. YN and WDFW must release any ESA-listed adult fish that are immobilized while sampling for juveniles, and such take must be reported.

2g. YN and WDFW exercise care during spawning ground surveys to avoid disturbing ESA-listed adult salmonids when they are spawning. Visual observation must be used instead of intrusive sampling methods, especially when just determining fish presence.

2h. YN and WDFW follow NMFS' Backpack Electrofishing Guidelines (NMFS 2000b).

2i. YN and WDFW obtain approval from NMFS before changing sampling locations or research protocols.

2j. YN and WDFW are responsible for any biological samples collected from ESA-listed species. The YN and WDFW may not transfer biological samples to anyone not listed in the HGMPs without prior written approval from NMFS.

2k. The person(s) actually doing the research carry a copy of this ITS while conducting the authorized activities.

2l. YN and WDFW allow any NMFS employee or representative to accompany field personnel while they conduct the research activities.

3a. All reports, as well as all other notifications required in the permit, be submitted electronically to the NMFS point of contact for this opinion:

Richard Turner (503) 737-4737, rich.turner@noaa.gov

NMFS – Sustainable Fisheries Division
Anadromous Production and Inland Fisheries Branch

1201 N.E. Lloyd Boulevard, Suite 1100
Portland, Oregon 97232

3b. SFD is notified, as soon as possible, but no later than two days, after any authorized level of take is exceeded or if such an event is likely to occur. This includes the take of any ESA-listed species not otherwise included in this ITS. The BPA shall ensure that the YN and WDFW submit a written report detailing why the authorized take level was exceeded or is likely to be exceeded.

3c. YN and WDFW provide annual reports to SFD that summarize numbers, pounds, dates, tag/mark information, locations of artificially propagated fish releases, and ME&R activities that occur within the hatchery environment, and the number and spatial and temporal distribution of hatchery fish that return to any naturally spawning area and to hatchery facilities. Reports shall also include any preliminary analyses of scientific research data, any problems that may have arisen during conduct of the authorized activities, a statement as to whether or not the activities had any unforeseen effects, and steps that have been and that will be taken to coordinate the ME&R with that of other researchers. These annual reports can include, but are not limited to, reports provided to BPA. The reports shall be submitted to SFD by January 31st of the year following release (e.g., brood year 2010, release year 2011, report due January 2012).

2.9. Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat (50 CFR 402.02). NMFS has identified

1. The BPA, in cooperation with the NMFS, YN, and WDFW, should continue to improve anadromous fish habitat conditions within the Yakima River Basin to support the establishment of natural Chinook salmon and coho salmon populations.
2. The BPA, in cooperation with the NMFS, YN, and WDFW, should continue to investigate the level of ecological interactions between hatchery-produced salmon and listed steelhead within the Yakima River Basin to identify additional methods to minimize these interactions.

2.10. Reinitiation of Consultation

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 agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat that was not considered in this opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action. In addition, reinitiation is required if implementation of the Proposed Action is continued beyond July 15, 2023.

3. Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation

The consultation requirement of section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. The MSA (Section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Adverse effects include the direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside EFH, and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

This analysis is based, in part, on descriptions of EFH for Pacific coast salmon (PFMC 2003a) contained in the fishery management plans developed by the Pacific Fishery Management Council (PFMC) and approved by the Secretary of Commerce.

3.1. Essential Fish Habitat Affected by the Project

The proposed action is the funding and implementation of three hatchery programs rearing salmonids in the Yakima River, as described in detail in Section 1.3. The action area of the Proposed Action includes habitat described as EFH for Chinook and coho salmon. Because there are no extant natural coho populations in the action area, and EFH has not been described for steelhead, the analysis in this section is restricted to the effects of the Proposed Action on EFH of Chinook salmon.

The area affected by the proposed action includes the Yakima River Basin (Figure 1).

As described by PFMC (2003a):

> "Freshwater EFH for [C]hinook salmon consists of four major components, (1) spawning and incubation; (2) juvenile rearing; (3) juvenile migration corridors; and (4) adult migration corridors and adult holding habitat."

The aspects of EFH that might be affected by the Proposed Action include effects of hatchery operations on ecological interactions and genetic effects on natural Chinook salmon spawning and rearing areas.

3.2. Adverse Effects on Essential Fish Habitat

The Proposed Action generally does not have effects on the major components of EFH. Spawning and rearing locations and adult holding habitat are not expected to be affected by the operation of the programs, as no modifications to these areas would occur, and no structures that would impede migration are included or proposed to be constructed. Potential effects on EFH by the Proposed Action are only likely to occur in the migration corridor in the mainstem Yakima River.

As described in section 2.4.2, water withdrawal for hatchery operations can adversely affect salmon by reducing streamflow, impeding migration, or reducing other stream-dwelling organisms that could serve as prey for juvenile salmonids. Water withdrawals can also kill or injure juvenile salmonids through impingement upon inadequately designed intake screens or by entrainment of juvenile fish into the water diversion structures. The proposed hatchery programs include designs to minimize each of these effects. The amount of water removed for each of the facilities that use river water is consistent with water rights that are conditioned to prevent the streams from being de-watered. Further, the amount of water to be removed will be largely returned to the river at points between 60 and 7,000 feet (depending on the facility) from the point of withdrawal. The CESRF removes water from the mainstem Yakima River and releases it into connected side-channel rearing habitat that reconnects to the mainstem Yakima River 7,000 below the intake. The CESRF also supplements the flows in the side-channel with pumped groundwater. All intakes will be screened in compliance with (NMFS 2008a) screening criteria.

