Department of Energy

Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

ENVIRONMENT, FISH AND WILDLIFE

June 21, 2011

In reply refer to: KEC-4

To: Parties Interested in the Confederated Tribes and Bands of the Yakama Nation's (Yakama Nation) Mid-Columbia Coho Restoration Program

You are invited to review and comment on the draft environmental impact statement (EIS) for the Yakama Nation's Mid Columbia-Coho Restoration Program located in Chelan and Okanogan counties, Washington. The Yakama Nation would sponsor the reintroduction program; the Bonneville Power Administration (BPA) would provide the funding if approved. The draft EIS describes the proposed fish production program and hatchery facilities, and analyzes the potential environmental effects from program operations and facility construction. Your comments on the draft EIS will help us refine the environmental analysis and decide whether to fund the program.

The restoration program is an effort to restore coho salmon to the Methow and Wenatchee basins using information and techniques developed as part of the Yakama Nation's Mid-Columbia Coho Reintroduction Feasibility Project. The Yakama Nation has also prepared a Master Plan to guide the development of the reintroduction program.

Project background

Over the next 20-25 years, the proposed program would develop a locally adapted, self-sustaining population of coho in the Mid-Columbia basin, capable of supporting harvest. Hatcheries and acclimation facilities used in the feasibility studies would continue to be used. In addition, a new small hatchery in the Wenatchee basin is proposed; and a few existing ponds or side channels would be modified and new ones constructed to serve as semi-natural rearing and acclimation areas for juvenile coho salmon.

Public Meetings

You are also invited to attend our open house public meetings on this project. The meetings will be held:

July 13, 2011 5:30 – 8 p.m.
Chelan Fire District 3 Community Center
228 Chumstick Highway
Leavenworth, WA 98826

July 14, 2011 5:30 – 8 p.m.
Methow Valley Community Center
201 South Methow Valley Highway
Twisp, WA. 98856

Meeting Agenda:

5:30-6:00 Open house
6:00-7:00 Presentation
7:00-8:00 Return to open house

Project team members will be available to take your comments on the draft EIS and answer any questions you may have.

How to comment
Comments are encouraged and will be accepted through **August 8, 2011.** Comments may be submitted online at: www.bpa.gov/comment, via mail to: Bonneville Power Administration, Public Affairs Office – DKE-7, P.O. Box 14428; or by fax to (503) 230-4019. You also may call us with your comment toll free at 1 (800) 622-4519. Please reference "Mid Columbia-Coho Restoration Program" with your comments. All your comments will be posted in their entirety on BPA's website at www.bpa.gov/comment. Comments and responses to them will be made part of the final EIS.

Copies available
If you have received this letter, we are providing the entire draft EIS, including appendices, on CD. If you would like to receive a hard copy of the draft EIS please call BPA's toll-free document request line at 1 (800) 622-4519. Please leave a message naming this project, giving your complete address. The draft EIS and its appendices may also be viewed at the project's website: www.bpa.gov/go/midcolumbiacoho.

Next Steps
BPA expects to complete and publish the final EIS in December 2011 and then issue a Record of Decision in spring 2012 that will explain BPA's decision about whether to proceed with the project.

For More Information
If you need more information or have questions, please call me directly at (503) 230-5192 or toll free at 1 (800) 282-3713 or e-mail me at sfbreeden@bpa.gov.

Sincerely,

/s/ Stephanie Breeden

Stephanie Breeden
Environmental Protection Specialist

Enclosure:
Draft EIS (CD)

B O N N E V I L L E   P O W E R   A D M I N I S T R A T I O N

Mid-Columbia
Coho Restoration Program

Draft Environmental Impact Statement

June 2011

DOE/EIS-0425

Cooperating Agencies:
The Confederated Tribes and Bands of the Yakama Nation
Okanogan County

Mid-Columbia Coho Restoration Program

Draft

Environmental Impact Statement

DOE/EIS-0425

Bonneville Power Administration

Okanogan County

The Confederated Tribes and Bands of the Yakama Nation

June 2011

Abstract - Mid-Columbia Coho Restoration Program

Environmental Impact Statement

Responsible Agency: U.S. Department of Energy - Bonneville Power Administration (BPA)

Title of Proposed Project: Mid-Columbia Coho Restoration Program

Cooperating Tribe: The Confederated Tribes and Bands of the Yakama Nation

State Involved: Washington

Lead State Agency: Okanogan County

Abstract: The Draft Environmental Impact Statement (DEIS) describes a coho salmon restoration program sponsored by the Confederated Tribes and Bands of the Yakama Nation (YN). BPA proposes to fund the construction, operation and maintenance of the program to help mitigate for anadromous fish affected by the Federal Columbia River Power System dams on the Columbia River. The YN wants to restore naturally spawning populations of coho salmon in harvestable numbers to the Methow and Wenatchee river basins in north central Washington State. The DEIS discloses the environmental effects expected from facility construction and program operations and a No Action alternative.

The Proposed Action is to implement the remaining phases of the restoration program as outlined in the Mid-Columbia Coho Restoration Master Plan (YN 2010). This would involve building a new, small, in-basin adult holding/spawning, incubation and rearing facility on the Wenatchee River at one of two potential sites; and constructing and improving several sites in both the Wenatchee and Methow river basins for acclimating coho in key habitats in the upper portions of the basins.

Public review of and comment upon this Draft EIS will continue through August 8, 2011. Responses to comments will be made part of the Final EIS, which is scheduled for completion in December 2011. BPA expects to issue a Record of Decision whether to implement the project in January 2012.

For more information about the Draft EIS, please contact:

Stephanie Breeden, Environmental Protection Specialist
Bonneville Power Administration
P. O. Box 3621, KEC-4
Portland, OR 97208-3621
Telephone: (503) 230-5192
Email: sfbreeden@bpa.gov

For additional copies of this document, please call 1-800-622-4520 and ask for the document by name. You may also request additional copies by writing to:

Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208
ATT: Public Information Center – CHDL-1

The EIS is also on the Internet at: http://efw.bpa.gov/environmental_services/Document_Library/Mid-Columbia_Coho_Restoration_Project/.

For additional information on DOE NEPA activities, please contact Carol M. Borgstrom, Director, Office of NEPA Policy and Compliance, GC-54, U.S. Department of Energy, 1000 Independence Avenue S.W., Washington D.C. 20585-0103, phone: 1-800-472-2756 or visit the DOE NEPA Web site at www.eh.doe.gov/nepa.

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Executive Summary

Bonneville Power Administration (BPA), in partnership with the Yakama Nation (YN), proposes to fund transition of the Mid-Columbia Coho Restoration Program from its feasibility phase to a comprehensive program to restore naturally spawning populations of coho salmon in harvestable numbers to the Wenatchee and Methow river basins in north central Washington State. Construction of a new hatchery on the Wenatchee River in Chelan County, and construction and use of small acclimation facilities in natural settings in Chelan and Okanogan counties, are included in this proposal. Figure ES-1 shows the general project area.

Since 1996, BPA has funded the Yakama Nation to study the feasibility of reintroducing coho in north central Washington, from which natural populations were extirpated. The studies show a reasonable likelihood of success for full-scale coho reintroduction, so the YN prepared a Master Plan (YN 2010) for a program to increase local adaptation and self-sustainability of the newly developed Mid-Columbia coho broodstock and to increase their abundance in the upper tributaries of the two basins. This Environmental Impact Statement (EIS) analyzes the effects of the Proposed Action as described in the Master Plan and the No Action Alternative required by the National Environmental Policy Act (NEPA).

Underlying Need for Action

BPA's underlying need for action is to return naturally spawning, locally adapted populations of coho to the Wenatchee and Methow basins as a way to help fulfill its obligations under the Pacific Northwest Electric Power Planning and Conservation Act (Act), 16 U.S.C. § 839 et seq., Section 4(h)(10)(A); and the 2008 Columbia Basin Fish Accords Memorandum of Agreement with the YN and others.

Under the Act, BPA must protect, mitigate, and enhance fish and wildlife affected by the development, operation, and management of federal hydroelectric facilities on the Columbia River and its tributaries. BPA must fulfill this duty in a manner consistent with the Columbia River Basin Fish and Wildlife Program developed by the Northwest Power and Conservation Council. The Council and its Independent Science Review Panel reviewed drafts of the Master Plan, and on March 9, 2010, the Council recommended that BPA implement the project as described in the plan.

On May 2, 2008, BPA, Bureau of Reclamation, and U.S. Army Corps of Engineers signed the 2008 Columbia Basin Fish Accords Memorandum of Agreement with three of the Treaty Tribes—the Confederated Tribes and Bands of the Yakama Nation, the Confederated Tribes of Warm Springs Reservation, and the Confederated Tribes of the Umatilla Indian Reservation. The agreement includes funding for the YN's Mid-Columbia Coho Restoration Program. BPA conditioned its funding commitment on securing a favorable recommendation from the Council and on compliance with all its other mandates, including NEPA. Salmon are a part of the spiritual and cultural identity of the Columbia River tribes. Salmon also play an important role in the economic well-being of tribal members. Restoring coho salmon to north central Washington would help the tribes to exercise their fishing rights as well as provide for fishing by sport and commercial fishers. Reintroducing coho in these basins could also contribute to restoring the ecological balance of the system. The Wenatchee Subbasin Plan recognizes that "Restoration of individual populations may not be possible without restoration of other fish and wildlife populations with which they co-evolved." (NPCC 2004a).

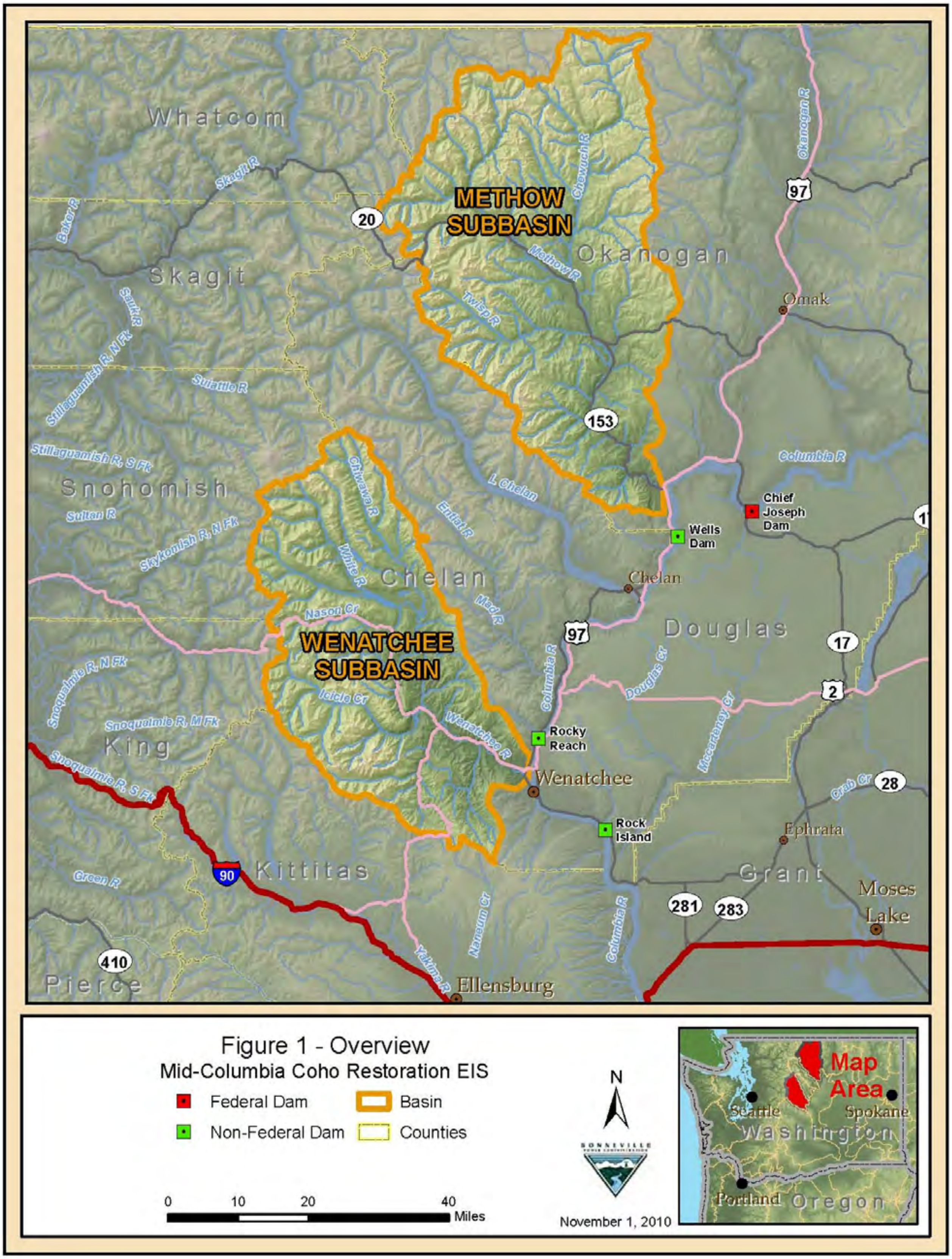

Figure ES-1. Project Area Overview

Purposes

In meeting the underlying need, the alternatives considered should achieve the purposes listed below. BPA will base its choice among alternatives on how well each one meets them.

- Develop a locally adapted, self-sustaining, naturally spawning coho stock that occupies its historical habitat in the Wenatchee and Methow river basins.
- Increase the abundance of Mid-Columbia coho salmon to numbers sufficient to sustain a mainstem and terminal harvest in most years.
- Maintain consistency with the Council's Columbia River Basin Fish and Wildlife Program and its recommendations as well as with the visions and goals of other regional plans, including subbasin plans.
- Maintain consistency with the coho production objectives specified in the 2008-2017 *United States v. Oregon* Fish Management Agreement for the Wenatchee and Methow subbasins.
- Minimize harm to natural or human resources, including species listed under the Endangered Species Act.

History of Coho in the Mid-Columbia Region

Historical Conditions and Extirpation

Mullan (1984) estimated historical mid-Columbia River adult coho populations as follows:

- Wenatchee basin—6,000 - 7,000
- Methow basin—23,000 - 31,000.

Prior to the establishment of BPA in 1937, mid-Columbia coho salmon populations were decimated by impassable dams, harmful forestry practices, and unscreened irrigation diversions in the tributaries, along with an extremely high harvest rate in the lower Columbia River. The loss of natural stream flow degraded habitat quality and further reduced coho productivity. Over the years, irrigation, livestock grazing, mining, timber harvest, road and railroad construction, residential and other development, and fire management also contributed to destruction of salmon habitat. By the 1930s, coho were considered extirpated from the mid-Columbia region.

Current Conditions

In the past two decades, conditions and practices have changed and improved to a certain degree.

- Some of the local habitat causes of coho depletion have been corrected: many irrigation diversions have been screened, tributary dams have been removed, new logging practice regulations have provided increased environmental protection, mining has ended, and grazing practices have been improved.
- Habitat Conservation Plans have been negotiated between fisheries resource managers and Mid-Columbia Public Utility Districts (PUDs)[1] to ensure that the hydroelectric projects associated with each plan can be considered to have No Net Impact on anadromous species.

[1] Grant County PUD, Chelan County PUD, and Douglas County PUD.

- The listings under the Endangered Species Act (ESA) of several salmonid species that migrate through the lower Columbia River have curtailed coho fisheries in the ocean that once over-harvested the mid-Columbia stocks of coho. Fisheries restrictions based on ESA-listings have curtailed ocean harvest of Lower Columbia River coho from an annual average of 80% between 1970 and 1983; to 49% from 1984 to 1993; to 10% from 1994 to 2007 (NMFS 2008a). These restrictions are likely to be in effect for a number of years.
- Recent improvements in artificial production practices would also improve efforts aimed at supporting natural production.

Coho Reintroduction Feasibility Studies

In 1996, BPA began funding the Yakama Nation to study the feasibility of reintroducing coho to the mid-Columbia region.[2] BPA analyzed the effects of a proposed plan for feasibility studies in the Mid-Columbia Coho Reintroduction Feasibility Project Final EA, completed in April 1999 (DOE/EA-1282). Supplemental Analyses (DOE/EA-1282/SA-01, -02, -03, and -04) were prepared to analyze effects of additional activities and facilities proposed for the studies.

Feasibility studies were designed to achieve two primary goals:

1) ***Determine whether a broodstock can be developed from lower Columbia River coho stocks whose progeny can survive in increasing numbers to return as adults to the mid-Columbia region.***

2) ***Initiate natural reproduction in areas of low risk to sensitive species and in other select areas to study the risks and interactions with sensitive species.***

The feasibility goals have been met (see Table 1-1 in Chapter 1). The Yakama Nation prepared a Master Plan based on the results of the feasibility studies (YN 2010). The Master Plan, with review and assistance by a number of scientists and fish and wildlife agencies, developed the approach and biological rationale for building on the feasibility studies to realize the YN's long term vision for coho in the region (see Proposed Action below and in Chapter 2).

Current Experimental Program

During the feasibility phase of the project, a local coho broodstock was developed. A total of 1.5 million smolts are acclimated and released in the two basins annually. In 2009, approximately 22,000 coho adults passed Rock Island Dam, the closest mainstem Columbia River dam downstream from the Wenatchee River mouth (Figure ES-1). Facilities used in the current program are listed in Table ES-1.

[2] Years after this project began (and was named), many entities in the region began using the term "upper Columbia" to refer to the region in which the Wenatchee and Methow subbasins lie. We have chosen to continue using "mid-Columbia" to refer to this project in order to demonstrate the continuity of the project from the feasibility studies onward. As well, because the Columbia River originates hundreds of miles upstream in Canada, the term "mid-Columbia" seems to be more geographically accurate.

Table ES-1. Facilities used in current coho restoration program

BROODSTOCK COLLECTION	
Wenatchee	**Methow**
Tumwater Dam	Wells Fish Hatchery (FH)
Dryden Dam	Wells Dam ladders
Leavenworth National Fish Hatchery (NFH)	Winthrop National Fish Hatchery (NFH)
HOLDING, INCUBATION AND/OR REARING	
Leavenworth NFH	Note: Rearing facilities provide coho for both basins
Winthrop NFH	
Peshastin Incubation Facility	
Cascade FH	
Willard NFH	
SMOLT RELEASES	
Wenatchee	**Methow**
• 500,00 above Tumwater Dam in Nason Creek and Beaver Creek • 500,000 from Icicle Creek	• 300,000 from Winthrop NFH • 75,000 from Lower Twisp • 125,000 from Wells FH
ACCLIMATION	
Wenatchee	**Methow**
Leavenworth NFH (Icicle Creek)	Winthrop NFH
Rohlfing	Lower Twisp
Coulter	Wells FH
Butcher	
Beaver	

Proposed Action

Vision and Biological Approach

The Yakama Nation's long-term vision for the Mid-Columbia Coho Restoration program, as stated in the Master Plan (YN 2010), is:

> ***To re-establish naturally spawning coho populations in mid-Columbia tributaries to biologically sustainable levels which provide significant harvest in most years.***

Building on the feasibility studies that have been conducted since 1996, the proposal would maintain a phased approach to reintroducing coho into the Wenatchee and Methow basins: two broodstock development phases and three natural production phases. The broodstock development phases were designed to eliminate transfers of lower Columbia brood coho and to encourage broodstock adaptation so that returning coho can reach key habitat within the basins. The first phase of broodstock development has been accomplished and lower Columbia broodstock are no longer used in the program; however, the second phase continues the process of increasing broodstock stamina. After all broodstock development goals are met (see Section 2.2.1.2), the natural production phases would manage broodstock composition so that eventually the percent of natural-origin fish in the hatchery broodstock exceeds the percent of hatchery-origin fish on the spawning grounds (HSRG 2004). The numbers of smolts released would increase from 1.5 million to 2.16 million for the first three years of the natural production phase, then return to 1.51 million and eventually decrease (see Table 2-5). This short-term increase would begin the local adaptation process by releasing enough smolts in the natural environment to increase the number of adults returning to each tributary to spawn without the aid of a hatchery. The coho restoration program is designed to end when a self-sustaining naturally reproducing population that supports harvest is established. This goal would be met when there is a natural-origin return escapement of more than 1,500 coho to each basin, with a terminal and mainstem harvest in most years; it is expected to be achieved by approximately 2028.

Facilities

Facility requirements for the Proposed Action are listed in Table ES-2 and described in detail in Section 2.2.2. No new facilities would be required during the ongoing broodstock development phase. During the natural production phases, the plan proposes to continue rearing most program fish at existing hatcheries. A new, small, in-basin adult holding/spawning, incubation and rearing facility also is proposed for these phases at a site on the Wenatchee River near Dryden Dam or a site on the Wenatchee River downstream of Lake Wenatchee.

Acclimation is planned at a combination of existing and new sites. Most acclimation sites would be existing water bodies (e.g., beaver ponds, side channels, etc.) and small constructed ponds.

The project proposes to use existing broodstock capture sites in upstream areas in addition to those used during the broodstock development phase, all of which are owned by other entities and operated by the YN and/or other fisheries resource agencies. One broodstock capture site (Chiwawa Weir) would need to extend its period of operation in order to capture coho adults.

Juvenile trapping for monitoring and evaluation of the program would take place at existing traps in both basins, with one exception: a new trap is proposed for the Little Wenatchee River, the site to be determined.

Table ES-2. Summary of facilities: Proposed Action

<table>
<tr><th colspan="6">BROODSTOCK COLLECTION</th></tr>
<tr><th>Wenatchee</th><th>C or F [a]</th><th>Construction?</th><th>Methow</th><th>C or F</th><th>Construction?</th></tr>
<tr><td>Dryden Dam</td><td>**C**</td><td>No</td><td>Wells FH</td><td>**C**</td><td>No</td></tr>
<tr><td>Leavenworth NFH</td><td>**C**</td><td>No</td><td>Wells Dam ladders</td><td>**C**</td><td>No</td></tr>
<tr><td>Tumwater Dam</td><td>**C**</td><td>No</td><td>Winthrop NFH</td><td>**C**</td><td>No</td></tr>
<tr><td>Chiwawa Weir</td><td>**F**</td><td>No</td><td>Methow State FH</td><td>**C**</td><td>No</td></tr>
<tr><td></td><td></td><td></td><td>Twisp Weir</td><td>**F**</td><td>For acclimation only</td></tr>
<tr><td></td><td></td><td></td><td>Lower Twisp</td><td>**F**</td><td>No</td></tr>
<tr><th colspan="6">INCUBATION/REARING</th></tr>
<tr><td>Cascade FH</td><td>**C**</td><td colspan="3">No construction</td><td rowspan="8">Note: Rearing facilities provide coho for both basins</td></tr>
<tr><td>Willard NFH</td><td>**C**</td><td colspan="3">No construction</td></tr>
<tr><td>Winthrop NFH</td><td>**C**</td><td colspan="3">No construction</td></tr>
<tr><td>Leavenworth NFH</td><td>**C**</td><td colspan="3">No construction</td></tr>
<tr><td>Peshastin</td><td>**C**</td><td colspan="3">No construction</td></tr>
<tr><td>Entiat NFH **Backup**</td><td>**C**</td><td colspan="3">No construction</td></tr>
<tr><td>**Proposed** Dryden Hatchery</td><td>**F**</td><td colspan="3">New facility on 1.5 acres: hatchery building, 4 raceways, 2 rearing ponds, water pipelines, wells, waste treatment tank and wetland; 4 acres total construction disturbance</td></tr>
<tr><td>**Backup** George Hatchery</td><td>**F**</td><td colspan="3">New facility on 1.5 acres: similar facilities to proposed Dryden site except no waste treatment wetland; 2.5 acres total construction disturbance</td></tr>
</table>

a. C = Currently in use; F = Future

Table ES-2. Summary of facilities: Proposed Action (continued)

ACCLIMATION/ADULT PLANTS (Primary)					
Wenatchee	**C or F[a]**	**Construction?**	**Methow**	**C or F**	**Construction?**
Leavenworth NFH	**C**	No	Winthrop NFH	**C**	No
Beaver	**C**	No	Lower Twisp	**C**	No
Butcher	**C**	New well, 50-ft surface water channel	Goat Wall	**F**	No
Clear	**C**	No	Gold	**F**	Expand pond
Coulter	**C**	No	Heath	**F**	No
Rohlfing[b]	**C**	No	Lincoln[b]	**F**	No
Brender	**F**	No	Mason	**F**	No
Chikamin	**F**	New pond, water intake, 120-ft buried pipe, 70-ft surface discharge channel	MSWA Eightmile	**F**	New well, 500-ft surface water channel, 450-ft buried power line
Minnow	**F**	New pond, 600-ft road	Parmley	**F**	No
Scheibler	**F**	Expand pond	Pete Creek Pond	**F**	No
Tall Timber	**F**	New water intake, 800-ft buried pipe	Twisp Weir	**F**	New pond, well, water intake on diversion ditch, 400-ft surface water channel, buried water (500 ft) & power (400 ft) lines, 20-ft road
Two Rivers[c]	**F**	No			
White River Springs	**F**	No			
Dirty Face (adults)	**F**	No	Hancock (adults)	**F**	No
ACCLIMATION (Backup)					
Wenatchee	**C or F**	**Construction?**	**Methow**	**C or F**	**Construction?**
Allen	**F**	No	Balky Hill	**F**	No
Coulter/Roaring	**F**	No	Biddle	**F**	No
Dryden[d]	**F**	New ponds, well, 850-ft buried water supply & discharge pipes	Chewuch AF	**F**	New pond, well, 300-ft buried water delivery and discharge pipes, 50-ft buried power line
McComas[e]	**F**	No	MSRF Chewuch	**F**	New pond, well, 1,000-ft surface water delivery & discharge channels, 100-ft buried power line
Squadroni	**F**	New pond, well, 50-ft water supply & 20-ft discharge channels	Newby	**F**	New pond, intake structure, 400-ft surface water channel, 350-ft buried discharge pipes.
			Poorman	**F**	No
			Utley	**F**	New 80-ft long channel as outlet for existing pond.

a. C = Currently used; F = Future
b. Construction at Rohlfing and Lincoln in 2011 is done under a different program; impacts are evaluated in other NEPA processes.
c. Previously used by project; not in use currently.
d. Activities refer to those required if the Dryden site is used for acclimation only and not as a hatchery site.
e. McComas is a new site proposed to be constructed by Grant PUD; impacts will be evaluated in other permitting processes.

Program Costs

The program currently is funded by BPA, Grant County PUD, and Chelan County PUD. (Douglas County PUD contributed $600,000 in 2008 towards capital costs related to the feasibility studies.) The current program also shares rearing costs with National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries). The total amount from NOAA Fisheries and Grant and Chelan PUDs is close to $1.5 million annually. The current program also shares monitoring and evaluation costs with Washington Department of Fish and Wildlife (WDFW). If the Proposed Action is implemented, cost sharing with all these entities is expected to continue. Table ES-3 shows expected operating costs for 2013, the year they are likely to be at their peak.

Table ES-3. Peak operating costs (2013) by basin

	Wenatchee	Methow	Total
Planning, Design, Permits	-	-	-
Rearing	$ 530,870	$ 388,385	$ 919,255
Tagging	$ 513,820	$ 375,911	$ 889,731
O&M	$ 955,706	$ 699,196	$ 1,654,902
M&E	$ 429,586	$ 314,286	$ 743,872
TOTAL OPERATING	**$ 2,429,982**	**$ 1,777,778**	**$ 4,207,760**

No Action Alternative

NEPA requires federal agencies to consider the effects of not taking the proposed action. BPA is the main funding source for this coho restoration project, although not the only one, as described above. If BPA were to choose the No Action Alternative, BPA would discontinue funding. A coho program would continue in the mid-Columbia basins, but at a reduced scope from the current program because funding would essentially be cut in half. Some existing cost-sharing might be reduced as well, commensurate with the program level. The reduced funding would require cutting staff numbers. The result would be reductions in all aspects of the current program.

Biological Approach

The program would be reduced from the current program. Reduced staff levels would mean that fewer fish could be incubated and reared, even if existing capacity remained unchanged. As a result, fewer fish would be released: 500,000 in the Wenatchee basin and 200,000 in the Methow basin, as opposed to the current level of 1 million in the Wenatchee and 500,000 in the Methow. No attempt would be made to expand production into new habitat; with reduced staff and funding, the program could not operate new acclimation facilities in natural production areas. The program primarily would be propagating hatchery fish and probably would be replaced by a hatchery program to promote fisheries only. The amount of monitoring and evaluation would be limited.

Facilities

The program would continue to rely on existing facilities. The new facilities proposed as part of the Proposed Action would not be constructed, and it is unlikely that existing facilities would be modified. While most of the existing infrastructure would be available, the lack of personnel would dictate its use.

- **Broodstock capture**: The current broodstock capture locations—Tumwater, Dryden, Leavenworth National Fish Hatchery (NFH), Wells, Winthrop NFH—would remain available; however, the reduced budget would limit staff numbers, thus likely reducing the number of sites where broodstock would be collected. Numbers of broodstock collected would be half that of the current program. New broodstock capture locations would not be added.
- **Incubation/Rearing:** Willard NFH, which receives 60% of its operating costs from BPA's coho program dollars, would not be used as an incubation/rearing facility, and use of the in-basin Peshastin Incubation Facility would be eliminated. Instead, Cascade FH, Winthrop NFH, and Leavenworth NFH would be used at a reduced capacity.
- **Smolt releases:** Table ES-4 shows a potential production program for the No Action Alternative and the acclimation sites that could be used. All but two of these sites are currently being used to acclimate coho. The exceptions, Lincoln and Heath in the Methow basin, currently are planned for spring Chinook and steelhead acclimation only; however, the Yakama Nation could choose to add coho acclimation at these sites sometime in the future. While the program depicted in Table ES-4 is possible, given the availability of sites, the reduced budget, with fewer staff available to stock and monitor sites, would probably allow use of only one or two release sites and the hatchery.
- **Monitoring and Evaluation:** Until 2011, the Integrated Status & Effectiveness Monitoring Program (ISEMP) (BPA project #2003-017-00) contributed a quarter of the funding for the Nason Creek smolt trap; that contribution has now ended. Currently, Grant County PUD and BPA through the coho project are the only remaining funding agencies for this trap; without the BPA contribution, it is unclear whether Grant PUD would continue funding the trap without a cost-share available. No new traps would be installed.

Table ES-4. No Action Alternative release numbers and locations

Location	Facility Name	Smolt Release	Total Basin Release
Wenatchee River[a]	Leavenworth NFH	100,000	500,000
	Butcher Creek	100,000	
	Coulter Pond	100,000	
	Beaver Creek	100,000	
	Rohlfing Pond	100,000	
Methow River[b]	Winthrop NFH	100,000	200,000
	Lincoln	60,000	
	Heath	20,000	
	Lower Twisp	20,000	

a. Wenatchee production would be spawned and eggs early-incubated at Leavenworth NFH and transferred to Cascade Hatchery (funded by Mitchell Act) for final incubation and rearing to the pre-smolt stage prior to transfer to acclimation/release sites identified above.

b. Methow production would be spawned and eggs early-incubated at Winthrop NFH and transferred to Cascade NFH for final incubation and rearing to the pre-smolt stage prior to transfer to acclimation/release sites identified above. Some fish may be able to be reared at Winthrop NFH but at a very reduced number.

Comparison of Alternatives

Table ES-5 compares the two alternatives considered in detail in this EIS—No Action and the Proposed Action—in terms of how well they meet the purposes defined in Section 1.2.

Table ES-5. Comparison of the Proposed Action and the No Action Alternative to Purposes

Purpose	Proposed Action	No Action
Develop a locally adapted, self-sustaining, naturally spawning coho stock that occupies its historical habitat in the Wenatchee and Methow river basins	By providing funding for expanding coho distribution into natural production areas of the basins, model results indicate that a locally adapted, self-sustaining, naturally spawning coho stock has an excellent chance of being established.	Without funding to expand into natural production areas, a locally adapted, self-sustaining, naturally spawning coho stock is unlikely to be established. The majority of fish produced by the project would be hatchery fish.
Increase the abundance of Mid-Columbia coho salmon to numbers sufficient to sustain a mainstem and terminal harvest in most years	Program projections indicate that by funding increased coho production for a limited period and expanding their distribution into natural production areas, natural coho abundance would be increased by 2028 sufficient to sustain harvests.	Without BPA funding, numbers of juveniles reared would be reduced, thus reducing the likelihood that natural coho abundance would be increased sufficiently to provide significant harvest.
Maintain consistency with the Council's Columbia River Basin Fish and Wildlife Program and its recommendations as well as with the visions and goals of other regional plans, including subbasin plans	Would be consistent with the Council's recommendation to implement the program proposed in the Master Plan. Would be consistent with subbasin plans by restoring coho as part of ecologically balanced systems.	Would not be consistent with the Council's recommendation to implement the program proposed in the Master Plan. Would not be consistent with subbasin plans because naturally spawning populations of coho are unlikely to be restored.
Maintain consistency with the coho production objectives specified in the 2008-2017 *United States v. Oregon* Fish Management Agreement for the Wenatchee and Methow subbasins	Continued BPA funding would provide the personnel, equipment, and facilities needed to maintain the *U.S. v. Oregon* production goal of 1.5 million smolts released from the Wenatchee and Methow subbasins.	Without BPA funding, the *U.S. v. Oregon* production goal of 1.5 million smolts would not be met because personnel, equipment, and facilities would have to be reduced below current levels.
Minimize harm to natural or human resources, including species listed under the Endangered Species Act	Proposed mitigation measures would minimize harm to natural and human resources. Approvals by and reporting to regulatory agencies would minimize the risk of adverse effects to listed species. Could provide ecological benefits that would aid in listed species recovery.	With no construction of new facilities, natural and human resources would not be adversely affected. Low numbers of naturally produ-ced coho could reduce the risk of adverse effects to listed species but also would not provide potential ecological benefits.

Summary of Environmental Effects

Table ES-6 summarizes the environmental effects, discussed in detail in Chapters 3 and 4.

Table ES-6. Summary of Impacts of the Proposed Action and the No Action Alternative

Impact	Proposed Action	No Action Alternative
Effects on water quality from facility discharges	There would be minor, localized impacts from phosphorus in effluent, but model simulations show that the maximum possible impact of all facilities, including the proposed hatchery, would be undetectable downstream in the sections of the river that are water quality limited.	No change from current program, or reduced impacts: existing facilities would continue to be used, but fewer fish would be produced, resulting in lower discharges of fish waste and chemicals attributable to the coho project.
Effects of surface and groundwater withdrawals on surface water quantity	Local reduction in flows at withdrawal points for groundwater and in bypass reaches for surface water, offset by return flows from facilities.	No change from existing conditions because no new withdrawals are proposed.
Effects of water withdrawals on groundwater supply	Local reductions at 5 acclimation sites and the hatchery; no regional reductions.	No change from existing conditions because no new wells would be developed.
Effects of surface and groundwater withdrawals on water rights	Potential impact to ground water rights at Dryden; potential impact to on- or off-site wells at 5 acclimation sites. No impacts to surface water rights at any of the sites.	No change from existing conditions because no new wells would be developed.
Sedimentation effects on fish	Minimal or no effects on ESA-listed and other fish from temporary sedimentation due to excavation and construction: best management practices would be used for erosion control.	No sedimentation effects because no new facilities would be constructed.
Effects of surface water withdrawal on ESA-listed and other fish	- Relatively small withdrawal volumes at acclimation sites would not substantially reduce in-stream flow quantities, change habitat availability including hiding/resting/foraging habitats, or affect migratory movements (fry, juvenile, and adult) of listed salmonids. - Withdrawals from Dryden fishway and discharge into Peshastin Cr. could increase spawning habitat for summer Chinook in Peshastin Cr. but have little or no effect on species in Wenatchee R. - Water intake systems would follow NMFS 2008 guidelines to reduce potential to entrain all fish species.	No change from current conditions because no new surface water withdrawals would be made.
Reduced access to migration or rearing habitat for ESA-listed and other fish	Fish other than coho would be excluded from 2.5 acres of 4.6 acres of currently accessible habitat at proposed acclimation sites in both basins. For ESA-listed fish, this translates to: - Up to 113 spring Chinook juveniles and 237 steelhead juveniles excluded annually from Wenatchee basin sites out of a total annual wild population of 55,619 – 311,669 Chinook smolts and 17,499 - 85,443 steelhead smolts. - Approx. 314 spring Chinook juveniles and 201 steelhead juveniles excluded annually from Methow basin sites out of a total annual wild population of 15,306 – 33,710 Chinook smolts and 8,809 - 15,003 steelhead smolts. - Juvenile bull trout numbers excluded from sites in each basin are very small (Wenatchee 3; Methow 10).	Approximately ½ acre of currently accessible habitat at acclimation sites would be excluded from use by fish other than coho, for a total of 2 acres excluded from use for 6 weeks each year, due to potential use of 2 Methow basin acclimation sites not in 2010 program.
Trapping of fish at adult traps	Trapping at all but one trap is occurring under existing operations. Potential take of bull trout at Chiwawa Weir if operations are extended to allow coho trapping.	Trapping could be reduced at Dryden Dam and Wells FH; without coho trapping, the traps would be open less, with potential for incidental take of listed fish reduced.

Impact	Proposed Action	No Action Alternative
Trapping of fish at juvenile traps	Incidental take of spring Chinook or bull trout is possible at a potential new trap on the Little Wenatchee R.; impacts would be evaluated when location is proposed.	No change in current conditions; existing traps are operated with or without coho project. No new traps proposed.
Coho predation on ESA-listed fish	Studies show that approximately 0.28% of hatchery coho smolts and 2.7 % of naturally produced coho prey on listed species, with less than 1% of the Chinook fry population consumed. Listed populations would be monitored and changes evaluated to determine if increasing numbers of coho increase predation with adverse effects on listed species.	Minimal predation by hatchery smolts as in existing program. Minimal predation by naturally produced smolts, as significant numbers of naturally produced coho are unlikely to be established.
Competition between naturally produced coho and ESA-listed species	Studies show species use different microhabitats, so competition is not expected at low densities. Listed species would be monitored to determine if adverse effects occur with increasing densities.	Without the expanded program, naturally produced coho numbers and densities would remain low, so potential competition with listed species would be limited or non-existent.
Effects on ecological balance	The addition of coho carcasses at the onset of winter might provide an increased marine-derived source of nutrients and improve over-winter survival for all species. Juvenile and adult coho provide prey for fish-eating predators including bald eagles, mergansers, otters, and bears. Ecological balance could improve with coho occupying a critical niche in the natural environment	Current conditions would continue; e.g., in Nason Creek, there is very little carcass production, leaving a potential void in the nutrient balance prior to the onset of winter. Little potential for improvement in ecological balance.
Habitat reductions for ESA-listed wildlife	Slight potential reduction in spotted owl habitat possible at Tall Timber (w/in 1 mi. of management circle); qualified biologist would confirm presence or absence of nests in any trees needing removal.	No change in current conditions.
Habitat reductions for state-listed wildlife	No noticeable reductions in available habitat for any species listed under WDFW Priority Habitat and Species program. Slight increase in aquatic habitat due to new ponds.	No change in current conditions.
Disturbance to wildlife	Construction noise could cause certain species to avoid 9 sites for 1-60 days, May-October of 2012. Operations, including use of noise-baffled generators, would not noticeably disturb wildlife because all primary sites currently experience human activity.	No change in current conditions.
Effects on wetlands	Total estimated wetland impacts at primary sites: - Temporary: 1,350 sq ft. would be replanted - Permanently removed: 3,179 sq ft. - New wetland created: 52,272 sq ft.	No change in current conditions.
Changes to floodplain function	Construction would occur in floodplains, requiring permits at up to 6 primary sites in the Wenatchee and 1 primary site in the Methow. - Flood elevations are not expected to change. - New ponds could add a small amount of flood storage. - Excavated material would be disposed outside of floodplains and not change grade that could divert flood flows to nearby properties.	No change in current conditions.
Effects on aesthetic/visual quality	Dryden Hatchery could reduce the contrast of the site with the surrounding area and add to the aesthetic appeal for viewers. Acclimation sites would not change visual quality.	No change in current conditions.
Effects on recreation	No interference with current recreation uses. Generators at noise-sensitive acclimation sites would be enclosed in noise-muffling structures to meet state noise standards.	No change in current conditions.
Economic effects	Minimal increase in employment, temporary and permanent. No new infrastructure or services required.	Loss of 11 permanent and 10 seasonal YN jobs.

Impact	Proposed Action	No Action Alternative
Effects on harvest	Potential terminal, mainstem, and ocean tribal, commercial, and sport harvest by 2028.	No harvest of naturally produced fish; potential harvest of hatchery fish if program changes to harvest augmentation.
Effects on cultural resources	Unknown. Surveys scheduled for 2011 before Final EIS.	No effect.
Noise effects	Construction noise at residences or properties near acclimation sites 8 a.m. – 5 p.m. M-F, for 1 day to 4 months in 2012. Construction noise likely not noticeable for the 5-month hatchery construction period due to noise from surrounding uses at Dryden. Noise from generators would be muffled to meet state standards.	No change in current conditions.
Effects on air quality	Minor short-term increases in dust during spring and summer of 2012 from construction activities. Undetectable increases in greenhouse gases.	No change in current conditions.
Consistency with comprehensive plans	Proposed activities would be consistent with goals and policies in Chelan County and Okanogan County comprehensive plans.	Current program is consistent with comprehensive plans in Chelan and Okanogan counties.
Consistency with subbasin plans	If successful, the program would restore naturally spawning coho populations to the Methow and Wenatchee subbasins as envisioned in both subbasin plans.	Would not restore natural populations of coho as called for in Wenatchee and Methow subbasin plans.
Consistency with Council F&W Program	Would implement Council recommendations regarding this program which began with its identification as a high-priority project in the 1994 Fish and Wildlife Program.	Would not implement Council recommendations regarding this program.

Chapter 1. Purpose of and Need for Action

Bonneville Power Administration (BPA), in partnership with the Yakama Nation (YN), proposes to fund transition of the Mid-Columbia Coho Restoration Program from its feasibility phase to a comprehensive program to restore naturally spawning populations of coho salmon in harvestable numbers to the Wenatchee and Methow river basins in north central Washington State. Construction of a new hatchery on the Wenatchee River in Chelan County, and construction and use of small acclimation facilities in natural settings in Chelan and Okanogan counties, are included in this proposal. Figure 1-1 shows the general project area.

Since 1996, BPA has funded the Yakama Nation to study the feasibility of reintroducing coho in north central Washington, from which natural populations were extirpated. The studies show a reasonable likelihood of success for full-scale coho reintroduction, so the YN prepared a Master Plan (YN 2010) for a program to increase local adaptation and self-sustainability of the newly developed Mid-Columbia coho broodstock and to increase their abundance in the upper tributaries of the two basins. This Environmental Impact Statement (EIS) analyzes the effects of the Proposed Action as described in the Master Plan and the No Action Alternative required by the National Environmental Policy Act (NEPA).

1.1 Underlying Need for Action

BPA's underlying need for action is to return naturally spawning, locally adapted populations of coho to the Wenatchee and Methow basins as a way to help fulfill its obligations under the Pacific Northwest Electric Power Planning and Conservation Act (Act), 16 U.S.C. § 839 et seq., Section 4(h)(10)(A); and the 2008 Columbia Basin Fish Accords Memorandum of Agreement with the YN and others.

Under the Act, BPA must protect, mitigate, and enhance fish and wildlife affected by the development, operation, and management of federal hydroelectric facilities on the Columbia River and its tributaries. BPA must fulfill this duty in a manner consistent with the Columbia River Basin Fish and Wildlife Program developed by the Northwest Power and Conservation Council. The Council and its Independent Science Review Panel reviewed drafts of the Master Plan, and on March 9, 2010, the Council recommended that BPA implement the project as described in the plan.

On May 2, 2008, BPA, Bureau of Reclamation, and U.S. Army Corps of Engineers signed the 2008 Columbia Basin Fish Accords Memorandum of Agreement with three of the Treaty Tribes—the Confederated Tribes and Bands of the Yakama Nation, the Confederated Tribes of Warm Springs Reservation, and the Confederated Tribes of the Umatilla Indian Reservation. The agreement includes funding for the YN's Mid-Columbia Coho Restoration Program. BPA conditioned its funding commitment on securing a favorable recommendation from the Council and on compliance with all its other mandates, including NEPA. Salmon are a part of the spiritual and cultural identity of the Columbia River tribes. Salmon also play an important role in the economic well-being of tribal members. Restoring coho salmon to north central Washington would help the tribes to exercise their fishing rights as well as provide for fishing by sport and commercial fishers. Reintroducing coho in these basins could also contribute to restoring the ecological balance of the system. The Wenatchee Subbasin Plan recognizes that "Restoration of individual populations may not be possible without restoration of other fish and wildlife populations with which they co-evolved." (NPCC 2004a).

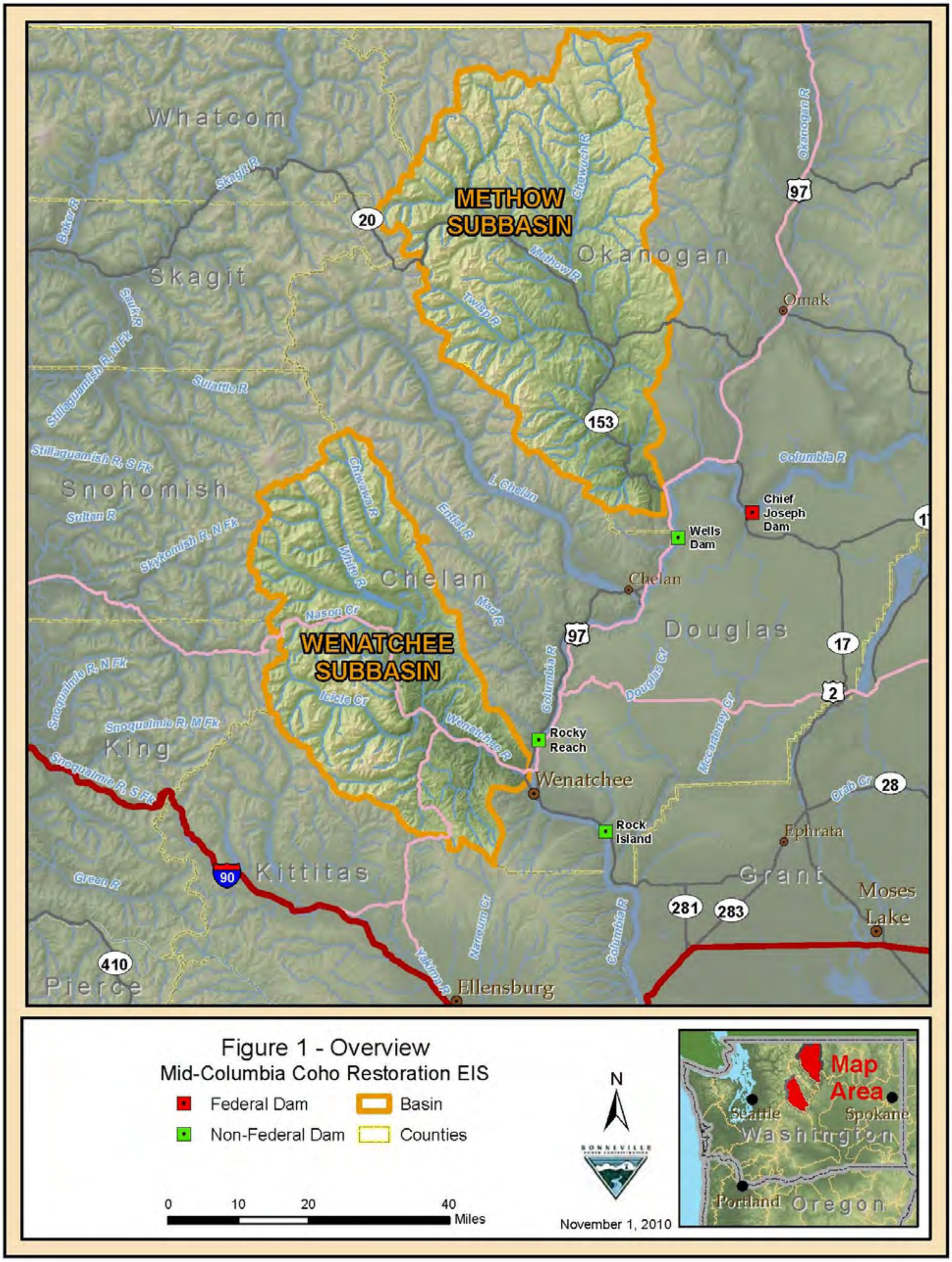

Figure 1-1. Project Area Overview

1.2 Purposes

In meeting the underlying need, the alternatives considered should achieve the purposes listed below. BPA will base its choice among alternatives on how well each one meets them.

- Develop a locally adapted, self-sustaining, naturally spawning coho stock that occupies its historical habitat in the Wenatchee and Methow river basins.
- Increase the abundance of Mid-Columbia coho salmon to numbers sufficient to sustain a mainstem and terminal harvest in most years.
- Maintain consistency with the Council's Columbia River Basin Fish and Wildlife Program and its recommendations as well as with the visions and goals of other regional plans, including subbasin plans.
- Maintain consistency with the coho production objectives specified in the 2008-2017 *United States v. Oregon* Fish Management Agreement for the Wenatchee and Methow subbasins.
- Minimize harm to natural or human resources, including species listed under the Endangered Species Act.

1.3 History of Coho in the Mid-Columbia Region

1.3.1 Historical Conditions and Extirpation

Mullan (1984) estimated historical mid-Columbia River adult coho populations as follows:

- Wenatchee basin—6,000 - 7,000
- Methow basin—23,000 - 31,000

Prior to the establishment of BPA in 1937, mid-Columbia coho salmon populations were decimated by impassable dams, harmful forestry practices, and unscreened irrigation diversions in the tributaries, along with an extremely high harvest rate in the lower Columbia River. The loss of natural stream flow degraded habitat quality and further reduced coho productivity. Over the years, irrigation, livestock grazing, mining, timber harvest, road and railroad construction, residential and other development, and fire management also contributed to destruction of salmon habitat. By the 1930s, coho were considered extirpated from the mid-Columbia region.

For several reasons, self-sustaining coho populations were not re-established in mid-Columbia basins despite plantings of 46 million fry, fingerlings, and smolts from Leavenworth, Entiat, and Winthrop National Fish Hatcheries between 1942 and 1975:

- A substantial amount of critical physical fish habitat was lost or severely degraded (Tyus 1990; Petts 1980; Diamond and Pribble 1978).
- Existing coho programs were unsuccessful or lower priority than programs for other salmonid species. For example, the most recent coho hatchery program in the mid-Columbia region was at Turtle Rock Hatchery, funded by Chelan Public Utility District. The coho program was terminated due to poor adult returns, thought to be caused in part by pathogenic water supplies resulting in disease problems at the hatchery. Because fall Chinook and steelhead were higher priority species, they were given priority use of the

limited supply of high quality hatchery water. The last coho releases from this program were in 1994.

- Fish culture practices in general resulted in poor adult return rates. Rearing at high densities in concrete raceways, an incomplete understanding of fish health and nutritional needs, the use of water supplies with unnatural temperature profiles, and un-acclimated, non-volitional releases directly from hatcheries into the wild environment produced smolts with low survival rates.
- Release locations did not support returns to high quality coho habitat. Releases from hatcheries did not imprint smolts with migratory clues that would encourage them to populate habitats that were far upstream of the release sites.
- The construction and operation of mainstem Columbia River hydropower projects were detrimental to mid-Columbia River salmonid populations. Coho had to pass through a number of dams and reservoirs, leading to deaths from turbines, predation, migration delays, gas bubble trauma, and so forth.
- Hatchery spawning protocols did not support the development of coho stocks that would be successful in the natural environment and migrate long distances to the upper Columbia basin.
- Harvest was not managed for the protection of weak stocks. Open ocean troll and gill net fisheries, the lack of near real-time catch monitoring, and the limited ability to predict run sizes resulted in over-harvest of wild fish and weak hatchery stocks.

Since Priest Rapids Dam northeast of Yakima, Washington, was completed in 1960, the peak escapement of adult coho upstream of the dam was probably never greater than 10,000 coho and, as of 1998, had not exceeded 1,300 since 1974 (WDFW/ODFW 1998). From 1988 to 1994, adult counts at Priest Rapids Dam averaged only 16 coho, probably a result of releases from Turtle Rock Hatchery, which annually produced about 600,000 coho smolts until the program was terminated in 1994 (WDFW/ODFW 1995).

While no one knows for sure why natural populations of spring Chinook and steelhead persisted (admittedly at low levels) when coho did not, possible reasons include:

- Very high harvest rates on coho in the lower Columbia River in the late 19th and early 20th centuries—as much as 90-95%; other species were not harvested at this rate.
- The fixed three-year coho life cycle. Spring Chinook and steelhead have greater variability in their life cycles than do coho. Spring Chinook can return as age 3, 4, or 5 adults. Steelhead can be residents in freshwater for up to 3 years and then migrate to the ocean, or they can be freshwater residents for their entire life cycle and still have progeny that migrate to the ocean. This variability in life cycles allows more potential for at least some members of a generation of spring Chinook or steelhead to survive adverse local or regional environmental conditions. For coho, however, the production from any one spawning year would occupy the same habitat at the same time throughout their life cycle. Thus all would be exposed to extreme conditions at the same time, with the potential to significantly reduce the survival rate of the entire generation.
- Unscreened irrigation diversions on small tributaries in mid-Columbia basins. Coho spawn in smaller tributaries than spring Chinook or steelhead, so these small diversions

could have diverted and trapped more coho juveniles than juveniles of other species that might not occupy small tributaries. This entrainment could have reduced the numbers of juveniles that survived to negotiate the other hazards that affect all salmonids in their life cycle.

1.3.2 Current Conditions

In the past two decades, conditions and practices have changed and improved to a certain degree. Some of the local habitat causes of coho depletion have been corrected, although there is still work to be done. For example, many irrigation diversions have been screened, tributary dams have been removed, new logging practice regulations have provided increased environmental protection, mining has ended, and grazing practices have improved.

Habitat Conservation Plans have been negotiated between fisheries resource managers and Mid-Columbia Public Utility Districts (PUDs).[3] The plans have strict performance standards (survival criteria) for both project passage and hatchery compensation so that the hydroelectric projects associated with each plan can be considered to have No Net Impact on anadromous species.

The ESA listings of several salmonid species that migrate through the lower Columbia River have curtailed coho fisheries in the ocean that once over-harvested the mid-Columbia stocks of coho. Fisheries restrictions based on ESA-listings have curtailed ocean harvest of Lower Columbia River coho from an annual average of 80% between 1970 and 1983; to 49% from 1984 to 1993; to 10% from 1994 to 2007 (NMFS 2008a). These restrictions are likely to be in effect for a number of years.

Recent improvements in artificial production practices would also improve efforts aimed at supporting natural production. Supplementation techniques, featuring refined genetic objectives, the production of "natural-like" hatchery smolts, and acclimation and release in wild habitat, are being used.