The PFMC (2003a) recognized concerns regarding the "genetic and ecological interactions of hatchery and wild fish … [which have] been identified as risk factors for wild populations." The biological opinion describes in considerable detail the impacts hatchery programs might have on natural populations (Section 2.4.1). Hatchery spring Chinook salmon are intended to spawn naturally and supplement the natural population in the Upper Yakima River. The summer/fall Chinook salmon are also intended to spawn naturally in an effort to reestablish naturally spawning populations within the Yakima River. Genetic and ecological risks are being address through the use of natural-origin spring Chinook salmon as broodstock for spring Chinook salmon that are intended to spawn naturally, and by acclimating the hatchery juvenile prior to release. The summer/fall Chinook salmon and coho salmon programs are reintroducing life-histories that were present historically in the Yakima River Basin and would reduce genetic risks by developing a localized broodstock using only adults from fish produced in the basin. Risks to naturally-produced summer/fall Chinook salmon and coho salmon are being reduced by segregating hatchery salmon intended to support harvest from the naturally spawning salmon areas.

In addition to the effects on habitat as the result of hatchery operations affecting water quality and quantity (discussed above), hatchery effects that might involve habitat would likely be the result of exceeding carrying capacity of the natural populations, with adverse effects resulting from increased competition for spawning areas, rearing space, and juvenile feeding. The proposed action is not expected to result in increases in numbers of hatchery adults or juveniles in natural spawning areas sufficient to approach carrying capacity. Furthermore, hatchery Chinook salmon produced in the Yakima River are not known to stray into other areas outside the Yakima River Basin. Predation by adult hatchery salmon on juvenile natural Chinook salmon would not occur due to timing differences and the fact that adult salmon stop feeding by the time they reach spawning areas, and predation by juvenile offspring of hatchery salmon on juvenile natural-origin Chinook salmon would not occur for reasons discussed in section 2.4.2.

3.3. Essential Fish Habitat Conservation Recommendations

For each of the potential adverse effects by the proposed action on EFH for Chinook salmon, NMFS believes that the proposed action, as described in Section 1.3, and the ITS (Section 2.8) include the best approaches to avoid or minimize those adverse effects. The Reasonable and Prudent Measures and Terms and Conditions included in the ITS constitute NMFS' recommendations to address potential EFH effects. BPA shall ensure that the Reasonable and Prudent Measures implementing Terms and Conditions of the ITS are carried out.

To address the potential effects on EFH of hatchery fish on natural fish in natural spawning and rearing areas, the PFMC (2003a) provided an overarching recommendation that hatchery programs:

> "[c]omply with current policies for release of hatchery fish to minimize impacts on native fish populations and their ecosystems and to minimize the percentage of nonlocal hatchery fish spawning in streams containing native stocks of salmonids."

The biological opinion explicitly discusses the potential risks of hatchery fish on native fish populations and their ecosystems, and describes operation and monitoring appropriate to minimize these risks. The primary purpose of the summer/fall Chinook salmon program and the coho salmon program is to use nonlocal hatchery fish to reestablish naturally spawning populations in the Yakima River where native populations have been extirpated. Thus, the goal of the hatchery programs is for the hatchery fish to spawn naturally. The purpose of the spring Chinook salmon program is to supplement the native population using hatchery fish that are derived from naturally produced adults. Again, the goal of the hatchery program is for the hatchery fish to spawn naturally. NMFS expects that full implementation of the pertinent requirements described in the ITS would protect, by avoiding or minimizing the adverse effects described in section 3.2, designated EFH for Pacific coast salmon.

3.4. Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the BPA must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation from NMFS. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH Conservation Recommendations, unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NMFS Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects [50 CFR 600.920(k)(1)].

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5. Supplemental Consultation

The BPA must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations [50 CFR 600.920(l)].

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-554) ("Data Quality Act") specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, document compliance with the Data Quality Act, and certifies that this opinion has undergone pre-dissemination review.

4.1. Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. NMFS has determined, through this ESA section 7 consultation that the proposed hatchery programs in the Yakima River will not jeopardize ESA-listed species and will not destroy or adversely modify designated critical habitat. Therefore, NMFS can issue an ITS. The intended users are the BPA (funding entity), and the YN and WDFW (operating entities). The scientific community, resource managers, and the stakeholders benefit from the consultation through the anticipated increase in returns of salmonids to the Columbia and Yakima Rivers, and through the collection of data indicating the potential effects of the operation of the programs on the viability of natural populations of MCR steelhead. This information will improve scientific understanding of hatchery-origin Chinook and coho salmon and steelhead effects that can be applied broadly within the Pacific Northwest area for managing risks associated with similar hatchery operations.

4.2. Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, "Security of Automated Information Resources," Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

4.3. Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased, and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA Regulations, 50 CFR 402.01 *et seq*., and the MSA implementing regulations regarding EFH, 50 CFR 600.920(j).

Best Available Information: This consultation and supporting documents use the best available information, as described in the references section. The analyses in this biological opinion/EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data, and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with Northwest Region ESA quality control and assurance processes.

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