1.4 Coho Reintroduction Feasibility Studies

In 1996, BPA began funding the Yakama Nation to study the feasibility of reintroducing coho to the mid-Columbia region.[4] BPA analyzed the effects of a proposed comprehensive plan for feasibility studies in the Mid-Columbia Coho Reintroduction Feasibility Project Final EA, completed in April 1999 (DOE/EA-1282). Supplemental Analyses (DOE/EA-1282/SA-01, -02, -03, and -04) were prepared to analyze effects of additional activities and facilities proposed for the studies.

Feasibility studies were designed to achieve two primary goals:

1) ***Determine whether a broodstock can be developed from lower Columbia River coho stocks whose progeny can survive in increasing numbers to return as adults to the mid-Columbia region.***

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[3] Grant County PUD, Chelan County PUD, and Douglas County PUD.

[4] Years after this project began (and was named), many entities in the region began using the term "upper Columbia" to refer to the region in which the Wenatchee and Methow subbasins lie. We have chosen to continue using "mid-Columbia" to refer to this project in order to demonstrate the continuity of the project from the feasibility studies onward. As well, because the Columbia River originates hundreds of miles upstream in Canada, the term "mid-Columbia" seems to be more geographically accurate**.**

2) ***Initiate natural reproduction in areas of low risk to sensitive species and in other select areas to study the risks and interactions with sensitive species.***

The feasibility goals have been met; results are summarized in Table 1-1.

Table 1-1. Summary of feasibility study goals and results

Feasibility Study Goals	Results	Goal Achieved
1) Determine whether a broodstock can be developed from Lower Columbia River stocks.	Lower Columbia River (LCR) coho were transferred to the Wenatchee Basin in 1999, 2000, and 2001. A limited number of LCR transfers were used to supplement local broodstocking efforts in 2002. Since 2003, no LCR broodstock have been released in the Wenatchee basin (YN 2010 Table 3-4). The program is currently releasing third generation local broodstock. Releases of LCR coho salmon smolts were discontinued in the Methow River basin in 2006. Broodstock collection goals have been met or exceeded since 2006 in the Wenatchee basin and since 2009 in the Methow basin. By no longer relying on the transfer of coho from Lower Columbia River hatcheries, YN has demonstrated that a local broodstock can be developed from Lower Columbia River stocks. Smolt-to adult returns (SARs) have trended upwards with each generation of broodstock development (YN 2010 Figures 3-1 & 3-2).	Yes
2) Initiate natural reproduction in areas of low risk to sensitive species and in other select areas to study the risks and interactions with sensitive species.	The YN has documented spawning escapement in the Wenatchee and Methow basins (YN 2010 Figures 3-4 & 3-5). In the Wenatchee basin, redd counts have ranged from a low of 28 in 2002 to a high of 1,666 in 2007 (mean = 627; YN 2010 Figure 3-4). While redd numbers are lower in the Methow (a maximum of 306 redds in 2007), the annual fluctuations are similar to the Wenatchee. Juvenile production has been documented in the Wenatchee (Methow analysis is incomplete). Annual population estimates of naturally produced coho emigrating from the Wenatchee River range from a low of 5,826 in 2002 to a high of 48,708 in 2007 (YN 2010 Table 3-7). The naturally produced coho smolts have survived to return as adults. SARs for naturally produced coho range from 0.15% to 1.64% (YN 2010 Table 3-7). Studies of interactions with sensitive species (spring Chinook, steelhead, and sockeye) were developed under the direction, guidance, review and approval of the Mid-Columbia Coho Technical Work Group[a]. Critical uncertainties answered include rates of residualism, redd superimposition, predation by hatchery coho on naturally produced spring Chinook fry, and competition for space and food during freshwater rearing. The YN detected no significant impacts on listed fish throughout the evaluations (YN 2010 section 3.2).	Yes

a. Members of the Technical Work Group (TWG) represented NOAA Fisheries, U.S. Fish and Wildlife Service, Washington Dept. of Fish and Wildlife, Northwest Power and Conservation Council, BPA, Colville Tribe, Nez Perce Tribe, U.S. Forest Service, Chelan County PUD, Douglas County PUD.

1.5 Decisions to be Made and Responsible Officials

BPA will use the final EIS to decide whether to fund continued coho reintroduction efforts, including the construction of new facilities, in the Wenatchee and Methow basins. The Responsible Official is the Administrator and Chief Executive Officer.

The EIS is part of the second step in a 3-step project planning process established by the Council. The first step was preparation of the project Master Plan (YN 2010) which provides the basis for the proposal analyzed in this EIS. The third step is the final design and cost estimate review leading to construction of the proposed facilities, should BPA decide to fund the program.

The Yakama Nation is a cooperating agency and assisted with preparation of this EIS. The YN must decide whether to support BPA's decision on a preferred alternative for the Mid-Columbia Coho Restoration Program. As co-manager of fish and wildlife resources in the Wenatchee and Methow basins, along with the Washington Department of Fish and Wildlife; and because of its long-term cultural interest in the project; the YN must consider the potential effects of the project on the tribal community and the natural resources it manages.

Okanogan County is a cooperating agency and has agreed to serve as the lead agency to satisfy Washington State Environmental Policy Act (SEPA) procedural requirements.

Information in this EIS may also be used by other agencies to base decisions on permits, authorizations, management plans and other approvals associated with the project.

1.6 Public Involvement and Scoping

Over the years, the Mid-Columbia Coho Restoration Program has involved state and federal agencies, other tribes, Mid-Columbia public utilities, the Northwest Power and Conservation Council, and interested residents and citizens in developing and reviewing the scope of the feasibility studies, methods used, and monitoring and evaluation studies and results. The YN also consulted with these organizations and individuals, as well as with a variety of scientists throughout the region, to develop the Master Plan (YN 2010), on which the proposed action is based.

On July 30, 2009, the public process for the NEPA review of the current proposed action began with the publication in the Federal Register of a Notice of Intent to Prepare an Environmental Impact Statement. Meetings to provide an opportunity for the public to contribute to defining the scope of the EIS analysis and alternatives were held in Leavenworth, Washington, on August 20, 2009 and in Twisp, Washington, on August 21, 2009. At those meetings, YN staff presented an overview of the proposed project, and oral and written comments were recorded at both meetings. Written comments were accepted by BPA until September 15, 2009 and are posted on BPA's web site.

The following summary lists the general issues raised at the meetings and in written comments and where they are addressed in the EIS. Complete comments are accessible through the BPA website. http://www.bpa.gov/applications/publiccomments/CommentList.aspx?ID=79

Need for Project

YN has access to adequate supplies of coho and other species on the lower Columbia; the tribes have plenty of money from casinos and should pay for the project themselves; too many ratepayer dollars are spent on salmon restoration projects that benefit only a small number of people; money should be spent on salmon programs in the lower Columbia, not here. (See Sections 1.1 and 1.2)

Reviewers and Decision-makers

Does the project receive an independent scientific review; who makes the decision on this project; which agencies have been involved in this project. (See Sections 1.4, 1.5, and 1.6)

Alternatives to consider

Can you get wild donor fish from out of the area, like Alaska or Canada; can you use egg boxes instead of hatcheries as an alternative rearing method. (See Section 2.4)

No Action Alternative

Effect on Yakama Nation's ability to implement the program; effect on BPA's ability to meet Power Act responsibilities. (See Section 2.5)

Results of Feasibility Studies

(Summarized briefly in Section 1.4; more detail in Master Plan [YN 2010]; greatest detail in project annual reports, cited in Chapter 5, References)

Biological Program Design

Manage composition of the return to incorporate more natural fish than hatchery fish in the broodstock; need clear production goals; number of adults for harvest vs. for broodstock; likelihood that population will be self-sustaining. (See Section 2.2.1)

Facilities Location, Design, and Operation

Provide details on project design and location of new and temporary facilities; water quality and temperature requirements for coho; how will acclimation ponds be maintained; are fish fed in the ponds; techniques of predator control, including use of paid employees or volunteers. (See Section 2.2.2 and Appendices 1, 2, and 3)

Monitoring Program

Compare survival rates of hatchery and natural fish; amount of mortality caused by dams; percent of fish released that return as adults; techniques used to monitor competition between naturally produced coho and other species; coho escapement; coho losses to predation; coho production numbers in small tributaries; superimposition of coho redds on summer Chinook redds. (See Section 2.2.3 and Appendix 5 [monitoring program techniques]; Section 3.7 [redd superimposition]; Master Plan and annual reports [detailed monitoring results])

Existing Environment

History of coho in basins; reasons for coho extirpation and how or if conditions are different now; why spring Chinook and steelhead persisted in the basins and coho did not; current status of coho; numbers of spring Chinook, steelhead and bull trout in Icicle Cr.; status of spring Chinook in Mission Cr.; existing water quality. (See Sections 1.3.1, 1.3.2, 3.4 [history and status of coho]; 3.5 [water quality]; and 3.7 and Appendix 9 [status of other fish species])

Impacts

Fish: predation by coho on at-risk and/or ESA-listed species, including steelhead, spring Chinook, lamprey, bull trout; interspecies competition, specifically coho with steelhead and spring Chinook; differences in competition between hatchery and natural fish; benefits to listed fish from coho carcasses; benefits of volitional releases to other salmonids. (See Section 3.7)

Water quality: effects of existing, new, and temporary facilities; effects of runoff contaminants on fish; effects of discharge from ponds; types of contaminants from ponds; disposal of carcasses from acclimation ponds; proposed mitigation. (See Section 3.5 [project effects on water quality]; 3.7 [discharge effects on fish])

Water use/quantity: effects of existing, new, and temporary facilities; effects of use of water from storage in riparian areas, ponds, irrigation; effects of project on water rights of irrigation districts; availability of water rights; proposed mitigation. (See Section 3.6)

Floodplains: impacts to floodplain function, channel migration, riparian habitat. (See Section 3.10 and 4.5)

Visual quality: effects on riverfront view of property owner. (See Section 3.11)

Recreation: effect of the Dryden facility on boaters. (See Section 3.11)

Land use: effects on farmers; effects on state highway rights-of-way; access and mitigation issues on private property used for acclimation sites. (See Sections 3.11, 3.12, and 4.8)

Socioeconomic: effect of project costs on electricity and irrigation rates. (See Section 3.12)

Consistency with local, regional, and national plans and programs: consistency of this project and MOA projects in general with Northwest Power Act, ESA, and the Columbia Basin fish and wildlife program. (See Sections 1.1, 4.2, 4.3, and the last bullet in Section 1.7 below)

Harvest: effect of harvest on native runs of salmon, steelhead, walleye, and sturgeon in Wenatchee area; location of harvest; condition of fish for harvest; who can participate in harvest. (See Section 3.12 and the first bullet in Section 1.7 below)

1.7 Issues Beyond the Scope of this EIS

The following issues were raised during scoping but are beyond the scope of this EIS; the issues are more appropriately addressed in other forums or with other agencies, as specified below.

- Potential for increase in gillnetting in the project area; effects of various harvest techniques, including gillnetting, on other species; how harvest is regulated on lower Columbia to protect mid-Columbia fish: (Harvest methods, timing, and numbers would be regulated by state, federal, and tribal agencies through the Columbia River Fish Management Plan (CRFMP), as part of Court-supervised requirements of *U.S. v. Oregon*).
- Use of surplus coho for Colville Tribal programs: (The potential for the Colville Tribe to use surplus coho to build a broodstock for programs under their jurisdiction is a short-term activity currently being negotiated and would not affect the number of coho available for this proposal).
- Purchase of conservation easements in the lower Methow: (Habitat protection activities, including purchase of conservation easements, are part of other BPA and YN programs focused on protecting habitat of the ESA-listed mid-Columbia spring Chinook salmon).
- Effects on wild coho: (No wild coho exist in these basins).
- Effects on landowners of regulations regarding activities in riparian areas, e.g., cutting trees and keeping cattle out: (Washington State and federal agencies have regulations governing forestry and grazing practices in riparian areas. Coho in a stream would not change a stream classification or the state regulations governing forestry or grazing adjacent to the stream.)
- Consistency of MOA projects with Northwest Power Act, ESA, and Columbia Basin fish and wildlife program. (Projects other than the one that is the subject of this EIS are beyond the scope of the analysis.)

Chapter 2. Alternatives Including the Proposed Action

This EIS analyzes in detail the Proposed Action and the No Action alternatives. Other options considered and eliminated from detailed analysis in this EIS are briefly discussed in Section 2.4.

2.1 Current Experimental Program

Chapter 1, Sections 1.3 and 1.4 describe the history of the Yakama Nation's coho reintroduction experiments that BPA has funded to date. The history includes feasibility studies to determine if the Yakama Nation could succeed in developing a local coho stock, originating from lower Columbia River hatchery stocks, that would return to mid-Columbia tributaries with increasing survival rates. That goal was achieved (YN 2010): in 2009, 100% of the coho smolts released in both basins were progeny of second- and third-generation mid-Columbia broodstock (see Section 1.4).

The program currently is collecting more of its broodstock from upstream capture sites than during the feasibility studies. The objective is to determine if spawning more adults from upstream sites selects for characteristics that allow their progeny to exceed what might be the current limits of stamina and run timing for the reintroduced population. Such characteristics might allow coho to return to the better quality habitat in the upstream portions of the basins if they are acclimated in those areas as proposed in the Proposed Action (Murdoch et al. 2004).

A total of 1.5 million smolts are acclimated and released in the two basins annually. In 2009, approximately 22,000 adults passed Rock Island Dam, the closest mainstem Columbia River dam downstream from the Wenatchee River mouth (Figure 2-1). Facilities used in the current program are listed in Table 2-1 and shown in Figures 2-2 through 2-4.

The schedule of fish culture activities is shown in Table 2-2. The timing of egg and fish transfers between facility components is guided by this schedule. Adults are moved from capture sites to holding facilities in the fall for ripening and spawning. Green eggs are incubated at or near these holding facilities. All eyed eggs from the Wenatchee program and a portion of the Methow production are transported to hatcheries in late fall/early winter for final incubation and rearing to the pre-smolt stage. The following fall, some of the hatchery production can be moved to target watersheds for over-winter/intermediate rearing to take advantage of a prolonged period of imprinting on natal waters and rearing in a semi-natural environment. Site locations may vary depending on which rearing strategy is employed. In late winter to early spring (mostly weather dependent), the remaining pre-smolts are moved to final acclimation/release sites.

Table 2-1. Facilities used in current coho restoration program

BROODSTOCK COLLECTION	
Wenatchee	**Methow**
Tumwater Dam	Wells Fish Hatchery (FH)
Dryden Dam	Wells Dam ladders
Leavenworth National Fish Hatchery (NFH)	Winthrop National Fish Hatchery (NFH)
HOLDING, INCUBATION AND/OR REARING	
Leavenworth NFH	Note: Rearing facilities provide coho for both basins
Winthrop NFH	
Peshastin Incubation Facility	
Cascade FH	
Willard NFH	
SMOLT RELEASES	
Wenatchee	**Methow**
• 500,00 above Tumwater Dam in Nason Creek and Beaver Creek • 500,000 from Icicle Creek	• 300,000 from Winthrop NFH • 75,000 from Lower Twisp • 125,000 from Wells FH
ACCLIMATION	
Wenatchee	**Methow**
Leavenworth NFH (Icicle Creek)	Winthrop NFH
Rohlfing	Lower Twisp
Coulter	Wells FH
Butcher	
Beaver	

Table 2-2. Coho production timetable

	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
BROOD AND EGGS																					
Adult Holding	▐	■	■																		
Spawning		■	■																		
In-basin incubation		■	■	■	▌																
Out-of-basin incubation				■	■	■															
HATCHERY REARING																					
Raceway/Tanks							■	■	■												
Grow Out									■	■	■	■	■	■	■	■	■	■	▌		
ACCLIMATION																					
Overwinter															▐	■	■	■	■	■	■
Short Term																			▐	■	■

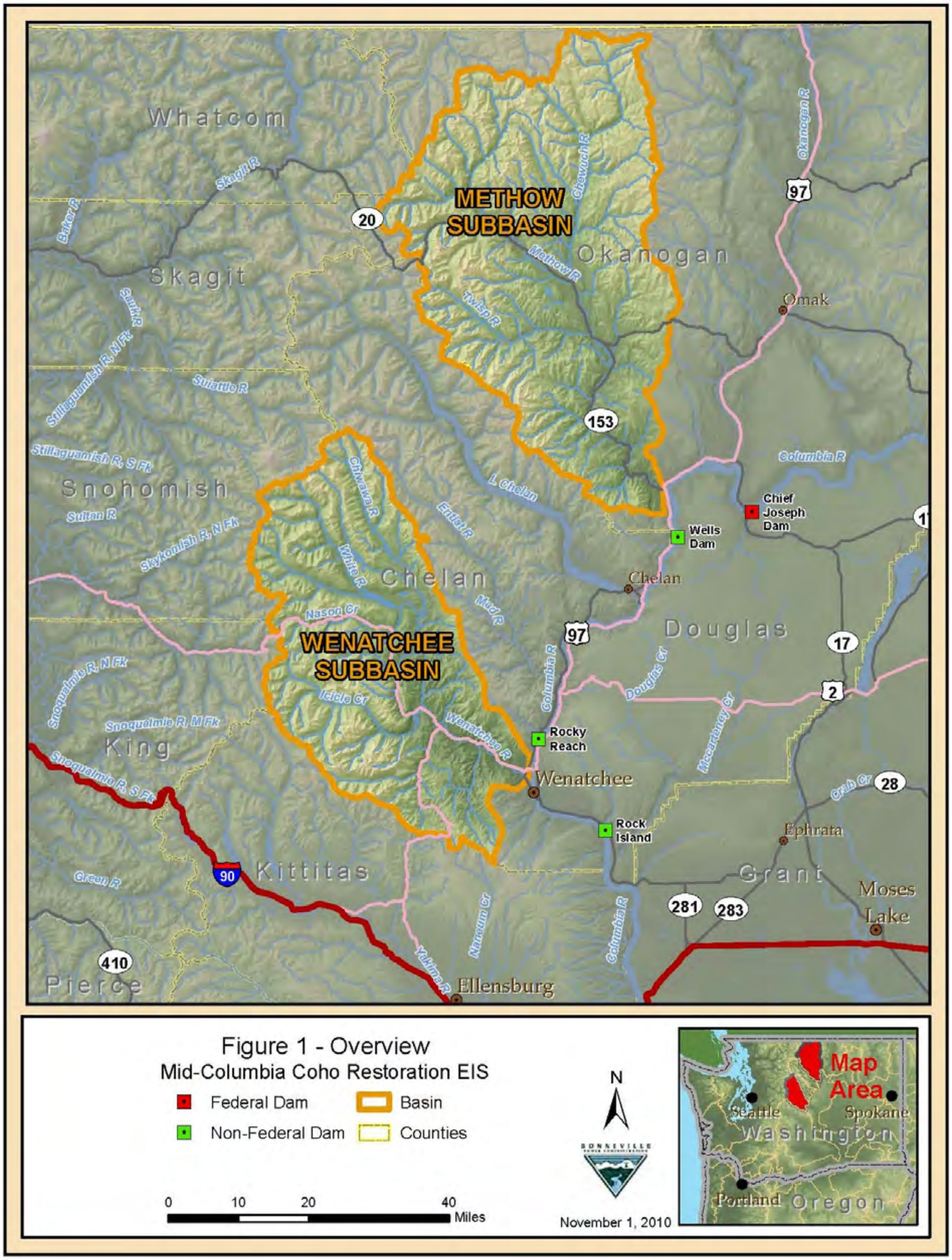


Figure 2-1. Wenatchee and Methow Basins in Relation to Upper Columbia River Dams

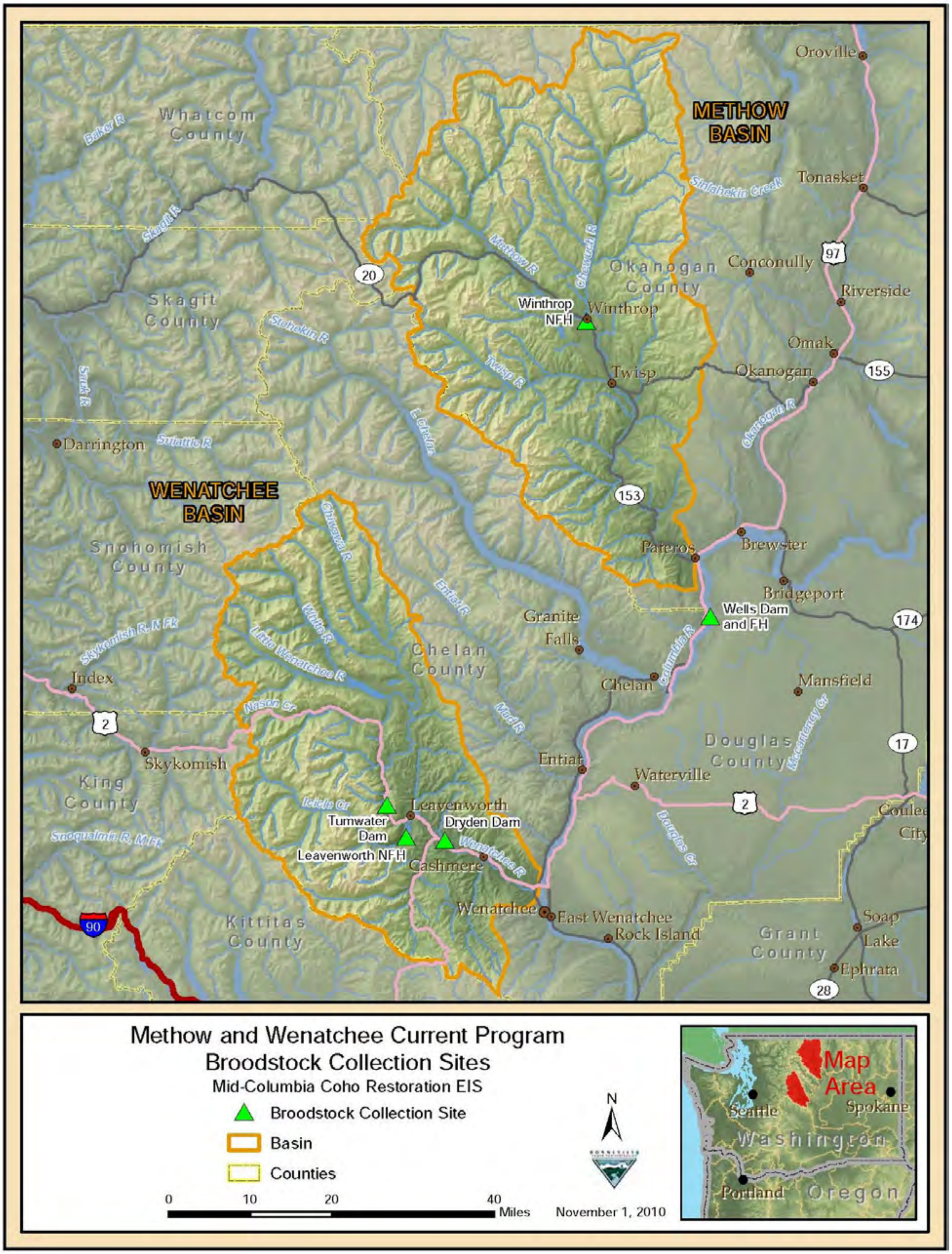


Figure 2-2. Current Program: Broodstock Collection Sites

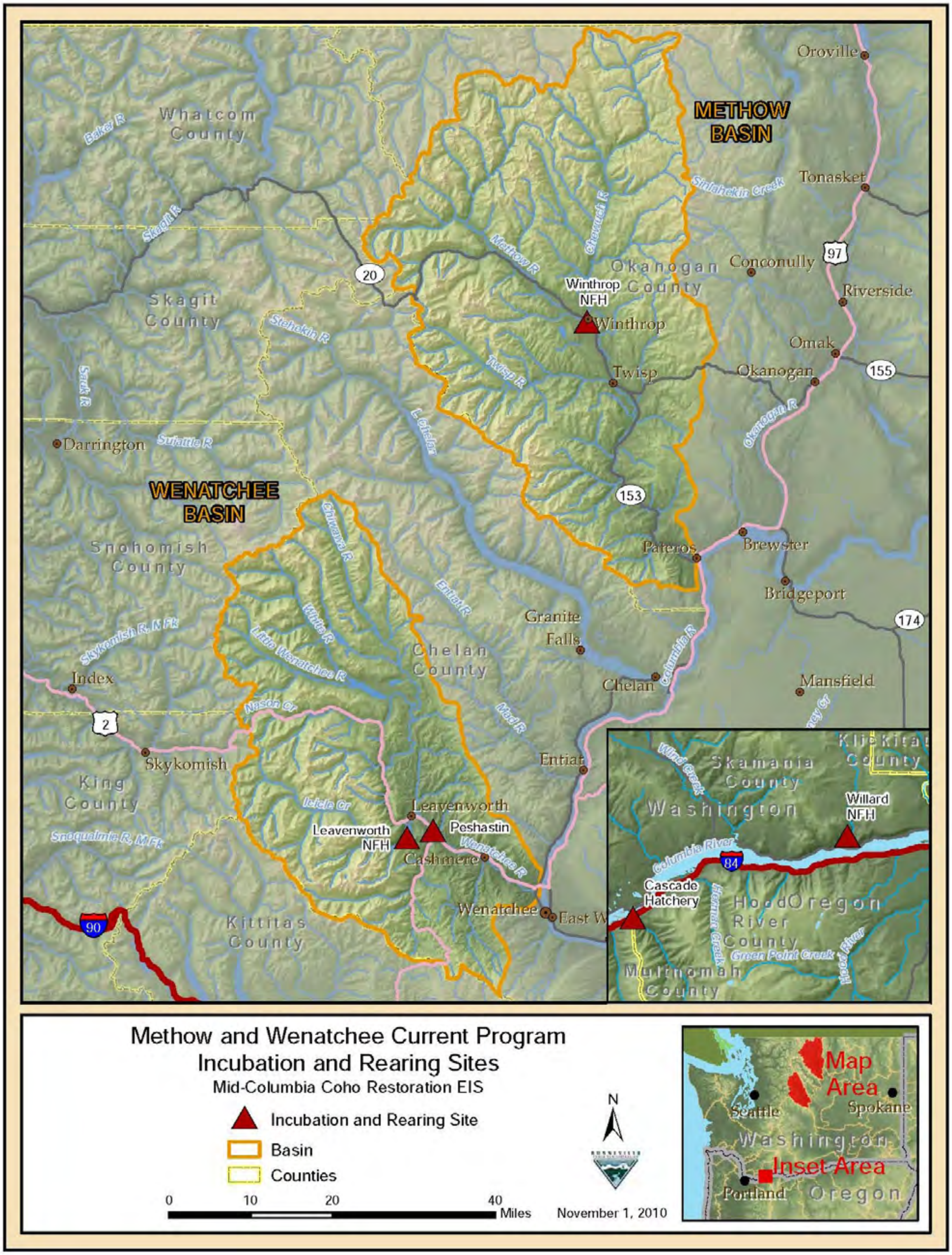


Figure 2-3. Current Program: Incubation and Rearing Sites

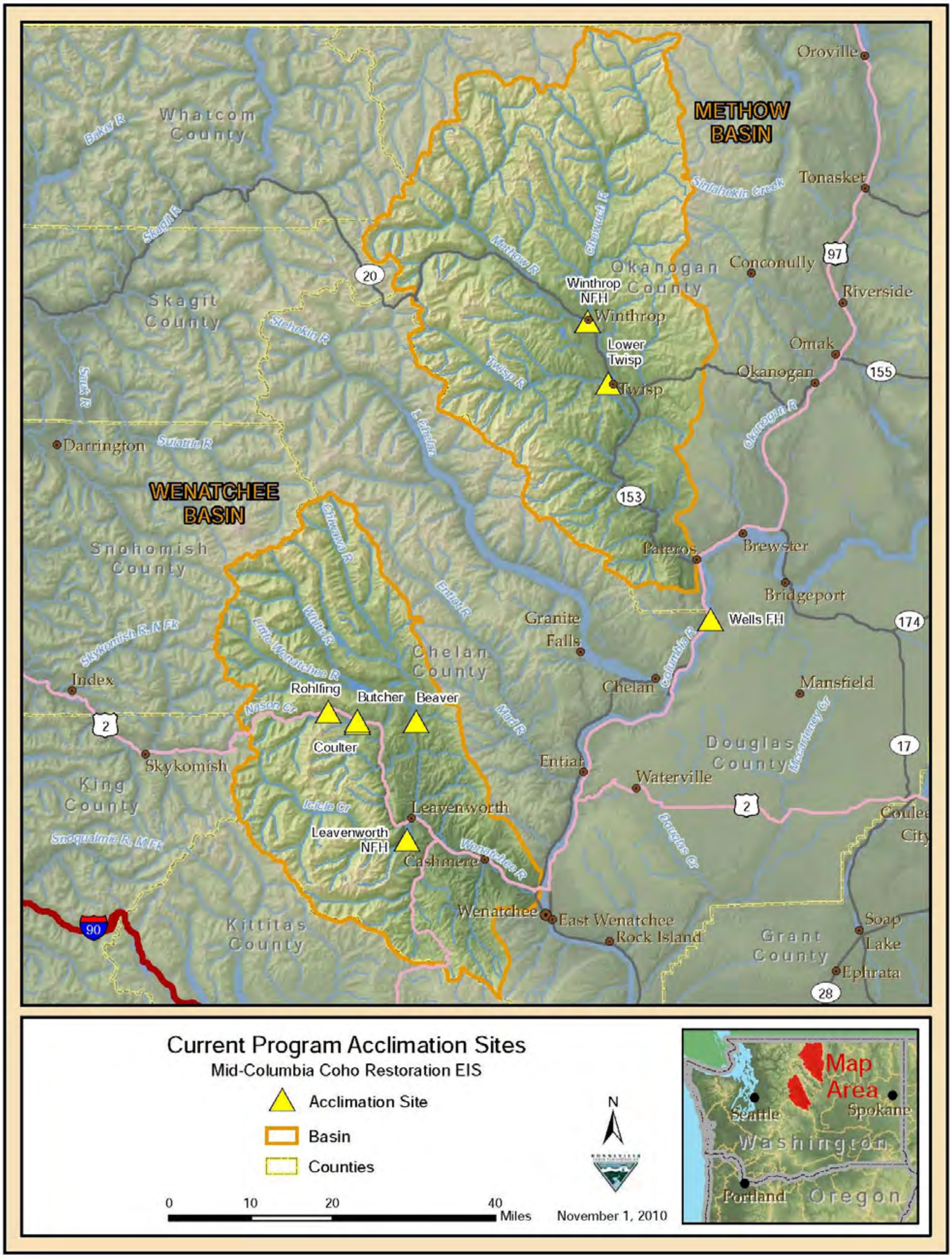


Figure 2-4. Current Program: Acclimation Sites

2.2 Proposed Action

The Yakama Nation's long-term vision for the Mid-Columbia Coho Restoration program, as stated in the Master Plan (YN 2010) is:

> ***To re-establish naturally spawning coho populations in mid-Columbia tributaries to biologically sustainable levels which provide significant harvest in most years.***

Building on the feasibility studies that have been conducted since 1996, the proposal would maintain a phased approach to reintroducing coho into the Wenatchee and Methow basins: two broodstock development phases and three natural production phases. The broodstock development phases were designed to eliminate transfers of lower Columbia brood coho and to encourage broodstock adaptation so that returning coho can reach key habitat within the basins. The first phase of broodstock development has been accomplished and lower Columbia broodstock are no longer used in the program; however, the second phase continues the process of increasing broodstock stamina. After all broodstock development goals are met (see Section 2.2.1.2), the natural production phases would manage broodstock composition so that eventually the percent of natural-origin fish in the hatchery broodstock exceeds the percent of hatchery-origin fish on the spawning grounds (HSRG 2004). The coho restoration program is designed to end when a self-sustaining naturally reproducing population that supports harvest is established. This goal would be met when there is a natural-origin return escapement of more than 1,500 coho to each basin, with a terminal and mainstem harvest in most years; it is expected to be achieved within five coho generations[5] (by approximately 2028).

2.2.1 Biological Approach: Phased Reintroduction

2.2.1.1 Objective and Measures of Success

> ***Biological Objective: By 2028, develop a locally adapted, naturally spawning coho stock in the Wenatchee and Methow river basins capable of supporting harvest.***

The Yakama Nation proposes to increase the fitness of reintroduced coho salmon by reducing the effects of hatchery breeding and emphasizing local adaptation. Broodstock composition would be managed to incorporate natural-origin fish in the broodstock and limit the proportion of hatchery-origin adults on the spawning ground. Ultimately, the natural environment must have a greater influence on the population than the hatchery environment. The objective would be considered successful when the following numeric goals have been achieved:

> *Metric 1. The 3-year mean escapement of natural-origin returns in the Wenatchee (upstream of Tumwater Dam) and the Methow river basins exceeds 1,500 per basin.*

This metric predicts the abundance and effective population size required to satisfy the restoration goal without further hatchery supplementation. The figure of 1,500 per basin is supported by modeling results detailed in the Master Plan (YN 2010). Briefly, the All H's Analyzer (AHA) model calculations predict a level of sustainability based on:

- inputs from a habitat analysis system (Ecosystem Diagnosis and Treatment [EDT]) that predicts an individual stream's capacity for coho production;
- on harvest rates; and
- on hydro-system and marine survival (YN 2010).

[5] One coho generation = 3 years.

Metric 2. Achieve a total harvest rate of 23%, which includes a 10% mixed stock harvest, 10% mainstem harvest, and 5% terminal harvest in most years. [6]

The harvest management plan was developed to ensure that exploitation rates are based on forecasts of survival, abundance, and escapement goals, and are responsive to fluctuations in abundance (e.g., due to fluctuating ocean conditions). A detailed description of the harvest management schedule throughout the phases of the project can be found in the Master Plan (YN 2010).

2.2.1.2 Phased Approach

The proposed project, first described in the draft Master Plan submitted to the NW Power and Conservation Council (Council) in 2006, originally included five distinct phases. Since that version of the Master Plan was written, the first phase (Broodstock Development Phase 1), has been completed in both basins (YN 2010). The description of that phase is provided to show a complete picture of how each project phase is designed to build on the previous one. The program is projected to be discontinued after a minimum of five generations of natural production.

The objectives of each phase are described in more detail below.

- **Broodstock Development Phase 1** was designed to develop a mid-Columbia broodstock from lower Columbia River coho, so that they would become increasingly adapted to the longer migration to mid-Columbia tributaries. This phase focused on eliminating reliance on lower Columbia stocks and transitioning to a local broodstock and has been completed in both basins; lower Columbia-origin broodstock are no longer used. Broodstock collection goals have been met or exceeded since 2006 in the Wenatchee basin and since 2009 in the Methow basin (see detailed summary of feasibility study results in the Master Plan (YN 2010).
- **Broodstock Development Phase 2** would increase the percentage of broodstock captured from sites further upstream. The objective is to ensure that the reintroduced stock can reach the preferred habitat in the upstream portions of the basins (Murdoch et al. 2004), in preparation for the Natural Production phases. Both Wenatchee and Methow basins are expected to operate in this phase until 2013 or later.
- **Natural Production Phases** focus on decreasing domestication selection and increasing fitness in the natural environment. These phases differ from broodstock development in that broodstock development selects for coho that can return to the Wenatchee and Methow rivers but does not address loss of fitness and adaptation to the natural environment. During the natural production phases, hatchery coho would be introduced to areas predicted by a habitat analysis system (Ecosystem Diagnosis and Treatment [EDT]) to be the most successful for coho. Broodstock compositions would be managed to increase the proportion of natural influence (PNI) in the population, with the goal of having a PNI value greater than 0.5; that is, the natural environment must have a greater influence on the population than the hatchery environment. Harvest could be used as a mechanism to manage the broodstock composition. Potential harvest schedules are detailed in the Master Plan but are only theoretical until actual

[6] These three types of harvest do not add up to 23% because the harvests occur sequentially. Harvest on 10% of the mixed stocks would leave the remaining 90% of the run subject to a 10% mainstem harvest; after the mainstem harvest, the remaining 80% of the run would be subject to a 5% terminal harvest.

returns of hatchery-origin and natural-origin coho occur. The natural production phases are described below.

- **Natural Production Implementation Phase** proposes high smolt release numbers into most habitat areas for one generation (3 years). The goal is to begin the local adaptation process by releasing enough hatchery smolts in the natural environment to result in a sufficient number of adult coho returning to each tributary to spawn without the aid of a hatchery. Their progeny would in turn produce enough returning first-generation natural-origin adults to be incorporated into the broodstock as the natural production phases continue. This phase is expected to begin in both basins in 2013.
- **Natural Production Support Phases 1 and 2** would emphasize further local adaptation and naturalization. Initially, release numbers would be reduced by 30% from the numbers released during the Natural Production Implementation Phase. The goal would be to increase the proportion of natural-origin fish in the broodstock (pNOB) to 35% and to limit the proportion of hatchery-origin fish on the spawning grounds (pHOS) to 75%. When this initial goal is reached, managers would continue to reduce the hatchery program size, increase the proportion of natural-origin broodstock and decrease the proportion of hatchery-origin coho in the spawning grounds to the point that the PNI value is greater than 0.5 (pNOB = 80%, pHOS less than 65%). A PNI greater than 0.5 is predicted to result in increased natural fitness and survival rates for the population (L. Mobrand, pers. comm.). The Wenatchee and Methow basins are expected to begin this phase in 2016. The total expected duration of the Support Phases is 4 generations (12 years).

Tables 2-3 and 2-4 summarize key goals and management strategies for the five phases in each basin. These goals and strategies are the Yakama Nation's best estimate of a program that has a realistic ultimate goal while acknowledging that many unknowns exist because of the experimental nature of this goal. A contingency plan was developed that suggests alternate courses of action in case goals of each phase are not met within the timeframe proponents believe is reasonable. This plan is detailed in the Master Plan (YN 2010). It suggests a decision-making process that includes evaluating reasons the goal was not achieved, determining if the cause can be ameliorated, and considering alternate courses of action or program changes. See Section 4.3.5 of the Master Plan for the detailed contingency plan.

Although water quality data collected for this project indicate that flows and temperatures currently are more than adequate to support this project (see Appendix 6), one of the potential reasons a goal might not be achieved could be related to water temperature and flow changes resulting from climate change. For example, Karl et al. (2009) suggest that approximately "one-third of the current habitat for the Northwest's salmon and other cold water fish will no longer be suitable for them by the end of this century as key temperature thresholds are exceeded." It has also been suggested that up to 40 percent of Northwest salmon populations may be lost by 2050 (Battin et al. 2007). These projections could result in more emphasis on regional hatchery production. In light of these concerns, it is important to understand how climate change could affect the Proposed Action, how it can be monitored, and the types of actions that may be necessary in the future to respond to those changes. Appendix 11 describes potential climate change adaption strategies that could be pursued based on projected changes in conditions.

If program or facility changes are required to respond to climate change or other contingencies, project proponents recognize that decision-makers must take into account political policies and ramifications as well as scientific methods and practices. If the Proposed Action is implemented, any changes to the approved original program must fall within legal limits established for the program, must still meet policy goals of many organizations at many levels, and must be scientifically credible. Changes are likely to require additional environmental review.

Table 2-3. Wenatchee basin program summary

	Broodstock Development Phase 1 (Completed)	Broodstock Development Phase 2	Natural Production Implementation	Natural Production Support	Fully Restored Population
Management Goal	-Eliminate transfers of Lower Columbia River broodstock. -Broodstock collection = 1,312.	-"Fine tune" broodstock so that returning coho can reach key habitat in the basins. -Broodstock collection = 1,050.[a]	-Initiate natural production in key habitat areas. -NOR [b] escapement >600.	-Develop locally adapted fully integrated stock. -NOR escapement >900	-Self-sustaining, naturally reproducing population is established. -NOR escapement >1,500. -Terminal and mainstem harvest in most years.
Management Strategy	-Primary release site in Icicle Creek. -Broodstock collected at Dryden Dam and Leavenworth NFH.	-Release 50% of smolts above Tumwater Dam, 50% in Icicle Creek. -Broodstock collected at Dryden and Tumwater Dam.	-Release Wenatchee broodstock in areas predicted by EDT to be most productive for coho in sufficient numbers to seed habitat and begin local adaptation. -Implement schedule for harvest and broodstock management. pNOB [c] = 10% pHOS [c] = 90%	-Continue local adaptation and reduce effects of hatchery breeding. -Convert to integrated hatchery program and move towards PNI >0.5.[d] -Implement matrix schedule for harvest and broodstock management. pNOB = 80% pHOS = 65%	-Harvest according to the matrix schedule. -Implement hatchery supplementation as needed to prevent extirpation and achieve harvest goals, subject to condition that PNI >0.5.

[a] Broodstock Development Phase 2 would be considered completed when 50% of the broodstock are available for trapping at Tumwater Dam.

[b] NOR = natural-origin recruits: the number of natural-origin coho allowed to pass collection points and proceed to spawning grounds.

[c] pNOB = proportion of natural-origin fish in broodstock; pHOS = proportion of hatchery-origin fish on spawning grounds.

[d] PNI = proportionate natural influence (in the population).

Table 2-4. Methow basin program summary

	Broodstock Development Phase 1 (Completed)	Broodstock Development Phase 2	Natural Production Implementation	Natural Production Support	Fully Restored Population
Management Goal	-Eliminate transfers of Lower Columbia River broodstock. -Broodstock collection = 656.	-Encourage broodstock adaptation so that returning coho can reach key habitat within the basins. -Broodstock collection = 1,312 trappable coho: at least 656 [a] at Winthrop NFH, the remainder at Wells FH.	-Initiate natural production in key habitat areas. -NOR [b] escapement >600.	-Develop locally adapted, fully integrated stock. -NOR escapement >900.	Self-sustaining naturally reproducing population is established. -NOR escapement >1,500. -Terminal and mainstem harvest in most years.
Management Strategy	-Primary release site(s) at Winthrop NFH and Wells FH. -Primary broodstock collection site is Wells Dam.	-Primary release site(s) at Winthrop NFH and selected tributaries (Twisp, Chewuch, etc.). -Primary collection site(s) at Winthrop NFH and tributary weirs.	-Release Methow broodstock in areas predicted by EDT to be most productive for coho in sufficient numbers to seed habitat and begin local adaptation. -Implement matrix schedule for harvest and broodstock management. pNOB [c] = 10% pHOS [c] = 90%	-Continue the local adaptation process and reduce effects of hatchery breeding. -Convert to integrated hatchery program and move towards PNI >0.5.[d] -Implement matrix schedule for harvest and broodstock management. pNOB = 80% pHOS = 65%	-Harvest according the matrix schedule. -Implement hatchery supplementation as needed to prevent extirpation and achieve harvest goals, subject to condition that PNI >0.5.

[a] A total of 1,312 broodstock would be needed to increase release numbers during the Natural Production ImplementationPhase, some of which may be trapped at Wells FH.

[b] NOR = natural-origin recruits.

[c] pNOB = proportion of natural-origin fish in broodstock; pHOS = proportion of hatchery-origin fish on spawning grounds.

[d] PNI = proportionate natural influence (in the population).

Table 2-5 shows proposed smolt release numbers for each phase in both the Wenatchee and Methow basins.

Table 2-5. Proposed smolt release numbers (in millions) by basin and project phase

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
WENATCHEE																				
Broodstock Dev																				
Phase 1																				
Phase 2	1.00	1.00	1.00	1.00	1.00															
Natural Production																				
Implementation						1.16	1.16	1.16												
Support Phase 1									0.81	0.81	0.81	0.81	0.81	0.81						
Support Phase 2															0.40	0.40	0.40	0.40	0.40	0.40
WEN. SUBTOTAL	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.16**	**1.16**	**1.16**	**0.81**	**0.81**	**0.81**	**0.81**	**0.81**	**0.81**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**
METHOW																				
Broodstock Dev																				
Phase 1	0.50	0.50																		
Phase 2			0.50	0.50	0.50															
Natural Production																				
Implementation						1.00	1.00	1.00												
Support Phase 1									0.70	0.70	0.70	0.70	0.70	0.70						
Support Phase 2															0.35	0.35	0.35	0.35	0.35	0.35
MET. SUBTOTAL	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**1.00**	**1.00**	**1.00**	**0.70**	**0.70**	**0.70**	**0.70**	**0.70**	**0.70**	**0.35**	**0.35**	**0.35**	**0.35**	**0.35**	**0.35**
TOTAL	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**2.16**	**2.16**	**2.16**	**1.51**	**1.51**	**1.51**	**1.51**	**1.51**	**1.51**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**

2.2.2 Facilities

The ongoing Broodstock Development Phase does not require construction of new facilities. The Natural Production phases, beginning in approximately 2013, would require additional acclimation facilities, some of which currently exist, a few of which would require new construction. A new in-basin incubation and rearing facility also is proposed.

Additional acclimation facilities are needed in order to acclimate juveniles in tributaries throughout the basins so that they return to those tributaries to spawn as adults, thus increasing the distribution of naturally spawning coho throughout the basins. An in-basin incubation and rearing facility is proposed to replace the Entiat NFH, which is no longer available to the coho program.[7] Such a facility located within the project area reduces the transfer of fish and gametes between watersheds and reduces transportation stress for part of the juvenile coho population, but capital costs would be minimized by keeping the size of the new facility small and continuing to use additional rearing capacity at existing available facilities.

2.2.2.1 Facility Locations

Broodstock Development Phase

Fish produced for the ongoing broodstock development phase are captured at existing adult traps, produced from existing hatcheries, and released from acclimation sites that do not require new construction. Locations of the facilities are shown under the description of the current program (Section 2.1) in Figures 2.2 through 2.4.

- Broodstock capture:
  Wenatchee: traps at Leavenworth NFH, Tumwater Dam and Dryden Dam.
  Methow: trapping facilities at Wells Dam and FH and at Winthrop NFH.

[7] Entiat NFH is not available to the coho program because the hatchery's focus is changing to a summer Chinook program which overlaps with coho spawn timing, causing logistical problems with holding and spawning.

- Broodstock holding and incubation:
  Winthrop NFH for adult holding, spawning, and incubation; Leavenworth NFH for adult holding, spawning and early incubation (green to eyed egg); Peshastin Incubation Facility for early incubation only. Entiat NFH would be used only as a backup site.
- Rearing to pre-smolt size:
  Cascade FH and Willard and Winthrop NFHs.
- Acclimation:
  Wenatchee: Rohlfing, Coulter, Butcher, and Beaver ponds in the upper Wenatchee and the Leavenworth NFH on Icicle Creek.

  Methow: Winthrop NFH, Lower Twisp, and Wells FH.

Natural Production Implementation Phases

The plan proposes to continue rearing most program fish at existing hatcheries during the Natural Production Implementation Phases. A new, small, in-basin adult holding/spawning, incubation and rearing facility also is proposed for these phases at a site on the Wenatchee River near Dryden Dam or a site on the Wenatchee River downstream of Lake Wenatchee. See Figure 2-6 and "Facility Designs" later in this section.

Acclimation is planned at a combination of existing and new sites. Most acclimation sites would be existing water bodies (e.g., beaver ponds, side channels, etc.) and small constructed ponds. See Section 3.3.2 for a brief description of each site, or Appendices 2 and 3 for more detailed descriptions and photographs. For locations, see Figures 2-7 and 2-8.

The project proposes to use existing broodstock capture sites in upstream areas in addition to those used during the broodstock development phase, all of which are owned by other entities and operated by the YN and/or other fisheries resource agencies. One broodstock capture site (Chiwawa Weir) would need to extend its period of operation in order to capture coho adults. Figure 2-5 shows their locations.

Juvenile trapping for monitoring and evaluation of the program would take place at existing traps in both basins, with one exception: a new smolt trap is proposed for the Little Wenatchee River, the site to be determined.

The proposed acclimation and release system has the following characteristics:

- At least two acclimation/release sites are proposed in each major tributary stream (one low in the system and one as far upstream as is practical); and one site is proposed in most minor streams.
- A total of 24 acclimation sites are proposed in the Wenatchee and Methow basins: 13 in the Wenatchee and 11 in the Methow.
- In each basin, one additional site would be for adult plants (Hancock and Dirty Face).
- Nine of the 24 acclimation sites would require some kind of construction, as follows:
  - A new pond at three sites (Minnow, Chikamin, Twisp Weir)
  - Expansion of existing ponds at two sites (Scheibler, Gold)
  - New wells at three sites (Butcher, MSWA Eightmile, Twisp Weir)
  - New water delivery systems at five sites (Butcher, Tall Timber, Chikamin, MSWA Eightmile, Twisp Weir)
  - New buried power lines at 2 sites (Butcher, MSWA Eightmile)
  - New road at 2 sites (Minnow, Twisp Weir)

- New groundwater rights are required at 5 sites (1 Wenatchee, 4 Methow); new surface water rights at 3 sites (2 Wenatchee, 1 Methow).
- Six sites require generators (Rohlfing, Butcher, Two Rivers, MSWA Eightmile, Lincoln, Twisp Weir).
- Twelve sites are potentially capable of over-winter acclimation (ten sites are proposed to be used in any one year, five in each basin).
- Eight of the sites have been used in the past by the current coho program.

Table 2-6 lists all the facilities that might be used for the proposed program, including alternative (backup) sites that might be used if one or more of the preferred (primary) sites is unavailable. The table shows those currently in use as of 2010 (C), those proposed for use in the future (F), potential backup sites, and whether any require new construction. Locations are shown on Figure 2-5 (Broodstock Collection Sites), Figure 2-6 (Hatchery and Rearing Sites) and Figures 2-7 and 2-8 (Primary and Backup Project Sites). Further detail is provided in Appendix 1 (Rearing and Brood Capture Site Descriptions); Appendix 2 (Wenatchee Acclimation Site Descriptions) and Appendix 3 (Methow Acclimation Site Descriptions).

Table 2-6. Summary of facilities: Proposed Action

<table>
<tr><th colspan="6">BROODSTOCK COLLECTION</th></tr>
<tr><th>Wenatchee</th><th>C or F[a]</th><th>Construction?</th><th>Methow</th><th>C or F</th><th>Construction?</th></tr>
<tr><td>Dryden Dam</td><td>C</td><td>No</td><td>Wells FH</td><td>C</td><td>No</td></tr>
<tr><td>Leavenworth NFH</td><td>C</td><td>No</td><td>Wells Dam ladders</td><td>C</td><td>No</td></tr>
<tr><td>Tumwater Dam</td><td>C</td><td>No</td><td>Winthrop NFH</td><td>C</td><td>No</td></tr>
<tr><td>Chiwawa Weir</td><td>F</td><td>No</td><td>Methow State FH</td><td>C</td><td>No</td></tr>
<tr><td></td><td></td><td></td><td>Twisp Weir</td><td>F</td><td>For acclimation only</td></tr>
<tr><td></td><td></td><td></td><td>Lower Twisp</td><td>F</td><td>No</td></tr>
<tr><th colspan="6">INCUBATION/REARING</th></tr>
<tr><td>Cascade FH</td><td>C</td><td colspan="3">No construction</td><td rowspan="8">Note: Rearing facilities provide coho for both basins</td></tr>
<tr><td>Willard NFH</td><td>C</td><td colspan="3">No construction</td></tr>
<tr><td>Winthrop NFH</td><td>C</td><td colspan="3">No construction</td></tr>
<tr><td>Leavenworth NFH</td><td>C</td><td colspan="3">No construction</td></tr>
<tr><td>Peshastin</td><td>C</td><td colspan="3">No construction</td></tr>
<tr><td>Entiat NFH Backup</td><td>C</td><td colspan="3">No construction</td></tr>
<tr><td>Proposed Dryden Hatchery</td><td>F</td><td colspan="3">New facility on 1.5 acres: hatchery building, 4 raceways, 2 rearing ponds, water pipelines, wells, waste treatment tank and wetland; 4 acres total construction disturbance</td></tr>
<tr><td>Backup George Hatchery</td><td>F</td><td colspan="3">New facility on 1.5 acres: similar facilities to proposed Dryden site except no waste treatment wetland; 2.5 acres total construction disturbance</td></tr>
</table>

a. C = Currently in use; F = Future

Table 2-6. Summary of facilities: Proposed Action (continued)

ACCLIMATION/ADULT PLANTS (Primary)					
Wenatchee	**C or F[a]**	**Construction?**	**Methow**	**C or F**	**Construction?**
Leavenworth NFH	**C**	No	Winthrop NFH	**C**	No
Beaver	**C**	No	Lower Twisp	**C**	No
Butcher	**C**	New well, 50-ft surface water channel	Goat Wall	**F**	No
Clear	**C**	No	Gold	**F**	Expand pond
Coulter	**C**	No	Heath	**F**	No
Rohlfing[b]	**C**	No	Lincoln[b]	**F**	No
Brender	**F**	No	Mason	**F**	No
Chikamin	**F**	New pond, water intake, 120-ft buried pipe, 70-ft surface discharge channel	MSWA Eightmile	**F**	New well, 500-ft surface water channel, 450-ft buried power line
Minnow	**F**	New pond, 600-ft road	Parmley	**F**	No
Scheibler	**F**	Expand pond	Pete Creek Pond	**F**	No
Tall Timber	**F**	New water intake, 800-ft buried pipe	Twisp Weir	**F**	New pond, well, water intake on diversion ditch, 400-ft surface water channel, buried water (500 ft) & power (400 ft) lines, 20-ft road
Two Rivers[c]	**F**	No			
White River Springs	**F**	No			
Dirty Face (adults)	**F**	No	Hancock (adults)	**F**	No
ACCLIMATION (Backup)					
Wenatchee	**C or F**	**Construction?**	**Methow**	**C or F**	**Construction?**
Allen	**F**	No	Balky Hill	**F**	No
Coulter/Roaring	**F**	No	Biddle	**F**	No
Dryden[d]	**F**	New ponds, well, 850-ft buried water supply & discharge pipes	Chewuch AF	**F**	New pond, well, 300-ft buried water delivery and discharge pipes, 50-ft buried power line
McComas[e]	**F**	No	MSRF Chewuch	**F**	New pond, well, 1,000-ft surface water delivery & discharge channels, 100-ft buried power line
Squadroni	**F**	New pond, well, 50-ft water supply & 20-ft discharge channels	Newby	**F**	New pond, intake structure, 400-ft surface water channel, 350-ft buried discharge pipes.
			Poorman	**F**	No
			Utley	**F**	New 80-ft long channel as outlet for existing pond.

a. C = Currently used; F = Future
b. Construction at Rohlfing and Lincoln in 2011 is done under a different program; impacts are evaluated in other NEPA processes.
c. Previously used by project; not in use currently.
d. Activities refer to those required if the Dryden site is used for acclimation only and not as a hatchery site.
e. McComas is a new site proposed to be constructed by Grant PUD; impacts will be evaluated in other permitting processes.

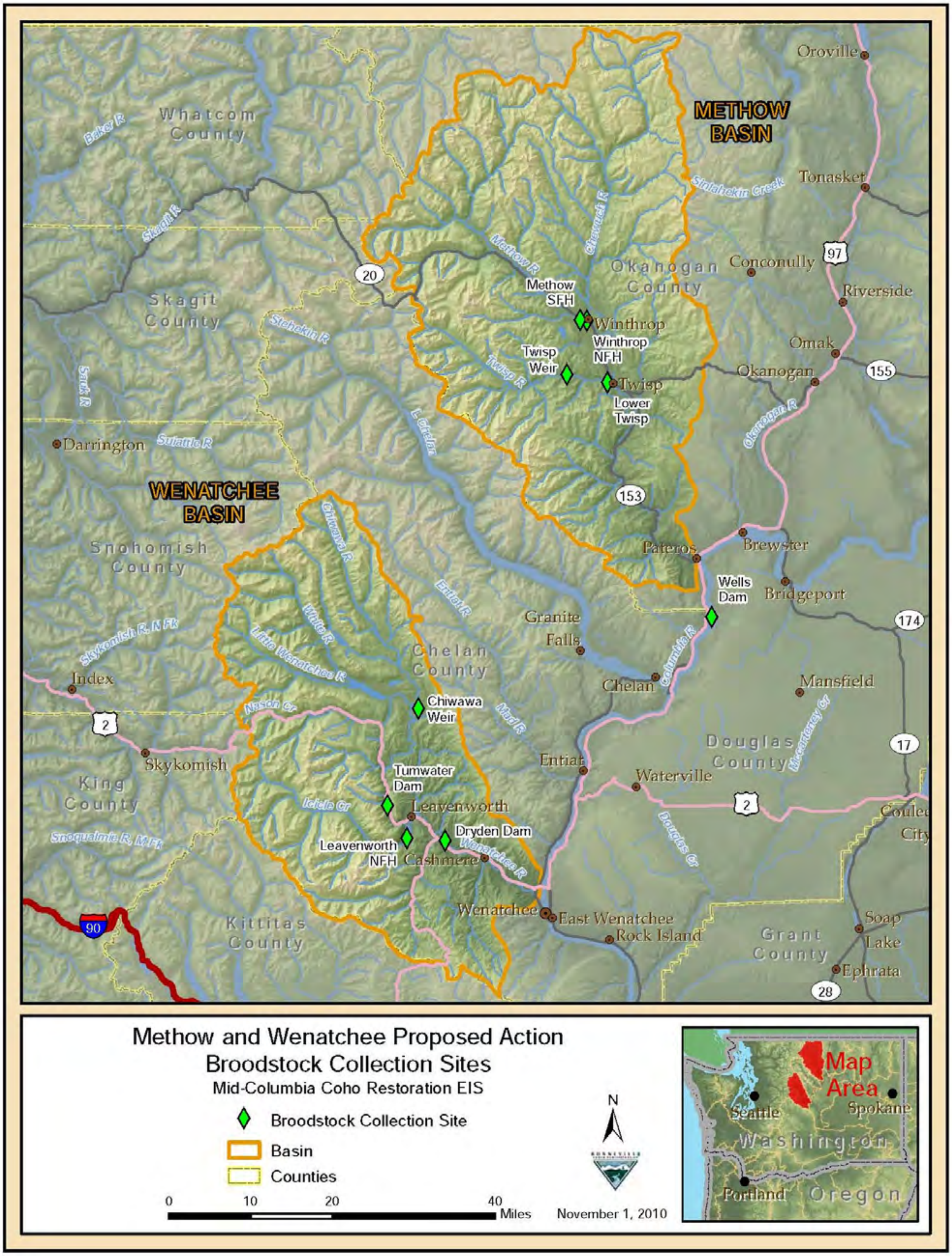


Figure 2-5. Proposed Action: Broodstock Collection Sites

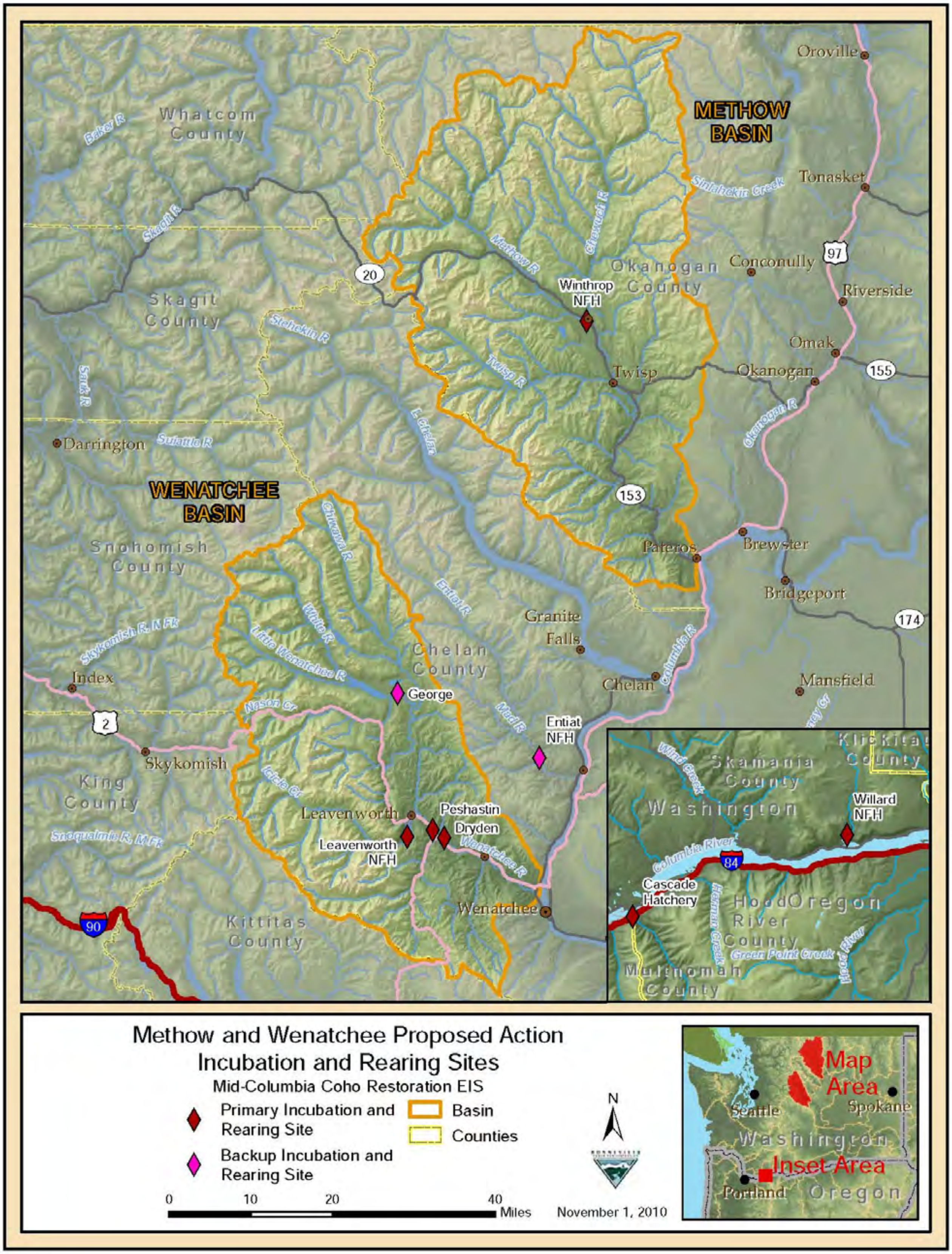


Figure 2-6. Proposed Action: Hatchery and Rearing Sites

Figure 2-7. Proposed Action: Wenatchee Basin Primary and Backup Sites

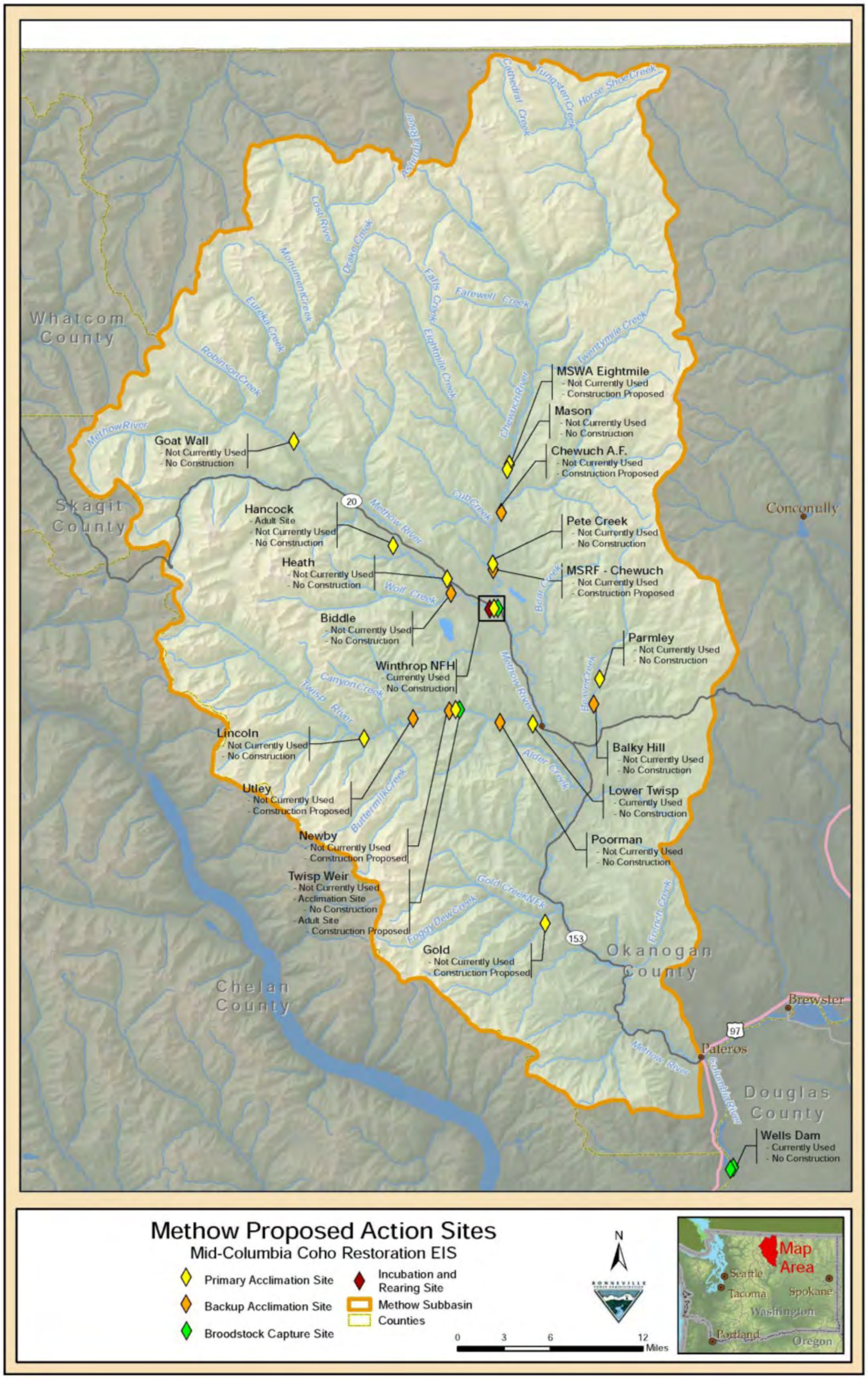


Figure 2-8. Proposed Action: Methow Basin Primary and Backup Sites

2.2.2.2 Factors Considered in Facility Location

Incubation/rearing sites

- Water quality and quantity.
- Proximity to other program facilities, especially acclimation sites.
- Availability of power: Three-phase power is required to operate water pumps, chillers, and other major motor-driven machinery.
- Environmental impacts.
- Environmental liability: Sites that have previously been used in other ways may have ground contamination, resulting in potential liability.
- Flexibility to adapt to future fish culture needs and changes in fish culture practices.
- Access in winter and high water periods.
- Cost.

Acclimation sites

Ecosystem Diagnosis and Treatment (EDT, a habitat analysis system) was used to quantify the capacity of tributaries in each basin that would be expected to provide high-quality coho habitat. Factors considered in identifying potential acclimation sites included the following:

- Water quality and quantity.
- Proximity to expected habitat based on model predictions, local experience, and professional judgment.
- Flexibility to adapt to monitoring results. For example, little is known about the preferred habitat of coho in snow-dominated watersheds, despite a thorough literature review and visits to Fraser River tributaries in British Columbia with First Nation groups and the interior Fraser coho recovery group. Ponds in multiple locations in the tributaries and sites scattered throughout the basins help maintain flexibility. If monitoring shows that habitat in certain areas is more productive, then those areas can be emphasized as the program progresses.
- Potential for low rearing densities, i.e., maximum density of 0.3 pounds of fish per cubic foot (lb/ft^3) at release for water supplies with high reliability, and 0.1 lb/ft^3 for sites without backup water supply systems.[8]
- Natural rearing environment.
- Environmental impacts.
- Accessibility by staff and by smolt trucks.
- Potential for overwintering coho.
- Distribution throughout the basins.
- Cost.
- Willing property owners.

[8] Studies have shown a survival benefit to low rearing densities, but it is unclear why both low volume densities and large rearing units perform well. They may reduce stress by providing escape areas when fish perceive threats (YN 2010 Appendix A).

2.2.2.3 Facility Designs

Hatchery Design

- Site functions: All captured local Wenatchee brood would be trucked to the proposed facility for holding and spawning. Eggs would be reared to the eyed stage, after which most would be moved to the lower river facilities, Cascade FH and Willard NFH, for hatching and early rearing. Eggs that remained would be reared until ready to be moved to acclimation sites. Some juvenile coho would also be trucked back to Dryden from the lower river hatcheries after spawning season for rearing through the winter.
- Production numbers: 1,300 adults, 1,400,000 eyed eggs, 200,000 smolts reared full-term.
- Development timing: Current plans call for hatchery construction to start in 2012 and operation to begin in 2013.

Dryden (Proposed Site)

Site Information

- Location, elevation: Near the mouth of Peshastin Creek at Wenatchee River (river mile [RM] 18.6); in T24N, R18E, SW ¼ of S22 in Chelan County; adjacent to Dryden Dam; elevation 984 feet.
- Ownership: The 24-acre Washington State Department of Transportation (WSDOT) property is lot number 241822745006, zoned Commercial Agricultural Lands (AC).
- Flood designation: Zone X500 (between 100- and 500-year floods).
- Land use: Used in the past by WSDOT for storage of highway sand. The site currently provides access to Dryden Dam and Fishway, portage for river rafters, and fishermen's access to the Wenatchee River.
- Access: Plowed, paved roads.
- Utilities: 3-phase power is available at the nearby Dryden right bank ladder facility.

Water Supplies

- Groundwater availability: Drill logs for nearby wells and the geology of the site suggest productive groundwater conditions. Historic gravel deposition at the Peshastin alluvial fan may have left layers of clean gravel.
- Groundwater withdrawal: Shallow wells near the river are proposed, minimizing impacts to deeper wells in the vicinity and producing water with some seasonal temperature variation. The production goal is 3.3 cubic feet per second (cfs) (including a 50% safety factor).
- Surface water supply: Wenatchee River water is proposed to be pumped from the Dryden fishway. An intake would be built into the existing concrete structure. This location allows water to be pumped at all river flow conditions without affecting fishway operation and does not require excavation in the river bank for construction. Water would be delivered to the hatchery in an 850-foot-long buried pipeline. Modeling for the hatchery estimates that a minimum flow of 3.1 cubic feet per second (cfs) is needed. Applying a 50% safety factor results in a water requirement of 4.7 cfs.
- Water Return. The option of returning water (and fish) upstream of the removal location in Peshastin Creek, at the dam, or just downstream of the dam would be possible by installing various return pipelines.

Facilities

- Adult holding: Four concrete raceways (100 x 10 x 4 feet deep), with multiple divisions in the raceways to allow sorting.
- Incubation: Vertical stack incubators and deep troughs inside a hatchery building would be fed with aerated, chilled groundwater.
- Rearing: The four concrete raceways would be used for fish production when adults are not present. Also, two ponds (40 x 120 x 3 feet deep) would add low-density rearing space.
- Predator control and cover: The site would be fenced and an overhead net system installed over the rearing units.
- Waste treatment: Discharge water treatment would likely require a high degree of nutrient removal to meet conditions of the Total Maximum Daily Load restrictions in place for the Wenatchee River (see Chapter 3, Section 3.5.1). Two treatment systems are proposed. An off-line treatment tank (10 x 20 x 4 feet deep) would hold and settle wastes vacuumed from the rearing units. Water from the hatchery would be directed to a 2-acre constructed wetland for additional nutrient removal. The waste treatment system would meet National Pollutant Discharge Elimination System (NPDES) permit requirements.
- Support systems: A 3,000-square-foot hatchery building would enclose the incubators, rearing troughs, offices, and a small shop. Generators would provide backup power. Parking would be provided for up to 10 vehicles.
- Site footprint: The Yakama Nation would acquire approximately 18.5 acres of the 24-acre parcel owned by WDOT, the purchase funded by other YN habitat projects in addition to the coho project. The hatchery site would require 1.5 acres of land. The full hatchery facility, including pipelines, water supply construction, the constructed wetland, and hatchery facilities, would require construction disturbance to a total of 4 acres of land. The additional 14.5 acres of the acquired parcel could be used by the YN in the future to re-establish a connection between an historic side-channel and Peshastin Creek.

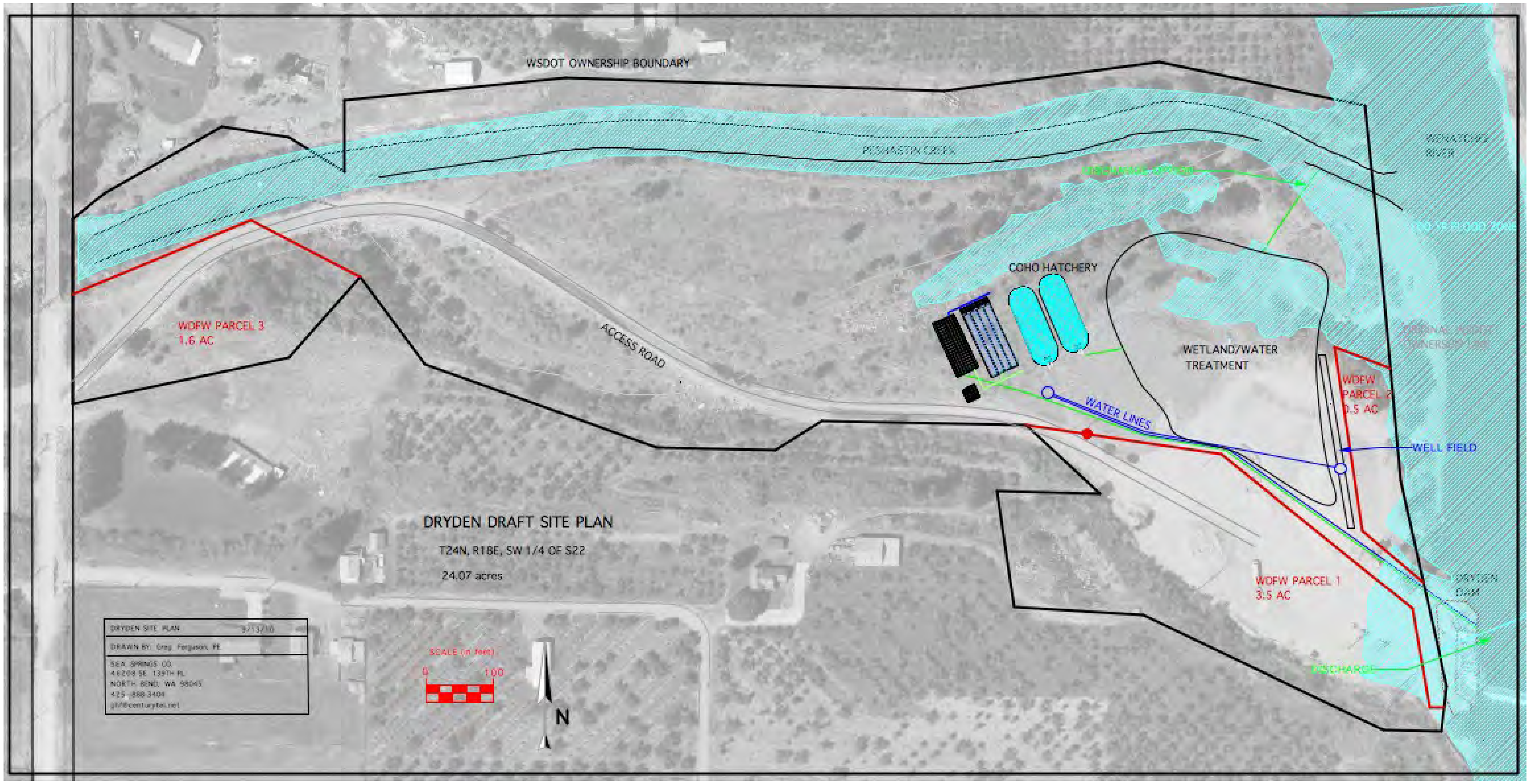


Figure 2-9. Proposed Dryden Hatchery: Draft Site Plan with Flood Boundaries

George (Backup Site)

A facility would be constructed at this site only if the Dryden site becomes infeasible.

Site Information

- Location, elevation: Downstream of Lake Wenatchee at Wenatchee River (RM 51.6); T27N, R17E, NW ¼ of S26 in Chelan County; elevation 1,870 feet.
- Ownership: The 150-acre parcel is currently in private ownership. The Yakama Nation is considering buying the site for habitat mitigation.
- Flood designation: Most of the site is in Zone A3, in the 100-year flood hazard area. The Base Flood Elevation near the proposed hatchery site is 1,875 feet.
- Land use: The site is undeveloped and has been logged in the past. It is zoned RR20, rural residential with a minimum lot size of 20 acres.
- Access: Un-surfaced, primitive roads provide limited access.
- Utilities: 3-phase power is 4,000 feet away.
- Soils: The Natural Resources Conservation Service classifies soils on the site as adfluvial (NRCS 2010).

Water Supply

- Groundwater: A preliminary evaluation would identify the potential for developing groundwater on the site. Two or more new wells could produce the required 3.3 cfs.
- Surface water: 4.7 cfs of surface water would be pumped from the Wenatchee River. A submerged intake screen would be built into an existing rock barb in the river (Figure 2-10).
- Pipelines: Surface water and groundwater would be delivered to the hatchery in separate pipelines approximately 1,500 feet long.

Facilities

- Adult holding: Four concrete raceways (100 x 10 x 4 feet deep).
- Incubation: Vertical stack incubators and deep troughs inside a hatchery building would be fed with aerated, chilled groundwater.
- Rearing: The four concrete raceways would be used for fish production when adults are not present. Two ponds measuring 40 x 120 x 3 feet deep would add low-density rearing space.
- Predator control and cover: The site would be fenced and an overhead net system installed over the rearing units.
- Waste treatment: Discharge water treatment would likely require a high degree of nutrient removal to meet conditions of the Total Maximum Daily Load restrictions in place for the Wenatchee River. An off-line treatment tank measuring 10 x 20 x 4 feet would hold and settle wastes vacuumed from the rearing units. Treated water from the hatchery would be directed to the existing 5,600-foot-long side channel on the site for further nutrient removal prior to entering the Wenatchee River.
- Support systems: A 3,000-square-foot hatchery building would enclose the incubators, rearing troughs, offices, and a small shop. Generators would provide backup power. Parking would be provided for up to 10 vehicles.
- Site footprint: Hatchery facilities would require 1.5 acres of land. Including pipelines, water supply construction, and hatchery facilities, a total of 2.5 acres of land would be disturbed.

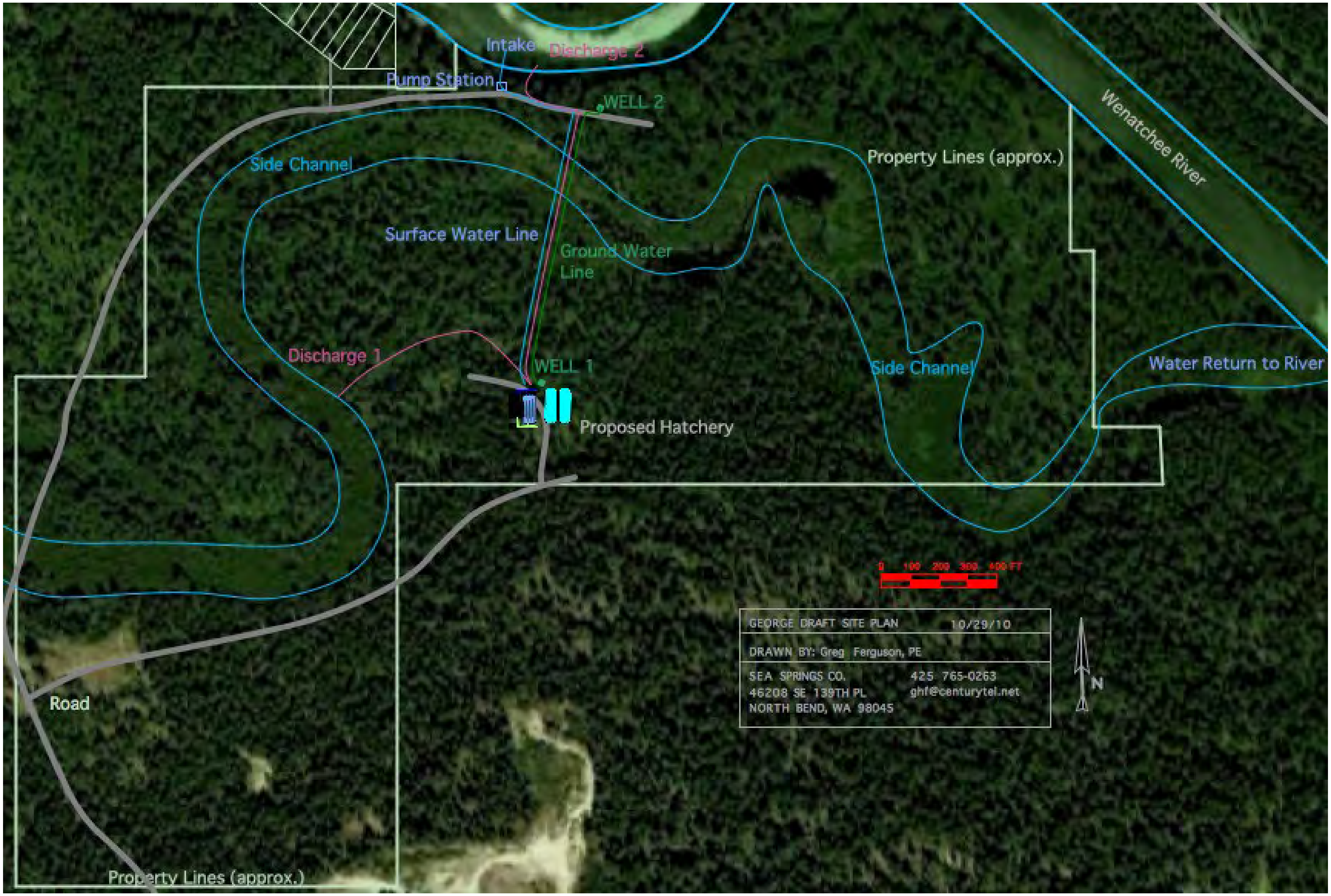


Figure 2-10. George Hatchery (Backup Site): Draft Site Plan

Acclimation Site Designs

Details of designs for each acclimation site (primary and backup) are outlined in Appendix 2 for Wenatchee basin sites and Appendix 3 for Methow basin sites. Photographs accompany the site descriptions. Figures 2-11 and 2-12 show a typical acclimation pond used by this program.

Net systems would be used to confine coho during the acclimation period at most sites. They can be configured in one of two ways (Figures 2-11 and 2-12). Both types are temporary and are in place only during acclimation. They would be designed to minimize premature escape and would include jump barriers and double lead lines. Double lead lines are weighted lines woven into the bottom of the net to maintain a sealed barrier across the earthen bottom of the pond.

Where loss of habitat and/or coho interaction with listed fish species is not expected to have negative impacts, nets that fully block fish passage in the ponds (barrier nets) could be installed. They are placed perpendicular to the flow (Figure 2-11).

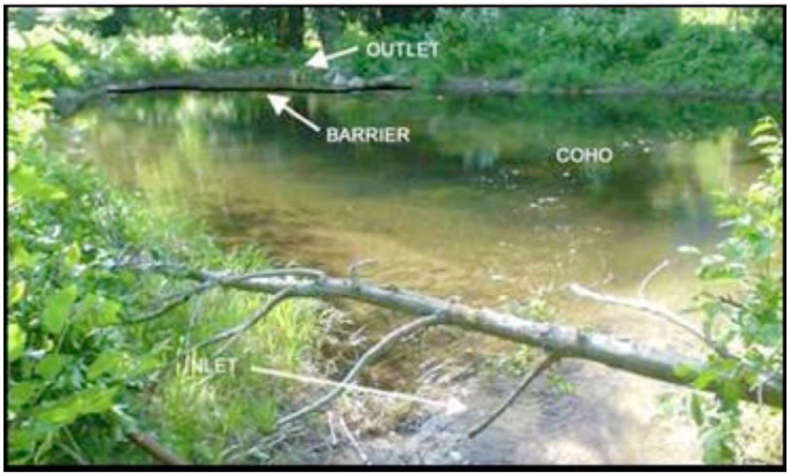


Figure 2-11. Barrier Net Example

Where free passage of fish up- and downstream is required, seine nets could be used: they form an enclosed impoundment of only a portion of the pond (Figure 2-12).

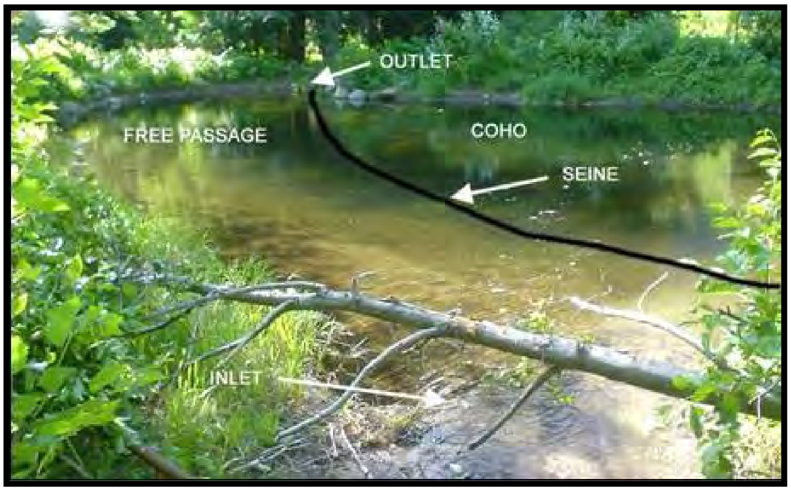


Figure 2-12. Seine Net Example

2.2.3 Monitoring and Evaluation Plan

The success of the proposed coho reintroduction plan depends on extensive monitoring and evaluation to answer key questions such as:

- which acclimation sites are most successfully producing fish that return to coho habitat;
- when the program in each basin can move into a new phase;
- whether continued supplementation would be appropriate; and
- whether naturally produced coho are adversely affecting listed and sensitive species.

The monitoring and evaluation plan is outlined in Appendix 5, but is not discussed further in this EIS because it is essentially the same as the current program.

2.2.4 Program Cost Summary

This section summarizes estimated costs for all the program elements. Costs are based on a fish release plan that is expected to last until 2028, as shown in Table 2-5 (Section 2.2.1).

The program currently is funded by BPA, Grant County PUD, and Chelan County PUD. (Douglas County PUD contributed $600,000 in 2008 towards capital costs related to the feasibility studies.) The current program also shares rearing costs with National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries). The total amount from NOAA Fisheries and Grant and Chelan PUDs is close to $1.5 million annually. The current program also shares monitoring and evaluation costs with Washington Department of Fish and Wildlife (WDFW). If the Proposed Action is implemented, cost sharing with all these entities is expected to continue.

Estimates of the capital and operating costs cover the proposed project period from 2012 through 2028. Capital costs are expected to total $6,730,000 and would include land purchase and facility construction. All capital costs are expected to be incurred in 2012. To minimize capital costs, the Proposed Action makes extensive use of existing regional facilities, including those for brood capture, rearing, and acclimation.

Operating expenses include the operation and maintenance of these facilities, as well as the monitoring and evaluation program, and general and administrative project costs. Operating costs would change over time. Expenses during years when release numbers and operating costs would be at their maximum are shown in Table 2-7. Of these costs, approximately 27% is projected to be contributed by Chelan County and Grant County PUDs. Their share of the operating costs gradually increases so that by 2017 they would contribute approximately 36% of the operating costs. After 2018, contributions are less certain; for example, Douglas County PUD is expected to contribute funding but the amount is unknown at this time.

Table 2-7. Peak operating costs (2013) by basin

	Wenatchee	Methow	Total
Planning, Design, Permits	-	-	-
Rearing	$ 530,870	$ 388,385	$ 919,255
Tagging	$ 513,820	$ 375,911	$ 889,731
O&M	$ 955,706	$ 699,196	$ 1,654,902
M&E	$ 429,586	$ 314,286	$ 743,872
TOTAL OPERATING	**$ 2,429,982**	**$ 1,777,778**	**$ 4,207,760**

2.3 No Action Alternative

NEPA requires federal agencies to consider the effects of not taking the proposed action. Presently, BPA is the main funding source for this coho restoration project, although not the only one, as described in the previous section. The total amount from NOAA Fisheries and Grant and Chelan PUDs is close to $1.5 million annually. If BPA were to choose the No Action Alternative, BPA would discontinue funding. A coho program would continue in the mid-Columbia basins, but at a reduced scope from the current program because funding would essentially be cut in half. Some existing cost-sharing might be reduced as well, commensurate with the program level. The reduced funding would require cutting staff numbers. Full-time staff would be reduced from 18 to a maximum of 7; up to 10 seasonal positions would be eliminated. The result would be reductions in all aspects of the current program.

2.3.1 Biological Approach

The program would be reduced from the current program (see Section 2.1 for a description of the current program). Reduced staff levels would mean that fewer fish could be incubated and reared, even if existing capacity remained unchanged. As a result, fewer fish would be released: 500,000 in the Wenatchee basin and 200,000 in the Methow basin, as opposed to the current level of 1 million in the Wenatchee and 500,000 in the Methow. No attempt would be made to expand production into new habitat; with reduced staff and funding, the program could not operate new acclimation facilities in natural production areas. The program's broodstock currently is essentially a domesticated hatchery stock, not adapted to conditions in the wild. Without acclimation and release of coho from more sites in high-quality habitat, coupled with the deliberate selection for increased percentages of natural-origin fish in the broodstock that originate from that habitat, the likelihood that viable natural populations of coho would be established is low. The program primarily would be propagating hatchery fish and probably would be replaced by a segregated hatchery program[9] to promote fisheries only.

The amount of monitoring and evaluation would be limited. In addition to reduced staffing levels, no PIT tags would be used, compared to 3,500-8,000 juveniles PIT-tagged per site under the current program (50,000 total for both basins); and only 50% of the hatchery releases would be marked with coded wire tags (CWTs), compared to a 100% CWT marking scheme with BPA funding. Spawning ground surveys likely would be reduced from the current program, and no monitoring of interactions between naturally produced coho and listed species would be done.

2.3.2 Facilities

The program would continue to rely on existing facilities. The new facilities proposed as part of the Proposed Action would not be constructed, and it is unlikely that existing facilities would be modified. While most of the existing infrastructure would be available, the lack of personnel would dictate its use.

- **Broodstock capture**: The current broodstock capture locations—Tumwater, Dryden, Leavenworth NFH, Wells FH, Winthrop NFH—would remain available; however, the reduced budget would limit staff numbers, thus probably reducing the number of sites where broodstock would be collected. Numbers of broodstock collected would be half that of the current program. New broodstock capture locations would not be added.

[9] A segregated hatchery program manages hatchery-origin fish as a reproductively distinct population. Only hatchery-origin adults are used for broodstock and are not allowed to spawn in the wild.

- **Incubation/Rearing:** Willard NFH, which receives 60% of its operating costs from BPA's coho program dollars, would not be used as an incubation/rearing facility, and use of the in-basin Peshastin Incubation Facility would be eliminated. Instead, Cascade FH, Winthrop NFH, and Leavenworth NFH would be used at a reduced capacity**.**
- **Smolt releases:** Table 2-8 shows a potential production program for the No Action Alternative and the acclimation sites that could be used. All but two of these sites are currently being used to acclimate coho. The exceptions, Lincoln and Heath in the Methow basin, currently are planned for spring Chinook and steelhead acclimation only; however, the Yakama Nation could choose to add coho acclimation at these sites sometime in the future. While the program depicted in Table 2-8 is possible given the availability of sites, the reduced budget, with fewer staff available to stock and monitor sites, would probably allow use of only one or two release sites and the hatchery.

Table 2-8. No Action Alternative release numbers and locations

Location	Facility Name	Smolt Release	Total Basin Release
Wenatchee River [a]	Leavenworth NFH	100,000	500,000
	Butcher Creek	100,000	
	Coulter Pond	100,000	
	Beaver Creek	100,000	
	Rohlfing	100,000	
Methow River [b]	Winthrop NFH	100,000	200,000
	Lincoln	60,000	
	Heath	20,000	
	Lower Twisp	20,000	

a. Wenatchee production would be spawned and eggs early-incubated at Leavenworth NFH and transferred to Cascade Hatchery (funded by Mitchell Act) for final incubation and rearing to the pre-smolt stage prior to transfer to acclimation/release sites identified above.
b. Methow production would be spawned and eggs early-incubated at Winthrop NFH and transferred to Cascade NFH for final incubation and rearing to the pre-smolt stage prior to transfer to acclimation/release sites identified above. Some fish may be able to be reared at Winthrop NFH but at a very reduced number.

- **Monitoring and Evaluation:** Until 2011, the Integrated Status & Effectiveness Monitoring Program (ISEMP) (BPA project #2003-017-00) contributed a quarter of the funding for the Nason Creek smolt trap; that contribution has now ended. Currently, Grant County PUD and BPA through the coho project are the only remaining funding agencies for this trap; without the BPA contribution, it is unclear whether Grant PUD would continue funding the trap without a cost-share available. No new traps would be installed.

2.4 Alternatives Considered but Eliminated from Detailed Evaluation

2.4.1 Independent Science Review Panel Alternative

During reviews of the Master Plan prepared for the Northwest Power and Conservation Council (Council), its Independent Science Review Panel (ISRP) suggested modifications to the program design. In some cases, their suggestions became part of the proposal. The most recent and significant alternative suggested by the ISRP is reproduced below from the ISRP letter of November 24, 2009 (Memorandum ISRP 2009-47 to Tony Grover, Director, Fish and Wildlife Division, Northwest Power and Conservation Council from Eric Loudenslager, ISRP Chair).

> *Under ideal circumstances one program design would involve splitting the combined production into lower and upper releases, each with unique tags, in the first generation. These two groups would be genetically identical for all practical purposes. The proportions (or numbers) of each of these two groups that arrive at Tumwater Dam would be compared. In this first generation, this would measure the environmental effect of the different release sites on the migration distance within the subbasin. In the second generation, fish that returned to Dryden and fish that returned to Tumwater would be mated within return locations. Paired releases of the progeny of these parents would be conducted both in the upper and lower sites in the river. The contrast of return site between the two subpopulations released from the same location would serve as a measure of response to selection (adaptation). The magnitude of the response would serve to predict the number of generations required to achieve the goals for each of the program phases and facilitate establishing causation, which is needed if the contingency plan needs to be implemented. If a program like this was used it would make a significant contribution to documenting genetic and environmental sources of variation influencing an attempt to reestablish a self-sustaining extirpated population.*

While this approach to program design could provide interesting data, it delays practical results in favor of a scientific exercise that develops alternative program designs in order to model their potential differing outcomes in advance. In addition, it would be difficult to evaluate the effect of migration distance on adult coho survival within the two basins. After surviving the hundreds of miles of migration from the Columbia River mouth to the mid-Columbia basins, it is unlikely that adult migration distance within the basins would be a significant survival factor. For example, in the Wenatchee basin, the distance between Dryden Dam and Tumwater Dam is only 15 miles, compared to the 486 miles and 7 dams from the mouth of the Columbia River to Dryden Dam. More likely, the in-basin key to survival would be the habitat conditions within the basins, and, for the Wenatchee, the hydrographic difficulty for adults (rather than the distance) of reaching high quality spawning and rearing habitat above Tumwater Canyon (K. Murdoch, YN Fisheries Biologist, personal communication, November 2009).

This ISRP alternative does not require detailed evaluation in this EIS because the effects on the environment would fall within the range of effects already being analyzed.

2.4.2 Use of Egg Boxes

During scoping, it was suggested that egg boxes could be used instead of building a hatchery. This is not a feasible alternative. Egg boxes could not replace a hatchery in this case for two main reasons. Due to the time of year and locations where coho spawn, egg boxes placed in those areas probably would freeze and the eggs would be killed. Even if egg boxes were used, the project still would need to capture, hold, spawn, and early-incubate the eggs, which would require the same infrastructure as proposed.

2.4.3 Use of Out-of-Area Wild Donor Fish

During scoping, a commenter suggested that the project use wild donor fish from other regions such as Alaska or Canada. At the outset of the feasibility studies, the project investigated using coho from the Fraser River in British Columbia to develop a locally adapted broodstock. This stock was the only remaining wild stock in the Northwest that migrates long distances, similar to the coho that used to occupy the mid-Columbia basins. At the time (mid-1990s), such fish were unavailable. With declining coho populations in the Fraser system, it is currently unlikely that an international agreement could be negotiated.

2.4.4 Alternative Rearing Systems

The Master Plan for the coho reintroduction program evaluated several alternative rearing systems, including the following:

- Existing public hatcheries
- A central conventional hatchery
- Small watershed rearing facilities
- Natural habitat rearing facility
- Long-term rearing at acclimation sites
- Constructed habitat

The analysis in the Master Plan shows that the alternative of using existing hatcheries has a much lower overall cost than the other options. It has no capital cost and a moderate operating cost. The construction and use of multiple small watershed hatcheries is estimated to have a very high total cost; all the other options are intermediate (YN 2010, Appendix B.1).

The differences in operating costs reflect the higher expense of producing fish from multiple locations. There is a certain fixed base cost associated with operating a facility that is independent of the numbers of fish produced. The difference between producing all the fish at one location versus at multiple locations may be in excess of $6,000,000 over a 20-year period. Differences in capital cost result from the number of facilities and their complexity.

Important factors used to evaluate rearing system options include the ability to produce fish that return to targeted areas at high survival rates. The degree of difference between the various systems' adult survival rates is unknown. Adult return rates are expected to be affected by the type and length of acclimation: long acclimation periods in natural conditions would improve the performance of fish produced from conventional hatcheries (YN 2010, Appendix B.2).

The central, conventional hatchery and the small watershed rearing facility had too many disadvantages related to cost and operational difficulties. Also, the natural habitat rearing facility is an untested concept. These alternatives were eliminated as rearing options. The program combined and modified the remaining options into the proposal evaluated in this EIS.

2.5 Comparison of Alternatives in this EIS

Table 2-9 compares the two alternatives considered in detail in this EIS—the Proposed Action and the No Action Alternative—in terms of how well they meet the purposes defined in Section 1.2. Table 3-1, at the beginning of Chapter 3, summarizes the environmental effects of both alternatives.

Table 2-9. Comparison of the Proposed Action and the No Action Alternative to the Purposes

Purpose	Proposed Action	No Action
Develop a locally adapted, self-sustaining, naturally spawning coho stock that occupies its historical habitat in the Wenatchee and Methow river basins	By providing funding for expanding coho distribution into natural production areas of the basins, model results indicate that a locally adapted, self-sustaining, naturally spawning coho stock has an excellent chance of being established.	Without funding to expand into natural production areas, a locally adapted, self-sustaining, naturally spawning coho stock is unlikely to be established. The majority of fish produced by the project would be hatchery fish.
Increase the abundance of Mid-Columbia coho salmon to numbers sufficient to sustain a mainstem and terminal harvest in most years	Program projections indicate that by funding increased coho production for a limited period and expanding their distribution into natural production areas, natural coho abundance would be increased by 2028 sufficient to sustain harvests.	Without BPA funding, numbers of juveniles reared would be reduced, thus reducing the likelihood that natural coho abundance would be increased sufficiently to provide significant harvest.
Maintain consistency with the Council's Columbia River Basin Fish and Wildlife Program and its recommendations as well as with the visions and goals of other regional plans, including subbasin plans	Would be consistent with the Council's recommendation to implement the program proposed in the Master Plan. Would be consistent with subbasin plans by restoring coho as part of ecologically balanced systems.	Would not be consistent with the Council's recommendation to implement the program proposed in the Master Plan. Would not be consistent with subbasin plans because naturally spawning populations of coho are unlikely to be restored.
Maintain consistency with the coho production objectives specified in the 2008-2017 *United States v. Oregon* Fish Management Agreement for the Wenatchee and Methow subbasins	Continued BPA funding would provide the personnel, equipment, and facilities needed to maintain the *U.S. v. Oregon* production goal of 1.5 million smolts released from the Wenatchee and Methow subbasins.	Without BPA funding, the *U.S. v. Oregon* production goal of 1.5 million smolts would not be met because personnel, equipment, and facilities would have to be reduced below current levels.
Minimize harm to natural or human resources, including species listed under the Endangered Species Act	Proposed mitigation measures would minimize harm to natural and human resources. Approvals by and reporting to regulatory agencies would minimize the risk of adverse effects to listed species. Could provide ecological benefits that would aid in listed species recovery.	With no construction of new facilities, natural and human resources would not be adversely affected. Low numbers of naturally produ-ced coho could reduce the risk of adverse effects to listed species but also would not provide potential ecological benefits.

The intent of the Proposed Action is to further mitigate the adverse effects of the Federal Columbia River Power System on fish in the Wenatchee and Methow basins by restoring naturally spawning coho salmon runs to these basins. Coho runs to these basins were virtually non-existent by the end of the 20th century due to a combination of factors discussed in detail in

Section 1.3.1. By applying the most current findings regarding acclimation and integrated hatchery reform, the Yakama Nation, through the Proposed Action, endeavors to establish self-sustaining, naturally reproducing coho populations in the Wenatchee and Methow basins. To that end, the YN would implement best available science for production and acclimation to encourage a locally adapted population that would eventually rebuild the coho runs to harvestable numbers. By reintroducing coho in these basins, BPA and the Yakama Nation also hope to contribute to restoring the ecological balance of the system. The Wenatchee Subbasin Plan recognizes that "Restoration of individual populations may not be possible without restoration of other fish and wildlife populations with which they co-evolved." (NPCC 2004a). By funding the Proposed Action, BPA would make continued progress toward meeting its obligations under the Pacific Northwest Electric Power Planning and Conservation Act and the 2008 Columbia Basin Fish Accords.

The No Action Alternative would be unlikely to achieve a self-sustaining, naturally reproducing population. The broodstock currently used by the coho program in the Wenatchee and Methow basins is essentially a domesticated hatchery stock, not adapted to conditions in the wild. Without the acclimation and release of coho from new sites in key habitat coupled with deliberate selection for increased percentages of natural-origin fish in the broodstock, with increased numbers of those fish originating from high-quality habitat, the likelihood that viable natural populations of coho would be established is low. This alternative would likely further reduce the very low risk to listed fish posed by naturally spawning coho. A harvestable number of coho could be produced if the current program were replaced by a program to produce only hatchery fish, funded by other entities. However, such an outcome is not predictable, would not help restore natural populations as envisioned in the subbasin plans, and would not meet BPA's obligations under the Northwest Power Act and the 2008 Fish Accords.

Chapter 3. Affected Environment and Environmental Consequences

3.1 Introduction: How this Chapter is Organized

This chapter analyzes the potential effects of the Proposed Action and the No Action Alternative on the physical, biological, and human environments.

- Section 3.2 summarizes the environmental effects analyzed in the remainder of the chapter.
- Section 3.3 provides an overview of the geography of the two basins and a brief description of each project site.
- Section 3.4 discusses the past and current status of coho salmon in the basins.
- Sections 3.5 through 3.14 evaluate the effects of the Proposed Action and the No Action Alternative on environmental and human resources.
- Section 3.15 discusses the cumulative effects of the project.
- Sections 3.16 and 3.17 identify adverse effects that cannot be avoided, irreversible and irretrievable commitments of resources, short-term uses of the environment, and effects on long-term productivity.

The analysis considers the effects of the alternatives in the following categories of action:

  - development and operation of a new small hatchery for adult holding/spawning, incubation and rearing;
  - development and operation of new, expanded, and existing acclimation and adult plant sites;
  - changes in the numbers and locations of coho being released into the basins.

Direct, indirect, and combined effects are described for each resource affected.

Effects of program use of facilities that are not proposed for physical modification or change in current operations are not evaluated. These facilities include:

- hatcheries near Bonneville Dam on the Columbia River (Willard and Cascade), impacts of which have been evaluated in other processes;
- Winthrop NFH and Leavenworth NFH;
- existing juvenile and broodstock capture sites in the two basins where operations would remain the same;
- the monitoring and evaluation program, because it is essentially the same as the current program, effects of which were evaluated in previous NEPA processes.

Although impacts of these sites and programs are not evaluated in this EIS, maps in the main document and in Appendix 4 show the locations of all facilities proposed for use in this program, and Appendix 5 describes the monitoring and evaluation program in detail.

The Mid-Columbia Coho Restoration Master Plan (Master Plan) (YN 2010) is incorporated by reference in this EIS in its entirety. It includes biological data, ecological rationale, and environmental and engineering research used to support much of the analysis in this EIS.

3.2 Summary of Environmental Effects

Table 3-1 summarizes the environmental effects that are discussed in detail in Chapters 3 and 4.

Table 3-1. Summary of Impacts of the Proposed Action and the No Action Alternative

Impact	Proposed Action	No Action Alternative
Effects on water quality from facility discharges	There would be minor, localized impacts from phosphorus in effluent, but model simulations show that the maximum possible impact of all facilities, including the proposed hatchery, would be undetectable downstream in the sections of the river that are water quality limited.	No change from current program, or reduced impacts: existing facilities would continue to be used, but fewer fish would be produced, resulting in lower discharges of fish waste and chemicals attributable to the coho project.
Effects of surface and groundwater withdrawals on surface water quantity	Local reduction in flows at withdrawal points for groundwater and in bypass reaches for surface water, offset by return flows from facilities.	No change from existing conditions because no new withdrawals are proposed.
Effects of water withdrawals on groundwater supply	Local reductions at 5 acclimation sites and the hatchery; no regional reductions.	No change from existing conditions because no new wells would be developed.
Effects of surface and groundwater withdrawals on water rights	Potential impact to ground water rights at Dryden; potential impact to on- or off-site wells at 5 acclimation sites. No impacts to surface water rights at any of the sites.	No change from existing conditions because no new wells would be developed.
Sedimentation effects on fish	Minimal or no effects on ESA-listed and other fish from temporary sedimentation due to excavation and construction: best management practices would be used for erosion control.	No sedimentation effects because no new facilities would be constructed.
Effects of surface water withdrawal on ESA-listed and other fish	- Relatively small withdrawal volumes at acclimation sites would not substantially reduce in-stream flow quantities, change habitat availability including hiding/resting/foraging habitats, or affect migratory movements (fry, juvenile, and adult) of listed salmonids. - Withdrawals from Dryden fishway and discharge into Peshastin Cr. could increase spawning habitat for summer Chinook in Peshastin Cr. but have little or no effect on species in Wenatchee R. - Water intake systems would follow NMFS 2008 guidelines to reduce potential to entrain all fish species.	No change from current conditions because no new surface water withdrawals would be made.
Reduced access to migration or rearing habitat for ESA-listed and other fish	Fish other than coho would be excluded from 2.5 acres of 4.6 acres of currently accessible habitat at proposed acclimation sites in both basins. For ESA-listed fish, this translates to: - Up to 113 spring Chinook juveniles and 237 steelhead juveniles excluded annually from Wenatchee basin sites out of a total annual wild population of 55,619 – 311,669 Chinook smolts and 17,499 - 85,443 steelhead smolts. - Approx. 314 spring Chinook juveniles and 201 steelhead juveniles excluded annually from Methow basin sites out of a total annual wild population of 15,306 – 33,710 Chinook smolts and 8,809 - 15,003 steelhead smolts. - Juvenile bull trout numbers excluded from sites in each basin are very small (Wenatchee 3; Methow 10).	Approximately ½ acre of currently accessible habitat at acclimation sites would be excluded from use by fish other than coho, for a total of 2 acres excluded from use for 6 weeks each year, due to potential use of 2 Methow basin acclimation sites not in 2010 program.
Trapping of fish at adult traps	Trapping at all but one trap is occurring under existing operations. Potential take of bull trout at Chiwawa Weir if operations are extended to allow coho trapping.	Trapping could be reduced at Dryden Dam and Wells FH; without coho trapping, the traps would be open less, with potential for incidental take of listed fish reduced.

Impact	Proposed Action	No Action Alternative
Trapping of fish at juvenile traps	Incidental take of spring Chinook or bull trout is possible at a potential new trap on the Little Wenatchee R.; impacts would be evaluated when location is proposed.	No change in current conditions; existing traps are operated with or without coho project. No new traps proposed.
Coho predation on ESA-listed fish	Studies show that approximately 0.28% of hatchery coho smolts and 2.7 % of naturally produced coho prey on listed species, with less than 1% of the Chinook fry population consumed. Listed populations would be monitored and changes evaluated to determine if increasing numbers of coho increase predation with adverse effects on listed species.	Minimal predation by hatchery smolts as in existing program. Minimal predation by naturally produced smolts, as significant numbers of naturally produced coho are unlikely to be established.
Competition between naturally produced coho and ESA-listed species	Studies show species use different microhabitats, so competition is not expected at low densities. Listed species would be monitored to determine if adverse effects occur with increasing densities.	Without the expanded program, naturally produced coho numbers and densities would remain low, so potential competition with listed species would be limited or non-existent.
Effects on ecological balance	The addition of coho carcasses at the onset of winter might provide an increased marine-derived source of nutrients and improve over-winter survival for all species. Juvenile and adult coho provide prey for fish-eating predators including bald eagles, mergansers, otters, and bears. Ecological balance could improve with coho occupying a critical niche in the natural environment	Current conditions would continue; e.g., in Nason Creek, there is very little carcass production, leaving a potential void in the nutrient balance prior to the onset of winter. Little potential for improvement in ecological balance.
Habitat reductions for ESA-listed wildlife	Slight potential reduction in spotted owl habitat possible at Tall Timber (w/in 1 mi. of management circle); qualified biologist would confirm presence or absence of nests in any trees needing removal.	No change in current conditions.
Habitat reductions for state-listed wildlife	No noticeable reductions in available habitat for any species listed under WDFW Priority Habitat and Species program. Slight increase in aquatic habitat due to new ponds.	No change in current conditions.
Disturbance to wildlife	Construction noise could cause certain species to avoid 9 sites for 1-60 days, May-October of 2012. Operations, including use of noise-baffled generators, would not noticeably disturb wildlife because all primary sites currently experience human activity.	No change in current conditions.
Effects on wetlands	Total estimated wetland impacts at primary sites: - Temporary: 1,350 sq ft. would be replanted - Permanently removed: 3,179 sq ft. - New wetland created: 52,272 sq ft.	No change in current conditions.
Changes to floodplain function	Construction would occur in floodplains, requiring permits at up to 6 primary sites in the Wenatchee and 1 primary site in the Methow. - Flood elevations are not expected to change. - New ponds could add a small amount of flood storage. - Excavated material would be disposed outside of floodplains and not change grade that could divert flood flows to nearby properties.	No change in current conditions.
Effects on aesthetic/visual quality	Dryden Hatchery could reduce the contrast of the site with the surrounding area and add to the aesthetic appeal for viewers. Acclimation sites would not change visual quality.	No change in current conditions.
Effects on recreation	No interference with current recreation uses. Generators at noise-sensitive acclimation sites would be enclosed in noise-muffling structures to meet state noise standards.	No change in current conditions.
Economic effects	Minimal increase in employment, temporary and permanent. No new infrastructure or services required.	Loss of 11 permanent and 10 seasonal YN jobs.

Impact	Proposed Action	No Action Alternative
Effects on harvest	Potential terminal, mainstem, and ocean tribal, commercial, and sport harvest by 2028.	No harvest of naturally produced fish; potential harvest of hatchery fish if program changes to harvest augmentation.
Effects on cultural resources	Unknown. Surveys scheduled for 2011 before the Final EIS.	No effect.
Noise effects	Construction noise at residences or properties near acclimation sites 8 a.m. – 5 p.m. M-F, for 1 day to 4 months in 2012. Construction noise likely not noticeable for the 5-month hatchery construction period due to noise from surrounding uses at Dryden. Noise from generators would be muffled to meet state standards.	No change in current conditions.
Effects on air quality	Minor short-term increases in dust during spring and summer of 2012 from construction activities. Undetectable increases in greenhouse gases.	No change in current conditions.
Consistency with comprehensive plans	Proposed activities would be consistent with goals and policies in Chelan County and Okanogan County comprehensive plans.	Current program is consistent with comprehensive plans in Chelan and Okanogan counties.
Consistency with subbasin plans	If successful, the program would restore naturally spawning coho populations to the Methow and Wenatchee subbasins as envisioned in both subbasin plans.	Would not restore natural populations of coho as called for in Wenatchee and Methow subbasin plans.
Consistency with Council F&W Program	Would implement Council recommendations regarding this program which began with its identification as a high-priority project in the 1994 Fish and Wildlife Program.	Would not implement Council recommendations regarding this program.

3.3 Overview of Wenatchee and Methow Basins and Project Sites

3.3.1 General Characteristics of the Basins

The **Wenatchee basin** is located within Chelan County in north central Washington. It consists of five sub-watersheds (the Chiwawa, White, Little Wenatchee, and Wenatchee rivers and Nason Creek), which drain a combined total of approximately 1,300 square miles (NPCC 2004a). The headwaters of the basin are in the Cascade Mountains and include portions of the Glacier Peak and Alpine Lakes wilderness areas. The Wenatchee River joins the Columbia River at river mile (RM) 470 between Rocky Reach and Rock Island dams. The majority of the basin is forested; the composition of forest species changes as distance from the Cascade crest increases and elevations decrease. Vegetation and wildlife habitat types consist of wet mixed-coniferous forests (mountain hemlock, silver fir and western hemlock), dry mixed coniferous forests (subalpine fir, grand fir, Douglas-fir, and/or ponderosa pine), grasslands, shrub steppe, herbaceous wetlands (sedges and rush), montane coniferous wetlands, and riparian wetlands (willow, black cottonwood, alder and red osier dogwood, with quaking aspen and bigleaf maple at the edges) (NPCC 2004a). These diverse habitats support an estimated 341 species of fish and wildlife (NPCC 2004a). Topography in the basin varies from mountainous alpine slopes (10,541 feet elevation at Glacier Peak in the White River watershed) to wide river valleys (600 feet elevation at the town of Wenatchee).

Land uses in the Wenatchee basin consist of commercial forest (86 percent areal coverage), commercial agriculture (1 percent), rural (12 percent), urban (0.5 percent), and open water (0.3 percent). Approximately 76 percent of the lands in the basin are managed by the U.S. Forest

Service (USFS). Approximately 18.5 percent of the basin is privately owned. Private lands border almost two-thirds of the mostly lower-gradient streams that support anadromous (sea-run) fish such as salmon and steelhead. Agriculture consists primarily of orchards (93 percent) with some production of hay, grains and row crops (6.5 percent) (NPCC 2004a).

The **Methow basin** is in Okanogan County in north central Washington. It consists of five sub-watersheds (the Methow, Twisp, Chewuch and Lost rivers and Early Winters Creek), which drain a combined total of approximately 1,825 square miles (NPCC 2004b and 2004c). The Methow River joins the Columbia River at the town of Pateros. Vegetation and wildlife habitat types consist of mixed coniferous forests (upper-montane and mid-montane), lodgepole and ponderosa pine woodlands, upland aspen forests, grasslands, shrub-steppe, herbaceous wetlands, montane coniferous wetlands, riparian wetlands, agriculture and urban/mixed use. These diverse habitats support well over 300 species of fish and wildlife. Topography in the basin varies from mountainous alpine slopes with elevations greater than 8,500 feet, to wide river valleys with elevations of approximately 800 feet. Land use in the basin consists of forest land (86.5 percent), rangeland (9.6 percent), other land uses (2.3 percent), and cropland (1.6 percent). More than 80 percent of the basin is managed by the USFS. Grazing and croplands are primarily in the lower and mid reaches of the basin. Agriculture consists of orchards, alfalfa and other irrigated crops.

3.3.2 Land Use at Proposed Project Sites

Figures 2-5 through 2-8 show the general locations of project sites in each basin. Large-scale maps of each proposed and backup site can be found in Appendix 4. The specific map number for each site is identified in the descriptions below.

3.3.1.1 Hatchery Sites

Dryden (Primary): The site is on property that contains an existing adult trapping facility adjacent to Dryden Dam at the mouth of Peshastin Creek (Figure 10c). The Washington State Department of Transportation (WSDOT) currently uses the site for gravel storage. Highway 2 passes by the site. The majority of the site is disturbed bare ground with small patches of grass and weedy species. Land use in the vicinity is dominated by light industrial development associated with the dam, residential and commercial development associated with the community of Dryden, and agricultural use. The hills south of Highway 2 contain second growth coniferous forest.

George (Backup): The George site is an undeveloped property consisting of multiple parcels totaling 150 acres along a large bend in the Wenatchee River (Figure 10ad). The site is accessed via gravel roads from State Route (SR) 207 and Beaver Valley Road. The topography is relatively flat; a majority of the site is below the base flood elevation for the Wenatchee River. Habitat is diverse and includes forested, shrub-scrub, emergent and open-water wetland and mixed deciduous and coniferous upland forest. Land use in the vicinity of the George site includes recreational areas, residences, farms and ranches, and private and federal forest lands. The landscape is dominated by mature forest, wetland systems, and riparian habitat associated with the Wenatchee River.

3.3.1.2 Primary Wenatchee Basin Acclimation and Adult Plant Sites

Beaver: This site contains a pond currently used by the project for coho acclimation (Figure 10h). The pond is on property owned by a recreation-oriented guest facility. An un-surfaced road extends 1,000 feet from the guest lodge to the pond. Chiwawa Loop Road is also within about 1,000 feet of the site but is not visible from it.

Brender: The Brender site includes an existing pond on an undeveloped parcel in the community of Cashmere (Figure 10b). Brender Creek flows through the site and an unpaved road provides access. Land use in the vicinity is dominated by residential and commercial development associated with the community of Cashmere. Highway 97 is about a quarter mile to the north.

Butcher: The Butcher site includes an existing pond currently used by the project for coho acclimation (Figure 10e). Highway 2 is a few hundred feet to the south and visible from the site. A paved access road from Highway 2 runs along the north side of the site and provides access to it. Butcher Creek flows into the pond and Nason Creek flows adjacent to the east side of the pond. Additional land use near the site includes a vacation home, an electrical transmission corridor, and a highway rest stop about a mile west of the site.

Chikamin: The Chikamin site, on the same property as the Minnow site (described below), is in a rural undeveloped area more than 15 miles from Highway 2 (Figure 10l). Chiwawa River Road provides access to the site. There is no existing pond. Timber has been harvested on the property and on the surrounding parcels.

Clear: The Clear site includes several existing ponds on property with a private campground, small cabins, and mowed lawns. The site is about 10 miles from Highway 2 (Figure 10i). Public roads provide access.

Coulter: The Coulter site is less than a mile from Highway 2 and includes an existing pond currently used by this project for coho acclimation (Figure 10e). Coulter Creek flows into and out of the pond. A vacation home that is part of a community of vacation homes is located near the site. An unpaved road associated with the vacation homes provides access.

Dirty Face: The Dirty Face site includes creeks that flow through an open field before entering the White River. The mouth of the creek is in the Chelan Wildlife Area - White River Unit and is owned and managed by the Washington Department of Fish and Wildlife (Figure 10k). A vacation home is on adjacent property. The property is about 10 miles north of Highway 2. White River Road provides access.

Leavenworth National Fish Hatchery: The Leavenworth National Fish Hatchery (NFH), operated by the U.S. Fish and Wildlife Service (USFWS), is on Icicle Creek Road, about 2 miles south of the city of Leavenworth (Figure 10d). The coho program currently acclimates and releases coho in Icicle Creek on hatchery property.

Minnow: The site, with no existing pond, is on the same undeveloped property as the Chikamin site, from which timber was harvested in the past (Figure 10l).

Rohlfing: The Rohlfing site is less than a mile from Highway 2 and includes an existing pond fed by a seasonal creek where the project currently acclimates coho (Figure 10g). A vacation home is at the site; an unpaved road associated with a community of vacation homes provides access. An electrical transmission corridor and railroad tracks are nearby.

Scheibler: The Scheibler site includes an existing pond associated with Chumstick Creek (Figure 10ab). Chumstick Highway provides access to the site.

Tall Timber: The site is on the Tall Timber Ranch more than 15 miles from Highway 2 (Figure 10j). A church camp is operated at the ranch. White River Road provides access.

Two Rivers: The Two Rivers property, about a mile from Lake Wenatchee, contains an operating gravel mine (Figure 10ak). The site includes an existing acclimation pond with a connection to the Little Wenatchee River that the coho project has used in the past. Little Wenatchee Road provides access. There is no public power at the site.

White River Springs: Beaver dams created ponds from springs that flow into the White River (Figure 10k). The site is on property with residential structures about 11 miles north of Highway 2.

3.3.1.3 Backup Wenatchee Basin Acclimation Sites

Allen: The Allen pond is in the Valley Hi residential community, in open space used for recreation by the community (Figure 10a).

Coulter/Roaring: The Coulter/Roaring site includes a pond system created by beaver dams on Yakama Nation property (Figure 10e). While the wetland is owned by the Yakama Nation, access to potential acclimation sites is through private property on an unpaved road. The site is less than a mile from Highway 2. Land use on YN property is habitat preservation; on adjacent properties it is recreation and rural residential.

McComas: The site includes existing ponds located near the White River about 5 miles north of Highway 2 (Figure 10ak). Land use is habitat preservation and rural residential. Little Wenatchee Road provides access.

Squadroni: The Squadroni site is on residential property near Highway 2, which is visible from the site (Figure 10f). If the site is used, a pond would be constructed that would connect to an existing ditch that connects to Nason Creek. An electrical transmission corridor and railroad tracks are located on the south side of Nason Creek.

3.3.1.4 Primary Methow Basin Acclimation and Adult Plant Sites

Goat Wall: A residence is adjacent to an existing pond; access is via Lost River Road (Figure 10y).

Gold: The site contains a series of small, man-made ponds adjacent to the South Fork of Gold Creek (Figure 10n). It is in a rural residential area, with several homes adjacent to the acclimation site. Walking trails and benches are located along the ponds and the creek.

Hancock: The Hancock site is a parcel of rural residential property associated with Hancock Spring, which flows into the Methow River (Figure 10t). A farm house is on the property, the majority of which is comprised of grass hay or pasture.

Heath: The Heath site includes existing ponds associated with springs that flow into the Methow River. The site is a ranch located near Highway 20 (Figure 10w). The highway provides access to the site and is visible from it. Structures associated with the ranch occupy part of the site, but the majority of the property is comprised of grass or hay/pasture. The adjacent upstream property is the Big Valley Unit of the Methow State Wildlife Area, owned and managed by WDFW for riparian habitat protection and wildlife conservation.

Lincoln: The Lincoln site includes existing ponds adjacent to the Twisp River (Figure 10ai). The property includes a conservation easement purchased by the Methow Conservancy. A farm and residence is adjacent to the ponds.

Lower Twisp: The Lower Twisp site is owned by the Methow Salmon Recovery Foundation and includes several ponds used for steelhead acclimation and one pond used for coho acclimation for this project. The site is less than a mile from the center of the town of Twisp and is adjacent to the Twisp River (Figure 10q). Twisp River Road provides access. A building associated with the Methow Salmon Recovery Foundation occupies part of the site.

Mason: The Mason site includes three man-made ponds near the mouth of Eightmile Creek; the ponds were used for coho acclimation in 1998. The site is about 10 miles north of the town of Winthrop; West Chewuch River Road provides access (Figure 10z). A vacation home is located at the site.

MSWA Eightmile: The site is in the Methow State Wildlife Area (MSWA), which is owned and managed by WDFW property managed for wildlife conservation and public recreation (Figure 10z). The well proposed for the site would be on private land in a field near the existing side channel; the side channel is on property owned by WDFW.

Parmley: The Parmley site includes an existing farm pond adjacent to Beaver Creek, about 6 miles from the community of Twisp (Figure 10m). Beaver Creek Road provides access to the site, which also contains a rural home with several farm structures.

Pete Creek Pond: The Pete Creek site includes a pond on a disconnected side channel of the Chewuch River about 4 miles north of the town of Winthrop (Figure 10v). An unpaved road off of the West Chewuch River Road provides access to the site. A rural home with several building structures and a nine-hole golf course is located adjacent to the pond. The MSRF Chewuch site (a backup site) is about 2,000 feet to the south.

Twisp Weir: The site is on the south side of Twisp River Road approximately 5.5 miles from Highway 20 (at Twisp) (Figure 10p). It includes an existing man-made acclimation pond for spring Chinook salmon, a salmon weir, and a smolt trap owned by Douglas County PUD and operated by WDFW. The existing acclimation pond and weir are accessible from Twisp River Road via existing gravel roads. A residence is located on the portion of the Twisp Weir site north of Twisp River Road. The western portion of the site, south of Twisp River Road, is a fenced mowed grassy field, with a shed covering a camping trailer close to the Twisp River.

Winthrop National Fish Hatchery: Winthrop NFH, about half a mile from the center of the town of Winthrop, is operated by USFWS; it has ponds associated with a back channel of the Methow River (Figure 10s). The coho project currently uses the hatchery facilities for broodstock collection, incubation, rearing, and acclimation.

3.3.1.5 Backup Methow Basin Acclimation Sites

Balky Hill: The site includes an existing pond near Beaver Creek about 3 miles north of Highway 20 (Figure 10r). Land use is agriculture. Structures associated with the farm are adjacent to the pond. The site is accessed via Beaver Creek Road.

Biddle: The site contains two existing ponds; a rural vacation home overlooks the ponds. Access is via Wolf Creek Road (Figure 10x).

Chewuch Acclimation Facility: The Chewuch AF site, on the east side of the Chewuch River, is on a parcel occupied by a recreational vehicle campground (Figure 10u). An existing acclimation pond operated by WDFW is adjacent to the site. Access is via the Eastside Chewuch Road bridge.

Methow Salmon Recovery Foundation - Chewuch: The mission of MSRF, which owns the site, is to enhance and preserve salmon habitat. A large estate is adjacent to the site (Figure 10v).

Newby: Newby is a small high-gradient tributary of the Twisp River just upstream of the Twisp trap. The site is recreation property. Access is via the Twisp River Road and the Newby Creek Road (Figure 10p).

Poorman: The site includes four large ponds near the Twisp River located about 3 miles from the community of Twisp (Figure 10o). Twisp River Road provides access to the site. A rural home with several farm structures is on the site.

Utley: The site contains a large pond fed by spring water adjacent to the Twisp River. A rural home is adjacent to the ponds. Access is via a 1,200-foot gravel road from Twisp River Road (Figure 10ah).

3.4 Coho Status, Life Cycle and Distribution in Wenatchee and Methow Basins

Timing of project activities and their impacts depends on the coho life cycle, abundance, and expected distribution. This section summarizes current conditions for coho in the two basins.

3.4.1 Coho Population Status

Historically 120,000-166,500 coho were attributed to the mid- and upper Columbia tributaries (Yakima, Wenatchee, Entiat, Methow, and Spokane rivers) (Mullan 1984). Mullan (1984) estimated that the Wenatchee River supported adult returns of approximately 6,000 – 7,000 coho and the Methow River supported 23,000 – 31,000.

By the 1930s, coho populations in the mid-Columbia region were considered extirpated. As discussed in Chapter 1, Section 1.3.1, although no one knows for sure why natural populations of spring Chinook and steelhead persisted when coho did not, possible reasons include:

- Very high harvest rates on coho in the lower Columbia River;
- Unscreened irrigation diversions on small tributaries in mid-Columbia basins;
- The fixed three-year coho life cycle versus the variable life cycles of spring Chinook and steelhead which provide more adaptability to changes in the environment.

Before the current coho reintroduction program began in the Wenatchee and Methow basins, two attempts were made to rebuild coho populations. Between the early 1940s and the mid-1970s, the USFWS raised and released coho as part of the mitigation for the construction of Grand Coulee Dam (Mullan 1984). Chelan PUD also had a coho hatchery program until the early 1990s. While some natural production might have occurred from these releases, fish were not released in natural production habitats in the watersheds. The programs overall were not designed or intended to re-establish naturally spawning populations—they were for harvest augmentation—so coho populations in mid-Columbia basins continued to be considered extirpated.

The Yakama Nation, funded by BPA, began a feasibility study in 1996 to evaluate coho reintroduction in mid-Columbia tributaries. Since the reintroduction of coho to the Wenatchee River in 1999, the number of adult returns has ranged between an estimated 350 to 5,031 (C. Kamphaus, YN Fisheries Biologist, personal communication, Feb. 28, 2011). A portion of these fish are taken into the hatchery for broodstock development; the remainder are allowed to spawn naturally. The first generation of naturally produced coho smolts emigrated from the Wenatchee River basin in 2002 with an estimated population size of 17,000 (Murdoch et al. 2004). In 2003, approximately 36,700 naturally produced coho smolts emigrated from the Wenatchee River (T. Miller, WDFW, unpublished data).

Since 1999, adult returns to the Methow River have ranged from 140 to 1,680 (C. Kamphaus, YN, personal communication, Feb. 28, 2011). Similar to the Wenatchee, a portion of the coho returning to the Methow River are used for broodstock development. At this point in the reintroduction process, neither population could sustain itself without hatchery supplementation.

3.4.2 Coho Life Cycle

Because the historical stocks of coho salmon were decimated near the turn of the 20^{th} century, most life history information was obtained through affidavits from older residents of the Wenatchee and Methow basins. The historical information suggests that these fish were probably early-returning-type adults, ascending the mid-Columbia tributaries in August and September (Mullan 1984). The coho currently occupying these basins that were developed from lower Columbia River stocks spawn from October to mid-December. Coho are reported to use a varied size range of substrate for spawning, from fine gravel to coarse rubble; the material typically is 6 inches (15 cm) in diameter or smaller (Groot and Margolis 1991).

In general, coho salmon emerge from eggs February through April. They rear in their natal tributaries. A portion of juvenile coho migrate downstream during the fall, presumably seeking over-winter habitat (Sandercock 1991). Some juvenile coho may also migrate upstream to overwinter in small tributaries (Tripp and McCart 1983). In studies done in the Wenatchee basin, the diets of both hatchery and naturally produced juveniles were dominated by insects (Murdoch et al. 2005); to a lesser extent juveniles prey on crustaceans and other juvenile fish (Groot and Margolis 1991, Murdoch et al. 2005). Typically, Columbia River coho spend a year in freshwater before out-migrating as yearling smolts in the spring (April and May). After out-migrating, coho spend approximately 18 months at sea before returning to their natal tributaries to spawn. Sexually precocious males (jacks) return to spawn after six months at sea.

3.4.3 Coho Distribution

Historically, many of the two basins' tributaries supported coho production, although little is known about their spatial distribution. Since the YN's program of coho feasibility studies began, coho have been found to spawn in the mainstem Wenatchee River (near the Wenatchee River confluence to Lake Wenatchee); in Nason, Beaver, Icicle, Peshastin, Chumstick and Mission creeks; and possibly in Chiwawa River. In 2004, coho also returned to the Little Wenatchee River to spawn. Coho salmon returning to the Methow basin are spawning in the mainstem Methow, Chewuch and Twisp rivers and in small tributaries such as Gold, Libby, and Beaver creeks.

3.5 Surface Water Quality

The analysis of water quality impacts is extensive due to the concerns raised during scoping by agencies and citizens. Consultants were hired to evaluate discharges from existing coho acclimation sites and current water quality in the vicinity of proposed new sites; and to assess project impacts to water quality in both basins using several methods, including modeling based on the QUAL-2K model developed by Washington State Department of Ecology (WDOE). The consultants provided two detailed reports which are appended to this EIS (Appendix 6 Water Quality Data and Appendix 7 Water Quality Impacts). Their data, analyses, and conclusions are incorporated by reference and summarized in this section. Please consult the appendices if more detail is desired.

3.5.1 Affected Environment

Washington's water quality standards are the basis for protecting and regulating the quality of the state's surface waters. The standards identify designated and potential uses of water bodies, such as aquatic life, swimming, fishing, domestic and agricultural water supplies, etc.; they set water quality criteria to protect those uses; they contain anti-degradation policies to protect high quality waters; and in many cases they specify how criteria are to be implemented, for example in permits (Washington Dept. of Ecology website: http://www.ecy.wa.gov/water.html).

Under section 303(d) of the 1972 federal Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters, known as 303(d) lists. The listed impaired waters do not meet water quality standards that regulatory entities have set for them. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop TMDLs (Total Maximum Daily Loads) for them. TMDLs determine the amounts of pollutants that a given water body (river, marine water, wetland, stream, or lake) can receive and still meet water quality standards (EPA website: http://www.epa.gov/lawsregs/laws/cwa.html).

In the Wenatchee watershed, the lower section of the Wenatchee River below the city of Leavenworth, portions of Icicle Creek, Mission Creek, and Brender Creek are on the State of Washington's 303(d) list of impaired water bodies for dissolved oxygen (DO), acidity/alkalinity (pH), and temperature. In other words, at times, especially during the low-flow summer and fall period, these waters have too little dissolved oxygen, have high pH levels, and are too warm for designated uses including aquatic life. WDOE has determined that the most critical impairments are in the lower Wenatchee River downstream of the City of Leavenworth, and in Icicle Creek below the Leavenworth NFH (Carroll et al. 2006, Carroll and Anderson 2009).

Water quality deterioration in the Wenatchee River and the lower portion of Icicle Creek more severely affects aquatic life compared to Mission and Brender Creeks because of the volume of water carried and the fact that these water bodies provide important travel pathways for salmonids during their migration to spawning grounds in the upper portions of the watershed. Therefore, to improve the water quality in the lower sections of the Wenatchee River and Icicle Creek, WDOE produced load allocations for total phosphorus originating from point and non-point sources that affect the water quality of the lower Wenatchee River. The WDOE TMDL study recommended load allocations to Mission and Brender creeks to reduce the phosphorus loading to the lower Wenatchee River (Carroll and Anderson 2009). Given the importance of water quality in the lower Wenatchee River and WDOE's focus on it in the TMDL study, water quality analyses for this EIS emphasize the water quality impacts of discharges in this section of the Wenatchee River.

The Wenatchee River upstream of Leavenworth is not included in the State's 303(d) list for DO and pH violations (Carroll and Anderson 2009). However, the WDOE TMDL document has recommended a limit for the total phosphorus (TP) loads entering the lower Wenatchee River from sources upstream of Leavenworth to help alleviate water quality degradation in the lower section of the Wenatchee River where the TMDL is in effect.

The Methow River is not listed in the State's 303(d) list of impaired water bodies for pH or dissolved oxygen violations. However, it is currently listed for temperature.

Aquatic organisms are very sensitive to reductions in DO levels in the water. The health of aquatic species depends on maintaining an adequate supply of oxygen dissolved in the water. Oxygen levels affect growth rates, swimming ability, susceptibility to disease, and the relative ability to endure other environmental stressors and pollutants (Carroll and Anderson 2009).

The pH value is a measure of the relative acidity or alkalinity of water (hydrogen ion concentration); it both directly and indirectly affects the ability of waters to have healthy populations of fish and other aquatic species. A lower pH value (below 7) indicates that an acidic condition is present, while a higher pH (above 7) indicates a basic or alkaline condition. A pH of 7 is considered to be neutral. Since the pH scale is logarithmic, a water sample with a pH of 8 is ten times more basic than one with a pH of 7 (Carroll and Anderson 2009).

Aquatic organisms, including fish and the food they eat, are at times exposed to high pH levels in parts of the lower Wenatchee watershed. High pH stresses aquatic organisms by impairing their salt and water balancing processes and increasing the toxicity of some contaminants. Anadromous (sea-run) species of fish encounter this stress in their adult upstream migration, and as juveniles in rearing areas and during downstream migration. In addition, salmonid eggs in the substrate are exposed to the high pH as surface water flows through spawning gravels (Carroll and Anderson 2009).

Nutrients such as phosphorus and nitrogen are essential for plant growth and aquatic community health. However, as in the lower Wenatchee River, too much of one or both of these nutrients (phosphorus in the lower Wenatchee and Icicle Creek) can cause excessive aquatic plant growth (Carroll and Anderson 2009).

In streams affected by eutrophication, natural re-aeration processes cannot compensate for plant and bacterial respiration, and DO levels become too low at night. Additionally, pH becomes high at night and too low during the day. These 24-hour (day to night) swings in DO and pH can be harmful, and even fatal, to fish and aquatic insects (Carroll and Anderson 2009).

Nutrients can also create nuisance conditions in streams by choking them with excessive plant and algae growth. These conditions may interfere with water intake structures, water conveyance in irrigation canals, and fishing, boating, and swimming (Carroll and Anderson 2009).

Washington state law provides protection for surface water quality through an anti-degradation policy (WAC 173-201A-300 of Washington Administrative Code; WAC 2006). Under this law, three levels of protection are provided: Tier I protection extends to all water bodies and maintains the current and designated uses for a given water body and prevents any further pollution; Tier II does not allow degradation of surface waters that are of exceptional quality (that exceed the water quality standards) through new or proposed actions unless such degradation is necessary and in the overriding public interest; and Tier III protection applies to water bodies classified as outstanding resource waters.

Much of the upper Wenatchee subbasin and nearly the entire Methow basin exceed the water quality standards for temperature, DO, and pH. Thus, these waters are protected by the Tier II anti-degradation policy. The lower Wenatchee River and portions of Icicle Creek where the TMDL is in effect (to prevent pH and DO violations) are protected under the Tier I policy.

Most of the existing and proposed acclimation-related sites are located in waters protected by the Tier II anti-degradation policy. Washington State requires the permit applicant to perform a Tier II anti-degradation evaluation if the proposed activity has the potential to cause a measureable change in water quality. The measurable changes relevant to this project are defined in the Washington Administrative Code as:

- temperature increase of 0.3 degree Celsius (C) or greater;
- DO decrease of 0.2 milligrams per liter (mg/L) or greater;
- pH change of 0.1 unit or greater.

For Tier I waters, human-caused discharges must not affect the existing and designated uses.

3.5.2 Types of Impact

Project activities could cause the following kinds of impacts to water quality.

Construction

- Construction can increase sediment levels where construction activity is in the stream or in riparian areas, with resulting effects on fish and other aquatic species. See analysis and impact avoidance measures in Section 3.7 Fish.
- Construction equipment operating in or near streams can leak petroleum products and other pollutants. Such leakage would be minimized by proper equipment maintenance, use of absorbents, and refueling away from the water body.

Operation

- Discharges from the proposed hatchery and acclimation sites could increase nutrient levels in streams.
- Carcasses from returning adult coho could increase the nutrient content of the waters in which they spawn. Because this is part of a natural ecological process, it is presumed to be on balance a desirable condition and was not a factor in the analysis of water quality impacts. See discussions in Section 3.7 Fish.
- Chemicals used at the proposed new hatchery could affect water quality if not properly handled or disposed. This issue is addressed in Chapter 4, Section 4.11.

The analysis of potential water quality impacts in this EIS focuses on increases in pH and DO attributable to nutrients added from the proposed coho rearing and acclimation sites in the Wenatchee and Methow basins. WDOE determined that phosphorus is the primary nutrient causing growth of algae in the lower river and therefore is the primary concern for water quality degradation. For that reason, phosphorus was the primary nutrient considered in the analysis.

Discharges from coho rearing and acclimation facilities might contain nutrients (phosphorus and nitrogen) at levels that promote growth of algae. Algal photosynthesis and respiration cycles can induce changes in pH and DO beyond the ranges found under natural conditions. Such changes may violate water quality standards and can negatively impact the designated uses of water bodies in the basins, which include swimming; domestic, industrial, and agricultural water supply; aesthetic values; wildlife habitat; harvesting of aquatic life; and spawning, rearing, and migration for ESA-listed fish.

Whether discharges from acclimation sites contribute measurably to phosphorus loads depends not only on the amount of nutrients discharged but on the amount of flow in the receiving stream, the stream's temperature, the bioavailability of the nutrient form,[10] and the amount of time the nutrients remain in the system. Cooler water is less conducive to algae growth than warm water. Higher volumes of water tend to flush the nutrients through the system more quickly and thus reduce concentrations, which reduces the potential for algae to grow. All these factors were considered in the analysis.

3.5.3 Impacts of the Proposed Action

The following process was used to evaluate the local and combined impacts of the acclimation sites:

- For discharges from existing project sites that are in waters protected by the Tier II policy, compare the phosphorus levels to existing background conditions to assess whether acclimation-related discharges produce algal blooms that could cause a change in DO and pH beyond the mixing zone of the discharge that would violate the state standards.
- For discharges from proposed sites in waters protected by the Tier II policy, compare estimated phosphorus load from those sites to existing background load to assess the likelihood of change in DO and pH that would violate the state standards.
- For the lower Wenatchee River (currently protected by Tier I policy), determine whether proposed activities are likely to cause a measurable change in DO and pH, as defined in the state standards, that is sufficient to affect the existing and designated uses.

In order to assess the impacts of proposed coho acclimation activity on water quality, analysts estimated nutrient loading (total phosphorus [TP]) at two operating coho acclimation sites in the Wenatchee basin, Rohlfing and Butcher. Estimates from these operating Nason Creek sites were used to forecast the amount of nutrients that could be contributed to downstream waters by proposed new sites in both basins. To estimate these loads, data were collected in 2009 and 2010 on stream flow and water quality both upstream and downstream of the two operating sites. Where appropriate, water quality modeling was used to facilitate the evaluation.

Using data from active coho acclimation sites as a way to assess water quality impacts of the proposed sites is reasonable because: 1) the sites would be used to acclimate the same species; 2) feeds are expected to be similar or identical to those used in the operating Nason Creek sites; 3) climatic conditions are similar, which would result in similar metabolism; and 4) the majority of the acclimation sites are small, natural ponds that are fed by small tributary streams.

Table 3-2 shows estimates of TP loads from the Rohlfing and Butcher sites. Based on these data, the TP load contributed to the receiving stream was estimated to be 0.32 milligrams (mg) per day

[10] Phosphorus is an essential nutrient for algal growth. However, not all forms of phosphorus can be taken up by algae. Any form of phosphorus that is readily available for biological uptake is said to be bioavailable (i.e., available for ready assimilation by algae).

per fish (Table 3-2). To estimate the contribution of each proposed site, this average per-day figure was multiplied by the number of fish to be acclimated at that site. This contribution was evaluated against the phosphorus loads calculated at the mouth of the major creeks that carried these loads into the Wenatchee and the Methow rivers in order to assess the significance of the loads relative to the background loads in the system.

Table 3-2. TP loads from two existing acclimation sites in Nason Creek

	Rohlfing			Butcher[a]			Total		
	2009	**2010**	**Overall**	**2009**	**2010**	**Overall**	**2009**	**2010**	**Overall**
Total number of fish acclimated	101,000	85,656	186,656	136,000	144,632	280,632	237,000	230,288	467,288
Average TP load (g/d)	35.72	38.53	74.25	51.35	22.66	74.02	87.07	61.19	148.27
TP load per fish acclimated (mg/d/fish)	0.35	0.45	0.40	0.38	0.16	0.26	0.37	0.27	**0.32**

a. Coulter is also an existing site, to be used alternately with Butcher in the Proposed Action. Number of fish acclimated would be the same as Butcher; therefore TP loads would be the same.

g/d = grams per day

mg/d/fish = milligrams per day per fish

3.5.3.1 Wenatchee Basin Acclimation Sites (Primary)

Table 3-3 shows the estimated TP loads at the primary sites proposed in the Wenatchee basin. The estimates for each site are discussed in the following subsections. Sites are grouped according to the rivers or streams into which discharge from the sites empties.

White River (3 sites)

Two acclimation ponds and an adult plant site are proposed in the White River watershed. The White River flows into Lake Wenatchee (Figure 2-7 in Chapter 2). Flows in the White River were estimated based on the WDOE gauge near Plain. Water quality data were derived from multiple sources, including data collected by the Yakama Nation (Appendix 6, Water Quality Data), supplemented by monitoring data collected in Lake Wenatchee by Grant County Public Utility District (Grant PUD 2009) and Chelan PUD (2009 – unpublished data).

Tall Timber: This site is the most upstream of the three proposed acclimation ponds and does not flow directly into the White River, but it is located close to the confluence of the Napeequa and White rivers. The estimated TP load from this acclimation site is 19.1 g/d, which is less than one fifth of a percent of the average TP loads delivered by the White River to Lake Wenatchee during the acclimation periods in 2009 and 2010 (Table 3-3). This level is well within the natural variability of the TP loads in the White River. Moreover, loads released at this site would have to travel more than 10 miles before entering Lake Wenatchee. Nutrient loading in Lake Wenatchee is of concern because it can promote growth of algae. In-stream processes between Tall Timber and the lake, such as dilution, settling, or use by organisms, would reduce the load downstream from the discharge. Downstream phosphorus data collected from active sites in Nason Creek suggest that concentrations can be expected to return to background levels within a few miles downstream of the discharge. Given this evidence and the distance of the discharge from Lake Wenatchee, it is reasonable to conclude that loads from the Tall Timber discharge are unlikely to cause a measurable change at the mouth of White River when it enters Lake Wenatchee.

White River Springs: This is one of the smallest proposed ponds, with acclimation of 50,000 coho. Loads from this site are expected to be quite small, at less than one-tenth of a percent of the average White River loads.

Dirty Face: Data from Nason Creek are not applicable to the Dirty Face site because the project proposes to enclose adult fish at this site. Adult fish are not fed, so water quality impacts associated with the acclimation and feeding of juvenile fish are not relevant here.

Little Wenatchee River – Two Rivers

The Two Rivers site is located upstream of the Little Wenatchee River's confluence with Lake Wenatchee (see Figure 2-7, Chapter 2). This is one of the larger sites, with an estimated 120,000 coho proposed for acclimation.

WDOE's gauge at Little Wenatchee River below Rainy Creek was used to estimate flows. As with White River, water quality data came from data collected for this project, as well as from the Grant and Chelan PUD monitoring programs (Grant PUD 2009; Chelan PUD 2009 – unpublished data).

The estimated loads contributed by this proposed site are higher than for individual White River sites because of the greater number of fish proposed for acclimation. Nevertheless, the TP loads from acclimation activity are estimated to be about one-third of a percent of the average TP loads carried by Little Wenatchee River during the acclimation period (Table 3-3).

Chiwawa River (3 sites)

Three sites are proposed in the Chiwawa River watershed. The Chiwawa flows directly into the Wenatchee River near Plain, Washington. Flow data for this site were obtained from the U.S. Geological Survey (USGS) gauge at the Chiwawa River near Plain. Water quality data were collected by the Yakama Nation near the mouth of the Chiwawa River.

Minnow: This is the most upstream of the three proposed acclimation ponds and enters the Chiwawa River through Chikamin Creek. TP contributions from this site are expected to be less than one half of a percent of the load carried by the Chiwawa River during the acclimation period (Table 3-3). Also, given its distance from the mouth of the Chiwawa River (Figure 2-7), loads from this site are likely to be reduced by in-stream processes and are unlikely to impact the Wenatchee River.

Chikamin: The Chikamin site is close to the Minnow site and similarly enters the Chiwawa River through Chikamin Creek. Because the number of fish acclimated at this site is the same as at the Minnow site, the TP contributions from this site are expected to be similarly less than one half of a percent of the load carried by the Chiwawa River during the acclimation period. As with the Minnow site, TP loads would be assimilated in-stream due to the distance from the confluence with the Wenatchee River, and therefore are unlikely to impact its water quality.

Table 3-3. TP loads estimated for proposed acclimation sites in the Wenatchee basin

Proposed Site	No. of Fish (thousands)	TP Load[a] (kg/d)	Receiving Stream[b]	No. of Days[c]	No. of Sampling Events[d]	Record Start Date	Record End Date	Receiving Stream Load[e] (kg/d)	Relative Contribution (%)
Tall Timber	110	0.035	White River	84	14	3/15/2009	4/12/2010	19.1	0.18
White River Springs	50	0.016	White River	84	14	3/15/2009	4/12/2010	19.1	0.08
Two Rivers	120	0.038	Little Wenatchee	83	12	3/23/2009	5/9/2010	11.8	0.33
Chikamin	100	0.032	Chiwawa	71	7	4/4/2009	5/9/2010	7.3	0.44
Minnow	100	0.032	Chiwawa	71	7	4/4/2009	5/9/2010	7.3	0.44
Clear	150	0.048	Chiwawa	71	7	4/4/2009	5/9/2010	7.3	0.66
Beaver	100	0.032	Beaver	N/A	N/A	N/A	N/A	N/A	N/A
Scheibler	65	0.021	Chumstick	23	2	4/11/2009	5/3/2009	2.7	0.77
Leavenworth NFH[f]	100	0.032	Icicle	N/A	N/A	N/A	N/A	1.5	2.21
Brender[g]	50	0.016	Brender	N/A	11	3/10/1997	5/3/2004	1.2	1.39

Notes:

a. Estimated from average load of 0.32 mg per fish per day calculated from measured data at active discharges in Nason Creek. kg/d = kilograms per day

b. Nearest stream for which estimation of TP load at the downstream end of the receiving stream was possible.

c. Number of days in the acclimation period over which interpolation of loads was possible with available flow and concentration data.

d. Number of water quality sampling events during the acclimation period (3/10/2009 through 5/10/2009 and 3/23/2010 through 5/9/2010). To maximize data coverage, this period was extended to include additional samples. Some events included collection of duplicates.

e. TP load estimated at the mouth of the receiving stream was based on nutrient data collected during the acclimation period.

f. Loads for the receiving stream (Icicle Creek) represent the total load at the mouth of Icicle Creek for 2002 as determined in WDOE TMDL.

g. Average TP load for receiving stream (Brender) was calculated over the acclimation months (March through May) based on historical flow and TP data reported by WDOE for Brender Creek near Cashmere Station (45D070).

Clear: Discharge from the Clear Creek site would enter the Chiwawa River through Clear Creek close to the confluence with the Wenatchee River. This is the largest site proposed in the Wenatchee basin, with 150,000 coho planned for acclimation. Therefore, this site has the highest estimated TP load of all the sites. However, in terms of relative magnitude, this load is about two-thirds of a percent of the average TP loads carried by the Chiwawa River. Therefore, this site, on its own, is not expected to significantly alter loads to the Wenatchee system.

Beaver

Water quality data for this site is limited and was not sufficient to estimate background TP loads in the stream. Beaver Creek drains a watershed that is smaller but geographically similar to nearby streams where it was possible to compare TP loads from acclimation ponds to background TP loads (for example Chiwawa and Chumstick). Assuming background TP concentrations in Beaver Creek are comparable to nearby streams, where water quality impacts from acclimation discharges with similar numbers of fish were estimated to be negligible, a similar impact can be expected for TP loads from the proposed facility on Beaver Creek.

Chumstick Creek - Scheibler

The Scheibler site is 8.1 miles upstream of the confluence of Chumstick Creek with the Wenatchee River. Water quality data collected by the Yakama Nation at the mouth of Chumstick Creek and flow estimated by WDOE near the river mouth were used to calculate background loads (Appendix 6 Water Quality Data). Even though nutrient data were collected in 2010, the loading calculations used data from 2009 only, due to lack of flow measurements in 2010 (WDOE has suspended the gauge operation). The loads from acclimation pond activity are estimated to be less than one percent of the average background load carried by Chumstick Creek (Table 3-3). Therefore, the water quality impacts are expected to be negligible.

Icicle Creek – Leavenworth National Fish Hatchery

Facilities at the Leavenworth NFH currently are being used for acclimation as part of this project. Discharges from this facility flow through the main hatchery outfall that dominates the Icicle Creek flow during low-flow season. Data at Icicle Creek were not collected as part of this project, and Leavenworth NFH discharge reports for its National Pollution Discharge Elimination System (NPDES) permit contained no nutrient data. Thus, TP load specified at the Icicle Creek mouth in the WDOE TMDL (Carroll et al. 2006) was used as a basis for comparison.

The proposed coho acclimation is estimated to contribute about 2 percent of the TP loads used in the WDOE TMDL for summer low stream flows (“7Q10 conditions”). However, because coho are acclimated over the winter and during spring, a large portion of the load would enter Icicle Creek during spring high flow; therefore, it is likely to be rapidly flushed from the system and would be unlikely to directly affect water quality in the lower Wenatchee River and Icicle Creek.

Brender Creek

Brender Creek site discharge would reach the Wenatchee River through Mission Creek. Mission Creek is on the state’s 303(d) list for violations in DO and pH under low-flow conditions. The water quality surveys for this EIS focused on the upper watersheds where the majority of the sites are proposed and did not include Mission or Brender creeks. A comparison to historical water quality and flow data available for this site from WDOE suggests that TP loads discharged from the acclimation site could contribute up to two percent of the loads carried by the creek, indicating that loads from this site could exacerbate the local water quality problems. However, most of the nutrient discharges would occur during spring high flow, so dilution and flushing of the nutrients through the system would play a major role in mitigating the local impacts. Further, the estimated average contribution of 16 g/d of TP is a negligible proportion of the loads carried by the Wenatchee River. Thus impacts in the critical portions of the lower Wenatchee River are also likely to be negligible.

3.5.3.2 Wenatchee Basin Acclimation Sites (Backup)

Table 3-4 shows TP loads estimated for acclimation activity at backup sites in the Wenatchee basin. One or more of these sites might be used if any of the proposed sites cannot be used. Each site is discussed separately in the following subsections.

Table 3-4. TP loads estimated at backup acclimation sites: Wenatchee basin

Proposed Site	No. of Fish	TP Load[a] (kg/d)	Receiving Stream[b]	No. of Days[c]	No. of Sampling Events[d]	Record Start Date	Record End Date	Receiving Stream Load[e] (kg/d)	Relative Contribution (%)
McComas	50,000	0.016	White R.	84	14	3/15/2009	4/12/2010	19.1	0.08
Squadroni	105,000	0.034	Nason Cr.	112	22	3/14/2009	5/9/2010	6.3	0.53
Coulter/ Roaring	105,000	0.034	Nason Cr.	112	22	3/14/2009	5/9/2010	6.3	0.53
Allen[f]	50,000	0.016	Peshastin Cr.	N/A	N/A	N/A	N/A	0.2	10.46

a. Estimated from average load of 0.32 mg per fish per day calculated from measured data at active discharges in Nason Cr.
kg/d = kilograms per day
b. Nearest stream for which estimation of TP load at the downstream end of the receiving stream was possible.
c. Number of days in the acclimation period over which interpolation of loads was possible with available flow and concentration data.
d. Number of water quality sampling events during the acclimation period (3/10/2009 through 5/10/2009 and 3/23/2010 through 5/9/2010). To maximize data coverage, this period was extended to include nearby samples. Some events included collection of duplicates.
e. TP load estimated at the mouth of the receiving stream was based on nutrient data collected during the acclimation period.
f. There were no data available for the receiving stream. Loads from the WDOE TMDL model for the 7Q10 natural conditions simulation (summer low stream flows) are used here for comparison.

McComas

The McComas site is located on White River; it might be used to acclimate up to 50,000 juvenile fish. The corresponding phosphorus loads are expected to be less than one-tenth of a percent of the loads carried by White River (Table 3-4). Therefore, the impacts are not expected to adversely affect water quality.

Squadroni

The Squadroni site is located on Nason Creek. If used, 105,000 fish are expected to be acclimated at this site. Based on the active Nason Creek sites, the TP load due to acclimation activity is expected to be 34 g/d (see Table 3-2). This is about half a percent of the TP loading from Nason Creek to the Wenatchee River. Moreover, as discussed previously, analysis of loads shows that the active acclimation sites at Rohlfing and Butcher, with more than twice the number of fish

(237,000 in 2009 and about 230,000 in 2010), did not adversely affect water quality in Nason Creek. Thus, the Squadroni site, if developed, is not likely to adversely affect water quality.

Coulter/Roaring

The Coulter/Roaring site is part of a wetland complex owned by the Yakama Nation. As with Squadroni, if used, up to 105,000 fish could be acclimated here; impacts are likely to be similar to those at Squadroni. However, because this site is in a wetlands complex, the TP loads from ponds probably would be assimilated within the marsh environs. Thus, impacts from acclimation activity are expected to be minimal.

Allen

The Allen site, if used, would acclimate up to 50,000 fish, which could result in phosphorus loading of up to 16 g/d to Peshastin Creek. No nutrient or flow data were available for Peshastin Creek for the month of March. To obtain a general idea of the relative contribution of nutrients from this site to the total load in the stream, the loading estimate for the site was compared to the loads specified in the WDOE TMDL summer natural conditions model (Carroll and Anderson 2009). The model specifies a TP load of 200 g/d under 7Q10 low-flow conditions in Peshastin Creek. At summer flow levels, acclimation activity at the Allen site could contribute about 10 percent of the total phosphorus load carried by the stream during the summer season. Summer flows are substantially lower than typical spring flows when acclimation would actually occur. For example, based on 1990 – 2010 flow records from the USGS gauge on the Wenatchee River at Monitor, average flow in August-September is roughly 16% of the average flow in April-May. Thus, even if background concentrations of phosphorus remain at 4.7 micrograms per liter as estimated in WDOE TMDL study (Carroll and Anderson 2009), one can expect that loads in spring would be roughly 5 times higher. Based on this calculation, it can be expected that the acclimation-related loads would be less than 2% of the background loads carried by the stream. When viewed in light of the flushing effect from higher flows, this small proportional increase in TP loading is unlikely to produce a measurable change in the water quality.

3.5.3.3 Hatchery Sites

Dryden (Primary)

The Dryden site is proposed for use as a year-round rearing operation. Therefore, it was necessary to evaluate impacts during low-flow conditions when water quality is most vulnerable to increases in nutrient loading.

The QUAL-2K model was used in the WDOE TMDL process (Carroll et al. 2006; Carroll and Anderson 2009) to allocate nutrient loading of point and non-point sources to bring DO and pH into compliance with existing state regulations. A phased implementation of load reductions has been recommended in the TMDL. Based on discussion with WDOE (November 12, 2009, meeting with Ryan Anderson, Yakima Regional office, Yakima), it is assumed for this evaluation that the load reduction measures will be implemented as recommended in the TMDL.

The QUAL-2K model was set up for 7Q10 low-flow conditions, with publicly owned treatment works (POTW) discharging at design flow and a phosphorus concentration of 90 micrograms per liter. Other sources were set to the estimated maximum natural condition values as determined in the WDOE TMDL (Carroll and Anderson 2009).

Nutrient loading for the proposed hatchery was estimated based on rearing approximately 220,000 smolts, with about 110,000 smolts removed in November and 110,000 removed the following March. Table 3-5 presents the details on the nutrient loading expected from hatchery operation. The average flow for the month of September, estimated at about 0.06 cubic meter per second (m^3/s) (about 1,000 gallons per minute), was specified for the QUAL-2K model. Discharge from the hatchery was assumed to occur immediately upstream of Dryden Dam at river kilometer (RKM) 56.5 (RM 35.1).

The Skretting Nutra Fry feed proposed for use at the hatchery contains about 1.42% phosphorus by weight. Tipping and Shearer (2007) report a phosphorus retention range of 29% to 36% for coho fed commercial diets with similar phosphorus content (range 1.1% to 1.3%). Similar research on rainbow trout estimated phosphorus retention at 50% (Flimlin et al. 2003). This analysis assumed the average of these values, 39% phosphorous retention. The effluent from the hatchery would be treated prior to discharge to the Wenatchee River. For analysis purposes, a treatment efficiency of 50% was assumed, which is the minimum requirement for any treatment system.

The phosphorus loads estimated for the month of September (see Table 3-5) were specified as a point source in the QUAL-2K model. Other water quality parameters were set to the same values as those used for Leavenworth NFH in the Icicle Creek water quality model used in the WDOE TMDL analysis (Carroll et al 2006). This is appropriate because the level of treatment at Dryden Hatchery is expected to be similar or better than what is being implemented at Leavenworth NFH. All other settings remained unchanged from the 7Q10 simulations in the WDOE TMDL analysis (Carroll and Anderson 2009).

Model simulations for flow, TP, DO, pH, and temperature over the length of the Wenatchee River are shown in graphs in Appendix 7, Section 4.2.9. The modeling shows that effluent from the hatchery is unlikely to significantly change flows and water quality in the lower Wenatchee River due to the relatively small flows out of the proposed Dryden Hatchery. Indeed, DO remains in compliance downstream of the hatchery discharge, and the change in minimum DO meets the “no measurable change” criterion laid out in state standards. Hatchery effluent would have no effect on temperature.

The model predicts that pH could exceed the upper limit of 8.5 units downstream of the Cashmere public treatment works (POTW) discharge. After about RKM 60 (RM 37.3), there is little difference in the model predictions with and without the proposed hatchery discharge. This suggests that the pH excursion[11] does not result from the hatchery loads, but is rather a consequence of the Cashmere treatment works loads. This interpretation is reinforced by the WDOE TMDL, which acknowledges that Cashmere POTW discharge should release phosphorus at less than 90 micrograms per liter to prevent pH excursion downstream of the city of Cashmere.

In the vicinity of the hatchery as well as downstream of the Cashmere POTW, the difference in the pH range marginally exceeds the measurable change criterion (by much less than 0.1 unit which is well below the limits of instrument accuracy—see Chapter 5 in Appendix 6) and is well within the typical ranges encountered within a day (Figure 3-1).

Based on the analysis provided here, it is expected that the discharges from the Dryden Hatchery would have minimal impacts on the water quality of the lower Wenatchee River even under critical low-flow conditions.

[11] Excursion is the word used to indicate that a water quality limit has been exceeded.

Table 3-5. Estimation of effluent phosphorus loads for proposed hatchery at Dryden

Month	Number of Fish[a]	Flow (m^3/s)	Total Weight of Fish (kg)	Feed Rate (g feed/ g fish/d)	Phosphorus Feed Rate[b] (g/d)	Phosphorus Concentration (mg/L)			Effluent Phosphorus Load (g/d)
						Feed	Untreated Effluent[c]	After Treatment[d]	
Mar	236703	0.010	106.5	2.9%	43.86	0.051	0.016	0.008	6.69
Apr	235135	0.015	190.5	2.8%	75.73	0.060	0.018	0.009	11.55
May	233578	0.020	315.3	2.7%	120.90	0.069	0.021	0.010	18.44
Jun	232031	0.028	511.6	2.6%	188.89	0.078	0.024	0.012	28.81
Jul	230495	0.033	663.8	2.6%	245.08	0.085	0.026	0.013	37.38
Aug	228968	0.041	906.7	2.5%	321.88	0.091	0.028	0.014	49.09
Sep	227452	0.060	1627.4	2.4%	554.62	0.106	0.032	0.016	84.58
Oct	225946	0.079	2420.8	2.2%	756.27	0.111	0.034	0.017	115.33
Nov	224449	0.089	2929.1	2.0%	831.85	0.108	0.033	0.016	126.86
Dec	112963	0.048	1626.7	1.9%	438.87	0.106	0.032	0.016	66.93
Jan	112215	0.049	1666.4	1.9%	449.59	0.107	0.033	0.016	68.56
Feb	111472	0.049	1705.5	1.9%	460.15	0.108	0.033	0.017	70.17
Mar	110733	0.052	1843.7	1.9%	497.43	0.111	0.034	0.017	75.86

Notes:

a. Numbers back-calculated to produce 220,000 smolts, and assuming mortality of 0.7 percent per month, with 110,000 fish removed in November and the remaining 110,000 removed in March.

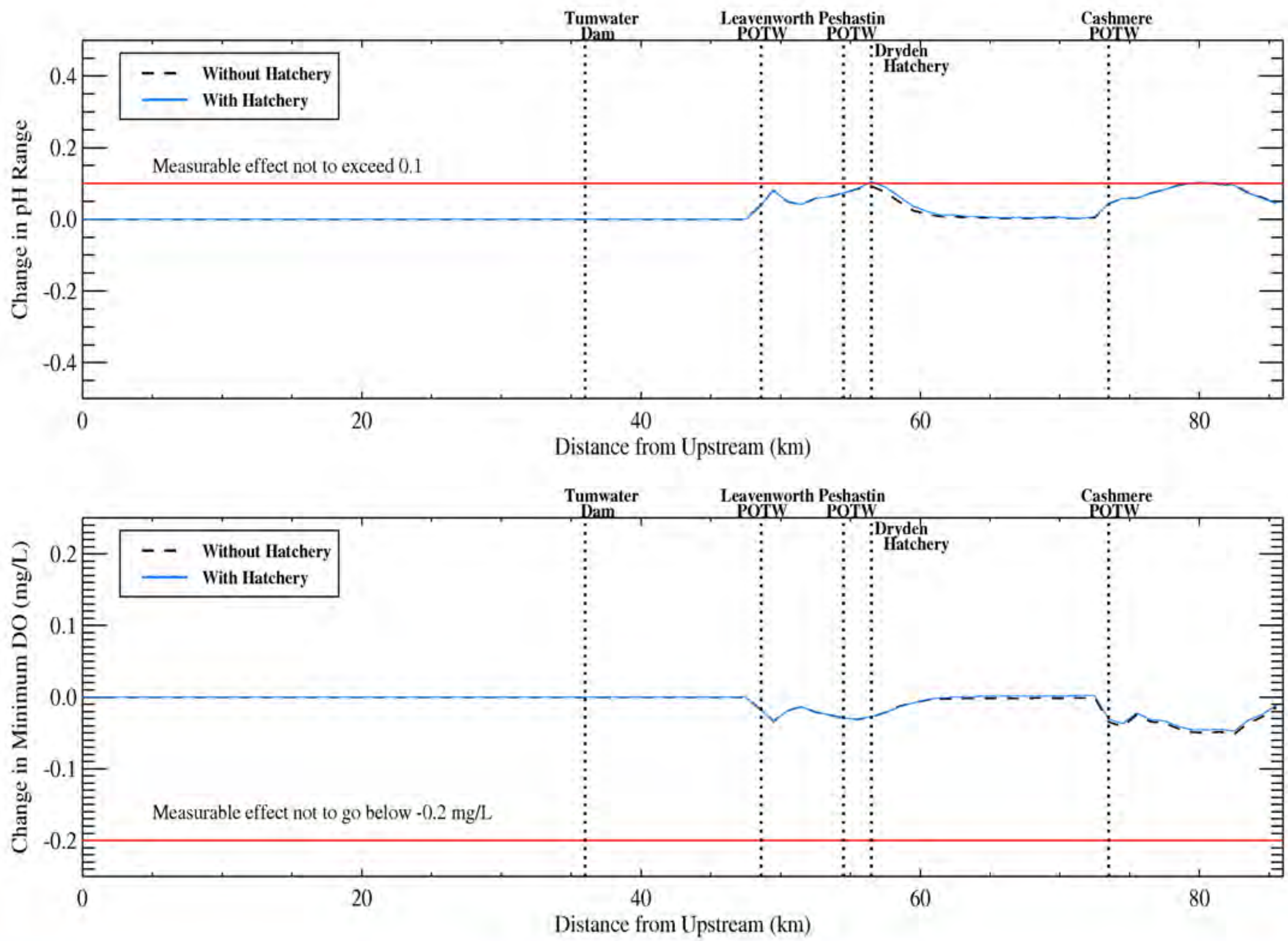
b. Skretting Nutra Fry diet contains 1.42 percent phosphorus by weight.

c. Assumes assimilation of 39 percent based on a highly digestible diet.

d. Assumes treatment efficiency of 50 percent.

mg/L = milligrams per liter
m^3/s = cubic meters per second
kg = kilograms
g feed/g fish/d = grams of feed per gram of fish per day
g/d = grams per day

Figure 3-1. Difference from natural conditions in range of pH (top graph) and minimum DO (bottom graph) at permissible POTW loading with and without proposed hatchery at Dryden



George (Backup)

The George site is being considered as an alternative to the Dryden site if a small hatchery at Dryden is determined to be infeasible. Discharge from the George facility would enter the Wenatchee River 1.8 miles downstream of the Lake Wenatchee outlet. Discharges from this hatchery, if operated, would flow through an existing flood overflow side channel for about a mile before entering the Wenatchee River.

The hatchery is expected to be operated under the same conditions as Dryden, so the same QUAL-2K modeling approach was used to evaluate the discharge impacts. The impact of hatchery operation was evaluated for 7Q10 summer low flow conditions. The only difference between this model setup and the one employed for Dryden is the location of the discharge.

The discharge from the facility would enter a channel that is vegetated significantly and flows only during flood events. Therefore, it is unlikely that the entire hatchery discharge would enter the Wenatchee River during critical summer conditions, due to infiltration losses to the underlying aquifer. Also, significant amounts of nutrients would be assimilated in the 20 acres of side-channel habitat between the hatchery discharge and the river. However, for the purposes of this evaluation it is assumed that the entire discharge would reach the Wenatchee River without any assimilation of phosphorus and without any loss in flow. This is likely a substantial over-estimate of the loading to the Wenatchee River but provides a worst-case scenario.

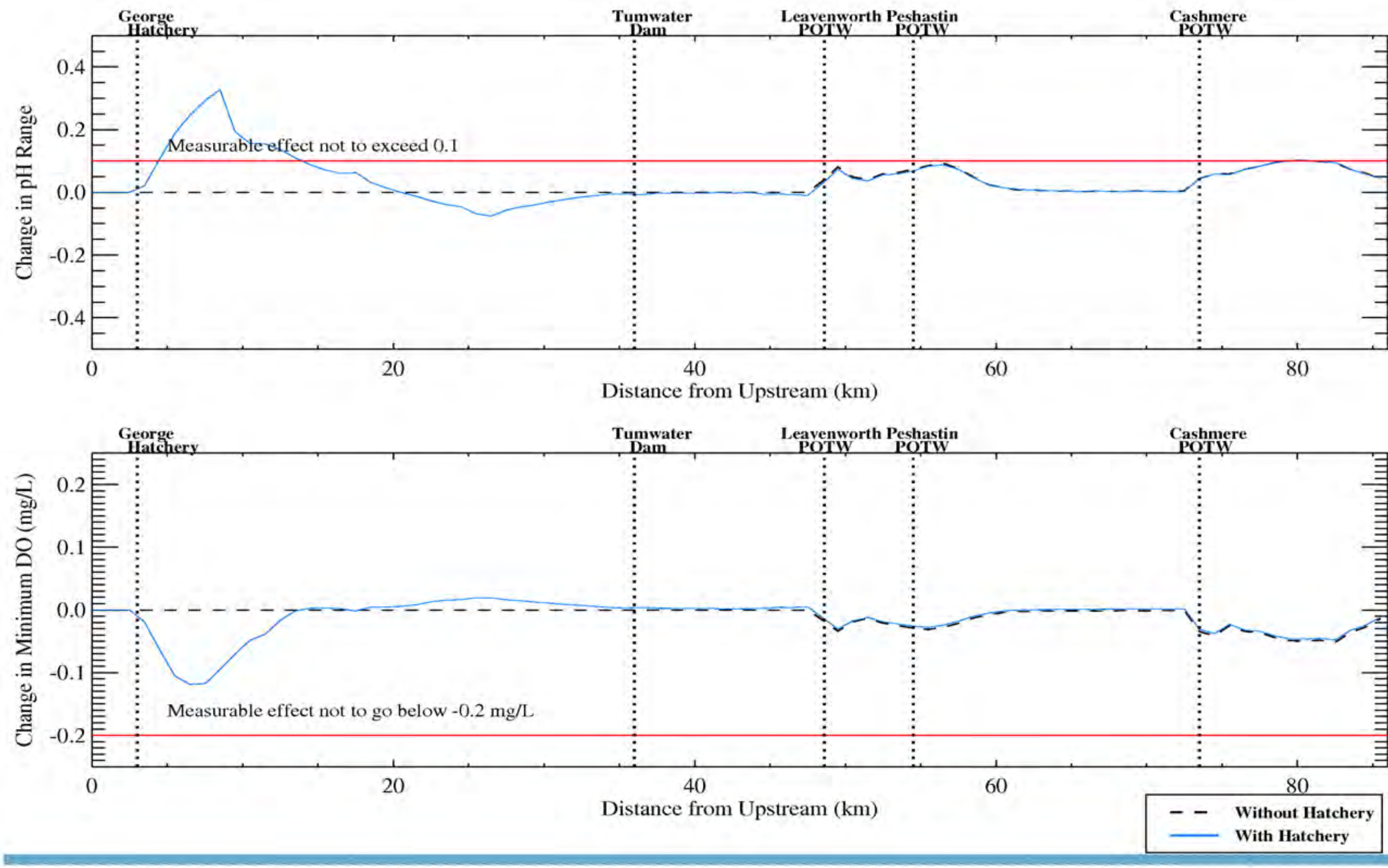
Analysis shows that changes to flow are minimal given the small quantity of flow expected from the discharge, and the predicted temperature range showed negligible change over the simulation of natural conditions. Phosphorus concentration was predicted to increase downstream of the discharge, but the differences over natural conditions are imperceptible past Tumwater Dam, approximately 35 kilometers (km) (22 miles) downstream. In the same section of the river, both dissolved oxygen and pH show significantly wider ranges compared to the natural condition predictions. Graphs in Section 4.2.10 in Appendix 7 demonstrate these differences.

Figure 3-2 shows the difference from maximum natural conditions when hatchery discharges are included. In the section of the river upstream of Tumwater Dam, the hatchery discharge noticeably changes the existing condition, particularly between RKM 5 through 15 (RM 3.1 through 9.3), where the changes are predicted to exceed the threshold for measurable change.

These differences can be explained from the context of the hatchery loading relative to the background phosphorus load. The hatchery loading contributes about 9% of the background load in the upstream section. The relative contribution for the Dryden Hatchery was calculated to be about 3% of the predicted background load immediately upstream of the discharge. Thus, the higher background concentration downstream of the George Hatchery discharge could produce a measurable change in DO and pH on a localized scale.

Because a very conservative estimate was used for specifying the load (i.e., the entire hatchery discharge and all phosphorous would reach the Wenatchee River); and because in the downstream reaches, particularly in the TMDL domain (i.e., downstream of the city of Leavenworth), the water quality changes resulting from the hatchery loads are imperceptible from the background condition; it is concluded that, while localized impacts are possible due the hatchery, impacts farther downstream are unlikely.

Figure 3-2. Difference from natural conditions in range of pH (top graph) and minimum DO (bottom graph) at permissible POTW loading with and without George Hatchery discharge



3.5.3.4 Combined Impacts of Wenatchee Basin Hatchery and Acclimation Sites

The combined impact of the proposed coho restoration activities on water quality in the Wenatchee basin is expected to be negligible for the reasons listed below. Explanation of these conclusions follows the list.

- The nutrient load is negligible. The maximum total addition of phosphorous due to the project, at peak production levels, is estimated to be 0.38 kilogram per day during the acclimation period, which is about 1% of average Wenatchee River load when acclimation activity is ongoing.
- Despite the conservative modeling assumptions used, impacts to DO and pH due to upstream acclimation are estimated to be negligible in the TMDL domain (the lower Wenatchee River downstream of the city of Leavenworth).
- Lower water temperatures during the acclimation period limit in-stream biological activity.
- An analysis of travel times suggests that the residence times of any nutrients discharged to the system would be small during spring high flows that are prevalent when feed rates are highest. Therefore, most of the loads would be removed during spring high flows and impacts are not expected later in the year, including the summer low-flow period.
- In-stream data collected from the Wenatchee basin showed that most of the phosphorous being discharged is not in a readily bio-available form. Even the travel times calculated under low-flow conditions were not expected to provide a sufficiently long residence of the total phosphorus loading in the system, thereby keeping it largely unavailable for biological uptake during transport through the basin.

The analysis supporting these conclusions is discussed below.

The QUAL-2K model developed by WDOE for the purpose of establishing load allocations (Carroll et al. 2006; Carroll and Anderson 2009) was applied to assess both the combined and cumulative impacts for the Wenatchee River (referred to as the lower Wenatchee subbasin). The portion of the Wenatchee basin composed of Lake Wenatchee and its tributaries, the White River and the Little Wenatchee River (referred to as the upper Wenatchee subbasin), was evaluated based on mass balance analyses using existing water quality and flow data.

Upper Wenatchee Subbasin to Lake Wenatchee

Lake Wenatchee is a deep water lake (maximum depth of nearly 100 feet) that is fed by the Little Wenatchee River and the White River and discharges to the Wenatchee River. Three of the proposed acclimation sites discharge to this receiving water system: the Two Rivers site in the Little Wenatchee River and the Tall Timber and White River Springs sites in the White River. While the Dirty Face site is in the White River system, it is an adult plant site, not a juvenile acclimation site. Adults are not fed, so nutrient additions to the river from feed would not occur from that site.

Given the relatively large size of the lake and its associated long hydraulic retention period, it is unlikely that loads entering the lake would reach the Wenatchee River directly; instead, they are likely to be cycled within the lake. Data comparing pH levels flowing into and out of the lake show that pH levels are substantially lower when leaving the lake. The lake likely buffers the upstream phosphorus loads and transmits only a fraction of the upstream loads to the Wenatchee River. Therefore, the water quality impact of concern within the upper Wenatchee subbasin is Lake Wenatchee proper.

To estimate the combined impact of the three proposed locations, the total phosphorus loads anticipated from acclimation activity were calculated based on the proposed number of coho to be acclimated. Table 3-6 shows the relative contribution of the loads from combined acclimation activity in the White River and the Little Wenatchee River. In 2009, these loads were estimated to contribute less than 0.25% of the total background loads that entered the lake over the acclimation period (March through May) from these two tributaries. This calculation does not account for in-stream assimilation, which, if considered, would further reduce the relative contribution from acclimation activity.

Table 3-6. Estimated contribution of TP loads from 50 days of acclimation activity in the three upper Wenatchee acclimation sites

Location	No. of Fish	TP Loading from Acclimation[a] (kg)	TP Load In System[b] (kg)	Contribution to Total
Little Wenatchee River	120,000	1.92	604.50	0.32%
White River	160,000	2.56	1242.86	0.21%

kg = kilograms
a. Assumes 0.32 mg/d/fish (derived from active sites in Nason Creek; see Table 3-2)
b. Loads calculated using 2009 flows and TP measurements from 3/23/2009 to 5/10/2009

Lower Wenatchee Subbasin – Wenatchee River

The WDOE TMDL model was used with minimal changes to determine the Wenatchee River and Icicle Creek phosphorus load allocations (Carroll and Anderson 2009) and to assess the potential impacts of the proposed acclimation sites on water quality in the lower Wenatchee subbasin. Changes to the model focused on representing conditions for the month of March, as represented by the assumptions listed below. Modifications were also made to air and water temperature functions to reflect March conditions. Using these assumptions to set up the evaluation model ensured that the maximum potential impact was identified in the results.

1. March was chosen as the critical period for evaluation. All the proposed acclimation sites would be operational at this time. Flows later in the spring increase significantly, diluting nutrient loads and scouring attached algae from the system. Approximately half the sites might be operated through the winter, but due to the smaller number of fish being acclimated, low water temperatures, and low feed rates, water quality impacts in winter are expected to be lower than during March.
2. Flows in March were specified as the 7Q10 summer low flow calculated by WDOE for the TMDL evaluation (typically, March flows are somewhat higher).
3. Phosphorus discharged due to acclimation activity was considered to be 100% bioavailable (i.e., phosphorus discharges are all in the orthophosphate form such that they can be readily taken up by algae during photosynthesis).
4. Phosphorus released from the acclimation ponds is not assimilated in the receiving stream before it reaches the Wenatchee River. This assumption ensures that, in the model, the entire phosphorus load discharged from the ponds reaches the Wenatchee River; normally, however, some phosphorus would be assimilated before reaching the Wenatchee River.
5. Average phosphorus loads from the proposed acclimation ponds that were developed based on the data collected from the active ponds in Nason Creek from late March through early May are applicable in March, even though feed levels in March are lower than later in the acclimation period because fish are smaller in March.

To assess the combined impacts, TP loads were estimated for the active sites (Table 3-2) and proposed sites (Table 3-3). Dryden facility inputs for the month of March (Table 3-5) were also used. The estimated TP loads from the discharges were included with the background orthophosphate load in the model. The final orthophosphate concentrations were calculated using the flows used in the model and the combined load estimate.

Even though a separate analysis was done for upper Wenatchee subbasin sites in White River and Little Wenatchee River (see previous subsection), and given that Lake Wenatchee would buffer TP loads originating from the upper subbasin sites, discharges from these sites were represented in the model as being 100% available at the outlet of Lake Wenatchee. These assumptions provide an estimate of the maximum potential impacts in the Wenatchee River.

Figure 3-3 presents predictions for combined TP impacts and compares them to background conditions. TP is higher in the upper reaches (upstream of Leavenworth) and declines steadily after an initial increase. The increase in the first 10 kilometers (6 miles) of the river reflects inputs from the Nason Creek, the upper Wenatchee subbasin, and the Chiwawa River sites. Much of the phosphorus appears to be assimilated around RKM 27 (RM 16.8), which is upstream of Tumwater Canyon.

Differences in the range of DO simulated with and without the project-related loads are negligible; the maximum difference is less than 0.1 milligram per liter (mg/L). The daily minimum DO is well above the water quality threshold for DO. These results indicate that in the absence of other nutrient sources, the project alone is not expected to adversely impact DO resources within the Wenatchee River.

The range of pH with the project is generally equal to the range simulated for the natural conditions (Figure 3-4). At approximately RKM 27 (RM 16.8), the upper bound of the pH appears to be somewhat higher than the pH simulated for background conditions. This is a consequence of the higher algal levels simulated in this reach over background conditions.

Finally, there is no appreciable difference in the range of the temperature simulated with and without the project loads.

The measurable change criterion defined in Section 3.5.1 was the basis for determining potential water quality impacts of the proposed project. The range of pH evaluated against the measurable change criterion of 0.1 unit is presented in Figure 3-5. The model simulations are generally well below the criterion. The minor increase in the difference in range near RKM 27 can be attributed to induced biological activity associated with project loads. Nonetheless, these increases are well below the criterion. Figure 3-5 also shows that the DO concentrations simulated by the model do not produce any deficit that exceeds 0.2 mg/L. The only deviation from the background conditions appears to be at RKM 27 and is associated with algal activity.

The spatial differences in TP, DO, and pH simulated by the model with and without the loads from the proposed project show that the majority of the phosphorus load from the project enters in the upstream reaches, and much of it is assimilated in the Wenatchee River prior to entry into the lower reaches (below the city of Leavenworth). These results indicate that even under the worst-case flow and project-related loading conditions simulated here, the proposed project would not adversely impact water quality. The model simulations demonstrate that the maximum predicted impact from the proposed project, including discharges from the proposed hatchery at Dryden, is so small as to be undetectable.

Figure 3-3. Maximum (top line) and minimum (bottom line) total phosphorus concentrations simulated by QUAL-2K model compared for cases with and without the proposed project for 7Q10 low-flow and March climatic condition with maximum background loadings determined in WDOE TMDL

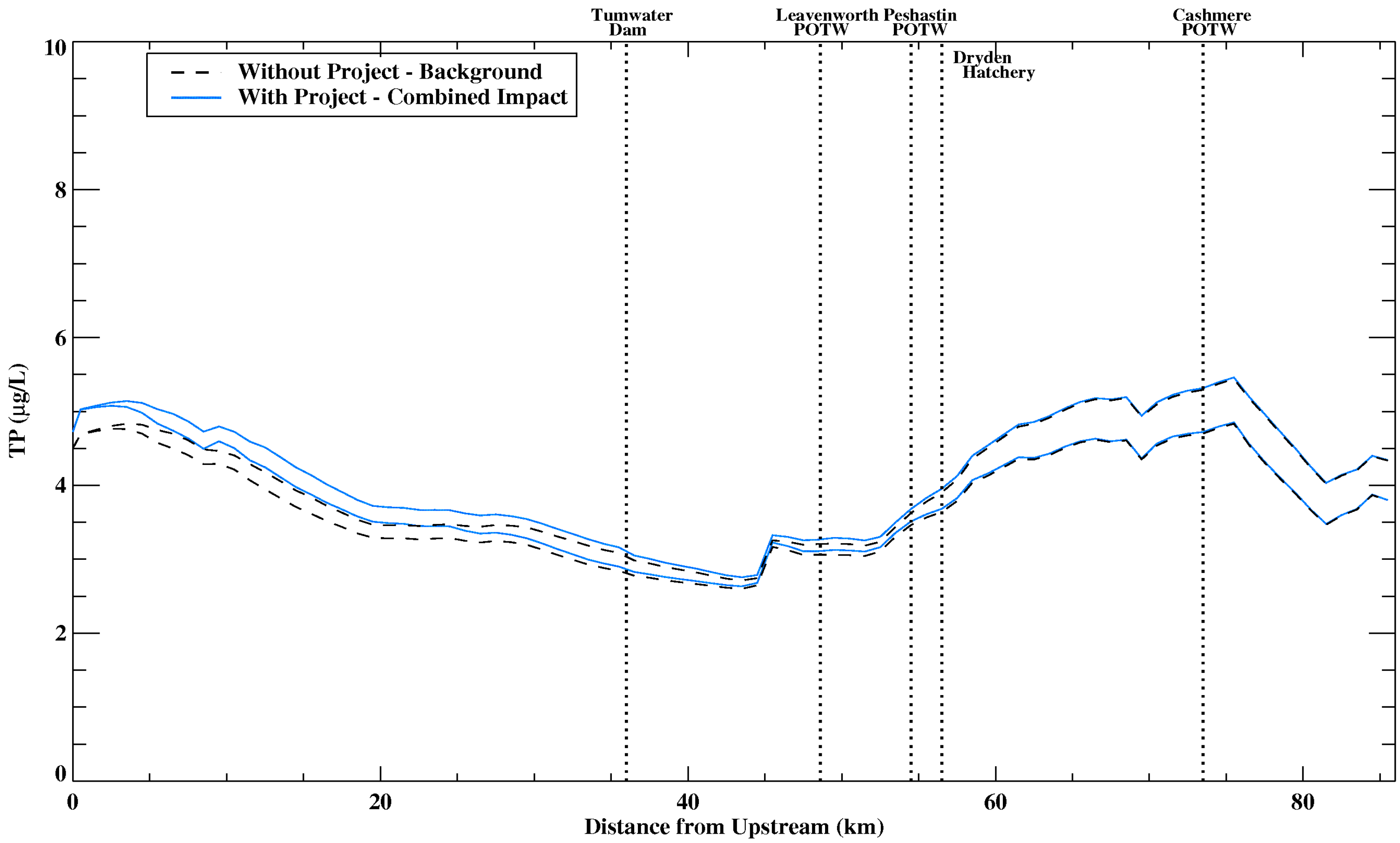


Figure 3-4. Maximum (top line) and minimum (bottom line) pHs simulated by QUAL-2K model compared for cases with and without the proposed project for 7Q10 low-flow and March climatic condition with maximum background loadings determined in WDOE TMDL

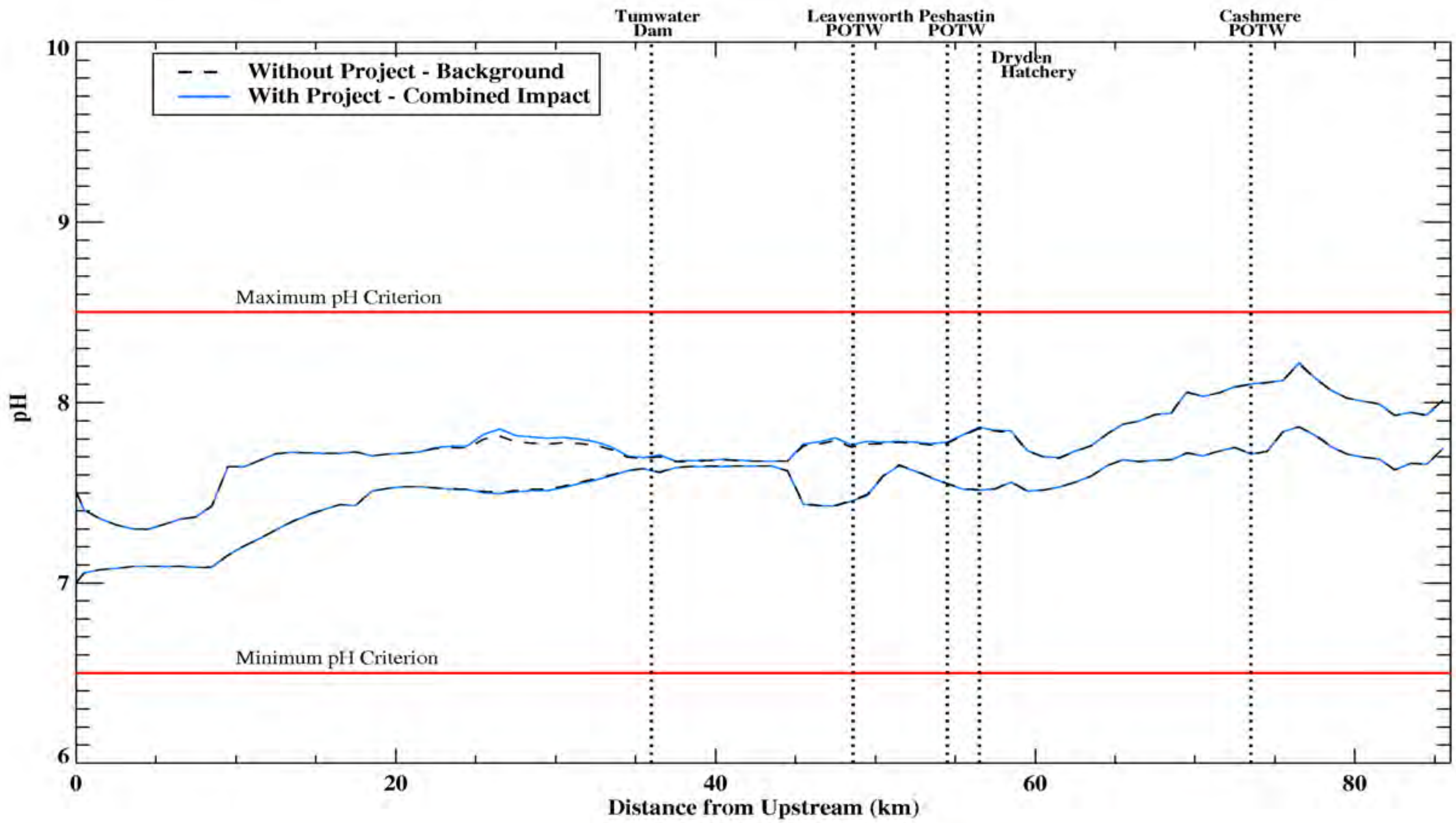
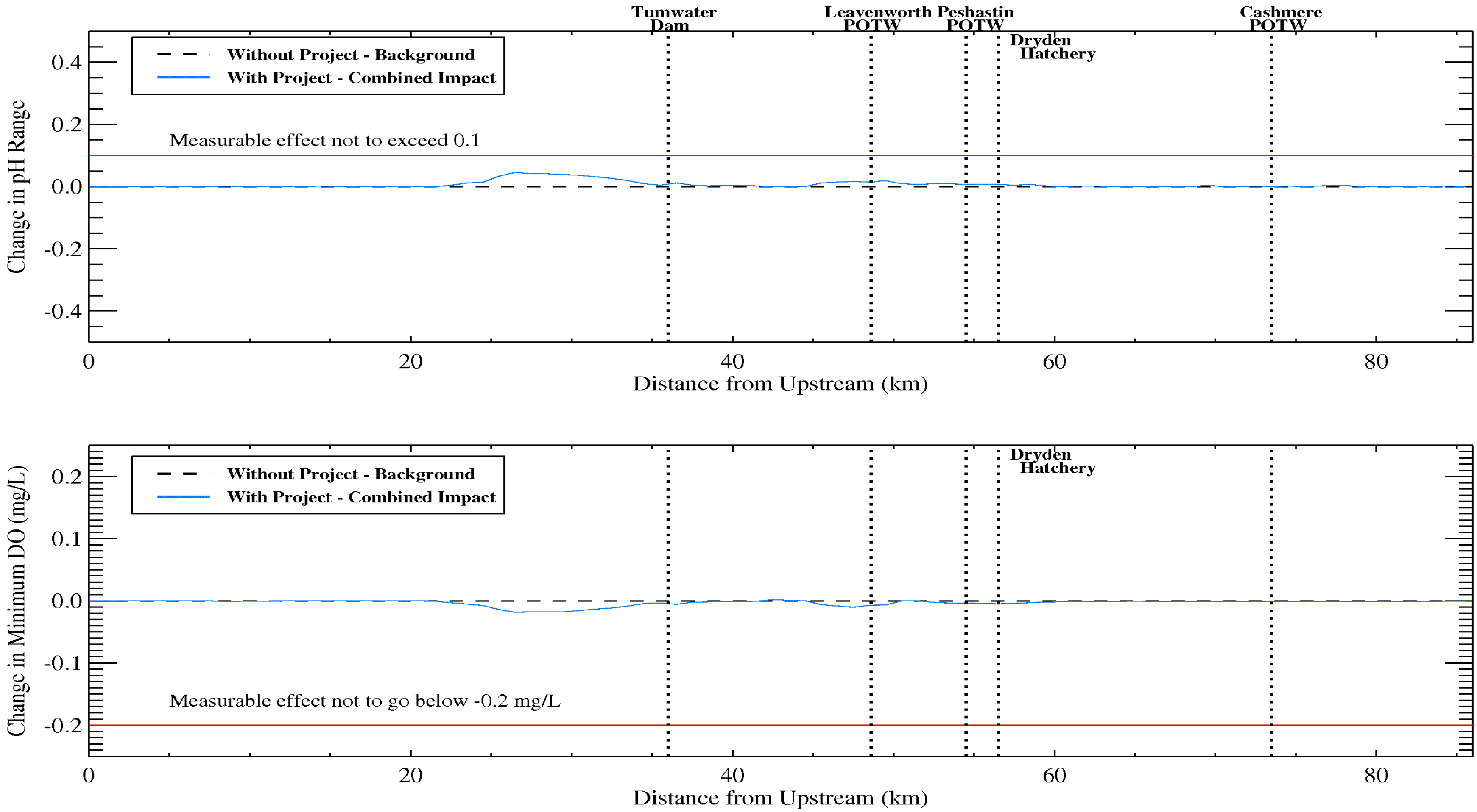


Figure 3-5. Difference from March background conditions in the range of pH (top graph) and minimum DO (bottom graph) with and without the proposed project in the Wenatchee basin



3.5.3.5 Methow Basin Sites (Primary)

The site-specific acclimation-related nutrient loads for the Methow sites were calculated using an approach similar to that of the Wenatchee sites. Loads estimated from measured data at active acclimation sites in Nason Creek (see Table 3-2) were used for this analysis. The TP loads estimated for the proposed sites in the Methow basin are shown in Table 3-7.

Table 3-7. TP loads estimated for proposed acclimation activity in the Methow basin

Proposed Site	No. of Fish (thousands)	TP Load[a] (kg/d)	Receiving Stream
Goat Wall	50	0.016	Methow
Heath	200	0.064	Methow
Winthrop NFH	100	0.032	Methow
MSWA	87.5	0.028	Chewuch
Mason	87.5	0.028	Chewuch
Pete Creek Pond	125	0.040	Chewuch
Lincoln	110	0.035	Twisp
Twisp Weir	110	0.035	Twisp
Lower Twisp	30	0.010	Twisp
Parmley	50	0.016	Beaver
Gold	50	0.016	Gold

a. Estimated from average load of 0.32 mg per fish per day calculated from measured data at active discharges in Nason Creek
kg/d = kilograms per day

Methow River Mainstem (3 sites)

Goat Wall: This is the most upstream site proposed that would discharge directly into the Methow River. For the relatively small number of smolts (50,000) acclimated, the TP loading to the Methow River is expected to be about 16 g/d. The average flow from 1990 through 2010 for the months of March through May in this section of the Methow River (USGSG Gage 12447383, Methow River near Goat Creek) is about 900 cfs, which is comparable to the flow at the mouth of the White River in the Wenatchee basin (WDOE Station 45K090, March through May average from 2003 through 2010 is about 1,000 cfs). Given the predominantly forested nature of the upper portions of the Wenatchee and Methow basins, the background phosphorus concentrations are likely to be similar. It was shown that a TP load of up to 35 g/d (see Table 3-3) from individual acclimation-related discharges in the White River would comprise only a very small fraction (less than a fifth of a percent) of the background load. Given the similarity in the flows and land type between the two watersheds, the impacts of discharges from Goat Wall are expected to be similarly negligible in this reach of the Methow River.

Heath: About 200,000 smolts are expected to be acclimated in a large pond at the Heath site. The TP loads from this site are estimated to be four times that of Goat Wall at about 64 g/d. This site is located upstream of the city of Winthrop in the same section of the river as Goat Wall (although farther downstream). Therefore, the assessment applied for Goat Wall can be applied here. Even though the load is almost double, it is still expected to be a small fraction of the background conditions and comparable in magnitude to the largest load expected for the White River sites. Similar to Goat Wall, the impacts are expected to be negligible.

Winthrop National Fish Hatchery: Discharges from this public hatchery are covered by a discharge permit. The loads from acclimation activity are expected to be about 32 g/d. Some level of treatment of the discharge that is associated with hatchery operations is expected. Thus, the loads from this site would be even smaller. Therefore, potential impacts related to acclimation activity are expected to be negligible.

Chewuch River (3 sites)

Methow State Wildlife Area (MSWA) Eightmile: The MSWA Eightmile site is the most upstream proposed site on the Chewuch River, located in a side channel above the confluence with Eightmile Creek. About 87,500 smolts are proposed to be acclimated, for which the estimated TP load to the system is 28 g/d. The watershed for the Chewuch is similar to the upper portions of the Methow River (predominantly forested with very little human influence). Thus, a similar approach as that used for the upper Methow sites (Goat Wall and Heath) was used here. The long-term (1991 through 2010) average flow for March through May reported at the USGS Gage in Winthrop is about 700 cfs, which is lower than but comparable to the upper Methow River flows. Given the similarity in the subbasin characteristics, background loads, and acclimation-related nutrient loads, water quality impacts from acclimation activity are expected to negligible.

Mason: Discharges from Mason would enter the Chewuch River through Eightmile Creek. The number of smolts to be acclimated at this site is identical to MSWA Eightmile. Given Mason's proximity to that site and their similar in-stream conditions, impacts are also expected to be similar.

Pete Creek Pond: Approximately 125,000 smolts are expected to be acclimated at this site, corresponding to a TP load of 40 g/d. This site is proposed on the lower Chewuch River where the watershed and background loads would be comparable to the other two Chewuch River sites. While the acclimation-related loads are expected to be higher (by 40% compared to MSWA) due to the greater number of fish acclimated, the background loads in the Chewuch River are much higher than the proposed new loads. Therefore, acclimation-related impacts on the receiving stream are expected to be negligible.

Twisp River (3 sites)

Lincoln: This site is the most upstream among the proposed sites on the Twisp River. The TP load in the discharge associated with the proposed acclimation of 110,000 smolts is expected to be about 35 g/d.

The primary human influence in the Twisp River occurs near the city of Twisp, which is at the confluence of the Twisp and Methow rivers, leaving much of the Twisp River watershed as forest—similar to the upper section of the Methow River and the Chewuch River. Therefore, background phosphorus concentrations in the Twisp River likely would be similar. The Twisp River flows are smaller than those in the upper Methow River and Chewuch River (average flow at the USGS Gage 12448998 on the Twisp River near the city of Twisp for March through May in 1990 through 2010 is about 440 cfs). Therefore, background loads in the Twisp River would be smaller, and the acclimation-related loads can be a larger proportion of the background loads than what would be encountered in the Chewuch River and upper Methow River sites. Even if the proportion is double what is expected at the upper Methow River and Chewuch River sites, it is still expected be a small fraction of the background conditions (see proportions calculated for the upper Wenatchee River sites in Table 3-3 for an order of magnitude estimate). Impacts on the receiving stream are therefore expected to be negligible.

Twisp Weir: This site is approximately midway between the Lincoln site and the confluence of the Twisp River with the Methow. As with Lincoln, the TP load in the discharge associated with the proposed acclimation of 110,000 smolts is expected to be about 35 g/d. Given that in-stream conditions are similar to the Lincoln site and the same number of fish is proposed, impacts resulting from the Twisp Weir site are expected to be negligible.

Lower Twisp: The site is close to the Twisp River confluence with the Methow River. For the 30,000 fish proposed at this site, the acclimation-related TP loads are expected to be similar—less than 10 g/d. Given the site's proximity to the Methow River, greater dilution of the TP load can be expected downstream of the confluence. Therefore, impacts for this site would likely be lower than for the Lincoln site.

Beaver Creek – Parmley

The Parmley site is expected to acclimate 50,000 smolts. The TP load associated with this site is an estimated 16 g/d. Beaver Creek is smaller than the other streams considered thus far; however, the number of fish proposed for acclimation at this site is proportionally smaller. Consequently, the nutrient loading that could occur as a result of acclimation at this site is also expected to be smaller than the other sites previously discussed. Impacts are therefore likely to be negligible. A more definitive evaluation was not possible due to the lack of sufficient data for calculating background loads in the creek.

Gold Creek – Gold

This proposed site is located in the lower Methow basin. About 50,000 smolts would be acclimated here, with a corresponding TP load of about 16 g/d to Gold Creek. Gold Creek is similar in size to Beaver Creek. Also, because this is the only acclimation site proposed on Gold Creek with the same number of fish as proposed for the Parmley site on Beaver Creek, localized impacts are expected to be similarly negligible.

3.5.3.6 Methow Basin Sites (Backup)

Seven backup sites are being considered for the Methow basin, one or more of which would be used if one or more of the proposed sites is determined to be infeasible. The TP loads estimated for these sites are presented in Table 3-8 and discussed in the following sections.

Chewuch Acclimation Facility

This existing acclimation facility might be expanded if other sites on the Chewuch River are not developed. About 125,000 smolts would be acclimated at the site. The TP loads associated with this activity would be about 40 g/d. The assessments from the other Chewuch River sites would apply here due to the similar location and number of fish. Impacts are expected to be negligible.

Table 3-8. TP loads estimated for backup sites in the Methow basin

Proposed Site	No. of Fish	TP Load[a] (kg/d)	Receiving Stream
Chewuch AF	125,000	0.040	Chewuch
MSRF	125,000	0.040	Chewuch
Biddle	50,000	0.016	Wolf
Utley	83,000	0.027	Twisp
Newby	83,000	0.027	Twisp
Poorman	83,000	0.027	Twisp
Balky Hill	50,000	0.016	Beaver

a. Estimated from average load of 0.32 mg per fish per day calculated from measured data at active discharges in Nason Creek.
kg/d = kilograms per day

Methow Salmon Recovery Foundation (MSRF) Chewuch

The number of fish acclimated at the MSRF site would be the same as for the Chewuch Acclimation Facility (about 125,000). Given the site's proximity to the confluence with the Methow River and the similarity of the estimated TP loads to the other Chewuch sites, localized impacts on the Chewuch River due to TP loading from this site are expected to be negligible.

Biddle

This site is on Wolf Creek. About 16 g/d of TP would be discharged due to acclimation of about 50,000 smolts. This site is on a relatively small creek, and the impacts are likely to be similar to those estimated for the Parmley and Gold Creek sites. Lack of data prevented a detailed evaluation of localized impacts associated with this site.

Balky Hill

This site is located on Beaver Creek, and impacts are expected to be similar to those at the Biddle and Parmley sites. As with the Biddle site, due to lack of sufficient data, a detailed evaluation of localized impacts was not possible.

Utley

The Utley site would acclimate 83,000 smolts, if used. For those 83,000 smolts, the TP loads are expected to be about 27 g/d. The number of fish would be less than at Lincoln and Twisp Weir (the two primary sites) on the Twisp River, which are projected to have negligible impacts, so this site would also be expected to have a negligible impact.

Newby

The Newby site is downstream of the Utley site and would acclimate the same number of smolts, if used. The TP loads and the impacts are expected to be similar to the Utley site.

Poorman

This acclimation site is the farthest downstream of all backup sites on the Twisp River. Because the site would acclimate the same number of fish as the other Twisp sites, Poorman would also be expected to have a negligible impact.

3.5.3.7 Combined Impacts of Methow Basin Acclimation Sites

A rigorous mass balance model, such as the one developed by WDOE for the Wenatchee basin, was not undertaken for the Methow basin due to the lack of data for model development and calibration. The evaluation for the Methow basin applied existing data. Historical information on phosphorus concentrations for the acclimation months was limited. Therefore, the evaluations of the potential for the acclimation-related TP loads to dominate the background conditions are based on a comparison to the impacts assessed for the Wenatchee basin. This method is possible because the characteristics of the Wenatchee and Methow basins are comparable.

Both watersheds are predominantly forested. Both have the high peaks of the Cascade Mountains that contribute the majority of flows through snowmelt in spring. In both basins, much of the precipitation occurs during the months of October through March, and this precipitation is predominantly in the form of snow (Andonaegui 2001; Konrad et al. 2003).

Although the Methow basin is somewhat drier than the Wenatchee, the flow patterns are consistent between the two basins, with similar peak-flow and low-flow periods. This indicates that flow-driven processes such as mobilization of particulates, dilution of nutrients, in-stream re-aeration, and habitat conditions for attached algae are likely to be similar between the two basins.

The Methow basin is sparsely populated, even between Winthrop and Pateros.[12] Konrad et al. (2003) concluded, based on an analysis of water quality data collected throughout the basin, that human-caused impact is generally low. The major human sources of water pollutants in the basin are the publicly operated treatment works (POTWs) at Twisp and Winthrop and the Winthrop NFH.

Based on data collected by WDOE for March, April, and May 2005-2009, the average TP load over the 3-month period was estimated at approximately 39 kg/d. As with the Wenatchee basin, the loads generally followed the flow, with peaks in May that were much larger than March and April.

In order to estimate the combined impact of the proposed project, the TP loads from POTWs were separated from the overall loads to provide an estimate of background conditions. Based on discharge monitoring reports (DMR), the average daily loads from the POTWs were estimated and subtracted from the average loads calculated for the Methow River at Pateros. A DMR was not available for Winthrop NFH. Thus, the loads from this facility could not be differentiated.

Acclimation activity may contribute about 0.9% of the average background loads (Table 3-9). Noting that loads from Winthrop NFH and other minor point sources were not included, this is likely an overestimate of the relative contribution of the acclimation activity loads. In addition, discharge monitoring report data from fall were used for estimation of the loads due to lack of data for spring periods. Despite these limitations, the estimate of loads is considered reasonable, because loads from municipal POTWs generally do not show strong seasonal variability and basin flows in October through February are generally comparable to flows in early spring.

[12] Population of less than 5,000, based on 2000 census.

Table 3-9. TP loads estimated for the Methow basin with and without POTW loads

Source	TP Load (kg/d)
Methow River at Pateros [a]	39.20
Twisp POTW [b]	1.30
Winthrop POTW [c]	0.58
Estimated Background Load	37.31
Acclimation Activity Loads [d]	0.32

a. Average over March - May calculated from paired TP and flow data collected respectively by WDOE (48A070) and USGS (12449950) in the Methow River at Pateros in 2005 through 2009.
b. Based on NPDES discharge monitoring report information from October 2009 through February 2010.
c. Based on NPDES discharge monitoring report information from November 2009.
d. Sum of the loads estimated for the individual sites in Table 3-7.

As a check on the load estimates for the Methow basin, a similar loading calculation was performed for the Wenatchee basin, where point source discharge data were available for spring, and the results for the two basins were compared. Once the human influences were subtracted from the loads, the background load at the downstream reaches of the Wenatchee and Methow basins are 25.6 kg/d and 37.3 kg/d respectively (see Table 15 in Appendix 7 Water Quality Impacts and Table 3-9 above). The similarity in the characteristics of the two basins is supported further by the fact that the geographic areas and the background TP loads are proportional between the two basins; i.e., the background TP load in the Wenatchee basin is 69% of the Methow basin load, and the Wenatchee basin covers an area 73% the size of the Methow basin.

Project sites in the Wenatchee basin contribute approximately 1.5% of the background load. This is higher than the Methow basin estimate of 0.9%. This difference is expected because a larger number of fish are proposed for acclimation in the Wenatchee basin (about 1.15 million versus 1 million in Methow) and because of the contribution of TP loads from the proposed year-round rearing activities at the Dryden facility in the Wenatchee basin.

The modeling for the Wenatchee basin suggests that, even for critical conditions, acclimation-related nutrient loads are not expected to produce a measurable change in DO and pH (see discussion in Section 3.5.3.4 “Combined Impacts to Water Quality of Wenatchee Basin Acclimation Sites”). Based on the analysis in this section and considering the similarities between the two basins, it is concluded that the TP loads introduced to the Methow basin from this project are unlikely to produce a measurable change in DO and pH (defined in Section 3.5.1).

3.5.4 Impacts of the No Action Alternative

3.5.4.1 Wenatchee Basin

The mechanistic modeling approach used for estimating the combined and cumulative impacts for the Proposed Action (see Section 3.5.3 Impacts of the Proposed Action) was used for the No Action Alternative sites in the Wenatchee basin. The estimated phosphorus loads for the sites in the No Action Alternative (Table 3-10) were used to calculate the phosphorus concentrations of the respective tributaries receiving the discharge in the QUAL-2K model. Loading from any other site in the Proposed Action that is not listed in Table 3-10 was excluded. All other simulation conditions and modeling assumptions remained unchanged from the Proposed Action simulations.

Table 3-10. TP loads estimated for No Action Alternative sites in Wenatchee basin

No Action Site	No. of Fish	TP Load[a] (kg/d)	Receiving Stream
Rohlfing	100,000	0.032	White River
Coulter	100,000	0.032	White River
Butcher	100,000	0.032	Little Wenatchee River
Beaver	100,000	0.032	Beaver
Leavenworth NFH	100,000	0.032	Icicle
Total	**500,000**	**0.16**	

a. Uses an estimate of 0.32 mg/d/fish derived from active sites in Nason Creek; see Table 3-2.

3.5.4.2 Methow Basin

Under the No Action Alternative, 200,000 fish would be acclimated in the Methow basin (Table 3-11), which is 20% of the number of fish for the Proposed Action (Table 3-7). Therefore, the TP loads for the No Action Alternative are expected to be lower by 80%. Based on the background and basin loads estimated for the Methow basin in Table 3-9, it is expected that the No Action Alternative would contribute less than 0.2% of the basin loads. Therefore, water quality impacts on the Methow River are expected to be negligible if the No Action Alternative is implemented.

Table 3-11. TP loads estimated for No Action Alternative sites in Methow basin

No Action Site	No. of Fish	TP Load[a] (kg/d)	Receiving Stream
Heath	20,000	0.006	Twisp River
Lincoln	60,000	0.019	Twisp River
Lower Twisp	20,000	0.006	Methow River
Winthrop NFH	100,000	0.032	Methow River
Total	**200,000**	**0.064**	

a. Uses an estimate of 0.32 mg/d/fish derived from active sites in Nason Creek; see Table 3-2; numbers don't add up due to rounding.

3.5.4.3 Combined Impacts

The combined impact simulation showed that the impacts to water quality are negligible if the project were to continue without the changes in the Proposed Action (see Appendix 7, Section 6.1.1). This is to be expected, given that the results discussed in previous sections demonstrated that, even with the greater number of sites in the Proposed Action, impacts would be negligible.

3.5.5 Mitigation for the Proposed Action

The project proposes several practices to reduce nutrient levels, several of which are already incorporated into the design of the project:

- Acclimate and release small numbers of coho smolts from multiple sites to dilute the loads and reduce local effects.
- Select ponds with flow rates that are higher than those used in constructed regional fish facilities so that there is substantial dilution of nutrients in the discharges.
- Acclimate in large, natural ponds; their higher water volumes provide greater dilution of fish feed and wastes and buffer nutrient loading to the receiving stream.
- Feed high-phosphorus-digestibility foods.
- Periodically remove sediments from some acclimation ponds to eliminate potential long-term accumulation of nutrients.
- At the Dryden Hatchery, treat water at a level comparable to Leavenworth NFH.

3.6 Surface and Groundwater and Water Rights

3.6.1 Affected Environment

The potential affected environment for this resource includes surface water flows, surface water temperatures, water quality, local groundwater levels, and existing users (water rights) in the immediate vicinity and downstream of the sites where new groundwater sources are developed. The potential affected environment at individual sites is discussed in Section 3.6.3 Impacts of Proposed Action. Only two acclimation sites in the Wenatchee basin (one primary and one backup) would require new groundwater development as part of this project; four acclimation sites in the Methow would require new groundwater sources. Other facilities that could be used by the project use groundwater, but the impacts of their development and use have been or will be evaluated as part of other permitting processes. Only the sites requiring new development are discussed, except in the cumulative impacts section (Section 3.15).

Washington State's Administrative Code establishes stream management units, maximum future allocations, basins that are closed to further water right appropriation, and in-stream flow regulations for the two basins. In the Wenatchee River basin, the Chumstick Creek subbasin is closed to future appropriations. Several stream basins and lakes within the Methow River basin also are closed to future appropriations (WAC 173-545 [Wenatchee] and WAC 173-548 [Methow]).

3.6.2 Types of Impact

New water supplies to acclimation sites and the proposed hatchery that are based on **new groundwater wells** could have the following impacts:

- Reduction in the production capacity of nearby wells
- Reduction or increase in surface water flows
- Reduction in surface water quality

Reduction in the production capacity of nearby wells. Such impacts are considered to be an adverse effect on the existing well-owner's water rights. The criteria used to evaluate the potential impacts of proposed groundwater withdrawals on existing groundwater users are based on the amount of drawdown interference the withdrawal would cause in the existing wells. Drawdown interference of less than one foot likely would not affect the production capacity of existing wells. Drawdown interference of greater than one foot would require case-specific analysis to evaluate whether the drawdown would impact production capacity.

The Washington Department of Ecology (WDOE) is charged with administering state water rights laws. The term "impairment" is used by WDOE as the criterion for assessing impacts to groundwater rights. Washington Administrative Code (WAC) 173-150-060 describes how to determine whether a groundwater right has been impaired. Specifically: "A ground water right which pertains to qualifying withdrawal facilities, shall be deemed to be impaired whenever:

> 1) there is an interruption or an interference in the availability of water to said facilities, or a contamination of such water, caused by the withdrawal of ground water by a junior water right holder or holders; and
>
> 2) significant modification is required to be made to said facilities in order to allow the senior ground water right to be exercised."

Reduction in surface water flows. The criterion for surface water flow impacts (local, downstream, in-stream, and low-flow) used in this analysis is any measurable or theoretical reduction in surface water flow rates.

Reduction in surface water quality. Water quality criteria are established in Washington State by WAC 173-200 for groundwater and WAC 173-201A for surface water. The criterion for assessing potential impacts to surface water quality is any measurable or theoretical change to surface water quality resulting from groundwater usage.

Groundwater withdrawals can affect surface water levels depending on the degree to which the groundwater source is in hydraulic continuity with surface water. Hydraulic continuity is a scientific term that describes how easily water flows between groundwater and surface water (streams, rivers, lakes, and wetlands). When hydraulic continuity is high, water flows easily between groundwater and surface water. This impacts how water should be managed because anything done to the groundwater (such as, pumping from wells or pollution seeping into the groundwater) will affect the surface water, and vice versa (Chehalis Basin Watershed Planning Issue Paper, accessed at www.crcwater.org/cbp).

New water supplies to acclimation sites and the proposed hatchery that are based on **new surface water withdrawals** could reduce surface water flows.

3.6.3 Impacts of the Proposed Action

Four primary sites and one backup site in the Wenatchee basin (Tall Timber, Chikamin, Dryden [primary] and George [backup]); and one primary and one backup site in the Methow basin (Twisp Weir [primary] and Newby [backup]) require new surface water intakes. The stream reaches between the intakes and outlets would have slightly lower total flow when water is diverted, but these distances are generally 1,500 feet or less. Because the water used would be returned close to the intakes, the withdrawals are essentially water neutral and would have no regional impact on flows. In-stream flows required by WDOE would be maintained. For these reasons, surface water withdrawals will not be discussed further.

Table 3-12 summarizes potential impacts from new groundwater withdrawals at primary sites.

Table 3-12. Summary of potential impacts in the Wenatchee and Methow basins from new groundwater withdrawals at primary acclimation and hatchery sites

Site	Proposed Groundwater Withdrawal (gpm)[a]	Potential Groundwater Level Impacts	Potential Surface Water Flow Impacts	Potential Groundwater Right Impacts
Wenatchee River Basin Primary Sites				
Dryden Hatchery	1,485	Local: depends on amount and type of withdrawal; no regional impacts	Slight reduction within drawdown cone; no impacts downstream	Potential impacts to nearby groundwater rights
Butcher	225	Potential local: no regional impacts	Slight reduction within drawdown cone; no impacts downstream	Impacts to existing off-site wells unlikely
Basin Total	**1,710**			
Methow River Basin Primary Sites				
MSWA Eightmile	800	Potential local: no regional impacts	Slight reduction within drawdown cone; no impacts downstream	Potential impact to existing on-site well
Mason	225	Potential local: no regional impacts	Slight reduction within drawdown cone; no impacts downstream	Minimal potential impact to nearby well
Twisp Weir	225	Potential local: no regional impacts	Slight reduction within drawdown cone; no impacts downstream	Low potential for impact to existing on-site well and off-site well
Lower Twisp	225	Potential local: no regional impacts	Slight reduction within drawdown cone; no impacts downstream	Low potential for impact to existing on-site well and off-site well
Basin Total	**1,475**			

a. gpm = gallons per minute

3.6.3.1 Wenatchee Basin Acclimation Sites

This and subsequent sections discuss only sites where the project proposes new groundwater wells.

Butcher (Primary Site)

The Butcher site is in an east-west trending basin occupied by Nason Creek and underlain by Quaternary alluvium, terrace deposits or alpine glacial drift. No site-specific studies are available; however, reports by Anchor QEA, LLC (2009) and GeoEngineers (2009) summarize the results of a geophysical investigation and the drilling of two test wells located approximately 500 and 1,000 feet to the southeast of the Butcher site. The Quaternary deposits cover a northeast-southwest trending normal fault that appears to run beneath the site. The underlying bedrock is banded gneiss to the west of the fault and sedimentary rocks to the east of the fault. The groundwater source for the Butcher site would be the unconsolidated deposits overlying the bedrock. The unconsolidated alluvium is composed of sand, gravel, silt and clay layers. Several water-bearing layers of sand and gravel appear to have the potential to be moderately productive based on nearby well log descriptions and pumping tests. Though the thickness, lateral extent and other characteristics of the aquifer at the site are not known, the aquifer is likely to be in hydraulic continuity with Nason Creek.

The proposed groundwater supply well at the Butcher site probably would be less than 250 feet deep. The proposed pumping rate is approximately 225 gallons per minute (gpm).

Groundwater Levels. Groundwater withdrawals at the Butcher site could cause localized impacts to groundwater levels. The extent of the potential impacts depends on aquifer characteristics, which are not known at this time. Based on limited information that indicates a potential for a moderately productive aquifer and the assumed hydraulic continuity with Nason Creek, the area of groundwater level change (area of greater than 1 foot of drawdown) would likely extend laterally approximately 300 to 1,500 feet within the source aquifer.

Surface Water Flows. Groundwater withdrawals could affect stream flow locally due to the potential that the source aquifer is in hydraulic continuity with surface water (Nason Creek). The potential change in groundwater levels discussed above may result in a localized reduction in stream flow. The percentage of the proposed 225 gpm withdrawn from the well that comes indirectly from the stream depends on the degree of hydraulic continuity between aquifer and surface water. This potential reduction in stream flow would be completely offset and balanced by return flows from the acclimation site. As a result, there would be no regional impacts to stream flow within the Wenatchee River basin.

Water Rights. The proposed activities at the Butcher site are not likely to impact groundwater rights. Based on state well records, there are five existing water-supply wells within ½ mile that are in the unconsolidated deposits. There are no known groundwater rights within 1,500 feet of the Butcher site. The expected drawdown at the nearest wells is not enough to impair the wells, or even have measurable impact on the production capacity of the wells.

The proposed activities at the Butcher site would not impact surface water rights. Because of the water-balance neutrality of the proposed withdrawal of groundwater from an aquifer in hydraulic continuity with the stream and discharge of the groundwater into the stream, there would be no regional impacts to stream flow upstream or downstream of the Butcher site.

Squadroni (Backup Site)

The site is within the northwest-southeast trending basin occupied by Nason Creek and underlain by Quaternary alluvium or alpine glacial drift. The underlying bedrock is tonalite of the Mount Stuart batholith of Cretaceous age. The proposed groundwater source at the Squadroni site, located near the confluence of Nason and Gill Creeks, is the unconsolidated alluvium or glacial deposits overlying the bedrock. The lateral extent of the aquifer is generally restricted to the valley floor adjacent to Nason Creek.

There is an existing domestic well and residence at the site. If the site is used, a new well or wells would terminate in the unconsolidated alluvium composed of sand, gravel, silt and clay layers. It is likely that multiple wells would be needed to meet the proposed demand of 720 gpm (1.6 cfs). Several water-bearing layers of sand and gravel appear to have the potential to be moderately productive based on nearby well log descriptions. Although the thickness, lateral extent and other characteristics of the aquifer at the site are not known, the aquifer is likely to be in hydraulic continuity with Nason Creek.

Groundwater Levels. Groundwater withdrawals could cause localized impacts to groundwater levels, with specific water level reductions in the existing domestic well at the site. Based on existing information on the source aquifer, the drawdown cone, defined by drawdown greater than 1 foot, would reach approximately 500 to 1,500 feet depending on aquifer characteristics and the degree of confinement of the source aquifer.[13]

Surface Water Flows. Groundwater withdrawals could cause localized impacts to stream flows due to the potential that the source aquifer is in hydraulic continuity with surface water (Nason and Gill Creeks). A change in groundwater levels would reduce stream flow, the magnitude of which depends on the degree of hydraulic continuity between aquifer and surface water. However, any reduction in stream flow would be completely offset and balanced by return flows from the acclimation pond and would result in no regional impact to stream flow in the Wenatchee River basin.

Water Rights. The proposed activities at the Squadroni site could impact groundwater water rights. Logs of eight wells were located within the radius of influence of the proposed Squadroni point of withdrawal (500 – 1,500 feet), plus the Squadroni domestic well; these wells could be impaired by the proposed well. There are two known groundwater rights within the potential groundwater source area of the Squadroni site.

The proposed activities at the Squadroni site would not impact surface water rights. Because of the water-balance neutrality of the proposed withdrawal of groundwater from an aquifer in hydraulic continuity with the stream and discharge of the groundwater back into the stream, there would be no regional impacts to stream flow upstream or downstream of the Squadroni site.

3.6.3.2 Methow Basin Acclimation Sites

MSWA Eightmile (Primary Site)

In order to supply the site's proposed water need of 800 gpm (1.8 cfs), multiple new wells could be required.

The surface geology of the MSWA Eightmile site is recent Chewuch River alluvium and older Quaternary alluvium underlain by orthogneiss bedrock of Cretaceous-Jurassic age. The unconsolidated alluvium is composed of sand, gravel, silt and clay layers. Water-bearing layers of sand and gravel may have the potential for groundwater supply based on well log descriptions.

An existing 6-inch-diameter well is located approximately 300 feet west of the proposed acclimation pond on the alluvial terrace with an elevation of approximately 2,120 feet mean sea level (MSL). The well, referred to as Mason Well 1, was drilled in August 1999 to 60 feet below the ground surface (bgs). Unconsolidated materials interpreted to be the Quaternary alluvium deposits were encountered to 60 feet bgs. No bedrock was encountered. An existing 6-inch well, referred to as Mason Well 2 (see analysis for the Mason site below), is located near the residence approximately 1,400 feet south of the Mason Well 1.

The depth to bedrock and the thickness of the unconsolidated deposits are unknown at this time. Bedrock is exposed locally along Eightmile Creek and in the hills surrounding the MSWA Eightmile site. The aquifer in which the existing Mason Well 1 is completed is assumed to be unconfined and at least 30 feet thick based on the well log information. Most likely the local alluvial aquifer is in direct continuity with the Chewuch River. Groundwater levels are expected to fluctuate in elevation, magnitude and timing similar to the nearby surface water elevations.

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[13] A confined aquifer has limited continuity with other aquifers and surface waters.

Groundwater Levels. Groundwater withdrawals at the site could cause localized impacts to groundwater levels. Based on existing information on the source aquifer, the drawdown cone, defined by drawdown greater than 1 foot, would reach approximately 500 to 1,500 feet depending on aquifer characteristics, the degree of confinement of the source aquifer and the degree of hydraulic continuity with the Chewuch River. The production capacity of the existing Mason Well 1 could be affected by drawdown interference. The amount of the effect is unknown until the well is drilled and tested, although it might be on the order of 1 to 5 feet.

Surface Water Flows. Due to the potential that the source aquifer is in hydraulic continuity with the Chewuch River, groundwater withdrawals at the site could cause localized impacts to stream flows. A preliminary analysis of the theoretical drawdown within the aquifer at 300 feet from the pumping well indicates that the drawdown would be between 1 and 5 feet, depending on the amount of confinement of the aquifer. This change in groundwater levels would result in minimal reduction in stream flow (perhaps hundreds of gallons per day), which depends on the degree of hydraulic continuity between aquifer and surface water. This minor reduction in stream flow (the Chewuch has a daily flow on the order of tens of millions of gallons per day) would be completely offset and balanced by return flows from the facility; there would be no regional impacts to stream flow in the Methow River basin.

Water Rights. The Mason Wells 1 and 2 are the only known groundwater supply wells close enough to be affected by a new well near the proposed MSWA Eightmile acclimation pond. There is less potential for impacting the Mason Well 2 because a new well or wells would be located more than 1,500 feet from Mason Well 2 (outside the zone of influence). Also, the proposed wells would be close to the Chewuch River, a recharge boundary[14] that would reduce drawdown interference at distances of greater than 100 feet from the proposed wells. Drawdown interference at Mason Well 1 could be on the order of 1 to 5 feet assuming a distance of 300 feet and a conservative transmissivity[15] of 40,000 gallons per day per foot (gpd/ft). However, Mason Well 1 currently is not used. Discussions with the landowner would determine whether mitigation is needed, and if so, what would be done. The drawdown at Mason Well 2 would be effectively unmeasurable under the same assumptions.

The proposed activities at the MSWA Eightmile site would not impact surface water rights. Because of the water-balance neutrality of the proposed withdrawal of groundwater from an aquifer in hydraulic continuity with the stream and discharge of the groundwater back into the stream, there would be no regional impacts to stream flow upstream or downstream of the MSWA Eightmile site.

Mason (Primary Site)

The proposed demand on groundwater for the existing well at this site is a maximum of 225 gpm (0.5 cfs). The geology is the same as for the MSWA Eightmile site described above.

The existing 6-inch-diameter well, Mason Well 2, is located at the site adjacent to Eightmile Creek. The well was drilled in 1990 to 100 feet bgs. Unconsolidated materials interpreted to be the Quaternary alluvium deposits were encountered to 100 feet bgs. No bedrock was

[14] The **recharge boundary** is where the drawdown cone intersects a stream. The drawdown cone cannot spread beyond the recharge boundary.
[15] **Transmissivity** is a measure of the ability of groundwater to flow in a horizontal direction.

encountered. Mason Well 2 is completed with an open bottom within a coarse sand and gravel deposit encountered from 96 to 100 feet.

The aquifer in which Mason Well 2 is completed is assumed to be unconfined and at least 42 feet thick based on the well log information. Most likely the local aquifer is in direct continuity with the Chewuch River and the mouth of Eightmile Creek. Groundwater levels are expected to fluctuate in elevation, magnitude, and timing similar to the nearby surface water.

Groundwater Levels. Groundwater withdrawals could affect groundwater levels locally. Based on existing information on the source aquifer, the drawdown cone, defined by drawdown greater than 1 foot, would reach approximately 300 to 1,000 feet depending on aquifer characteristics and the degree of confinement of the source aquifer.

Surface Water Flows. Stream flows from groundwater withdrawals could be locally affected due to the potential that the source aquifer is in hydraulic continuity with surface water (Chewuch River and Eightmile Creek). Based on the water level and screened elevation, the aquifer would intersect Eightmile Creek near the confluence with the Chewuch River to the east. A preliminary analysis of the theoretical drawdown within the aquifer at 300 feet from the pumping well indicates that the drawdown would be between 0.1 to 1 foot, depending on aquifer characteristics and the amount of confinement of the aquifer. This change in groundwater levels would minimally reduce stream flow (by perhaps a few hundred gallons per day); the amount depends on the degree of hydraulic continuity between aquifer and surface water. This minor reduction in stream flow of the Chewuch River would be completely offset and balanced by return flows from the facility, with no regional impacts to stream flow in the Methow River basin.

Water Rights. Mason Well 1 is the only groundwater supply well close enough to be affected by increased groundwater withdrawals for the proposed Mason acclimation pond. There is minimal potential for impacting Mason Well 1 because of its distance from the site (more than 1,500 feet) and the proximity of the proposed well to Eightmile Creek and the Chewuch River (recharge boundaries that would reduce drawdown interference at distances of greater than 300 feet from the proposed well). Assuming a conservative transmissivity of 40,000 gpd/ft, the drawdown at Mason Well 1 would be unmeasurable if it were in use, which it currently is not. There are no known groundwater rights in the vicinity of the Mason site.

The proposed activities at the Mason site would not affect surface water rights because of the water-balance neutrality of the proposed withdrawal.

Twisp Weir (Primary Site)

The proposed groundwater source at the Twisp Weir site would be one new 8-inch diameter well. The well would be adjacent to the Twisp River in order to use a shallow aquifer in hydraulic continuity with the Twisp River.

The acclimation site is located within an east-west trending basin occupied by the Twisp River and underlain by Quaternary alluvium or alpine glacial drift. The underlying bedrock is volcanic and sedimentary rocks. The groundwater source at the Twisp Weir site is the unconsolidated alluvium or glacial deposits overlying the bedrock. The lateral extent of the aquifer is generally restricted to the valley floor adjacent to the Twisp River.

Groundwater Levels. Groundwater withdrawals could affect groundwater levels locally. Based on available information on the source aquifer, the drawdown cone, defined by drawdown greater than 1 foot, would reach approximately 300 to 1,000 feet, depending on the degree of confinement of the source aquifer. There is an existing domestic supply well adjacent to the existing residence.

Surface Water Flows. Groundwater withdrawals could locally affect stream flows due to the potential that the source aquifer is in hydraulic continuity with the Twisp River. This change in groundwater levels would minimally reduce stream flow (by perhaps hundreds of gallons per day), depending on aquifer characteristics and the degree of hydraulic continuity between aquifer and surface water. This minor reduction in stream flow (the Twisp River has a daily flow on the order of tens of millions of gallons per day) would be completely offset and balanced by return flows from the facility, with no regional impacts to stream flow in the Twisp River or the Methow River basin.

Water Rights. At least two known wells, including the on-site well, near or within the groundwater source area of the Twisp Weir site could be affected by the proposed well development. Although well logs are incomplete or unrecorded, the expected drawdown at the existing wells is not expected to be great enough to impair them, or even measurably impact their production capacity.

The proposed activities at the Twisp Weir site would not impact surface water rights because of the water-balance neutrality of the proposed withdrawal.

Lower Twisp (Primary Site)

The proposed groundwater source at the Lower Twisp site is an existing 12-inch-diameter well drilled to a depth of 51 feet. It is adjacent to the existing side-channel ponds and approximately 300 feet south of the main channel of the Twisp River. On August 25, 2010, the well was tested at rates up to 600 gpm; results indicate that it is capable of producing the desired flow of 1 cfs.

The geology of the site is the same as that for the Twisp Weir site.

Effects. Effects on groundwater levels , surface water flows, and water rights would be the same as for the Twisp Weir site.

MSRF Chewuch (Backup Site)

The surface geology of the MSRF site is recent Chewuch River alluvium and older Quaternary alluvium deposits underlain by sedimentary rocks. A north-south trending fault occurs along the Chewuch River at the site; the fault is concealed under the alluvial deposits.

No groundwater quality information is available for the MSRF site. However, water quality information for two nearby water systems indicates high water quality, with no violations of state drinking water quality standards.

A number of well logs for wells in the vicinity of the site were examined. Some wells were completed in unconsolidated alluvium and some in bedrock. The logs indicate that water levels in the wells that were completed in the unconsolidated alluvium aquifer range from 8 to 39 feet below the top of the well casings. This alluvial aquifer is likely in hydraulic continuity with the Chewuch River.

The bedrock aquifer is not likely to be a potential source for groundwater for this project due to low production capacity and presumed lower water quality. It is possible that multiple wells would be needed to meet the proposed demand of 850 gpm (1.9 cfs).

Groundwater Levels. There is potential for localized impacts to groundwater levels due to groundwater withdrawals at the MSRF site. Based on existing information on the source aquifer, the drawdown cone, defined by drawdown greater than 1 foot, would reach approximately 500 to 1,500 feet depending on aquifer characteristics, the degree of confinement of the source aquifer and the degree of hydraulic continuity with the Chewuch River. It is unlikely that the production capacity of the existing wells could be impacted by drawdown interference.

Surface Water Flows. Groundwater withdrawals could affect stream flows locally due to the potential that the source aquifer is in hydraulic continuity with the Chewuch River. A preliminary analysis of the theoretical drawdown within the aquifer at 300 feet from the pumping well indicates that the drawdown would be between 1 and 5 feet, depending on the amount of confinement of the aquifer. This change in groundwater levels would minimally reduce stream flow (by perhaps hundreds of gallons per day); the magnitude depends on the degree of hydraulic continuity between aquifer and surface water. This minor reduction in stream flow given the daily flows in the Chewuch would be completely offset and balanced by return flows from the facility.

Because of the water-balance neutrality of the proposed withdrawal of groundwater from an aquifer in hydraulic continuity with the stream and discharge of the groundwater back into the stream, there would be no regional impacts to stream flow within the Methow River basin.

Water Rights. The proposed activities at the MSRF site are not likely to impact groundwater rights. The nearby wells are not close enough to be impaired by a new well near the proposed MSRF acclimation pond. Groundwater drawdown from pumping would largely be mitigated by proximity to the Chewuch River (a recharge boundary that would reduce drawdown interference at distances of greater than 100 feet from the proposed wells). Drawdown interference at the other wells would be on the order of less than 0.1 foot (effectively unmeasurable) assuming a distance of 1,000 feet and a conservative transmissivity of 40,000 gpd/ft.

The proposed activities at the MSRF site would not impact surface water rights. Because of the water-balance neutrality of the proposed withdrawal of groundwater from an aquifer in hydraulic continuity with the stream and discharge of the groundwater back into the stream, there would be no regional impacts to stream flow upstream or downstream of the MSRF site.

3.6.3.3 Hatchery Sites

Dryden (Primary Site)

A water supply of up to 2,775 gpm (7.4 cfs) is proposed for the Dryden Hatchery facility from a combination of surface water and groundwater sources. Groundwater sources originally considered were either an infiltration gallery adjacent to Peshastin Creek or production well(s). A preliminary investigation indicated that the shallow soils would not support an infiltration gallery along the Wenatchee River in the area explored. Two test pits showed low permeability and a relatively deep groundwater table (GeoEngineers 2010). Therefore, only wells are proposed as the groundwater source for this site.

The Dryden site is located at the confluence of Peshastin Creek and the Wenatchee River and is underlain by Quaternary alluvium and terrace deposits. The underlying bedrock is a sandstone that is exposed on the valley wall immediately opposite of the Dryden site and in the hills to the east and west. The groundwater source at the Dryden site is the unconsolidated alluvium or terrace deposits overlying the bedrock. The lateral extent of the aquifer is generally restricted to the valley floor adjacent to the Wenatchee River and Peshastin Creek. A preliminary depth-to-bedrock analysis indicates that the unconsolidated deposits are 45 to 130 feet thick based on information from logs of wells located on the terraces to the west of the Dryden site. Only a few wells in the immediate vicinity were drilled to bedrock. Wells in the area penetrate the alluvium and terrace deposits, described by drillers as sand, sand and gravel, "rocks," and cemented sand and gravel with cobbles. The bedrock is described in the logs as sandstone. In addition to the alluvial deposits of the Wenatchee River, Peshastin Creek deltaic deposits of coarse gravel, cobbles and boulders occur along the banks of Peshastin Creek and along the west bank of the Wenatchee River downstream of the mouth of the creek.

Water levels in the wells near the Dryden site are at elevations that generally correspond to the stage heights of the nearby Wenatchee River. This implies that the shallow unconsolidated aquifer is in hydraulic continuity with the Wenatchee River and/or Peshastin Creek. Groundwater levels are expected to fluctuate with the same timing as the changes in stage heights of the Wenatchee River and Peshastin Creek. Groundwater levels are expected to occur at 5 to 15 feet below ground surface (bgs) beneath the Dryden site, depending on the adjacent surface water levels.

Groundwater Levels. Groundwater withdrawals at the Dryden site could cause local impacts to groundwater levels. Well logs from 27 nearby wells with depths ranging from 50 to 150 feet indicate there are several water bearing zones within the alluvial deposits. The bottoms of three of the 27 wells in the vicinity are completed within the sandstone bedrock. Only one well has limited pumping test data available. This well was pumped at 60 gpm with 1.7 feet of drawdown after 4 hours. Other wells in the area produce from 7 to 12 gpm from the bedrock wells and 15 to 60 gpm from wells completed in the unconsolidated deposits based on the well logs. Specific capacities (pumping rate divided by drawdown) of the wells completed in unconsolidated deposits range from 6 to 35 gpm/foot of drawdown. Specific capacities of bedrock wells range from 0.2 to 0.6 gpm/foot of drawdown.

The bedrock is not a potential source for groundwater for this project because of its low yield and presumed relatively lower quality water.

The impacts to groundwater levels in the vicinity of the site would depend on the amount of production.

Surface Water Flows. Groundwater withdrawals could affect stream flows near the site due to the likelihood that the alluvial source aquifer is in hydraulic continuity with surface water (Wenatchee River and Peshastin Creek). Depending on the percentage of the proposed 7.4 cfs demand that is derived from groundwater sources, drawdown within the source aquifer might be significant. This change in groundwater levels would result in a local reduction in stream flow, the amount of which depends on the degree of hydraulic continuity between aquifer and surface water. This very localized reduction in stream flow would be completely offset and balanced by return flows from the facility; thus, there would be no regional impacts to stream flow within the Wenatchee River basin.

Water Rights. The proposed activities at the Dryden site could affect groundwater water rights. Active irrigation wells are known to exist in the area. If high-capacity production wells are constructed, the expected drawdown from pumping at the Dryden site could impair production at existing wells near the property boundaries.

The proposed activities at the Dryden site would not impact surface water rights. Because of the water-balance neutrality of the proposed withdrawal of groundwater from an aquifer in hydraulic continuity with the stream and discharge of the groundwater back into the stream, there would be no regional impacts to stream flow upstream or downstream of the Dryden site.

George (Backup Site)

The George site is located within the east-west trending basin occupied by the Wenatchee River and underlain by Quaternary alluvium, terrace deposits or alpine glacial drift. The underlying bedrock is sedimentary rocks of the Chumstick Formation of Eocene age. The proposed groundwater source at the George site, located adjacent to the Wenatchee River, is the shallow unconsolidated alluvium overlying the bedrock. The lateral extent of the aquifer is generally restricted to the valley floor adjacent to the Wenatchee River.

There are no existing wells or structures at the George site. A new well or wells are proposed for the groundwater source; it is likely that multiple wells would be needed to meet the proposed demand of 1,500 gpm (3.3 cfs). The wells would be completed in the shallow unconsolidated alluvium in hydraulic continuity with the river. Several water-bearing layers of sand and gravel appear to have the potential to be moderately productive based on nearby well log descriptions. Although the thickness, lateral extent and other characteristics of the shallow aquifer at the site are not known, the aquifer is likely to be in hydraulic continuity with Nason Creek.

Groundwater Levels. Groundwater withdrawals could cause local impacts to groundwater levels. Based on existing information on the source aquifer, the drawdown cone, defined by drawdown greater than 1 foot, would reach approximately 500 to 1,500 feet depending on aquifer characteristics and the degree of confinement of the source aquifer. There are no known wells within 1,500 feet of the likely well sites.

Surface Water Flows. Groundwater withdrawals could affect stream flows locally due to the potential that the source aquifer is in hydraulic continuity with surface water (Wenatchee River). A change in groundwater levels would reduce stream flow; the magnitude depends on the degree of hydraulic continuity between aquifer and surface water. Reduction in stream flow is likely to be minor and would be completely offset and balanced by return flows from the hatchery.

Because of the water-balance neutrality of the proposed withdrawal of groundwater from an aquifer in hydraulic continuity with the stream and discharge of the groundwater back into the stream, there would be no regional impacts to stream flow within the Wenatchee River basin.

Water Rights. Groundwater development at the George site would not affect groundwater rights. No wells are known to be within the radius of influence (1,500 feet) of the likely points of withdrawal for the facility. There are no known groundwater rights within 1,500 feet of the likely withdrawal source area.

Groundwater development at the George site would not affect surface water rights because of the water-balance neutrality of the proposed withdrawal.

3.6.3.4 Combined Impacts

A combined total increase of 1,710 gpm in groundwater production is proposed for two sites (Dryden Hatchery and Butcher) in the Wenatchee River basin; and a combined total increase of 1,475 gpm in groundwater production proposed for four acclimation pond sites (MSWA, Mason, Twisp Weir, and Lower Twisp) in the Methow River basin. The backup sites of Squadroni, George, and McComas in the Wenatchee and the backup site at MSRF Chewuch in the Methow also would increase groundwater withdrawals if the sites are used, but they are not included in this evaluation of combined impacts. If one or more of the backup sites replaces one or more primary sites, the combined effects could be locally different but would not noticeably change the basin-wide effects.

Surface water use for the acclimation ponds is balanced by return flows except for short reaches between the intakes and outfalls, and groundwater use for the proposed acclimation ponds would be water-budget neutral for the Wenatchee and Methow basins.

The discharge of groundwater into the surface waters of the Wenatchee and Methow river basins may increase or decrease the water temperature on a local basis depending on the season. The groundwater temperature would be relatively constant and stable compared to the surface water temperature, which fluctuates on a daily and seasonal basis. The amount of temperature impact would depend upon the stream-flow rate at the point of discharge and relative temperature difference; the larger the stream-flow rate and the smaller the temperature difference, the smaller the impact.

Surface water quality may be impacted by a discharge of groundwater into the stream. The shallow groundwater is expected to be of similar quality to the nearby surface water because the aquifer is in hydraulic continuity. Deeper groundwater typically contains higher levels of dissolved solids and lower dissolved oxygen levels than shallow groundwater. However, groundwater quality is expected to be more stable in parameters such as temperature, turbidity and total suspended solids as compared to surface water.

Impacts to other users of the unconsolidated aquifers are not likely to occur at distances more than 2,000 feet from new points of groundwater withdrawal.

Due to the continuity of the shallow aquifers with local surface streams and relatively high transmissivity of the subsurface alluvial aquifers, withdrawal impacts to the aquifers are limited to areas near the proposed sites. Impacts are not expected to extend between sites; therefore, the combined impact of all the withdrawals is equal to the sum of the individual impacts.

3.6.4 Impacts of the No Action Alternative

Because the No Action Alternative includes operation of fewer sites than the current program and no development of new groundwater supplies, the alternative would not directly or indirectly have adverse effects on groundwater, surface water, or water rights in the basins.

3.6.5 Mitigation for the Proposed Action

The following actions have been incorporated into the project design where feasible.

- For sites with enough room or access, the groundwater source would be placed downstream of the discharge into the acclimation pond to offset local impacts to surface water caused by groundwater level changes in aquifers in hydraulic continuity with surface water.
- Groundwater withdrawals would be located as close as possible to the surface water body and as far away from existing senior groundwater users as feasible to reduce the size and magnitude of the drawdown cone at distance from the site.
- As little as possible of the stream or side channel bottom would be disturbed to reduce the potential impacts to the hydraulic continuity between the surface water and shallow groundwater.

3.7 Fish

This section discusses impacts to fish species in the basin, focusing on effects to fish listed under the Endangered Species Act (ESA) and Washington Department of Fish and Wildlife's (WDFW's) Priority Habitats and Species (PHS) Program.

The Endangered Species Act of 1973 and its amendments (16 USC 1531 et seq.) require federal agencies to ensure that their actions do not jeopardize endangered or threatened species or adversely modify or destroy designated critical habitat. NOAA Fisheries identifies marine wildlife, including anadromous fish, determined to be at risk; U.S. Fish and Wildlife Service (USFWS) is responsible for the listing status of non-marine fish and wildlife and of plants.

Under the PHS Program, WDFW catalogs habitats and species as priorities for conservation, preservation, and management. Priority species require protective measures for their survival due to their population status, sensitivity to habitat alteration, and/or recreational, commercial, or tribal importance.

3.7.1 Affected Environment

Table 3-13 lists all species of fish found in waters of the Wenatchee and Methow basins, including those on ESA and PHS lists.

ESA-listed fish that are likely to be present at some hatchery and acclimation sites in both basins include spring Chinook (*Oncorhynchus tshawytscha)* (Endangered), summer steelhead (*O. mykiss)* (Threatened), and bull trout (*Salvelinus confluentus)* (Threatened).

Under ESA, an Endangered Species is any species which is in danger of extinction throughout all or a significant portion of its range; a Threatened Species is any species which is likely to become an endangered species in the foreseeable future throughout all or a significant portion of its range.

- National Marine Fisheries Service [NMFS]) (now called NOAA Fisheries) listed the Upper Columbia River spring-run Chinook salmon Evolutionary Significant Unit (ESU) as endangered on March 24, 1999 (64 FR 14308), and its status was reaffirmed on June 28, 2005 (70 FR 37160). The ESU includes all naturally spawned populations of spring-run Chinook salmon (spring Chinook) in Columbia River tributaries upstream of the Rock Island Dam as well as six artificial propagation programs.
- NMFS originally listed the Upper Columbia River steelhead distinct population segment (DPS) as endangered on August 18, 1997 (62 FR 43937) and subsequently upgraded it to "threatened" status in 2009 (74 FR 42605). The DPS includes all naturally spawned anadromous *O. mykiss* (steelhead) populations below natural and man-made impassable barriers in streams in the Columbia River Basin upstream from the Yakima River, Washington, to the U.S.-Canada border, as well six artificial propagation programs.
- USFWS listed Columbia River bull trout as threatened on June 10, 1998 (63 FR 31647).
- Critical Habitat was designated in the Wenatchee and Methow basins for both Chinook and steelhead in 2005 (70 FR 52630). The Wenatchee, Entiat, and Methow Rivers have been identified as core bull trout habitats for the Upper Columbia Recovery Unit, and designated as Critical Habitat October 18, 2010 (75 FR 63898).

Table 3-13. Fish species documented in the Wenatchee and Methow basins

Family & Species	Scientific Name	Wenat-chee[a]	Met-how[b]	Habitat	Origin
Lamprey Family	**Petromyzontidae**				
Pacific Lamprey	*Entosphenus tridentatus*	X	X	Larvae found in backwater silt	Native
Salmon Family	**Salmonidae**				
Mountain Whitefish	*Prosopium williamsoni*	X	X	Riffles in summer, pools in winter	Native
Pygmy Whitefish	*Prosopium coulteri*	X	X	Deep water, primarily lakes	Native
Brown Trout	*Salmo trutta*		X	Streams up to 75 degrees F.	Introduced
Cutthroat Trout	*Oncorhyncus clarki*	X	X	Cold water lakes and streams	Native
Rainbow/Steelhead	*O. mykiss*	X	X	Cold water lakes and streams	Native
Chinook Salmon	*O. tshawytscha*	X	X	Larger rivers and streams	Native
Sockeye/kokanee	*O. nerka*	X	X	Primarily lake rearing	Native
Coho Salmon	*O. kisutch*	X	X	Recently re-introduced	Native
Brook Trout	*Salvelinus fontinalis*	X	X	Cold water lakes and streams	Introduced
Bull Trout	*S. confluentus*	X	X	Cold water streams and pools	Native
Minnow Family	**Cyprinidae**				
European Carp	*Cyprinus carpio*	X	X	Shallow quiet water with dense vegetation	Introduced
Peamouth	*Mylocheilus cauinus*	X[c]		Lakes and slow stretches of rivers	Native
Chiselmouth	*Acrocheilus alutaceus*	X		Faster, warmer streams and rivers, and lakes	Native
Longnose Dace	*Rhinichthys cataractae*	X	X	Among stones at the bottom of swift streams	Native
Speckled Dace	*R. osculus*	X		Small clear well oxygenated streams	Native
Northern Pikeminnow	*Ptychocheilus oregonensis*	X	X	Lakes and slow streams	Native
Redside Shiner	*Richardsonius balteatus*	X	X	Warmer ponds, lakes, streams	Native
Sucker Family	**Catostomidae**				
Bridgelip Sucker	*Catostomus columbianus*	X	X	Bottom feeder in river backwaters and pools	Native
Largescale Sucker	*C. macrocheilus*	X	X	Bottom feeder in lakes, and pools in rivers	Native
Mountain Sucker	*C. platyrhynchus*	X		Bottom feeder in cool mountain streams	Native
Longnose Sucker	*C. catostomus*	X		Bottom feeder in lakes and streams	Native
Sunfish Family	**Centrarchidae**				
Smallmouth Bass	*Micropterus dolomieui*		X	Warm streams and lakes	Introduced
Largemouth Bass	*M. salmoides*		X	Shallow, warm weedy lakes and backwaters	Introduced
White Crappie	*Pomoxis annularis*	X	X	Lakes and streams with dense vegetation	Introduced
Catfish Family	**Ctaluridae**				
Brown Bullhead	*Ctalurus nebulosus*		X	Warm-water ponds, lakes, sloughs	Introduced
Sculpin Family	**Cottidae**				
Mottled Sculpin	*Cottus bairdi*	X[c]	X	Cold rivers	Native
Shorthead Sculpin	*C. confusus*	X[c]	X	Cold rivers	Native
Torrent Sculpin	*C. rhotheus*	X[c]	X	Cold rivers and lakes	Native
Perch Family	**Percidae**				
Stickleback	*Gasterosteus aculeatus*	X[c]		Lakes, sloughs, and slow moving streams	Native
Walleye	*Stizostedion vitreum*		X	Large lakes and streams	Introduced
Yellow Perch	*Perca flavescens*	X		Warm to cool clear lakes; slow weedy streams	Introduced

[a] Source: Wenatchee Subbasin Plan (NPCC 2004a) except where noted otherwise.
[b] Source: Methow Subbasin Plan (NPCC 2004b).
[c] Source: ISEMP database.

Table 3-14 shows fish species listed under PHS that might be found in the project area. Their status is defined under the following criteria:

Criterion 1. State-Listed and Candidate Species:

State-listed species are native fish and wildlife species legally designated as Endangered, Threatened, or Sensitive. State Candidate species are fish and wildlife species that will be reviewed by WDFW for possible listing as Endangered, Threatened, or Sensitive.

Criterion 2. Vulnerable Aggregations:

Vulnerable aggregations include species or groups of animals susceptible to significant population declines, within a specific area or statewide, by virtue of their inclination to aggregate. Examples include heron rookeries, seabird concentrations, marine mammal haulouts, shellfish beds, and fish spawning and rearing areas.

Criterion 3. Species of Recreational, Commercial, and/or Tribal Importance:

Native and non-native fish and wildlife species of recreational or commercial importance, and recognized species used for tribal ceremonial and subsistence purposes, whose biological or ecological characteristics make them vulnerable to decline in Washington or that are dependent on habitats that are highly vulnerable or are in limited availability.

Table 3-14. PHS Fish Species

Species	State Status	Wenatchee Basin	Methow Basin
Pacific Lamprey *Lampetra tridentata*	PHS 3	X	
Mountain Sucker *Catostomus platyrhynchus*	PHS 1 Candidate	X	
Pygmy Whitefish *Prosopium coulteri*	PHS 1 and 2 Sensitive	X	X
Sockeye salmon *Oncorhynchus nerka*	PHS 1, 2, and 3 Candidate	X	X
Westslope Cutthroat *Oncorhynchus clarki lewisi*	PHS 3	X	X

3.7.2 Types of Impact

Potential impacts to fish from construction and operation of hatchery and acclimation facilities fall into two categories: effects from construction or use of project facilities and effects of increased coho numbers in the basins.

Facility effects:

- **Sedimentation from construction**. Construction activities can increase sediment in waterways, causing fish to avoid the area or temporarily stop feeding, or causing mortality of eggs and alevins in spawning gravel.
- **Reduced access to habitat**. Barrier nets or seines used to enclose juvenile coho during rearing and acclimation could temporarily exclude fish from existing habitat or could prevent some adults from migrating upstream. Weirs placed across streams at two sites proposed for planting adult coho could prevent larger adults of other species from migrating upstream during October and November.
- **Surface water withdrawals.** Withdrawing water during low flow periods could slow or prevent fish migration and could reduce the availability and quantity of habitat. Withdrawing water during high flow periods can improve habitat by reducing depth and velocities that are greater than optimal for fish.
- **Fish entrainment in water intake facilities.** If allowed to pass through the intake screens, juvenile fish of a small enough size could be subject to predation by coho in the acclimation ponds, and all entrained fish could have free migration delayed by the pond discharge fish screens. NOAA Fisheries guidelines (NMFS 2008b) would be used for all intakes; therefore, entrainment of listed and other species is not expected and will not be discussed further.
- **Trapping of fish in juvenile and adult traps.** Traps to collect adult coho for broodstock or to monitor numbers and condition of migrating juveniles can also trap individuals of other species.

Effects of increased numbers of coho:

- **Predation**. Coho juveniles could prey on smaller fish during rearing and acclimation in the ponds or during their downstream migration.
- **Competition.** Naturally produced coho smolts could compete with other fish species for habitat and food.
- **Redd disturbance**. Coho could disturb or destroy other species' redds when spawning in the natural environment.
- **Ecological balance.** Reintroducing coho in these basins could help restore the ecological balance of the system: carcasses from spawned coho could add ocean-derived nutrients to the system at a critical period—the onset of winter. Carcasses could provide an important winter food resource, and coho in freshwater residence could be prey for several wildlife species.

3.7.3 Impacts of the Proposed Action

The analysis is divided into two major subsections: the effects of the development and use of facilities (Section 3.7.3.1) and the effects of increased numbers of coho in the basins (Section 3.7.3.2).

The impact analysis focuses on effects to ESA-listed fish; they are considered the most vulnerable due to their low numbers. The analysis assumes that project effects on ESA-listed fish represent the worst-case potential for effects on all fish species. Therefore, effects on other fish species are addressed only if impacts have come into question in the past as being different from those to ESA-listed fish. Effects to PHS-listed fish are summarized in Section 3.7.3.3.

3.7.3.1 Impacts of Facilities

Increased sedimentation from construction

Various construction or excavation activities are planned for 9 of the 24 primary juvenile acclimation sites in both basins and 6 of the 12 backup sites. Both the primary and backup hatchery sites would require construction. See details in Chapter 2.

Construction required for primary acclimation sites:

- New ponds at 3 sites (Minnow, Chikamin, Twisp Weir)
- Expansion of existing ponds at 2 sites (Scheibler, Gold)
- New wells at 3 sites (Butcher, MSWA Eightmile, Twisp Weir)
- New water delivery systems at 5 sites (Butcher, Tall Timber, Chikamin, MSWA Eightmile, Twisp Weir)
- New buried power lines at 2 sites (Butcher, MSWA Eightmile)
- New road at 2 sites (Minnow, Twisp Weir)

Construction required for backup acclimation sites:

- New ponds at 5 sites (Dryden, Squadroni, Chewuch AF, MSRF Chewuch, Newby)
- New water delivery systems at 6 sites (Dryden, Squadroni, Chewuch AF, MSRF Chewuch, Newby, Utley)
- New wells at 4 sites (Dryden, Squadroni, Chewuch AF, MSRF Chewuch)
- New buried power lines at 4 sites (Dryden, Squadroni, Chewuch AF, MSRF Chewuch)

Construction required for hatchery sites:

Proposed Dryden Hatchery: New facility occupying 1.5 acres: hatchery building, 4 raceways, 2 rearing ponds, water pipelines, wells, waste treatment tank and wetland; 4 acres total construction disturbance.

Backup George Hatchery: New facility occupying 1.5 acres: similar facilities to proposed Dryden Hatchery except no waste treatment wetland; 2.5 acres total construction disturbance.

Acclimation and hatchery facilities would be constructed during the summer months of one year, probably 2012. Excavation and construction of acclimation ponds, water supply and discharge lines or channels, and electrical lines would have the most potential to increase sedimentation, with somewhat less potential from road reconstruction and maintenance, where physical impacts would be limited to road crossings or where fish bearing streams are close to the road.

Construction at each acclimation site would take from one to 60 days (Tall Timber would take the longest, at 2 months). Hatchery construction would take approximately 5 months.

Table 3-15 lists life stages of ESA-listed fish that could be present during construction activities.

Table 3-15. ESA-listed fish by life stage present[a] during construction of project facilities

		Spr Chinook			Steelhead					Bull trout		
Wenatchee Basin		adults	eggs/alevin	parr	adults	eggs/alevin	fry	parr	smolts	adults	eggs/alevin	sub-adults
Primary Acc. Sites	**Affected stream**											
Butcher	Butcher Cr.							A	A			
Chikamin	Chikamin Cr.			P	P	P	P	P	P	P	A	P
Minnow	Minnow Cr.			P				P	P	A		P
Scheibler	Chumstick							A	A			
Tall Timber	Napeequa	P	P	P	U	U	U	U	U	A		A
Backup Acc. Sites	**Affected stream**											
Squadroni	unnamed											
Hatchery Sites	**Affected stream**											
Dryden (primary)[b]	Peshastin/ Wenatchee	A		A	P	P	P	P	P	A		A
George (backup)	Wenatchee R.	P	P	P	P	P	P	P	P	A	U	A
Methow Basin												
Primary Acc. Sites	**Affected stream**											
Gold	S. Fork Gold Cr.				P	A	A	P	P	A		P
Mason	Eightmile							P	P			
MSWA Eight Mile	Chewuch side channel							P	P			
Twisp Weir	Twisp R.	P	P	P	P	P	P	P	P	P		P
Backup Acc. Sites	**Affected stream**											
Chewuch AF	Chewuch R.	A	A	A	A	A	A	A	A	A		A
MSRF Chewuch	Chewuch R.	A	A	A	A	A	A	A	A	A		A
Newby	Newby Cr.							U	U	U		U
Utley	unnamed							U	U			

[a] Presence denoted by "P" indicates presence well documented, "A" presence is assumed, "U" presence possible but unlikely, and blanks indicate presence not expected.
[b] Dryden is both a primary site for a small hatchery, and a backup overwinter acclimation site.

The physical impacts from construction would be minimal for all fish species. The acclimation sites generally have been modified by humans and are regularly subject to human activity. The potential for impacts to listed fish is expected to be greatest when flow is provided to the site and discharged into the nearest stream. A light plume of suspended fine sediments could be discharged into the stream and dispersed downstream. These events are rarely lethal to fish, but their response can range from avoidance to temporary cessation of feeding activities (Hicks et al. 1991). Large amounts of fine sediment deposited on spawning gravels can reduce interstitial flow and dissolved oxygen levels causing mortality of eggs and alevins (Koski 1966, Meehan and Swanston 1977, Everest et al. 1987).

Construction of new surface water intake and discharge structures at facility sites would remove small amounts of streamside (riparian) vegetation. Vegetation along waterways provides a number of benefits to fish habitat, including shade (temperature control), bank stability (erosion control), woody debris (flow control and refuge), nutrients that provide a basis for the aquatic food chain (e.g., from decaying leaves and grasses), and sources of prey (e.g., insects and benthic invertebrates). The area affected by these activities would be very small (10 linear feet per site), and the number of individual fish adversely affected would be few, if any.

As listed in Section 3.7.5, best management practices for erosion and sedimentation control would be followed during construction to prevent discharging suspended sediments into the stream. For these reasons, construction impacts to any fish, including ESA-listed fish, are expected to be minimal.

Reduced access to habitat

An impact to fish that would result from project facilities is related to access to habitat during rearing and acclimation periods. Acclimation facilities in the natural environment would use nets to enclose coho for a 2- to 6-month period in the winter and/or spring. Some of this existing natural habitat might currently be used by other fish, which could be temporarily excluded from that habitat during coho acclimation. The amount of area that would be unavailable during rearing/acclimation would be limited to the area enclosed by seine or barrier nets at each acclimation site. The relative impact on other species from being excluded from this habitat would depend to some extent on the local availability of similar habitat. Section 3.7.5 lists measures that would be used to minimize impacts of reduced access to habitat.

The analysis of impacts focuses on juveniles of listed species. Adults spawn in the channels, streams, and rivers near acclimation sites but generally not in the ponds used for acclimation; however, adult access would not be affected because even the proposed in-channel ponds would retain passage.

In the Combined Effects section, numbers of ESA-listed juveniles potentially displaced from each site is calculated. Site-specific habitat access effects are discussed in Appendix 9 and summarized in Tables 3-16 to 3-21.

The analysis assumes that impacts to ESA-listed fish represent the worst-case scenario for effects on all fish due to the low numbers and vulnerability of listed species.

Wenatchee Basin Primary Sites

Table 3-16 lists life stages and size ranges of ESA-listed fish that could be present at proposed overwinter rearing sites (November through early May) and at spring-only acclimation sites (mid-March through early May). Leavenworth NFH is not included in the list because effects of its construction and use have been evaluated in other processes and would not change as a result of the Mid-Columbia Coho Restoration Program.

Table 3-17 lists proposed overwinter sites in the Wenatchee basin where access to existing habitat could be blocked for 5 - 6 months of each year (November-May), and Table 3-18 shows the same information for spring-only acclimation sites (mid-March through early May). Both tables show the species potentially affected and the amount of area currently accessible that could be blocked. The tables present the worst-case scenario for potentially affected species. In some cases, data on presence of ESA-listed fish were limited to one or two records, with the possibility that some species were misidentified (e.g., rainbow trout juveniles could have been mistaken for steelhead, or summer Chinook for spring Chinook). However, consultants assumed presence of listed fish even if only one record was found or if they were found elsewhere in the watershed, unless other factors obviously excluded them.

Table 3-16. ESA-listed fish by life stage present[a] during overwinter rearing and spring acclimation in the Wenatchee basin

Site name	Affected stream	Spring Chinook				Steelhead				Bull trout			
		eggs/alevin	fry	parr	smolts	adults	eggs/alevin	parr	smolts	adults	eggs/alevin	young-of-year	sub-adults
Primary Sites													
Beaver	Beaver Creek			U	U	P	P	P	P	U			U
Brender	Brender Creek			U	U			P	P				
Butcher	Butcher Creek		A	A				A	A				
Chikamin	Chikamin Creek			P	P	P	P	P	P	P	A	P	P
Clear	Clear Creek					P	P	P	P				
Coulter	Coulter Creek					A	A	A	A				
White River Springs	unnamed			A	A			A	A	A			A
Minnow	Minnow Creek			P	P			P	P	A			P
Rohlfing	unnamed							U	U				
Scheibler	Chumstick							A	A				
Tall Timber	Napeequa	P	P	P	P	U	U	U	U	A			A
Two Rivers	none												
Backup Sites													
Allen	Allen Creek												
Coulter/ Roaring	Coulter/ Roaring					P	A	P	P				
Dryden[b]	Peshastin/ Wenatchee			A	P	P	P	P	P	A			A
McComas	White River	P	P	P	P	U		U	U	P		A	P
Squadroni	unnamed												

[a] Presence denoted by "P" indicates presence well documented, "A" presence is assumed, "U" presence possible but unlikely, and blanks indicate presence not expected.
[b] Dryden is both a primary site for a small hatchery facility, and a backup overwinter rearing site.

Table 3-17. ESA-listed juveniles potentially displaced from existing Wenatchee basin habitat November - May

Site name	Accessible area excluded (acres)	Juveniles potentially displaced		
		Chinook	Steelhead	Bull trout
Butcher[1]	0.56	no	yes	no
Clear	0.24	no	yes	no
White River Springs	0.07	yes	yes	yes
Rohlfing	0.17	no	yes	no
Two Rivers		no	no	no
Total	**1.04**			

1. Butcher would alternate annually as an overwinter site or a spring-only site.

Table 3-18. ESA-listed juveniles potentially displaced from existing Wenatchee basin habitat March - May

Site name	Accessible area excluded (acres)	Juveniles potentially displaced		
		Chinook	Steelhead	Bull trout
Beaver	0.24	yes	yes	yes
Brender	0.08	yes	yes	no
Chikamin		no	no	no
Coulter[1]	0.37	no	yes	no
Minnow		no	no	no
Scheibler	0.03	no	yes	no
Tall Timber		no	no	no
Total	**0.72**			

1. Coulter would alternate annually as an overwinter site or a spring-only site; habitat excluded for this site represents the worst case, as steelhead presence is uncertain.

Methow Basin Primary Sites

Table 3-19 lists life stages of ESA-listed fish that could be present at proposed overwinter rearing sites and at spring-only acclimation sites. Tables 3-20 and 3-21 show the amount of habitat excluded from use by listed species for overwinter and for spring-only acclimation sites. Winthrop NFH is not included in the list because effects of its construction and use have been evaluated in other processes and would not change as a result of the Proposed Action.

Table 3-19. ESA-listed fish by life stage present[a] during overwinter rearing and spring acclimation activities in the Methow basin

		Spring Chinook				Steelhead				Bull trout			
Site name	Affected stream	eggs/alevin	fry	parr	smolts	adults	eggs/alevin	parr	smolts	adults	eggs/alevin	young-of-yr	sub-adults
Primary Sites													
Goat Wall	unnamed			U	U			A	P	A			P
Gold	S Fork Gold					P	A	P	P	A			P
Heath	Heath ponds (spring)			P	P			P	P	P			P
Lincoln	Twisp River	P	P	P	P	P	P	P	P	P			P
Lower Twisp	Twisp River	P	P	P	P	P	P	P	P	P			P
Mason	Eightmile			A	A	P	A	P	P	A			P
MSWA Eightmile	Chewuch side chan.			A	A			P	P	A			A
Parmley	Beaver Creek					P	P	P	P	P			P
Pete Cr. Pond	Chewuch River	A	A	P	P	P	P	P	P	A			P
Twisp Weir	Twisp River	P	P	P	P	P	P	P	P	P			P
Backup Sites													
Balky Hill	unnamed							U	U	U			U
Biddle	Wolf Creek	A	A	P	P	P	P	P	P	P			P
Chewuch AF	Chewuch River	A	A	A	A	A	A	A	A	P			P
MSRF Chewuch	Chewuch River	A	A	A	A	A	A	A	A	P			P
Newby	Newby Creek												
Poorman	unnamed			U	U			U	U	U			U
Utley	unnamed							U	U				

[a] Presence denoted by "P" indicates presence well documented, "A" presence is assumed, "U" presence possible but unlikely, and blanks indicate presence not expected.

Table 3-20. ESA-listed juveniles potentially displaced from existing habitat at primary Methow basin sites November - May

Site name	Accessible area excluded (acres)	Juveniles potentially displaced		
		Chinook	steelhead	bull trout
Heath	0.32	yes	yes	yes
Lincoln	0.20	yes	yes	yes
Lower Twisp	0.14	yes	yes	yes
Mason	0.00	no	no	no
Twisp Weir	0.00	no	no	no
Total	**0.66**			

Table 3-21. ESA-listed juveniles potentially displaced from existing habitat at proposed primary Methow basin sites March - May

Site name	Accessible area excluded (acres)	Juveniles potentially displaced		
		Chinook	steelhead	bull trout
Goat Wall	0.08	yes	yes	yes
Gold	0.08	no	yes	yes
MSWA Eightmile	0.14	yes	yes	yes
Parmley	0.08	no	yes	yes
Pete Cr. Pond	0.20	yes	yes	yes
Total	**0.58**			

Backup Acclimation Sites

In the Wenatchee basin, only one backup acclimation site is likely to exclude other fish from existing habitat. **Coulter/Roaring** could exclude steelhead from 0.17 acre of an existing 5.8-acre pond for six weeks in the spring. Likewise, in the Methow basin, only one backup acclimation site, **Biddle,** is likely to exclude other fish from existing habitat. Based on available data, Chinook fry, parr, and smolts; steelhead parr and smolts; and bull trout sub-adult and adult migrants may be present in the ponds during the acclimation period. If this site is used, these fish would be excluded from the enclosed area (0.08 acre of the 0.17-acre existing pond) for six weeks during the spring.

Adult Plant Sites

Two streams, one in each basin, are proposed as sites to plant adult coho. The **Dirty Face** site (Figure 10k) is on an unnamed stream in the Wenatchee basin and the **Hancock** site (Figure 10t) is on Hancock Creek in the Methow basin. Temporary weirs would be installed in these streams from early October through November. Adult coho salmon would be planted upstream of the weir to allow them to spawn in available habitat. Larger adults of other species would be blocked from migrating in and out of these streams when the weirs are in place; smaller fish would be able to pass the weirs. Adults of listed species would not be affected, however, because fall spawning species such as Chinook and bull trout are not known to spawn in these tributaries. Steelhead are known to spawn in Hancock Creek, and 23 spawning redds were counted in the lower 0.7 miles of Hancock in 2007 (Snow et al. 2008). However, adult steelhead are not expected to be present when the weir is in use and any steelhead fry will have emerged from the gravel well before coho spawn.

Combined Effects of Excluding Listed Fish from Incubation/Rearing and Acclimation Sites

Reduced access to existing habitat is a likely impact to ESA-listed fish that would result from coho rearing and acclimation activities. Habitat affected would be limited to the amount of area enclosed by seine or barrier nets at each coho acclimation site to which listed fish currently have access. Impacts would be balanced to some degree by newly constructed habitat. Table 3-22 shows the number of acres of existing pond or side channel habitat at primary sites that is currently accessible to ESA-listed fish or proposed to be added for new sites, compared to the amount that they would be prevented from using during coho overwinter rearing and spring acclimation periods. Listed fish and other species would be blocked during part of the year from 1.22 of the 1.69 acres of habitat currently accessible to them at primary coho acclimation sites in the Wenatchee basin, and from 1.24 of the 2.88 acres of habitat at primary coho acclimation sites in the Methow basin. About 0.26 acres of new habitat in the Wenatchee basin would be available to listed and other fish for at least a portion of the year (Table 3-22).

Table 3-22. Currently accessible habitat, habitat added by proposed new sites, and habitat excluded during coho overwinter rearing and spring acclimation

	Habitat (acres)	Habitat excluded (acres)			Accessible off-season [a]
		Overwinter	Spring	Total	
Wenatchee basin					
Existing habitat	2.23	0.48[c]	1.28[c]	1.76	2.06
Currently accessible [b]	1.69	0.31	0.91	1.22	1.69
Area added	1.03	0.00	0.60	0.60	0.26
Methow basin					
Existing habitat	2.88	0.66	0.58	1.24	2.88
Currently accessible [b]	2.88	0.66	0.58	1.24	2.88
Area added	None				

[a] Rohlfing is dry during summer and early fall so is not considered accessible to fish during most of the off-season.
[b] Accessible to ESA-listed fish.
[c] Number would vary in alternate years depending on whether Coulter or Butcher is used for overwintering coho.

The relative impact on listed species from being excluded from this habitat depends to some extent on the availability of similar habitats within each basin. Because a comprehensive habitat database was not available for these basins, an alternate method was needed to evaluate the relative magnitude of these impacts to ESA-listed populations.

Cramer and Ackerman (2009) demonstrated that the carrying capacity of habitat for various salmonids can be predicted based on channel units (e.g., pool, riffle, glide) and maximum fish densities based on a species' life-stage and habitat preference. The proposed rearing and acclimation sites are similar to beaver pond and backwater habitats. In the natural environment, coho prefer these slower velocity habitats above other habitats with stronger current (Solazzi et al. 1998). While other salmonid parr use these habitats, many prefer pools in streams or other channel habitats with more velocity (Cramer and Ackerman 2009). For this analysis, average fish (parr) densities for each species were based on literature values for similar habitats, or average values observed in the Chiwawa watershed (Hillman et al. 2008). The assumptions are made with the knowledge that fish densities vary seasonally and annually depending on environmental conditions and population numbers. Further, excluding ESA-listed fish from these habitats would presumably affect the populations only if the available habitat is fully seeded. If habitats are not at carrying capacity, displaced fish could occupy other underutilized habitat. However, this analysis provides a context to assess the relative magnitude of impacts due to acclimation and rearing.

The analysis suggests that the number of juvenile ESA-listed fish excluded during acclimation and rearing would be relatively small compared to overall basin populations.

Estimates indicate that a total of 350 juveniles of two species, spring Chinook and steelhead, might be excluded annually from sites in the Wenatchee basin, with the majority being steelhead (237) (Table 3-23). Between the years 2002 and 2007, the range of wild production was estimated to be 55,619 – 311,669 Chinook smolts and 17,499 – 85,443 steelhead smolts annually in the entire Wenatchee basin (Hillman et al. 2008). Using an average smolt-to-adult survival rate of 0.00465 for hatchery spring Chinook and 0.0105 for summer steelhead from the Wenatchee basin (Hillman et al. 2009), the number of juveniles excluded would represent 0.5 Chinook and 2.5 steelhead adult equivalents.

Table 3-23. Juvenile Chinook, steelhead, and bull trout potentially displaced from currently accessible habitat at proposed primary rearing and acclimation sites in the Wenatchee basin [a]

Site name	Overwinter	Accessible area excluded (acres)	Potential juveniles displaced		
			Chinook	Steelhead	Bull trout
Beaver		0.24	70	39	2
Brender		0.08	23	13	0
Butcher		0.56	0	91	0
Chikamin			0	0	0
Clear	Y	0.24	0	39	0
Coulter		0.37	0	0	0
White River Springs	Y	0.07	20	11	1
Minnow			0	0	0
Rohlfing	Y	0.17	0	28	0
Scheibler		0.03	0	16	0
Tall Timber			0	0	0
Two Rivers	Y		0	0	0
Total displaced			**113**	**237**	**3**
Wenatchee annual smolt production range (2002-2007)[b]			55,619 - 311,669	17,499 - 85,443	not applicable

[a] Based on assumed fish densities.
[b] Data source: Hillman et al. (2008).

In the Methow basin, approximately 515 juveniles of the two species are projected to be excluded annually from acclimation and rearing sites, with the majority being spring Chinook (314) (Table 3-24). Between the years 2000 and 2008, the range of wild production was estimated at 15,306 – 33,710 Chinook smolts and 8,809 – 15,003 steelhead smolts annually in the entire Methow basin (data provided by Alex Repp, WDFW, personal communication). Using the same smolt-to-adult survival rates used above, the number of juveniles potentially excluded from acclimation sites in the Methow basin would represent 1.5 spring Chinook and 2.1 summer steelhead adult equivalents.

Table 3-24. Juvenile Chinook, steelhead, and bull trout potentially displaced from currently accessible habitat at proposed primary rearing and acclimation sites in the Methow basin [a]

Site name	Overwinter	Accessible area excluded (acres)	Potential juveniles displaced		
			Chinook	steelhead	bull trout
Goat Wall		0.08	23	13	1
Gold		0.08	0	13	0
Heath	Y	0.32	93	52	2
Lincoln	Y	0.20	58	32	2
Lower Twisp	Y	0.14	41	23	1
Mason	Y		0	0	0
MSWA Eightmile		0.14	41	23	1
Parmley		0.08	0	13	1
Pete Cr. Pond		0.20	58	32	2
Total displaced			**314**	**201**	**10**
Methow annual smolt production range (2004-2008)[b]			15,306 - 33,710	8,809 - 15,003	not applicable

[a] Based on assumed fish densities.
[b] Data source: Alex Repp, WDFW, personal communication.

No estimates of juvenile bull trout abundance are available, but the number of juveniles projected to be excluded from sites in each basin was very small (3 in the Wenatchee and 10 in the Methow).

Excluding juveniles from rearing and acclimation sites does not necessarily mean these fish would not survive. As previously noted, most acclimation and rearing sites are not ideal habitat for listed species. Juveniles excluded from these habitats would seek out other suitable habitat in the area. Assuming that other habitats are not fully occupied by other fish, these excluded juveniles likely would continue to rear in the other habitat.

Surface water withdrawals

Acclimation Sites

Three primary sites in the Wenatchee basin (Dryden, Chikamin, and Tall Timber) and one in the Methow basin (Twisp Weir) would require new surface water withdrawals; two backup sites (George hatchery site in the Wenatchee and Newby acclimation site in the Methow) would also require new surface water withdrawals. These withdrawals would have local impacts to surface water from the point of withdrawal to the point of discharge—a distance of 1,500 feet or less. The impacts to listed fish would be limited to the affected portion of the stream and would vary depending on stream flow, species and life-stage. In-stream flows established by WDOE would be maintained.

Two different models were used to predict impacts to listed fish. The models and methods used are described in Appendix 10.

The maximum amount of water proposed for withdrawal at the Chikamin site would result in a very small reduction in habitat for all species. The reduction due to the withdrawal would be less than one square foot of habitat for all species and life-stages.

The effect of the proposed withdrawal at the Tall Timber site on ESA-listed fish varies with the flow and species. The maximum proposed withdrawal at this site generally results in small decreases in habitat for most species at extreme low flows, and slight increases in habitat at higher flows. However, the modeled withdrawal generally increases habitat for Chinook salmon rearing.

The proposed surface water withdrawal at the Twisp Weir site is projected to decrease habitat for most species during low flows by a small amount.

Newby Creek is a non-fish-bearing, high-gradient, small tributary to the Twisp River (Appendix 9). The Newby backup acclimation site, including the water intake and discharge sites, would be adjacent to Newby Creek above a series of cascades, which makes the site inaccessible to migratory fish. A habitat survey found natural fish passage barriers throughout the stream and that the substrate was comprised mostly of fines. Therefore, a diversion of flow from Newby Creek into an acclimation pond and return of water to the creek would have no adverse effects on ESA-listed spring Chinook salmon, steelhead or bull trout.

Hatchery Sites

Dryden: The proposed Dryden Hatchery would be on the Wenatchee River near Dryden Dam. A combination of surface and groundwater sources is being explored to supply up to 7.4 cfs (4.5 cfs surface water) to the site. The amount needed changes over the year. The impact of groundwater withdrawals on surface water is expected to be small as discussed in Section 3.6.

Surface water could be diverted either from the Wenatchee River or Peshastin Creek. An intake located on the Dryden fishway is currently the preferred source for surface water. Two options are being considered for the return flow. One is to discharge return water into Peshastin Creek upstream of the fishway, and another is in a pipeline on the river bottom in the vicinity of the fishway near the proposed intake. The Peshastin discharge could help adult salmon navigate the mouth during low flow and would increase flow from the discharge site to the intake site downstream. Discharge near the fishway could help flush rock away from the fishway but would essentially result in minimal change in flow because water would be discharged near the intake.

The Physical Habitat Simulation System (PHABSIM) analysis developed by EES Consulting (EES Consulting 2005) was used to assess the potential impacts of the Dryden hatchery water use on ESA-listed fish in Peshastin Creek and Wenatchee River (see Appendix 10 for a description of the model). The Peshastin discharge option was analyzed because it has the largest possible impact on stream flow, and therefore represents the greatest potential to affect fish and fish habitat. The affected environment would include Peshastin Creek from the point of discharge downstream to the proposed intake at the fishway in the Wenatchee River. This includes about 200 lineal feet of Peshastin Creek, and 650 feet of the Wenatchee River. The daily mean flow in Peshastin Creek ranges from a low of around 10 cfs in mid-August to over 500 cfs in May. The daily mean flow in the Wenatchee River ranges from a low of around 750 cfs in September to nearly 10,000 cfs by late May.

EES Consulting (2005) estimated that spawning habitat was maximized at Peshastin Creek flows of 80 cfs for non-ESA-listed summer Chinook salmon (spring Chinook do not spawn in the affected portions of the Wenatchee River and Peshastin Creek) and 120 cfs for ESA-listed summer steelhead. Estimated rearing habitat was maximized at flows of 55 cfs for Chinook, 130 cfs for steelhead, and 19 cfs for bull trout.

The increased flow had very little effect on the modeled percent of habitat in the Wenatchee River. Although there were both positive and negative effects on the percent of habitat, the difference was always less than 1%.

The increased flow typically resulted in a modeled increase in the percent of habitat in Peshastin Creek but varied with species and life stage. The increased flow had a greater effect on habitat at low flows than during high flow periods. Optimal flow for summer Chinook salmon spawning (80 cfs) is typically not reached during the spawning season, so any increase in flow had a positive effect on amount of habitat. The increased flow during the mean low flow increased the percent of summer Chinook spawning habitat from 15.9 to 34.8%. In a few scenarios, the increased flow resulted in slight reductions (less than 1%) in the percent of habitat.

The results of the analysis indicated that withdrawing water from the Dryden fishway and discharging it into Peshastin Creek would generally have a positive effect on ESA-listed fish in Peshastin Creek and little to no effect on those in the Wenatchee River. The effects would be limited to the impact reach, and the magnitude would depend on the amount of water involved.

Fish passage at the mouth of Peshastin Creek has been identified as being limited by low flow conditions in the late summer and early fall (Andonaegui 2001, NPCC 2004a). Discharge of hatchery water into the creek during these periods could improve hydraulic conditions for returning adults.

Depending on the final design of the proposed Dryden facility, water withdrawals could have no measureable impact, or could increase available habitat in a 200-foot section of Peshastin Creek during low flows.

George: An alternative to the proposed Dryden hatchery site is located on the Wenatchee River 1.25 miles downstream of Lake Wenatchee. Both surface and groundwater sources might be developed. Potential impacts of hatchery surface water withdrawals on microhabitat availability for ESA-listed fish were evaluated using the PHABSIM methodology. This approach was chosen to enable direct comparison to flow effects quantified for the Dryden hatchery site.

Wenatchee River mean discharge below Lake Wenatchee ranges between 200 cfs and 8,000 cfs annually. A total of 8 cfs of water would be supplied to the George hatchery via ground and surface water sources. Approximately 4.7 cfs of surface water would be withdrawn from the Wenatchee River and piped to the hatchery. Hatchery discharge would be returned to the river 3,800 feet downstream of the withdrawal via an historic side channel that maintains subsurface connectivity to the mainstem. Discharged hatchery water would travel 5,600 feet before reaching the mainstem, and some water would likely be lost to the ground depending on the river's flow stage. For simplicity, analysts assumed that returned flows would be equivalent to the amount of surface flow withdrawn; thus, the study reach was defined by the upstream withdrawal and downstream discharge locations. Analysis showed that the relative change in weighted useable area (WUA, i.e., habitat) was extremely small (less than 1.5%) for all species and life-stages. Therefore, a 4.7 cfs flow change during low and extreme low flows in the Wenatchee River had negligible effects on habitat simulated for spring Chinook, steelhead, and bull trout (for details, see Appendix 10, Effects of Surface Water Withdrawals on Listed Fish).

A secondary discharge location just downstream of the withdrawal site is being considered for the George hatchery (see Appendix 1). The proximity of "Discharge 2" to the intake indicates that this discharge site would not measurably affect fish habitat in the Wenatchee River.

Trapping of Fish at Juvenile and Adult Traps

With one exception, all juvenile traps the project proposes to use are currently operating under existing permits. For the Natural Production Implementation Phase, the project proposes a new juvenile trap on the Little Wenatchee River to generate population estimates of spring Chinook and coho. It would operate from early March to late November. The specific location of the proposed new trap is unknown at this time, but given what is known about listed fish in this river, it probably would impact spring Chinook or bull trout (steelhead are not known to regularly spawn in the Little Wenatchee River) (K. Murdoch, YN, pers. comm., 2010). Before it could be installed or used, its location in relation to habitat for listed species and its potential to trap juveniles of those species would need to be assessed and reviewed by NOAA Fisheries and USFWS.

No new adult traps are proposed for this project, and only one facility, Chiwawa Weir, would need to extend its period of operation to allow coho trapping. Extending operations of Chiwawa Weir into the fall could affect bull trout. Steelhead are not expected to be present, but monitoring with PIT tags would be done to confirm their presence or absence. Consultation with USFWS would be required to determine effects on bull trout; consultation with NOAA Fisheries would be required if steelhead are shown to occupy the area during the coho trapping period. All other adult traps proposed for use by the project (see Chapter 2, Table 2-6) operate under existing permits.

3.7.3.2 Impacts of Increased Numbers of Coho in the Basins

The ecological risk associated with coho reintroduction efforts may be greatest for endangered species or those of critically low abundance. Many types of ecological interactions are theoretically possible between coho and other native fish species. Potential interactions could include predation, competition, or behavioral changes. Priorities can be assigned to different ecological interactions based on their effect on the productivity and viability of impacted populations. Although the impact of predation on an individual prey animal is unambiguous, the impact on a population of prey animals is not. Depending on the abundance and productivity of the prey population, the impact of predation on the persistence and productivity of the prey population may range from negligible to serious. The ecological interactions that influence the survival, growth, or broad-scale distribution of the impacted population would potentially be the most serious. Other potential interactions could include competition for space or food in the natal streams, or competition for spawning space and associated redd superimposition by returning adults. At the same time, there might be benefits to reintroducing coho to basins they historically occupied. The potential impacts, both beneficial and adverse, from increased numbers of coho in the two basins are discussed below.

Coho predation on other species

Coho juveniles have been shown to prey on sockeye salmon (Ricker 1941; Foerster and Ricker 1953; Ruggerone and Rogers 1992), and fall Chinook salmon fry (Thompson 1966; Pearsons and Fritts 1999). Assuming that coho consume prey a third of their body length (or a ninth of their weight), fish less than 1.8 inches would be vulnerable to predation using the target coho smolt size of 5.5 inches (YN 2010). Only spring Chinook and bull trout fry would be small enough to be potential prey for juvenile coho during rearing and acclimation. Because Chinook fry typically remain near spawning areas or disperse downstream after emergence, they would be expected to be present at, or within 0.6 miles downstream of, spawning areas. In contrast, juvenile bull trout tend to remain in their natal streams for one or more years (McPhail and Baxter 1996, USFWS 2002). Fry would be expected to be present only at sites near spawning locations, except in the White River where bull trout fry have been documented moving downstream. In the White River drainage, bull trout fry would be assumed to be present in the mainstem down to Lake Wenatchee.

Predation studies conducted during the feasibility phase of this project found that hatchery coho juveniles feed primarily on insects and rarely prey on fish. Less than 0.28% of the 2,159 **hatchery** coho salmon sampled in Nason Creek over two years were found to have preyed on spring Chinook fry or other fish (Murdoch and LaRue 2002, Murdoch et al. 2005). The estimated number of spring Chinook fry consumed was 1,009 or 0.14% of the total spring Chinook fry population in Nason Creek (Murdoch et al. 2005). The Yakama Nation conducted similar studies in the Yakima River basin on fall and spring Chinook salmon (Dunnigan 1999), and in the Wenatchee River on summer Chinook fry (Murdoch and Dunnigan 2002). All coho predation evaluations in the Wenatchee and Yakima River basins showed very low rates of predation by hatchery coho smolts on Chinook fry (less than 1% of the fry population) (Dunnigan 1999; Murdoch and Dunnigan 2002; Murdoch and LaRue 2002).

In Nason Creek, the incidence of predation (percentage of samples that had consumed fish) on spring Chinook fry by naturally reared coho was 2.7% (Murdoch et al. 2005). Studies also investigated predation on sockeye fry by hatchery coho smolts emigrating through Lake

Wenatchee and found no predation on sockeye fry. Sample sizes for both naturally reared coho in Nason Creek and hatchery coho migrating through Lake Wenatchee were small, potentially increasing error in the estimates (Murdoch et al. 2005). Therefore, because populations of naturally produced coho were too small to make reasonable estimates of predation rates, populations of sensitive fish species would be monitored to determine if naturally produced coho prey on listed species with adverse effects (see Section 3.7.5.3 and Appendix 5).

Competition between naturally produced coho and other fish species

During the feasibility phase of this project, the Yakama Nation investigated the competition for space and food between sub-yearling coho salmon, sub-yearling Chinook salmon and yearling steelhead in Nason Creek. The studies, undertaken in 2002 and 2003, found that juvenile coho, Chinook, and steelhead select different microhabitats; at densities tested, juvenile coho did not appear to displace juvenile Chinook from preferred microhabitats (Murdoch et al. 2005). However, because populations of naturally produced coho were too small to make reasonable estimates of the amount of competition between coho and listed fish, populations of sensitive fish species would be monitored to determine if naturally produced coho compete with listed species with adverse effects (see mitigation described in Section 3.7.5.3 and in Appendix 5).

Disturbance of other species' redds by spawning adult coho

At the two sites where the project proposes to plant adult coho, spawning coho could disturb eggs deposited in spawning redds established earlier in the year. These impacts would be limited to species that spawn in late summer or early fall. Spring spawners such as steelhead and other trout would be able to access these areas and spawn well before the weirs are installed. Further, steelhead and trout fry emerge during the summer, so eggs and alevins would not be disturbed by coho spawning activities in October. Spring Chinook would spawn prior to weirs being installed, so they would not be prevented from accessing these sites, but spawning coho salmon could potentially disturb their eggs. However, fall spawning fish such as Chinook salmon and bull trout have not been documented spawning in either tributary proposed for adult plants.

Feasibility studies for this project examined the potential for coho to superimpose their redds on other species' redds, specifically on spring Chinook redds. In 2001, three coho redds were counted in Nason Creek and none had superimposed on spring Chinook redds. Since 2001, to determine Chinook redd locations, YN researchers relied on Chelan County PUD or WDFW to flag Chinook redds with a location description on the flagging; YN then followed an established procedure to identify coho superimposition. No redd superimposition in Nason Creek was observed. While it is possible that superimposition could occur with increased spawner densities of both Chinook and coho, in general, coho appear to select smaller gravels and different habitat types for spawning (coho select edges, while spring Chinook select pool tail outs) (YN 2010).

Benefits of nutrient additions from coho carcasses and coho as prey

Coho historically occupied the Wenatchee and Methow basins in significant numbers (Mullan 1984). Reintroducing coho in these basins could help restore the ecological balance of the system that changed as a result of human activities (see Chapter 1, Section 1.3.1). Carcasses from spawned coho could add nutrients to the system at a critical period—the onset of winter. Coho salmon may be a particularly important link in nutrient cycling processes. Coho spawn high in the watershed in late fall, delivering nutrients to the uppermost reaches where all species downstream would benefit (Vannote et al. 1980). The addition of coho carcasses during this period could provide an increased food base (Pearsons and Hopley 1999) and improve over-winter survival for all species, including those listed under the ESA. They could also provide a food source for wildlife such as bald eagles, bears, and other fish-eating species.

3.7.3.3 Summary of Effects on PHS Fish

Based on the types of habitat and the analysis to ESA-listed fish, Table 3-25 summarizes the potential effects on fish listed on WDFW's Priority Habitat and Species (PHS) list.

Table 3-25. Impacts on PHS Fish from the Proposed Action

Species	Habitat	Impact
Pacific Lamprey *Lampetra tridentata*	**Wenatchee:** Spawn in freshwater runs and riffles. Juveniles generally limited to soft-bottom slow water areas. Distribution in the Wenatchee basin is poorly understood.	Most project activities are unlikely to result in measurable impacts to Pacific lamprey. Construction would not occur in breeding habitat, although it is possible that deepening/expansion of existing ponds accessible to lamprey could result in some mortality. Increased naturally spawning coho could result in some redd superimposition. Population level effects are not expected. Small area disturbed and highly localized effects would impact only a few individuals at most.
Mountain Sucker *Catostomus platyrhynchus*	**Wenatchee:** Clear, cold creeks and small to medium rivers with clear rubble, gravel or sand substrate.	Most project activities are unlikely to result in measureable impacts to mountain sucker. Impacts would be similar to those described for ESA-listed fish, although displacement from rearing habitat is not expected. Population-level effects are not expected. Small area disturbed and highly localized effects would impact only a few individuals at most.
Pygmy Whitefish *Prosopium coulteri*	**Wenatchee and Methow:** Poorly sampled, believed associated with deep water habitat, primarily lakes.	No alteration of lake habitat is expected. If pygmy whitefish occur in the cold water streams near proposed construction sites, effects would be similar to those described for steelhead/rainbow trout. Population-level effects are not expected. Species probably are not present in areas of disturbance.
Sockeye salmon *Oncorhynchus nerka*	**Wenatchee and Methow:** Primarily lake rearing; spawn and rear in and above Lake Wenatchee (known in the White River up to the Napeequa confluence and Little Wenatchee below RM 5.[a] No reported spawning in the Methow, although reported in the lower system[b].	Similar potential effects as described for Chinook, although most rearing is likely in Lake Wenatchee, so displacement effects are expected to be less. Predation by coho on sockeye juveniles in the lake is not expected, based on feasibility studies. Population-level effects are not expected due to limited interactions and habitat disruption.
Westslope Cutthroat *Oncorhynchus clarki lewisi*	**Wenatchee and Methow:** Generally cold, clear streams with overhead cover and gravel/ cobble/boulder substrate. Streamnet does not indicate presence but PHS maps show westslope cutthroat in both watersheds.	Potential effects similar to those described for steelhead/rainbow trout. Population-level effects not expected due to small area impacted.

a. C. Kamphaus, YN Fisheries Biologist, Pers. comm. 2010
b. http://map.streamnet.org/website/bluesnetmapper/viewer.htm

3.7.4 Impacts of the No Action Alternative

Table 3-26 lists spring acclimation sites under the No Action Alternative where access to existing habitat could be blocked for 6 weeks of the year (mid-March through early May). Overwintering of coho is not expected under No Action due to lack of funding. A total of 2 acres of habitat could be excluded from use by listed fish; however, all but the Heath and Lincoln sites in the Methow are used for coho acclimation in the current program. Thus, under No Action, a total of half an acre of currently accessible habitat would be excluded from use by other fish species over what is inaccessible in the current program.

Table 3-26. ESA-listed juveniles potentially displaced from existing habitat in spring: No Action

	Accessible area	Potential juveniles displaced		
Wenatchee	**excluded (acres)**	**Chinook**	**Steelhead**	**Bull trout**
Beaver	0.24	yes	yes	yes
Butcher	0.56	no	yes	no
Coulter	0.37	no	no	no
Leavenworth NFH	0	no	no	no
Rohlfing	0.17	no	yes	no
Methow				
Heath	0.32	yes	yes	yes
Lincoln	0.20	yes	yes	yes
Lower Twisp	0.14	yes	yes	yes
Winthrop NFH	0	no	no	no
Total	**2 acres**			

The No Action Alternative would operate fewer of the same sites described for the Proposed Action. Because fewer sites would be operated and no new construction is involved, the combined effects of operation would be less than those of the Proposed Action; consequently, the adverse impacts would be less than significant.

Under the No Action Alternative, the potential impacts and benefits of increasing numbers of coho are unlikely to be realized. The program's broodstock currently is essentially a domesticated hatchery stock, not adapted to conditions in the wild. Without the deliberate selection for increased percentages of natural-origin fish in the broodstock, with increased numbers of those fish originating from high-quality habitat in upstream tributaries, the likelihood that viable natural populations of coho would be established throughout the basins is low. Experience with previous harvest augmentation programs suggests that naturally reproducing populations probably would not establish themselves in significant numbers, if at all (see Section 1.3.1).

3.7.5 Mitigation for the Proposed Action

The following measures would be undertaken to avoid or minimize impacts to fish.

3.7.5.1 Measures to avoid or mitigate impacts from construction activities

- Timing and methods of construction would be coordinated with resource agencies to minimize disturbance to listed species and life-stages.
- Discharge of sediment would be limited or prevented by implementing these measures:
  - A temporary barrier would be used to prevent backwater from entering the work area.
  - Prior to release of water flow to the project area, any sediment-laden water would be pumped out of the project area and through a filter medium.
  - When flow is returned to the active channel, the sediment plume would not be visible above background turbidity 150 feet downstream of the project.
  - New water channels would be lined with gravel and rock.
  - New ponds would be filled slowly to avoid suspending and mobilizing sediments.
  - Banks would be restored and replanted, trees would be avoided, and any habitat structures that must be moved (large rocks or large woody debris) would be re-installed immediately up- or downstream of the disturbance as feasible.

Permitting agencies such as WDOE or U.S. Army Corps of Engineers could require additional measures, which would be implemented.

3.7.5.2 Measures to avoid or mitigate habitat access impacts

- Barrier nets (see Chapter 2, Figure 2-11 for a description) would be used at acclimation sites where ESA-listed fish do not reside or use to migrate to existing habitat. This would minimize premature escape of coho salmon.
- Seine nets (see Chapter 2, Figure 2-12) would be used at acclimation sites to partition off a portion of a water body while allowing free upstream and downstream passage of ESA-listed fish to available habitat. In areas where emergent spring Chinook or bull trout fry could be present, predation would be minimized by using fine seine mesh to exclude fry from enclosed areas. Seines would be installed in a manner that excludes fry from the coho acclimation area by moving out from the bank to encapsulate the rearing area. The enclosed area would be snorkeled to verify no ESA-listed fish are present before hatchery coho are added.

3.7.5.3 Measures to avoid or mitigate predation and competition impacts

- Seine or barrier nets would be removed when coho reach a size that ensures most are ready to migrate. Feasibility studies showed that smolts migrate from the acclimation area quickly, reducing potential interactions with other species (Murdoch et al. 2005).
- Populations of listed fish would be monitored to establish baseline levels. As the coho project moves into the natural production phases, listed fish populations would continue to be monitored to determine if their numbers are decreasing. If so, evaluations would be made to determine if the decreasing numbers are due to predation or competition by naturally produced coho. For details of the monitoring plan, see Appendix 5.

3.8 Priority Habitat, Plants, and Wildlife

For this EIS, priority habitats, plants, and wildlife include habitats, plants, and terrestrial animals (amphibians, birds, insects, mammals, and reptiles) with federal or state protected status; and/or species and habitats identified under the WDFW Priority Habitats and Species (PHS) Program. This section discusses potential project impacts to the following categories of habitat, plants, and wildlife:

- Wildlife species (non-fish) federally listed under the ESA
- Plant species federally listed under the ESA and state-listed under the Washington Department of Natural Resources (WDNR) Natural Heritage Program's (WNHP) Rare Plant list
- Wildlife (non-fish) and habitats state-listed under the WDFW PHS Program.

Section 3.7 discusses project impacts to ESA-listed fish and fish on the WDFW Priority Habitat and Species list. Section 3.9 discusses impacts to wetlands.

The WDFW oversees the state listing and recovery of fish and wildlife species in danger of extinction due to loss and/or fragmentation of critical habitat, disturbance, or introduction of non-native species. The WDFW Species of Concern list includes all state endangered, threatened, sensitive, and candidate fish and wildlife species, and also includes all federally listed endangered, threatened, and candidate species. All Species of Concern are automatically included as priority species in the PHS list.

The PHS list identifies habitats and species that are priorities for conservation, preservation, and management. [16] Priority species include all federal and state listed species, as well as animal aggregations (e.g., heron colonies, bat colonies) that are sensitive to habitat alteration, and species of recreational, commercial, or tribal importance that are vulnerable. Criteria are defined in Section 3.7.1.

The WNHP manages site-specific and species/ecosystem-specific information on priority plant species and ecosystems that are rare or have very limited distribution. The WNHP identifies which species and ecosystems are priorities for conservation efforts, and designates the state status for each species (e.g., endangered, threatened, sensitive) on the Rare Plant list. All federally listed plant species are included in the WNHP Rare Plant list.

3.8.1 Affected Environment

In both basins, vegetation types vary due to elevation and precipitation, with precipitation decreasing in each basin from west to east, as elevations decrease from mountains to the Columbia River. With the exception of areas at the highest elevations where the landscape is characterized by permanent ice and snow or alpine meadows, the western portions of each basin are forested, while the non-agricultural eastern portions contain primarily shrub-steppe species. To a certain degree, wildlife varies with the habitat. (See Section 3.3 for a more detailed overview.)

Tables 3-27 through 3-29 show plants, wildlife, and habitat found in each basin that are on either federal or state lists.

[16] http://wdfw.wa.gov/hab/phslist.htm

Table 3-27. Federal and state listed species: plants

Species	State Status	Federal Status	Methow Basin	Wenatchee Basin
Showy Stickseed *Hackelia venusta*	Endangered	Endangered		X
Ute Ladies'-Tresses *Spiranthes diluvialis*	Endangered	Threatened	X	X
Wenatchee Mountains Checker-mallow *Sidalcea oregano var. calva*	Endangered	Endangered		X
Whited's Milk-vetch *Astragalus sinuatus*	Endangered	Species of Concern[a]		X
Triangular-lobed Moonwort *Botrychium ascendens*	Sensitive	Species of Concern	X	
Crenulate Moonwort *Botrychium crenulatum*	Sensitive	Species of Concern	X	
Two-spiked Moonwort *Botrychium paradoxum*	Threatened	Species of Concern	X	X
Stalked Moonwort *Botrichium pendunculosum*	Sensitive	Species of Concern	X	
Clustered Lady's Slipper *Cypripedium fasciculatum*	Sensitive	Species of Concern		X
Wenatchee Larkspur *Delphinium viridescens*	Threatened	Species of Concern		X
Chelan Rockmat *Petrophyton cinerascens*	Endangered	Species of Concern		X
Whitebark Pine *Pinus albicaulis*	N/A	Species of Concern	X	X
Seely's Silene *Silene seelyi*	Sensitive	Species of Concern		X
Thompson's Clover *Trifolium thompsonii*	Threatened	Species of Concern		X

a. Species of Concern: "An informal term referring to a species that might be in need of conservation action. This may range from a need for periodic monitoring of populations and threats to the species and its habitat, to the necessity for listing as threatened or endangered. Such species receive no legal protection and use of the term does not necessarily imply that a species will eventually be proposed for listing." (USFWS Endangered Species Glossary. http://www.fws.gov/nc-es/es/glossary.pdf)

Table 3-28. Federal and state listed species: wildlife [a]

Species	State Status	Federal Status	Methow Basin	Wenatchee Basin
Canada Lynx *Lynx canadensis*	Threatened	Threatened	X	X
Gray Wolf *Canis lupus*	Endangered	Endangered	X	X
Grizzly Bear *Ursos arctos horribilis*	Endangered	Threatened	X	X
Marbled Murrelet *Brachyramphus marmoratus*	Threatened	Threatened		X
Northern Spotted Owl *Strix occidentalis caurina*	Endangered	Threatened	X	X
Fisher *Martes pennanti*	Endangered	Candidate	X	X
Greater Sage Grouse *Centrocercus urophasianus*	Threatened	Candidate	X	
Yellow-Billed Cuckoo *Coccyzus americanus*	Candidate	Candidate	X	X
Bald Eagle *Haliaeetus leucocephalus*	Sensitive	Species of Concern*	X	X
Black Swift *Cypseloides niger*	N/A	Species of Concern	X	X
Burrowing Owl *Athene cunicularia*	Candidate	Species of Concern	X	
California Floater *Anodonta californiensis*	Candidate	Species of Concern	X	X
California Wolverine *Gulo gulo luteus*	Candidate	Species of Concern	X	X
Columbian Sharp-tailed Grouse *Tympanuchus phasianellus columbianus*	Threatened	Species of Concern	X	X
Ferruginous Hawk *Buteo regalis*	Threatened	Species of Concern		X
Giant Columbia Spire Snail *Fluminicola columbiana*	Candidate	Species of Concern	X	X
Kincaid Meadow Vole *Microtus pennsylvanicus kincaidi*	N/A	Species of Concern		X
Loggerhead Shrike *Lanius ludovicianus*	Candidate	Species of Concern	X	X
Long-eared Myotis *Myotis evotis*	N/A	Species of Concern	X	X
Northern Goshawk *Accipiter gentilis*	Candidate	Species of Concern	X	X
Olive-sided Flycatcher *Contopus cooperi*	N/A	Species of Concern	X	X
Pallid Townsend's Big-eared Bat *Corynorhinus townsendii pallescens*	Candidate	Species of Concern	X	X
Peregrine Falcon *Falco peregrines*	Sensitive	Species of Concern	X	X
Sagebrush Lizard *Sceloperorus graciosus*	Candidate	Species of Concern	X	X
Sharptail Snake *Contia tenuis*	Candidate	Species of Concern		X
Western Gray Squirrel *Sciurus griseus griseus*	Threatened	Species of Concern	X	X

a. See Section 3.7 for listed fish species.

Table 3-29. Critical Habitats

Type	Methow Basin	Wenatchee Basin
Critical Habitat for Canada Lynx	X	X
Critical Habitat for Northern Spotted Owl	X	X
Critical Habitat for Wenatchee Mountains Checker-mallow	X	X

Source: USFWS 2010a,b
X = Species/habitat is identified by USFWS as occurring in either Okanogan County (Methow basin) or Chelan County (Wenatchee basin).

3.8.2 Types of Impact

Construction Impacts

Potential impacts to priority habitats or species from project construction activities include the following:

- Clearing and grading of vegetation and soil could result in removal, loss, and fragmentation of potential plant and wildlife habitat.
- Construction of new ponds could create open water habitat, riparian habitat and a food source, with the potential to attract wildlife. Consequences include potential alterations to species migration, feeding, and foraging behaviors and the potential for increased wildlife-human interactions.
- Noise from the use of construction equipment and the presence of workers could temporarily disrupt existing wildlife migration, feeding, and foraging behavior.

The effects described below are common to all the sites with proposed construction activity, although the extent and duration may vary between sites (from one to sixty days for acclimation sites and up to five months for the hatchery site).

Priority habitat and species could be affected by removal, loss, and fragmentation of habitat at new and modified sites. This impact would vary in severity depending on the type and quantity of vegetation that would be affected. With the exception of the hatchery construction at the Dryden site (or the backup George site), no buildings or paved surfaces are proposed. Project features such as new ponds and side channels would be designed to conform to the natural environment of the site as much as possible and would be in areas where forested habitat would not need to be cleared or removed. Vegetation cleared would be primarily shrubs or grass.

The physical impacts from construction are expected to be minimal for all species. The acclimation sites are generally altered from natural conditions and regularly subject to human activity. Vegetation communities at the sites are commonly found throughout the region, although each site’s location near streams, rivers, tributary channels, and ponds likely results in a more diverse assemblage of wildlife and plants than would be found elsewhere (Kauffman et al. 2001).

A minimal amount of vegetation at the sites would be removed or crushed. Small mammals and reptiles that are present at the sites during construction could be injured or killed due to construction activities. However, since the area impacted likely would be small, and animals probably would avoid or move out of the area in response to the disturbance, the numbers of individuals injured or killed would be few if any.

Habitat for ground and shrub-nesting birds would be affected, but the relative amount would be small; there are no special or unique vegetation communities in the areas proposed for construction that could provide habitat for such species. Few if any large trees would be removed, thus avoiding or minimizing direct effects to tree-nesting bat species or birds such as diurnal raptors, owls, woodpeckers, and passerines. [17]

The most likely impact to wildlife that would result is construction-related disturbance (noise and visual). Potential construction noise would be limited to construction machinery such as backhoes and bulldozers for excavation. No blasting, pile driving, or paved road construction is proposed.

Potential wildlife disturbance from the proposed construction activities would depend on several factors, including sound levels, duration and surrounding topography and vegetation. The sound produced by conventional construction equipment typically ranges from about 75 to 90 decibels (dB): 78 dB for a dump truck, 80 dB for an excavator, 85 dB for a back hoe, and 87 dB for a bulldozer (LHSFNA 2009). Generally, disturbance activities would be limited to the immediate acclimation site, although noise from heavy machinery could extend approximately 600 to 1,000 feet outward from the site before diminishing to ambient levels. Adjacent hills and topographic changes in the landscape would reduce this distance by blocking or absorbing the sound. At all acclimation sites, construction would take place during summer months (May through September) for a period of from 1 to 60 days.

Noise and visual disturbance from pedestrians has been shown to elicit responses from nesting and foraging raptors at greater than 600 feet (Anthony et al. 1995, Richardson and Miller 1997), although these and other studies also suggest that noise without activity visible to the bird results in a much lower disturbance distance. There are no known bald eagle nests within two miles of any of the sites, but several regular concentrations are within one mile of several of the sites. No sites contain cliffs suitable for use by cliff-nesting raptors, but there is cliff habitat near the Rohlfing site and within a few thousand feet of the Tall Timber site. None of the sites contains trees of appropriate size for other raptor nests (e.g., red-tailed hawks), but some sites do have mature stands of trees in the vicinity that could provide nesting habitat. No raptors were observed during site visits; however, a comprehensive survey was not conducted, so existing nests might be unaccounted for.

Passerine birds and small mammals also would likely avoid the sites where construction is ongoing, but the area of effect would be small and the numbers affected would likely be very low compared to the numbers in the region.

Ungulates (deer and elk primarily) probably would avoid the sites while construction is actively occurring. Both species are known to avoid roads with vehicle traffic and pedestrian travel (Millspaugh et al. 2001, Wisdom et al. 2004). Construction is not likely to have a substantial effect on ungulates because: 1) human activity, including vehicle traffic to and from the sites, is already fairly common; 2) habitat is not known to be limiting; and 3) the amount of habitat excluded due to construction activities would be very small compared to what is available in surrounding areas.

[17] Passerine birds are perching birds or songbirds.

Operations Impacts

Disturbance from site operations would include vehicle noise associated with accessing the sites and crew presence. Each of the sites would require regular, daily human presence during the acclimation period. Crews of two people would be responsible for several sites and would drive between them during the course of the day. These activities would be consistent with average ambient noise levels.

All sites could require non-lethal bird hazing. Feeding and hazing activities average 3 hours per day per site and occur during daylight hours. For spring-only acclimation this is 1.4 percent of the year and for winter acclimation, 4.8 percent of the year. Hazing involves discouraging wildlife such as mergansers, kingfishers, herons, and otters from preying on coho by having humans on the site and moving around the ponds at key times (mornings and evenings).

Noise from generators could disturb wildlife. Two acclimation sites, Two Rivers and MSWA Chewuch, would have generators running continuously for six weeks from mid-March through early April; impacts of the Two Rivers site, previously used by the coho program, were evaluated in previous NEPA documents. Six other primary sites and three backup sites would have generators used as needed during power outages. Enclosing pumps and generators in noise-muffling structures would effectively eliminate disturbance to wildlife.

3.8.3 Impacts of the Proposed Action

Table 3-30 lists project sites with documented occurrences of ESA-listed wildlife species and designated critical habitat. Table 3-31 lists sites with documented occurrences of state-listed priority species and habitats. Site-specific discussions follow the tables. Wetlands are an important habitat for many PHS species; impacts to wetlands are evaluated in Section 3.9. Because operations impacts are expected to be consistent with ambient noise levels, the site-specific discussions following the tables focus on sites with proposed construction.

Table 3-30. Project sites with documented occurrences of USFWS ESA-listed species and habitat

ESA-listed wildlife species	Sites with ESA-listed wildlife species in the project area	Sites with ESA-designated Critical Habitat in the project area
Northern spotted owl	Wenatchee – primary w/ construction: Chikamin, Minnow, Tall Timber Wenatchee – primary no construction: Beaver, Clear Wenatchee – backup no construction: Allen Methow – primary no construction: Goat Wall	Wenatchee – primary w/ construction: Tall Timber

Table 3-31. Sites with documented occurrences of state-listed Priority Habitat and Species [a]

State-listed wildlife species / habitats	Sites with documented occurrences in the project area	Sites where habitat exists in the project area
Wildlife		
Bald eagle	Sites w/in regular concentration areas: Chewuch AF, Hancock, Heath, Lower Twisp, MSWA Eightmile, MSRF Chewuch, Poorman, Pete Cr. Pond, Winthrop NFH	All sites, except Dryden
Bat species	None	Tall Timber for breeding habitat, all sites for foraging habitat
Frog species	None	All sites, except Dryden
Great blue heron	None	All sites, except Dryden
Harlequin duck	Sites w/in regular concentration areas: Chewuch AF, Gold, Hancock, Heath, Lower Twisp, MSRF Chewuch, Poorman, Pete Cr. Pond, Winthrop NFH	Tall Timber
Mountain goat	Site w/in regular concentration area: Rohlfing Site w/in migration area: Tall Timber	Rohlfing, Tall Timber
Mule deer	Sites w/in breeding occurrence range: Beaver, Butcher, Clear, Coulter, Coulter/Roaring, Dirty Face, Gray, Rohlfing, Squadroni, Tall Timber Sites w/in parturition (birthing) area: Chikamin, Minnow Sites w/in regular concentration area: Balky Hill, Chewuch AF, Dryden, Goat Wall, Gold, Hancock, Heath, Lincoln, Mason, MSRF Chewuch, McComas, Parmley, Poorman, Pete Cr. Pond	All sites
Northwest white-tailed deer	Sites w/in parturition (birthing) area: Goat Wall, Pete Cr. Pond, Winthrop NFH Sites w/in regular concentration area: Pete Cr. Pond, Winthrop NFH	All sites
White-tailed deer	Site w/in regular concentration area: Heath	All sites
Waterfowl concentrations	None	All sites, except Dryden
Western gray squirrel	None	Tall Timber
Woodpecker species	None	Tall Timber
Habitat		
Meadows	Dirty Face, Squadroni, Tall Timber	Not Applicable
Riparian	Balky Hill, Beaver, Biddle, Chewuch AF, Dryden, Gold, Hancock, Heath, Leavenworth NFH, Lincoln, MSRF Chewuch, Lower Twisp, MSWA Eightmile, Parmley, Poorman, Scheibler, Pete Cr. Pond, Winthrop NFH	Not Applicable
Aspen	George	Not Applicable

a. The WDFW PHS list also includes all federal ESA-listed species (Table 3-30).

3.8.3.1 Wenatchee Basin Acclimation Sites (Primary)

Butcher

A well is proposed for the Butcher site. The exact location has not yet been determined but it would be close to existing roads to minimize access disturbances. A 50-foot-long by 5-foot-wide rock-lined, open channel would deliver water from the well to Butcher Creek upstream of the pond. Approximately 250 square feet of disturbance would occur in riparian habitat that is dominated by a mixture of shrub habitat with some young trees and areas of grass and herbaceous plants. Construction would take place for a few days in late summer or early fall.

Priority species potentially disturbed by construction at the site include bald eagles, frogs, great blue heron, deer, and waterfowl. The loss of a small area of habitat and temporary disruption caused by construction noise would not significantly affect native wildlife species.

Chikamin

A new pond and river intake are proposed for the Chikamin site, which is adjacent to the Minnow site. The pond would be approximately 120 feet long by 80 feet wide for a total area of about 9,600 square feet (0.2 acre). The pond would be excavated in a field dominated by grass and herbaceous vegetation. The intake structure would be placed in the Chikamin stream bank. A 120-foot-long water supply pipeline from the intake to the pond would be buried; approximately 0.03 acre of field and riparian (alder and willow) habitat would be disturbed. A rock-lined, open channel, about 70 feet long and 5 feet wide, would be constructed from the pond to the creek in the riparian zone of Chikamin Creek dominated by willow and alder with young pine trees. Pine or other conifer trees in this area would be avoided if possible. Approximately 0.29 acre of surface area would be disturbed by all construction activities.

WDFW maps (WDFW 2009) identify the Chikamin site as within an established territory management circle for spotted owl. Timber harvesting has occurred at and near the site; existing trees are young and relatively young second-growth stands, so northern spotted owls are not expected to occupy the site. No other federally protected species are documented within 2 miles of the site.

WDFW priority species documented within 1,000 feet of the site include concentrations of marten, breeding mule deer, and a northern goshawk nest. Additional priority species that could be disturbed by construction are bald eagles, frogs, great blue heron, deer, and waterfowl. Added pond and riparian habitat would provide additional aquatic habitat that could benefit these and other native wildlife species. The temporary disruption (less than two months) caused by construction noise would not significantly impact native wildlife species.

Minnow

A new pond and 600 feet of new road is proposed for the Minnow site adjacent to an existing creek channel. The site is under the same ownership as the Chikamin site. The Minnow site would require excavation in the existing channel of Minnow Creek, a tributary to Chikamin Creek. The pond would be approximately the same size as the Chikamin pond and would be excavated in the riparian zone of Minnow Creek. The exact location of the temporary access road has not yet been determined; however, all of the potential locations between the proposed pond and the existing road are in an open area dominated by grass and herbaceous species. Habitat cleared during construction would include a combination of grass field and alder, willow, and young pine trees; however, pines and other conifers would be avoided to the greatest extent possible. Approximately 0.2 acre of surface area would be disturbed.

The pond banks would be replanted with native vegetation, with no net loss of riparian habitat. Approximately 0.2 acre of pond habitat would be created that would provide additional aquatic habitat for wildlife species in the Minnow Creek watershed.

Priority species and impacts are the same as for the Chikamin site. Maps of PHS (WDFW 2009) identify the Minnow site as within an established territory management circle for spotted owl and adjacent to a second management circle. As with the Chikamin site, timber harvesting has occurred on and near the project site and existing trees are young second-growth stands, so it is unlikely that spotted owls use the area. No other federally protected species are documented within two miles of the Minnow site. WDFW priority species documented within 1,000 feet of the site that could be disturbed by construction include American marten, breeding mule deer, and a northern goshawk nest. Construction would occur from June to October, during the nesting season for waterfowl and songbirds.

Scheibler

An existing pond, about 100 feet long and 15 feet wide, would be expanded and deepened at this site. Approximately 350 cubic yards of material from the pond would be excavated to increase the pond capacity by 14,000 cubic feet. Construction would occur in late summer to early fall, within the nesting period for waterfowl and songbirds but avoiding the critical spring period.

Riparian priority habitat associated with Chumstick Creek adjacent to the site would not be disturbed. Priority species potentially disturbed are the same as for Chikamin and Minnow. The loss of a small area of agricultural and deciduous riparian habitat and temporary disruption caused by construction noise would not significantly impact native wildlife species.

Tall Timber

The Tall Timber site would require ground disturbance for an intake from the river and for a pipeline to deliver water to an existing, disconnected side channel. The intake structure would be in the riparian zone of the Napeequa River, where up to 400 square feet of forested and shrub habitat with cedar, pine, Douglas fir, willow, snowberry, and reed canarygrass would be disturbed. Conifer trees would be avoided, if possible. Rock and gravel would be placed around the intake to prevent erosion. An 800-foot-long water supply pipeline from the intake to the pond would be buried. Part of the pipeline would be dug through similar forest and shrub habitat. The disturbed areas would be replanted with native vegetation.

Impacts to the existing side channel (approximately 1,000 feet long and 60 feet wide) would be limited to filling the channel with water during the acclimation period.

The site is located within a spotted owl management circle (1.8 mile radius); vegetation within and adjacent to the area of proposed construction includes mature forest that could provide habitat for spotted owl. The nest associated with the management circle is located more than one mile from the site. The pipeline would be constructed near mature cedar, pine, and Douglas-fir trees, and it is possible that some trees may need to be removed. If so, a qualified biologist would confirm the presence or absence of nest activity in the trees. No significant impacts to spotted owls are anticipated because: 1) the absence of an owl nest would be confirmed prior to removing any trees; 2) the removal of a few trees within a densely forested area would not significantly modify habitat conditions; 3) the site includes a ranch and a church camp with regular, consistent human activity; 4) construction disturbances would be intermittent and temporary (normal weekday hours for up to four months); and 5) avoidance behavior by owls during construction would not likely result in a significant disturbance to the species.

Meadow priority habitat documented adjacent to the site appears to be outside the area of proposed construction.

Priority species potentially disturbed by construction at the site are bald eagles, bats, frogs, great blue heron, harlequin duck, mountain goat, deer, waterfowl, western gray squirrel, and woodpeckers. The presence of mountain goats near the project area would be associated with transient or migration behavior. The loss of mature trees would disturb potential breeding habitat for bald eagles, bats, harlequin duck, western gray squirrel, and woodpeckers. Given the relatively small area and number of trees that would be removed relative to the surrounding available forested habitat, significant impacts to these species are not anticipated. Construction noise might cause these species to temporarily avoid the area, but such behavior is not likely to result in significant impacts to these or other native wildlife species.

3.8.3.2 Wenatchee Acclimation Sites (Backup)

Allen

The site, if used, would not require construction. WDFW PHS maps (WDFW 2009) identify the Allen site as within an established territory management circle for spotted owl; however, the site does not provide spotted owl habitat and mature forest associated with spotted owl habitat is not located nearby. No other federally protected species and no other state-designated priority habitat and species are documented within one mile of the Allen site.

Squadroni

A new well, pond, 50-foot-long rock-lined open channel, and 20-foot-long discharge channel are proposed for the Squadroni site. Disturbances would occur in grass fields. A generator would be required to provide backup power in the event of a power outage during the acclimation period.

The species potentially disturbed by construction at the site are bald eagles, frogs, great blue heron, deer, and waterfowl. The loss of a small area of grass field habitat and temporary disruption caused by construction noise would not significantly impact native wildlife species.

3.8.3.3 Hatchery Sites

Dryden (Primary)

The Dryden site is proposed as a primary site for hatchery construction. Chapter 2, Section 2.2.2.3 and Appendix 1 provide more detailed descriptions of hatchery design and construction requirements. The Dryden site is also identified as a backup site for acclimation.

The Proposed Action would require excavations for rearing ponds, raceways, a hatchery building, water and power supply, and an effluent treatment system. These excavations would be in an area that is a combination of disturbed bare ground and patches of grass and weedy species and occasional shrubs. No trees would be cleared. A surface water intake would be built in the fishway, which would involve no excavation. Construction would occur from May to October 2012; four acres would be disturbed. Excavated material would be disposed in locations that meet permit conditions and minimize environmental impacts.

WDFW PHS maps (WDFW 2009) do not document any occurrences of federally listed wildlife or plant species within at least one mile of the Dryden site. The boundary of an established territory management circle for spotted owl is located between 1 and 2 miles from the site, south of Highway 2. Other WDFW priority species found within 1,000 feet of the site include concentrations of mule deer. Riparian priority habitat associated with the Wenatchee River is documented adjacent to the site but would not be disturbed. The loss of a small area of habitat that is mostly disturbed would not significantly impact native wildlife species. Noise from construction and operation of the facilities is unlikely to affect wildlife any more than current activities at and near the site.

George (Backup)

If used, the George backup hatchery site would require construction similar to the Dryden site (see Chapter 2 and Appendix 1 for more details). A fence would be constructed around the facility and predator-control nets would be installed over rearing units.

A number of priority species may use habitat at the George site during part of their life cycle, including bald eagles, northern goshawks, harlequin ducks, great blue herons, pileated woodpeckers, olive-sided flycatcher, mule deer, long-eared myotis, sharp-tailed snakes, and western toads. Priority habitat on-site includes quaking aspen stands and riparian habitat.

Construction of the surface water intake structure at the Wenatchee River and installation of the intake pipeline could affect riparian shrub-scrub and forested habitat. A large tract of priority aspen habitat exists near the area of the proposed intake and discharge pipelines. These pipelines would be located along the eastern boundary of this priority habitat to minimize the potential for impacts. Construction of the hatchery facility and rearing ponds as currently planned would not impact any priority aspen habitat. Some upland forested habitat is likely to be removed to construct the hatchery facility and rearing ponds. Impacts to forested habitat would be minimized to the extent possible; shrub/scrub and emergent vegetation removed along the intake or discharge pipeline corridors would be restored with native plants when the project is completed. Removal of forested habitat would be mitigated by replanting native vegetation around the construction site and in disturbed and cleared areas (approximately 2.5 acres).

Construction of the hatchery facility, discharge/intake pipelines and water supply wells would not alter a substantial portion of riparian and forested habitat for wildlife species that have more extensive home ranges. Impacts to habitat and some individual amphibians that have comparatively limited home ranges (e.g., the western toad) could be possible at the local population level.

Noise generated during construction may cause priority species to avoid the site during construction; however, this impact would be temporary and noise would not be significantly elevated above existing ambient noise from surrounding highway traffic and landowner activities. The existing network of roads would be used to access the site and for moving construction equipment and crews. Existing cleared areas would also be used for staging of construction equipment and supplies. Based on these measures to avoid or minimize potential impacts during the construction of the hatchery, there would be no significant impacts to priority species or habitat at the George site.

3.8.3.4 Methow Acclimation Sites (Primary)

Goat Wall

The site would not require construction but could have operational impacts. Maps of PHS distribution (WDFW 2009) indicate spotted owls are present in parts of Okanogan County. However, the location of the proposed Goat Wall acclimation site does not provide spotted owl habitat, and mature forest associated with spotted owl habitat is not located near the site. The USFWS has designated the Okanogan Unit of spotted owl critical habitat, a portion of which is approximately five miles from the Goat Wall site. Operation of the Goat Wall site would have minimal or no impact on any individual spotted owls that may be found in the vicinity. No other federally protected species and no other WDFW priority species are documented near the Goat Wall site that could be affected by site operations.

Gold

Approximately 260 cubic feet of silt, sand, and gravel deposits from an existing pond would be excavated. Vegetation adjacent to the pond includes mowed lawn that would be disturbed to access the ponds for excavation.

The reach of the South Fork Gold Creek adjacent to the Gold site is identified as riparian priority habitat but would not be disturbed. Bald eagles, frogs, great blue heron, deer, and waterfowl could be temporarily disturbed by construction noise but the impact would not be significant. No habitat would be lost.

MSWA Eightmile

A well and water supply channel from the well to the existing side channel are proposed. A generator would be installed near the well to provide the primary power source, and would run continuously during the acclimation period. It would be installed in a structure that would significantly attenuate the generator noise and limit the noise effects to the area within a few feet of the enclosure. Construction would be in an agricultural field in September. The reach of the Chewuch River adjacent to the site identified as riparian priority habitat would not be disturbed. Priority species and impacts are the same as Gold.

Twisp Weir

Proposed construction at Twisp Weir includes the excavation of a new pond, construction of intake and discharge structures from the Twisp River to the new pond, burial of water lines, construction of one well, and construction of a temporary access road to the pond. The location for the proposed pond is upland open space consisting of mowed grass. The exact location of the temporary access road has not yet been determined; however, all the potential locations between the proposed pond and the existing gravel road are managed and maintained as mowed grass. The intake structure would be located at the existing diversion in the Twisp River, which is adjacent to the edge of a wetland identified by the National Wetland Inventory (NWI) (USFWS 2008) (see Section 3.9.3.3). The proposed intake pipeline would extend across an upland meadow to the proposed acclimation pond site. The proposed location for the discharge pipeline from the acclimation pond crosses maintained upland areas and then would pass under the existing irrigation canal into forested riparian habitat adjacent to the Twisp River. The proposed locations for the well and associated pipelines are also within this forested riparian habitat.

It is unlikely that priority species occupy the maintained portion of the Twisp Weir site because of the ongoing maintenance and operation of the site as a fish hatchery and the lack of native habitat observed. Priority species that may use the forested riparian and stream habitat at the site include western gray squirrel, western toad, northern goshawk, bald eagle, long-eared bat, olive-sided flycatcher, Columbia spotted frog, great blue heron, harlequin duck, and mule deer. Removal of forested riparian habitat for the discharge pipeline and water supply wells would not alter a substantial portion of the habitat for mammals and birds with more extensive home ranges; mature trees would be avoided to the extent possible. Impacts to riparian habitat and some individual amphibians with more limited home ranges, such as the spotted frog or western toad, are possible at the local population level.

Overall impacts at the site would be minimized by: 1) locating the acclimation pond in a fenced, mowed grass field; 2) placement of the intake structure at an existing diversion structure; and 3) selecting pipeline corridors and well locations that do not contain mature trees to the extent possible. Impacts to shrub/scrub vegetation would be temporary and restored after completion. Construction noise would be temporary and not significantly higher than existing noise from adjacent highway traffic and landowner activities. Significant permanent impacts to priority species and habitat at the Twisp Weir site are not likely.

3.8.3.5 Methow Acclimation Sites (Backup)

Chewuch AF

If this site is used, a new pond would be constructed downstream of the existing facility. It would be approximately 150 feet long by 50 feet wide and 3.5 feet deep, occupying approximately 7,500 square feet (0.2 acre). The existing campground, with a combination of bare ground and patches of native trees and landscaping shrubs, would be disturbed.

The reach of the Chewuch River identified as riparian priority habitat adjacent to the site would not be disturbed. Construction activity could disturb bald eagles, frogs, great blue heron, deer, and waterfowl. The loss of a small area of an existing campground and temporary disruption caused by construction noise would not significantly impact native wildlife species.

MSRF Chewuch

A new pond would be constructed at this site, if used, occupying approximately 7,500 square feet (0.2 acres). Approximately 890 cubic yards of material would be excavated from tree, shrub, and grass habitat dominated by deciduous species such as black cottonwood, aspen, alder, and reed canarygrass. Large trees would be avoided. Rock-lined, open channels would be constructed from the well to the pond and from the pond to the Chewuch River.

The rock lined channel would be within a reach of the Chewuch River identified as riparian priority habitat. Priority species potentially disturbed by construction are the same as for the Chewuch AF site. The creation of additional pond and riparian habitat would benefit many of these and other native wildlife species. The temporary disruption caused by construction noise would not significantly impact native wildlife species.

Newby

Construction at the Newby site, if used, includes excavation of a new pond and construction of an intake structure at Newby Creek with intake and discharge pipelines. The pond would be in an upland meadow with vegetation consisting of upland grasses, mullein and goldenrod. The exact location of the temporary access road has not been determined; however, all the potential locations between the planned pond and the existing driveway are upland habitat with vegetation similar to the planned pond area. The locations for the intake structure and discharge are along a reach of Newby Creek that has a relatively high gradient (greater than 5 percent) and a defined steep-sided channel that lacks riverine wetlands.

Vegetation that would be disturbed to construct the pond and temporary access road includes upland grasses, mullein and goldenrod. Vegetation that would be disturbed to construct the intake and discharge structures and pipelines includes riparian forest habitat dominated by quaking aspen, Douglas-fir, red osier dogwood, snowberry, serviceberry, and Nootka rose. Disturbance of mature and large trees would be avoided if possible. Most impacts would be to habitat along the riparian edge of Newby Creek. Priority species that might use the forested riparian and stream habitat at the Newby site are the same as those at Lower Twisp, and impacts would be similar. Impacts to individual amphibians that have a comparatively limited home range (e.g., spotted frog or western toad) are possible at the local population level.

Utley

If the site is used, construction would include installation of a discharge pipeline between the drainage channel from the pond and the Twisp River. Access to the pond would be from the existing driveway southwest of the pond, across an upland maintained lawn. Existing trails and roads would allow access to the discharge site without damaging native wetland vegetation with construction equipment.

A culvert that would provide an outlet from the acclimation pond would also be constructed. Priority habitats that would be disturbed include some upland meadow habitat with vegetation consisting of upland grasses (approximately 150 square feet of temporary impact); and some areas of forested riparian habitat with vegetation consisting of spruce (approximately 5 to 18 inch diameter at breast height [DBH]), aspen (approximately 2-3 inch DBH saplings), mountain alder, snowberry, and tall Oregon grape (approximately 950 square feet of temporary disturbance).

Priority species that might use the forested riparian and stream habitat at the Utley site are the same as for the Lower Twisp and Newby sites, and impacts are also similar and minor. Avoiding the removal of mature trees while placing the pipeline in an area with shrub/scrub or emergent vegetation would avoid or minimize impacts to the species and habitat at the site.

3.8.3.6 Combined Impacts

Clearing and grading of vegetation communities during construction would be limited to areas that are small relative to the total native habitat in the region. Impacts to forested habitat and wetlands would be avoided, disturbed areas would be replanted with native vegetation, and construction noise would be temporary. Construction would create new ponds and/or side channel habitats.

Humans would be present at all sites. However, disturbances would be limited to vehicles accessing the site and crews of two people walking the site for a small part of the day for six weeks to six months each year. Impacts to wildlife would be limited to avoidance behavior associated with human presence. Operations disturbances are unlikely to significantly affect priority species or other native wildlife and would have no impact on priority habitats or plants.

Overall, based on existing natural resource information, the type and scale of proposed construction and operation activities, and the habitats and vegetation communities that would be disturbed at the project sites, no significant adverse impacts to federally listed species are likely. In addition, while potential habitat for many of the state-listed species exists at or near many of the sites, impacts likely would be minor or insignificant and would be avoided to the greatest extent possible. No significant adverse impacts to state-listed species or habitats or other native wildlife are anticipated.

3.8.4 Impacts of the No Action Alternative

Because no new sites would be constructed, either for incubation and rearing or for acclimation, there would be no construction impacts to federally listed or state priority habitats and species.

Two sites in the Methow basin not used in the current coho program might be used for coho acclimation if the No Action Alternative is implemented. As a result, impacts of operations under the No Action Alternative would be slightly greater than those already occurring under the existing program at existing sites. Those impacts are the same as for the Proposed Action (primarily wildlife avoidance behavior associated with limited and intermittent human presence) and are considered negligible.

3.8.5 Mitigation for the Proposed Action

The following measures are proposed to avoid or minimize impacts to priority habitat, plants, and wildlife. Site-specific measures to mitigate impacts are described under the individual site analyses in Section 3.8.3.

- Project features such as new ponds and side channels would be designed to be as natural as possible and in most cases would be in areas where forested habitat would not be cleared or removed.
- Few if any large trees would be removed, thus avoiding or minimizing direct effects to tree-nesting bat species or birds such as diurnal raptors, owls, woodpeckers, and passerines.
- Enclosing pumps and generators in noise-muffling structures would effectively eliminate disturbance to wildlife.

3.9 Wetlands

3.9.1 Affected Environment

Wetlands are classified in this EIS according to the USFWS classification developed by Cowardin et al. (1979). In this system wetlands are classified based on their physical characteristics, such as the general type of vegetation in the wetland (trees, shrubs, grass, etc.) and how much, and where, water is present. The wetland types found in the project area are:

- Palustrine forested (PFO) – These wetlands have at least 30 percent cover of woody vegetation that is more than 20 feet high.
- Palustrine scrub-shrub (PSS) – These wetlands have at least 30 percent cover of woody vegetation that is less than 20 feet high.
- Palustrine emergent (PEM) – These wetlands have erect, rooted, herbaceous vegetation present for most of the growing season in most years.
- Palustrine unconsolidated bottom (PUB) – These wetlands are characterized by open water, such as ponds, with less than 30 percent vegetation cover and substrate of cobbles, gravel, sand, mud, or organic material.
- Palustrine aquatic bed (PAB) – Areas of open freshwater that have rooted plants such as water lilies or cattails that project above the surface.

Due to the nature of the project, all the sites include or are adjacent to rivers, streams, or ponds; wetland habitat is typically limited to narrow patches along the shoreline of existing ponds or side channels. Although wetland habitat was anticipated at project sites, only a few require construction activities in wetlands. They are:

Wenatchee basin

- Wetlands present and construction is proposed: Scheibler, Tall Timber, George (backup hatchery site)

- Proposed construction but no wetlands present in construction area: Dryden, Butcher, Chikamin, Minnow, Squadroni (backup)

Methow basin

- Wetlands present and construction is proposed: Twisp Weir, MSRF Chewuch (backup), Utley (backup)
- Proposed construction but no wetlands present in construction area: Gold, MSWA Eightmile, Chewuch AF (backup), Newby (backup)

Maps of documented wetlands at all sites are included in Appendix 4.

3.9.2 Types of Impact

The primary potential impact to wetlands from project construction would be removal, loss, and fragmentation of wetland habitat. This impact would vary in severity depending on the type and quantity of vegetation that would be affected.

Disturbances associated with operation at the sites would include trucks accessing the sites and crews of two people walking the sites. Even if wetlands exist at a project site, these activities would not affect them.

3.9.3 Impacts of the Proposed Action

Table 3-32 summarizes wetland conditions identified near sites with proposed construction activity and sites with potential wetland impacts.

3.9.3.1 Wenatchee Acclimation Sites (Primary)

Butcher

A well is proposed for the Butcher site. The exact location has not yet been determined but it would be close to existing roads to minimize access disturbances. No wetland impacts are identified at this site. The riparian habitat in the construction area does not include wetlands. Potential wetland habitat along the pond shoreline is outside the area of proposed construction.

Chikamin

A new pond and river intake is proposed for the Chikamin site, which is adjacent to the Minnow site. Wetland habitat was not identified in the grass field or riparian habitat in the area of proposed construction. All disturbed areas would be replanted with native vegetation.

Minnow

A new pond is proposed for the Minnow site adjacent to an existing creek channel. Wetland habitat was not identified in the grass field or riparian habitat in the area of proposed construction. The pond banks would be replanted with native vegetation, with no net loss of riparian habitat.

Scheibler

Expanding and deepening an existing pond are proposed for the Scheibler site. Expanding the existing pond could disturb wetland habitat associated with the pond and Chumstick Creek. Following expansion of the pond, native vegetation would be planted along the pond shoreline to create and/or enhance wetland habitat to compensate for wetland impacts. Wetland delineations in spring of 2011 will quantify wetland impacts.

Tall Timber

The Tall Timber site would require ground disturbance for an intake from the river and for a pipeline to deliver water to an existing, disconnected side channel. No wetland impacts are identified within the proposed construction activity at this site. The buried pipeline would deliver water to an existing side channel that contains wetland habitat along the edges. Impacts to the existing side channel would be limited to filling the channel with water during acclimation. Wetland delineations in spring of 2011 will verify the presence and extent of impacts.

Table 3-32. Wetland conditions at or near project sites with construction activity

Site Name	Wetlands Observed During Site Visits	Wetlands Identified With Existing Information	Potential Wetland Impacts
Wenatchee Primary			
Butcher	Potential patches of PSS and PEM wetland along pond shoreline	None within 1,000 feet of site	No wetland impacts identified in proposed construction area.
Chikamin	None observed	PFO, PSS, and PEM wetland habitat mapped along riparian habitat a few hundred feet from the site	No wetland impacts identified in proposed construction area.
Dryden	None observed	PSS wetland habitat mapped along riparian habitat a few hundred feet from the site	No wetland impacts identified in proposed construction area. - New wetland potentially created: 52,272 sq ft.
Minnow	None observed	PFO, PSS, and PEM wetland habitat mapped along riparian habitat a few hundred feet from the site	No wetland impacts identified in proposed construction area.
Scheibler	PFO, PSS, and PEM wetland habitat associated with riparian habitat	PSS and PEM wetland habitat mapped along riparian habitat at the site	Permanent: 3,049 sq ft.
Tall Timber	PSS and PEM wetland habitat associated with side channels	PSS and PEM wetland habitat mapped along riparian habitat more than 1,000 feet from site	No wetland impacts identified in proposed construction area.
Wenatchee Backup			
Squadroni	Site visit not performed	PSS and PEM wetland habitat mapped along riparian habitat of Nason Creek a few hundred feet from the site	No wetland impacts identified in proposed construction area.
George (backup hatchery site)	Wetlands observed associated with the side channel (high-quality PSS and PAB wetland) and the Wenatchee River (PFO and PSS wetlands).	NWI PFO, PSS, and PAB identified associated with the Wenatchee River and the side-channel at the site.	Temporary: 45,000 sq ft (1 acre) Permanent: 1,075 sq ft (0.03 acres)

NWI – National Wetlands Inventory
PAB – Palustrine aquatic bed (wetland)
PEM – Palustrine emergent (wetland)
PFO – Palustrine forested (wetland)
PSS – Palustrine scrub-shrub (wetland)

Table 3-32 (continued)

Site Name	Wetlands Observed During Site Visits	Wetlands Identified With Existing Information	Potential Wetland Impacts
Methow Primary			
Gold	Potential small patches of PSS and PEM wetland along pond shoreline	None within 1,000 feet of site	No wetland impacts identified in proposed construction area.
MSWA Eightmile	PSS and PEM wetland habitat associated with riparian habitat	PSS and PEM wetland habitat mapped along riparian habitat at the site	No wetland impacts identified in proposed construction area.
Twisp Weir	None observed	NWI PFO and PEM wetland habitat identified along the Twisp River at the site.	Temporary: 1,350 sq ft (0.03 acres) Permanent: 130 sq ft (0.003 acres)
Methow Backup			
Chewuch AF	None observed	None within 1,000 feet of site	No wetland impacts identified in proposed construction area.
MSRF Chewuch	PFO, PSS, and PEM wetland habitat associated with riparian habitat	PFO, PSS, and PEM wetland habitat mapped along riparian habitat at the site	Proposed construction could impact wetlands along riparian habitat.
Newby	None observed	None identified	No wetland impacts identified in currently proposed construction area
Utley	Potential patches of riverine wetlands along the Twisp River east and northeast of existing pond. A large PSS NWI wetland north of the pond may be connected to the ditch that drains the pond.	PSS NWI wetland approximately 250 feet north of the existing pond. PFO NWI wetland approximately 400 feet southwest of the pond but outside of any proposed construction areas.	Temporary:150 sq ft (0.003 acres)

NWI – National Wetlands Inventory
PAB – Palustrine aquatic bed (wetland)
PEM – Palustrine emergent (wetland)
PFO – Palustrine forested (wetland)
PSS – Palustrine scrub-shrub (wetland)

3.9.3.2 Wenatchee Acclimation Sites (Backup)

Squadroni

A new well, pond, surface water supply and discharge channels are proposed for the Squadroni site. All construction would be in grass fields, with no wetland habitat in the construction area; wetlands would not be affected, and no new wetland habitat would be created.

3.9.3.3 Methow Acclimation Sites (Primary)

Gold

Excavation of approximately 260 cubic feet of silt, sand, and gravel deposits from the existing ponds would be required. No additional construction activity is proposed. Vegetation adjacent to the ponds and the riparian habitat of the creek includes young trees of cedar, alder, and willow, shrubs such as red-osier dogwood, twinberry, vine maple, and snowberry, and mowed lawn. Potential PSS and PEM wetland habitat observed at the site was limited to some small patches of grass along the shoreline of the pond. While small patches of shrub and emergent species along the pond shorelines might meet the criteria of wetland habitat, it is unlikely; therefore, excavation of the pond is not expected to affect wetlands. A wetland delineation conducted in spring of 2011 will determine if wetlands exist at this site.

MSWA Eightmile

No wetlands were identified in the area of proposed construction.

Twisp Weir

Twisp Weir development includes the excavation of a new pond; construction of an intake structure, a well, and a temporary access road; and burial of pipelines.

The proposed pond is located within a mowed meadow upland habitat. The exact location of the temporary access road has not yet been determined; however, all the potential locations between the proposed pond and the existing gravel road are upland habitat with vegetation consisting of upland grasses. Thus, wetlands would not be disturbed to construct the pond and temporary access road. The proposed location for the intake structure is at an irrigation channel at the edge of an NWI wetland habitat (PFO wetland area associated with the Twisp River) (USFWS 2008). The proposed location for the discharge pipeline traverses the NWI wetland habitat associated with the Twisp River (USFWS 2008). The proposed locations for the well is within the NWI wetland habitat associated with the Twisp River (USFWS 2008).

If the NWI wetland areas identified at the site are an accurate characterization of actual wetlands, then wetland impacts would be anticipated here. The portion of the NWI wetland on the site is approximately 2 acres or 84,500 square feet. Placement of the intake and discharge pipelines and groundwater well water lines crossing the NWI wetland would result in temporary wetland impacts (approximately 1,350 square feet). Construction of the intake structure and groundwater well would result in permanent wetland impacts (approximately 130 square feet). Wetland habitat that would be impacted would include the riverine wetlands associated with the Twisp River containing quaking aspen, black cottonwood, red osier dogwood and serviceberry. Impacts to mature and large trees could be avoided.

A wetland delineation performed in spring 2011 will determine if wetland habitats exist within proposed areas of construction.

3.9.3.4 Methow Acclimation Sites (Backup)

Chewuch AF

A new pond would be constructed at the Chewuch AF site, occupying approximately 7,500 square feet (0.2 acre). The pond would be dug in an existing recreational vehicle campground in an area of disturbed, bare ground and patches of native trees and shrubs used for landscaping the campground. Wetland habitat was not identified in the area of proposed construction, so no impacts to wetlands would occur.

MSRF Chewuch

A new pond would be constructed at this site. The majority of the proposed construction activity does not appear to be located within wetland habitat. The open channels could encroach into PFO, PSS, and PEM wetland habitat in the area near the Chewuch River. A wetland delineation performed in spring 2011 will quantify wetland impacts at this site.

Newby

Construction activities at the Newby site, if used, include excavation of a new pond and construction of an intake structure at Newby Creek with intake and discharge pipelines. No potential wetland impacts were identified at this site. If the locations of the intake and discharge structures changes, a wetland delineation would be performed to confirm the presence or absence of wetland habitat in the construction area.

Utley

Construction at the Utley site, if used, would include installation of a culvert between the existing pond (or the ditch draining the pond) and the Twisp River. Access to the pond would be from the existing driveway southwest of the pond, across an upland grassy area.

Approximately 150 square feet of riverine wetland within the normal channel of the Twisp River would be temporarily disturbed by installation of the culvert. If the ditch that drains the pond is identified as a wetland, any filling or excavation in the ditch would be considered wetland impacts. If the site is used, a wetland survey would be conducted to confirm the presence of wetlands and identify mitigation.

3.9.3.5 Hatchery Sites

Dryden (Primary)

The proposed hatchery site is currently used for gravel storage by Washington Department of Transportation. The majority of the site is disturbed bare ground with small patches of grass and weedy species. No evidence of wetland conditions were observed at the site. The riparian habitat of Peshastin Creek and the Wenatchee River includes patches of alder and black cottonwood trees. The USFWS Wetlands Mapper for NWI Map Information identifies a PSS wetland system associated with the Wenatchee River several hundred feet upstream of the Dryden site (USFWS 2009b). WDFW PHS maps do not document wetland priority habitat within 1 mile of the Dryden site (WDFW 2009). WDNR does not document any state rare/high quality wetland communities within 3 miles of the site (WDNR 2009).

George (Backup)

The hatchery would be located at the center of the site, south of the large meander bend on the side channel. Access roads for the hatchery site already exist. The intake, discharge and groundwater well pipelines traverse portions of the NWI wetland habitat associated with the Wenatchee River (USFWS 2008). In addition, the pump station and one of the wells would be located within the PFO NWI wetland (USFWS 2008). The intake structure could impact wetland, riparian vegetation and/or part of the Wenatchee River channel. Impacts to mature trees in all situations would be avoided during construction, and impacts to shrub/scrub and emergent vegetation from the pipelines, pump station, well, and intake structure would be restored with native plants after project completion.

If the NWI wetland areas identified at the site are an accurate characterization of actual wetlands present, then wetland impacts would be anticipated. The portion of the NWI wetland on the site is approximately 89 acres. Placement of the intake, discharge and groundwater well pipelines within the NWI wetland would result in temporary wetland impacts (approximately 45,000 square feet [sq ft] [1.0 acres]). Construction of the pump station, well, and intake structure would result in permanent wetland impacts (approximately 1,075 sq ft [0.03 acres]). Wetland habitat that would be impacted would include the riverine wetlands associated with the Wenatchee River containing quaking aspen, western redcedar, mountain alder, red osier dogwood, willows, Douglas spirea, and clover (Trifolium sp.).

Wetlands would be delineated to determine the exact extent of wetland habitat in construction areas.

3.9.3.6 Combined Impacts

Table 3-33 shows temporary and permanent impacts to wetlands at sites in the two basins.

Table 3-33. Total estimated square feet of temporary and permanent wetland impacts

	Temporary Impacts	Permanent Impacts	Construction of New Wetland Habitat
Wenatchee sites			
Primary acclimation			
Scheibler		3,049	
Primary hatchery			
Dryden			52,272
Backup hatchery			
George	45,000	1,075	
Methow sites			
Primary acclimation			
Twisp Weir	1,350	130	
Backup acclimation			
Utley	150		
MSRF Chewuch	undetermined	undetermined	
Total wetland impacts primary sites	**1,350**	**3,179**	**52,272**
Total wetland impacts backup sites	**45,150**	**1,075**	

The kinds of facilities that cause the impacts are summarized below.

Intakes. New surface water intakes are proposed at several sites. The intakes would be built into stream banks and have the potential to permanently impact wetlands. At most of the sites, consultants did not identify wetland plants at proposed intake locations. Twisp Weir (primary acclimation site) and George (backup hatchery site) are exceptions; at those sites, intakes could impact wetlands.

Water channels. Several sites include water channels that connect new wells to existing streams. Near the steams, riparian vegetation may be impacted during the construction of these channels. These impacts could be mitigated to a certain degree if appropriate native wetland and riparian vegetation can be established in disturbed areas after construction is completed.

Groundwater wells. New groundwater wells are proposed for several sites. Wells at Twisp Weir and a well and pump station at George could permanently remove wetland vegetation.

Ponds. An existing pond at Scheibler would be expanded into wetlands. The deeper pond water would not qualify as wetland habitat so there would be a net loss of wetland area. Non-native reed canarygrass that currently borders the pond and is the dominant species in the wetland would be removed and replaced with native wetland plants along the new pond margins.

A new pond would be constructed in Minnow Creek. Consultants did not identify wetland plants in the area where the pond would be built. Pond construction would include the planting of wetland plants along the new pond margins.

New wetlands. The discharge treatment system proposed for the Dryden hatchery includes creation of a new wetland of about 1.2 acres for the purpose of removing nutrients from hatchery effluent.

3.9.4 Impacts of the No Action Alternative

There would be no adverse construction impacts to wetlands under the No Action Alternative because no new facilities would be constructed. No new wetland habitat would be created.

Impacts of facility operations would be the same as under the current program, or less, depending on whether all current acclimation facilities are be used or if the number is reduced.

3.9.5 Mitigation for the Proposed Action

This section identifies measures designed to avoid, minimize, and mitigate potential impacts on wetlands and wetland buffers as a result of project implementation. Mitigation measures would be the same for all project sites.

- No development features such as buildings or paved surfaces are proposed in wetlands.
- Clearing and grading would be designed to avoid wetland areas to the greatest extent possible.
- Disturbed areas would be re-vegetated with native vegetation.
- Staging areas for construction would be located outside wetland buffers and re-vegetated with native vegetation as necessary.
- Construction permits issued to the project would include detailed measures for protecting wetland habitats. The conditions included in the permits would be met during construction.

3.10 Floodplains

3.10.1 Affected Environment

The climate of the Wenatchee and Methow basins is characterized by warm, dry summers and relatively cold winters. The average annual precipitation in the lower elevations is slightly more than 11 inches, increasing with elevation to about 35 inches. The bulk of this precipitation falls as snow, which reaches 100 inches or more in the upper watersheds. The Wenatchee and Methow rivers and other perennial streams follow an annual cycle, with peak stream flow in April and May and low stream flow in August and September. Normally, stream flow in many of the smaller drainages is seasonally intermittent, while drainages in lower elevations are often dry (Chelan County Department of Emergency Management 2006, Okanogan County Department of Emergency Management 2009).

Two types of flooding common in the basin are stage and flash flooding. Stage flooding is usually seen during periods of heavy rains, especially upon existing snow packs during early winter and late spring. Stage flooding problem areas occur along the Wenatchee River near its confluence with Icicle Creek, the headwaters of the Wenatchee River, and the confluence area of the Wenatchee River (Chelan County Department of Emergency Management 2006). Stage flooding problem areas occur along the Methow River, especially where the Twisp River and Chewuch River join (Okanogan County Department of Emergency Management 2009).

Flash floods are more likely during the summer months, in thunderstorm season. The primary cause of flash flooding, which can occur in any drainage in the project area, is high-intensity rainfall. Although infrequent, and usually of short duration, high-intensity rainfall has been seen in all seasons in the past. Depending upon the characteristics of a particular watershed, peak flows may be reached from less than one hour to several hours after rain begins. The debris flows and mudslides accompanying rapid runoff conditions make narrow canyons and alluvial fans at the mouths of the canyons extremely hazardous areas (Chelan County Department of Emergency Management 2006, Okanogan County Department of Emergency Management 2009). Currently in the Methow basin, flash flooding problem areas include drainages in the Methow/Twisp area that have experienced forest fires in the recent past (Okanogan County Department of Emergency Management 2009).

3.10.2 Types of Impact

Potential impacts to floodplains from construction and operation activities include:

- Obstruction of flood flows and alteration of local drainage patterns.
- Disposal of spoil materials, filling the floodplain.
- Pond creation or expansion, adding floodplain storage.
- Potential increase in flows due to discharge of groundwater.

The primary goal of floodplain management is to restrict non-compatible development in the floodplain to avoid repetitive losses. The Federal Emergency Management Agency (FEMA) delegates the responsibility of project review to the local regulatory agency through the National Flood Insurance Program. Both Chelan and Okanogan Counties prohibit development within the floodway, but do allow development in the floodplain outside the floodway, as long the proposed development does not increase water surface elevation of the base flood by more than 1 foot. Therefore, a project that would encroach into the floodway and increase the base flood elevation (BFE) or that would encroach upon the floodplain and increase the BFE by more than 1 foot would be determined to have a significant impact on flooding. A project that reduced the BFE would have a beneficial effect on flooding.

3.10.3 Impacts of the Proposed Action

Implementation of the Proposed Action would probably have little or no effect on flood elevations. Where there is an effect, it is likely to be beneficial, as the new or expanded acclimation ponds would provide some small amount of additional floodplain storage (difference between the existing land surface elevation and the working water surface elevation). The spoil materials created by construction activities such as excavation of ponds and ditches, grading of roads to improve winter access, or installation of buried water supply pipes would be disposed of outside the 100-year floodplain in accordance with the local grading and floodplain management ordinances. Consequently, there are not likely to be changes in grades that could direct or divert flood flows affecting properties either upstream or downstream of the individual project sites.

Site-specific impacts are discussed only for the primary and backup sites with substantial construction activities. Sites that require only minor improvements to existing ponds, access roads, or conveyance facilities are not expected to alter the potential for flooding at those sites and are therefore not discussed further. New wells, although providing additional flow through the acclimation sites, would withdraw water from shallow aquifers that are typically hydraulically connected to the adjacent creek or river. Therefore, there is no real gain or loss of water (see Section 3.6). Additionally, the well discharge would be very minor compared to flood flows (Section 3.6). Consequently, sites that require only flow augmentation from wells are not discussed further.

3.10.3.1 Wenatchee Acclimation and Hatchery Sites

Table 3-34 lists all the Wenatchee basin hatchery and acclimation sites, the floodplain development activities associated with each project, and the likely need for a floodplain development permit. Where the floodplain development permit process is required, a professional civil engineer would need to perform substantially more detailed analyses of floodplain impacts. These detailed floodplain analyses are not part of this impact evaluation and are beyond the scope of the EIS.

Surface water intakes proposed at the Tall Timber, Chikamin, and Dryden sites would be below grade and would match the existing contours of the river banks. They would be designed so they do not decrease flood storage volume and would not impede flow. Pipelines delivering water from these intakes would be buried and would have no impact on flood elevations. Site-specific discussions of sites requiring construction follow the table.

Table 3-34. Wenatchee acclimation and hatchery sites with development activities in floodplains

Wenatchee River Basin, in Chelan County, Washington		
Primary Site	**Activities in Floodplain**	**Floodplain Development Permit Required**
Butcher	Excavation of an open channel	Yes
Tall Timber	Excavation of Napeequa River bank and pipeline corridor	Yes
Chikamin	Excavation of a pond, Chikamin Creek bank, open channel, and pipeline corridor	Yes
Minnow	Excavation of bed and banks of Minnow Creek	Yes
Scheibler	Excavation of bed and bank of Chumstick Creek	Yes
Coulter	None	No
Rohlfing	None	No
White River Springs	None	No
Dirty Face	None	No
Two Rivers	None	No
Clear	None	No
Beaver	None	No
Brender	None	No
Leavenworth NFH	None	No
Dryden Hatchery	Possible development of water quality treatment wetlands	Maybe
Backup Site	**Activities in Floodplain**	**Floodplain Development Permit Required**
Allen	None	No
Coulter/Roaring	None	No
McComas	None	No
Squadroni	Excavation of pond and open channels	Yes
George Hatchery	Excavation and construction of fish hatchery facilities	Yes

Primary Acclimation Sites

Butcher

A new well and rock-lined channel are proposed for the site. Although the site is within the 100-year floodplain (Zone AH), it appears that the source of flooding is backwater from Nason Creek rather than Butcher Creek. Construction or operation of the well and associated facilities would have no effect on flooding.

Tall Timber

The Tall Timber site is located on the unmapped section of the Napeequa River near its confluence with the White River. Although FEMA has designated a special flood hazard area along the White River (Zone A), the project site is located outside the special flood hazard area. The Tall Timber acclimation site would require a river intake and pipeline delivering water to an existing disconnected side channel. An 800-foot-long water supply pipeline from the intake to the side channel would be buried. An existing culvert would convey water from the side channel back to the river. Because the pipeline would be buried, it is expected that there would be no effect on flooding. Floodwater elevations in the stream reach between the intake and the outlet of the acclimation diversion may be slightly reduced due to the withdrawal of water from the main channel.

Chikamin

Construction of an acclimation pond at the Chikamin site would require excavation of approximately 1,370 cubic yards of material. An intake would be constructed on the bank of Chikamin Creek and a 200-foot-long water supply pipeline from the intake to the pond would be buried. A rock-lined open channel, 100 feet long and 5 feet wide, would be constructed to convey water from the pond back to the creek. The Chikamin site is not located in a FEMA mapped flood hazard area, but is likely in the 100-year floodplain of Chikamin Creek. The construction of a pond would likely lower flood elevations a small amount due the removal of excavated soils from the floodplain. Overall, the project would have little effect on flooding.

Minnow

Construction of an acclimation pond at the Minnow site would require excavation of approximately 1,370 cubic yards of material from the bed and banks of Minnow Creek, essentially widening and deepening the channel. The Minnow site is not located in a FEMA mapped flood hazard area but is in the 100-year floodplain and floodway of Minnow Creek. During a flood, the flows would be essentially the same because there is not a substantial amount of active storage in the pond. Consequently, there may be very small reduction in flooding and no change to the floodway.

Scheibler

An impoundment was built in the Chumstick Creek channel forming a pond. Project construction would include excavating 350 cubic yards of material and enlarging the existing pond. Material excavated from the pond would be spread at approved areas, outside the floodplain. The site is located on Chumstick Creek floodplain in an area that has not been studied by FEMA. Furthermore, FEMA has not produced a flood hazard map of this reach. Because the construction is limited to excavation and the spoils would be disposed of outside the floodplain, the project may reduce flooding slightly along Chumstick Creek.

Backup Acclimation Sites

Squadroni

To construct the Squadroni acclimation pond, 1,200 cubic yards of material would be excavated. The seasonal flow from an existing ditch would contribute surface water, and a well would be constructed to supply additional water. Water from the well would be delivered through a 50-foot-long, rock-lined, open channel. A 20-foot-long discharge channel would return water from the pond to the ditch prior to discharge to Nason Creek. Spoil materials would be removed from the site for disposal outside the floodplain. Although the pond would provide some additional floodplain storage, the volume is very small compared to the flood flows. Consequently, the project may slightly reduce flooding on Nason Creek.

Hatchery Sites

Dryden

The Dryden hatchery would require excavations to create rearing ponds, raceways, a hatchery building, wells, and an effluent treatment system. These excavations would occur outside the flood hazard area. A flood study of the site was completed (Anchor QEA, 2009) and 100-year flood boundaries were mapped. They are shown in Figure 2-9 in Chapter 2. Some construction could occur in the floodplain if wetlands are built to treat hatchery discharges. Treatment systems have not yet been designed but if constructed wetlands are used, they would be built at existing grade and would not impact flood elevations.

Approximately 2,050 cubic yards of material is proposed to be removed from areas outside the floodplain. Material disposal areas have not yet been located but they would be in approved locations that meet grading permit conditions and minimize potential for floodplain fill. Consequently, there would be no effect on flooding.

George

The George hatchery would require grading to create rearing ponds, raceways, a hatchery building, parking areas, backup generator station, and an effluent treatment system. The hatchery facilities would require a permanent footprint of 1.5 acres. Including pipelines, water supply construction, and hatchery facilities, a total of 2.5 acres of land would be disturbed during construction.

Permanent hatchery facilities would be located outside the limits of the 100-year floodplain boundary. As this is a backup site, detailed engineering studies have not been completed. Because the project is near the edge of the floodplain, at an elevation similar to the BFE, it is not expected that the project would measurably obstruct flood flows or reduce floodplain storage. Development of the site would have not have a substantial adverse effect on flooding.

3.10.3.2 Methow Acclimation Sites

Table 3-35 lists all the Methow basin acclimation sites, the floodplain development activities associated with each site, and the likely need for a floodplain development permit. Where the permit process is required, a more detailed analysis of floodplain impacts would need to be performed by a professional civil engineer. These detailed floodplain analyses are not part of this impact evaluation and are beyond the scope of the EIS.

Primary Sites

MSWA Eightmile

The MSWA Eightmile site is located in an abandoned side channel of the Chewuch River, just upstream of the mouth of Eightmile Creek. Construction would include a well and a 100-foot long, 5-foot wide, rock-lined, open channel that would deliver water from the well to the side channel. FEMA has not mapped a special flood hazard zone near the site. There would be no effect on flooding.

Twisp Weir

Proposed construction at the Twisp Weir site would include a 140-foot long, 50-foot wide, 3.5-foot deep, constructed earthen pond occupying approximately 0.2 acres. Because the pond would be below existing grade and material would be removed and disposed of outside the floodplain, there would be no effect on flooding.

Gold

The Gold site consists of several existing ponds located adjacent to Gold Creek. Construction activities would involve removing some accumulated sediment from the ponds to restore water depths adequate for acclimation. Excavated materials would be disposed of outside the floodplain in accordance with grading permits. The project site is not within a FEMA-mapped special flood hazard area. The proposed construction would not alter the diversions from Gold Creek. Consequently, there would be no effect on flooding.

Table 3-35. Methow acclimation sites with development activities in floodplains

Methow River Basin, in Okanogan County, Washington		
Primary Site	**Activities in Floodplain**	**Floodplain Development Permit Required**
MSWA Eightmile	None	No
Mason	None	No
Twisp Weir	Excavation of pond and pipeline corridor	Yes
Gold	None	No
Goat Wall	None	No
Pete Creek Pond	None	No
Heath	None	No
Parmley	None	No
Lower Twisp	None	No
Hancock	None	No
Winthrop NFH	None	No
Backup Site	**Activities in Floodplain**	**Floodplain Development Permit Required**
MSRF Chewuch	Excavation of a pond and open channels	Yes
Chewuch AF	Excavation of the Chewuch River bank, pond and pipeline corridors	Yes
Utley	Excavation of outlet channel to the Twisp River	Yes
Newby	Excavation of pond and pipeline corridors	Yes
Poorman	None	No
Biddle	None	No
Balky Hill	None	No

Backup Sites

MSRF Chewuch

Acclimation pond construction would include the excavation of approximately 890 cubic yards of material. A well would also be constructed. Rock-lined, open channels, a total of 320 feet long and 5 feet wide, would be constructed from the well to the pond and from the pond to the Chewuch River. FEMA designated a special flood hazard area (Zone A5) along the Chewuch River in the vicinity of the project, but the project is outside the flood hazard area. There would be a minor increase in floodplain storage capacity and potentially a slight reduction in flood elevations due to pond construction.

Chewuch AF

Acclimation pond construction would include the excavation of approximately 975 cubic yards of material. Water would be diverted from the Chewuch River. Water delivery pipelines with fish screens would also be constructed. The Chewuch AF site is located in the FEMA mapped flood hazard area (A3). Excavated materials would be removed from the site and disposed of in an upland location outside of the floodplain in accordance with local floodplain management ordinance requirements. Consequently, there would a minor increase in floodplain storage capacity and potentially a slight reduction in flood elevations due to pond construction.

Utley

An 80-foot long, 3-foot wide channel from an existing pond to the Twisp River is proposed to allow acclimated smolts a route to the river. The pond and the proposed channel are within the special flood hazard area. Because excavated materials would be disposed of outside the floodplain, there would be no effect on flooding.

Newby

A 140-foot long, 50-foot wide, 3.5-foot deep earthen bottom pond and an intake on Newby Creek are proposed for the site. Buried water delivery pipelines from the intake to the pond and from the pond back to the Twisp River would also be constructed. The construction activities would be within the special flood hazard area along the Twisp River. Because excavated materials would be disposed of outside the floodplain there would be no effect on flooding.

3.10.3.3 Combined Impacts

The total amount of ground disturbed in floodplains during construction of all the primary sites is proposed to be less than 5 acres for new and expanded ponds, water delivery channels, and other facilities as described in Appendices 1, 2, and 3. The pond excavations would remove material from floodplains, slightly increasing floodplain storage capacity and potentially decreasing flood elevations.

Proposed clearing and grading during construction is limited to small areas relative to total floodplain areas. At each site, impacts to flooding would be avoided or compensatory floodplain storage would be created to offset facilities located above ground in the floodplain.

Overall, the combined effects to flooding due to proposed construction and operation of acclimation and hatchery sites are not considered to be a significant impact because the sites individually have negligible or no effect.

3.10.4 Impacts of the No Action Alternative

No Action would cause no impacts to floodplains because no new sites would be constructed.

3.10.5 Mitigation for the Proposed Action

Measures that would be implemented to minimize potential impacts to flooding include:

- Compensatory storage incorporated in the project design where aboveground facilities are located within the floodplain.
- Spoil materials removed and disposed in uplands or at offsite locations outside of the floodplain.
- Infrastructure buried below grade, not in elevated road prisms, preventing diversion or rerouting of floodwaters.
- Using as many existing ponds as possible for fish acclimation and release.

3.11 Visual Quality and Recreation

3.11.1 Visual Quality

The construction of a new small hatchery in the Wenatchee basin has the potential to alter the visual environment of the surrounding area. Both the primary and backup facility locations are included in this assessment. Proposed acclimation sites (including existing, expansion of existing, and construction of new) are small-scale ponds without significant structures such as buildings. Development or modification of these sites would not constitute a significant or noticeable change in the visual character of the area. Therefore, proposed acclimation sites would not have an impact on aesthetic quality and are not included in this analysis.

3.11.1.1 Affected Environment

The visual impact analysis included two areas in the Wenatchee basin. The Dryden site is the preferred (primary) location for a small, new incubation and rearing facility on the Wenatchee River (RM 18.6) at the mouth of Peshastin Creek. In the event construction at Dryden is infeasible, the George site is proposed as an alternative (backup) location on the Wenatchee River (RM 51.6) just downstream of Lake Wenatchee. Both sites are located in primarily rural areas in the Wenatchee watershed (see Chapter 2 and Appendix 1 for details).

3.11.1.2 Types of Impact

The level of impact to scenic or visual quality is determined by the number of viewer groups affected, the presence of scenic resources, the magnitude of change from the existing condition, and sensitivity of viewers to changes.

For purposes of this EIS, the intensity of impacts to visual resources is categorized as follows:

> ***Minor:*** Impacts to visual quality would attract attention, but would not dominate the view or detract from current user experience.
>
> ***Moderate:*** Impacts to visual quality would attract attention and be noticeable in the viewscape. User experience would be negatively affected locally and for a brief period.
>
> ***Major:*** Impacts would result in changes to the characteristic landscape that would dominate the viewscape. The majority of the user's experience in the area would be negatively affected by the change in the viewscape.

3.11.1.3 Impacts of Proposed Action

Dryden Study Area (Primary)

The Dryden study area encompasses lands and waterways within view of a new small hatchery on the right (west) bank of the Wenatchee River, just upstream of the Dryden Dam (Figure 3-6). The 24-acre parcel currently is owned by the Washington State Department of Transportation (WSDOT) and was used as a gravel pit and stockpile site from 1961 to 2008 when it was declared surplus property. The parcel has no buildings or structures and has been significantly modified from its natural state by over 40 years of WSDOT activities. Most of the parcel that would be affected by construction of the facility is currently covered in varying amounts of gravel and sand, and there is little or no vegetation. The topography of the parcel is relatively flat and sits at an elevation of 984 feet.

Figure 3-6. Visual Impact Analysis Study Area for the Dryden Incubation and Rearing Facility, Wenatchee River

The proposed new hatchery would modify up to four acres of the parcel. The facility would consist of a one-story building of about 3,000 square feet, parking for up to ten vehicles, four concrete raceways, two ponds, a two-acre constructed wetland for water treatment, and water supply pipelines (both above-ground and buried). Viewer groups that might be affected by the change to the site include boaters, fishers and other visitors who use these reaches of the Wenatchee River and Peshastin Creek; surrounding landowners and orchard workers; gun club visitors; and train riders.

View 1 – East of Dryden:

The parcel is bordered to the east by the Wenatchee River and steep terrain that quickly ascends from the river banks to an elevation of 1,400 feet. Boaters and recreationists on the Wenatchee River would potentially have a view of the proposed facility. Existing evergreen trees and other vegetation along the shoreline would block or significantly limit most lines of sight between the river and the facility, particularly during the busy summer season when deciduous vegetation is fully leafed. Along the east bank of the Wenatchee River, railroad tracks run along the base of the ridge and are used by a variety of railway companies, including Amtrak's Empire Builder route that currently passes the parcel twice a day—once between 5:00 a.m. and 6:00 a.m., and again between 8:00 p.m. and 9:00 p.m. Views of the facility from the trains would be partially limited by shoreline vegetation, daylight, and train speed, but brief unobstructed glimpses of the facility during the summer months would be possible. East of the railroad tracks, land that would be within view of the facility is largely undeveloped, with some orchards near the top of the ridge and to the southeast. There is one house in an orchard to the southeast at an elevation of approximately 1,100 feet that would have a year-round view of the facility. There are no public roads or trails on this side of the river that are within view of the study area.

View 2 – South of Dryden:

Areas in the southern portion of the Dryden study area include an unimproved pull-out site for rafters and kayakers for portaging around Dryden Dam, a gravel access road to the pull-out, and orchards. The boater pull-out is located adjacent to the southeast boundary of the parcel; users would have a partial view of the facility. Existing evergreen trees and other vegetation along the shoreline would block or significantly limit most lines of sight between the pull-out and the facility, particularly during the busy summer season when deciduous vegetation is fully leafed. Users of the gravel access road would travel along the southern perimeter of the parcel and would have unobstructed views of the entire facility. To the immediate south of the access road, elevation gradually increases to a bluff (approximately 1,050 feet) that is lined with evergreen trees and other vegetation. Beyond the vegetation is an orchard, portions of which would have a view of the Dryden facility. Views from these vantage points within the orchard would be limited or blocked by vegetation during much of the year.

View 3 – West of Dryden:

Areas in the western portion of the Dryden study area include orchards, houses and outbuildings, the Dryden Gun Club, and a section of Peshastin Creek. Views of the facility from the southwest would potentially be possible from parts of an orchard near the bluff edge and from the far edge of the gun club target range. These vantage points are privately owned and are not expected to be visited frequently, and views would be blocked or limited by vegetation much of the year. The house and outbuilding in the orchard, as well as the Dryden Gun Club clubhouse, parking lot, and shooting area, would not have a view of the facility at any time. Boaters and recreationists in and along the section of Peshastin Creek to the west of the parcel may have partial views of the one-story building. However, the vast majority of people who visit Peshastin Creek do so in the summer months when the potential for views of the facility would be blocked or significantly limited due to seasonal vegetation. Views of the facility from the northwest would be possible from one house and outbuilding in an orchard, primarily during the winter months when the trees are not leafed out.

View 4 – North of Dryden:

The study area to the north of the Dryden facility included the lower section and mouth of Peshastin Creek where it flows into the Wenatchee River and orchards on the opposite side of the creek. Boaters and other visitors to this section of Peshastin Creek may have views of the facility, though many lines of sight would be blocked or limited by vegetation. Some areas along the shoreline, particularly near the mouth of the creek, may have year-round views of parts of the facility. The orchards on the opposite side of the creek would have partial views of the facility from a few vantage points, primarily during the winter months when the trees are not leafed out.

Construction Impacts

Construction-related activities, including heavy equipment operation, clearing and grading, material stockpiles, and worker presence, would be visible from all identified viewpoints at Dryden throughout construction of the facility. Construction at Dryden would attract attention of sensitive viewers and alter the existing viewscape from those viewpoints. Sensitive viewers would experience a negative effect locally from construction activities; however, this effect would occur for a relatively brief period of 5 months until construction is completed.

Many of the viewpoints of the Dryden facility are blocked or limited by existing vegetation surrounding the site (see descriptions above). This vegetation would not be removed and would restrict the view of the site during construction. Therefore, construction of a new hatchery at the Dryden location would constitute a short-term moderate adverse impact to visual quality.

Operations Impacts

The Dryden facility would replace an existing gravel pit and stockpile site, and would be visible from the viewpoints identified above. The facility would be operated year-round. The new one-story building would be the most prominent feature of the facility and would be designed to reduce the contrast with the surrounding landscape (natural materials, neutral colors, etc.). The raceways, ponds and water supply system would be relatively low-profile and would have much less potential to be seen from the viewpoints, particularly during months when vegetation and trees are fully leafed. The constructed two-acre wetland would be designed to closely resemble a natural wetland environment and would likely be viewed as a significant improvement over existing conditions. Furthermore, the established wetland would eventually support vegetation that would contribute to the screening of the building and facilities from most viewpoints.

Considering that the existing condition of the Dryden site is significantly modified from its natural state, it is reasonably likely that construction of the new facility would reduce the contrast of the site with the surrounding area and add to the aesthetic appeal for viewers. Therefore, changes to the viewscape due to operation of the Dryden facility would represent a long-term minor beneficial impact to visual quality.

George Study Area (Backup)

The George study area encompasses lands and waterways within view of a new incubation and rearing facility that would be constructed if the primary location at Dryden is infeasible. The 150-acre parcel is approximately two miles downstream from Lake Wenatchee (the source of the Wenatchee River) and is at an elevation of 1,870 feet. The parcel was logged in the past and is currently privately owned and undeveloped. A few primitive, unimproved old logging roads provide limited access to the site. There are no public roads, trails, or sites near the area, and there are no homes within view of the proposed construction site.

The new incubation and rearing facility would modify up to 2.5 acres of the parcel. The facility would consist of a one-story building, parking for up to ten vehicles, four concrete raceways, two ponds, and water supply pipelines (both above-ground and buried). The facility would be constructed in the forest approximately ¼ mile from the river and out of view of anyone on or along the river. A concrete water intake structure installed in the river would be visible below the water surface. The water delivery pipeline would be buried and not visible between the intake and the hatchery. A small pump station would be located in the forest approximately 50 feet from the intake and may be visible through the trees from the river or the shoreline.

The only viewers who might be affected by the change to the site are boaters who use this reach of the Wenatchee River. Much of the upper Wenatchee River corridor is part of the Wenatchee National Forest; there are launch sites for rafts, kayaks and canoes approximately two miles upstream of the George site. The next access point for boaters is an unimproved site approximately ten miles downstream of the site. Considering the long stretch of river between launch and pull-out points, and that the reach adjacent to the proposed facility is inaccessible by any other means, there would be few potential viewers and they would be in the area for only a brief time as they move downstream.

Construction and Operation Impacts

The duration of construction within view of river users would be extremely short (days) and would require little to no disturbance to the surrounding areas. Due to the very low magnitude of change in visibility of the site and the infrequent and very low number of viewers, it is reasonably certain that construction and operation of the George facility would have an insignificant effect on the aesthetic quality of the area.

3.11.1.4 Impacts of the No Action Alternative

The No Action Alternative would require no new facilities, ground-disturbing activities, or alteration of the Dryden or George sites. The sites would remain in their current state, and views at each site would be unaffected by this alternative. No direct or indirect effects to aesthetic quality would result from the No Action Alternative.

3.11.1.5 Mitigation for the Proposed Action

To avoid, minimize, or mitigate potential impacts to visual quality, areas of disturbance would be minimized to the greatest extent possible. Upon completion of facility construction, all disturbed areas would be seeded with native grasses or planted with native vegetation, where appropriate.

3.11.2 Recreation

Recreational resources in the Wenatchee and Methow basins could potentially be impacted by project construction and operation activities. Proposed project sites where construction would occur and/or where there would be a change in operations from the current conditions were evaluated for proximity to recreational areas (e.g., campgrounds, trails, rivers, resorts). Sites were not included in the analysis if there were no nearby recreational resources that could be affected by project activities or if there was no potential for impact (i.e., no construction and no change from existing operating conditions).

3.11.2.1 Affected Environment

Of the 39 primary and backup sites proposed as part of the project, a total of 11 would be located in areas that are near or adjacent to existing recreational resources. Two of those sites would have no potential for impact (no construction and no change in operations from the current conditions) and are not included in the analysis. Therefore, the recreational impact analysis focuses on the construction and operation of one proposed new incubation and rearing facility at Dryden and eight new or expanded acclimation sites.

The Dryden study area is the same as described in the visual impacts analysis. Recreation in the Dryden study area largely centers on the Wenatchee River and Peshastin Creek. The Dryden Gun Club to the south of the facility is also included in the analysis.

The study areas for the eight acclimation sites included three sites in the Wenatchee basin and five in the Methow basin. Three of the sites would not require construction, and potential impacts would solely be the result of a change in operations activities from current conditions.

Figures 2-7 and 2-8 in Chapter 2 show the locations of project sites in each basin. Large-scale maps of each proposed and backup site can be found in Appendix 4.

3.11.2.2 Types of Impact

The impacts to recreation are determined by the presence of recreational resources, the number of affected recreational groups, the magnitude of change from the existing condition, and the sensitivity of area recreationists. Each level of impact is defined as follows:

> ***Minor:*** Impact would be detectable and/or would only affect some recreational users. Changes in access would be slight but detectable; however, use would not be affected.
>
> ***Moderate:*** Impact would be readily apparent and would affect many recreational users. Users would be aware of the effects associated with proposed changes and access and user experience would noticeably change.
>
> ***Major:*** Impact would affect a majority of recreational users. Users would be highly aware of the effects associated with proposed changes. Recreational user experience would noticeably change.

3.11.2.3 Impacts of the Proposed Action

Dryden (Primary Hatchery Site)

A variety of users visit the Dryden study area year-round for boating, fishing, and other river related types of recreation. The 17-mile reach of the Wenatchee River from Leavenworth to Cashmere (river mile 27 to 10) has an overall gradient of 0.4% with multiple class-2 and class-3 rapids, making it ideal for commercial and recreational rafting and kayaking. As a result, this reach has the most access points on the river, including improved pull-out and launch sites at Leavenworth and Cashmere and several unimproved sites throughout the reach. There are also several parking and walk-in easements for sport fishing access.

All boaters traveling downstream must pull out above Dryden Dam (adjacent to the southern boundary of the new facility location) and re-launch just downstream of the dam. The pull-out area is also accessible by a gravel road that leads west to Highway 2 (via Saunders Road). A section of the gravel access road would be within the boundaries of the southern portion of the facility property.

The Dryden Gun Club is located on Saunders Road off of Highway 2 and provides a recreational shooting range and target practice area for hunters, marksmen and other gun enthusiasts. The clubhouse and lot are also often used for a variety of public and private functions, including weddings, picnics, family reunions and conventions.

Construction

Recreational resources near the Dryden site could be temporarily affected during construction of the facility. Construction would have no direct impacts to users of the boaters' pull-out or other recreationists in the area; neither the pull-out nor the access road would be modified as part of the proposed project, and full access to the sites would be maintained for all users. Boaters, fishers, gun club visitors, and other recreationists who use Saunders Road and the gravel access road could be temporarily affected by the intermittent presence of construction vehicles and equipment. This temporary increase in traffic congestion may on occasion briefly delay travel along the roads due to slow-moving construction vehicles and equipment, and might also increase noise and dust in the immediate areas along the roads. Intermittent noise associated with the construction of the facility might also be heard by visitors to the area, but would be limited primarily to the immediate area surrounding the facility (e.g., the gravel access road) and would not be expected to significantly affect the experience of recreationists.

All traffic, noise and other construction-related impacts to recreationists in the area would be temporary in duration (up to five months), intermittent, low in magnitude and limited to normal workday hours (8:00 a.m. to 5:00 p.m., Monday through Friday). Though daily use of the area by recreationists could occur, it is expected that recreational activity peaks on the weekends when there would be no construction at the facility and no potential for impact. Therefore, it is reasonably certain that construction of the Dryden facility would have a short-term, minor adverse effect on recreational resources.

Operation

Operation of the Dryden facility would minimally affect recreational users in the area, if at all. Facility operations would have no direct impacts to users of the boat pull-out or other river recreationists in the area. Gun club members' use of the shooting range would not be affected by the presence of the hatchery facility and staff. The proposed new facility is accessible only from Saunders Road, so visitors to the area might notice occasional traffic of project vehicles. Hatchery vehicles would primarily be standard-sized pick-ups and, infrequently, larger fish-transport trucks. Traffic would occur daily, year-round, and would be noticeable but would not affect other users of local roads or the experience of visitors to the area.

Noise associated with facility operations would be maintained within state-approved environmental noise regulations (WAC Chapter 173-60 of the Noise Control Act of 1974) by installing all pumps and generators in sound-enclosures. It is reasonably certain that noise due to operations activities would not be detectable beyond the facility property and would not impact recreational visitors.

Potential impacts due to operations activities would likely be low in magnitude and would not affect access to recreation or the experience of recreational visitors; therefore, operations activities at the Dryden facility would have, at most, a minor adverse effect on area recreation.

Acclimation Sites

Table 3-36 lists the eight acclimation sites (four primary and four backup) where proposed construction and/or new use of the site as an acclimation facility could affect nearby recreational resources. All eight sites would have operations activities that are different from current conditions. A few existing, currently operating acclimation sites are on recreational property, but because no new construction is required, the proposed project would not affect them differently. In addition to the 8 sites, several others are on property with homes used for vacation homes.

Construction

Construction at five acclimation sites with nearby recreational resources could temporarily affect residents and visitors. The level of construction would vary between sites, and could include the construction of a new pond, the expansion of an existing pond, the installation of a new well, and/or the installation of a new or expanded water delivery system. The duration of construction activity would be from 1 to 60 days at each site, and would be limited to normal weekday work hours of 8:00 a.m. to 5:00. p.m., Monday through Friday. Recreational visitors to the area during the construction periods could notice intermittent increases in noise due to construction activity, but the magnitude of impact is likely to be low, temporary and brief, and is not expected to affect users' experience of the area. Therefore, it is reasonably certain that construction activities at the acclimation sites would have a short-term, minor adverse effect on recreation.

Table 3-36. Recreational resources near proposed acclimation sites

Basin	Primary or Backup	Site Name	Nearby Recreational Resources	Construction / Operation[a]	Generator
Wen	P	Tall Timber	Tall Timber Ranch church camp	new H_2O delivery system / new acclimation	None
Wen	B	Allen	Valley Hi community recreation pond	no construction / new acclimation	None
Wen	B	Coulter / Roaring	habitat preservation; adjacent recreation property	no construction / new acclimation	None
Met	P	Gold	walking trails and benches	expand existing pond / new acclimation	None
Met	P	MSWA Eightmile	wildlife conservation and public recreation	new well and H_2O delivery system / new acclimation	Primary power March-April
Met	P	Pete Creek Pond	adjacent 9-hole golf course	no construction / new acclimation	None
Met	B	Chewuch AF	RV campground	new pond, well and H_2O delivery system / additional acclimation	None
Met	B	Newby	recreation property	new pond and H_2O delivery system / new acclimation	None

a. Operations activities at all eight sites would change from existing conditions.

Operation

Ongoing project activities during operation of eight acclimation sites could infrequently affect nearby recreational properties. Project staff would access the sites daily during the spring acclimation period of March through April; none of the sites with recreational facilities nearby is an overwinter site. Traffic associated with site operations would typically consist of one or two standard-size pick-ups. A large fish transport truck would visit each site once per year to transfer juvenile coho from the hatchery to the acclimation ponds. A generator is proposed to provide primary power at one site (MSWA Eightmile) during the entire six-week acclimation period, and would be contained within a sound-enclosure to minimize noise; all sound levels would be maintained within state guidelines for environmental noise and would not be detectable beyond the immediate area surrounding the enclosure.

Operations activities at eight acclimation sites could be detectable by recreationists in the area, but would likely be very low in magnitude and are not expected to affect access to recreation or the experience of recreational visitors. Therefore, operations activities at the sites would have a minor or negligible adverse effect on recreational resources in the area.

3.11.2.4 Impacts of the No Action Alternative

The No Action Alternative would require no new facilities, no ground-disturbing activities, and no modifications at any of the proposed sites. Recreational resources and users would be unaffected by this alternative.

3.11.2.5 Mitigation for the Proposed Action

To avoid or minimize impacts to recreational resources and users, all construction activity would be limited to normal workday hours of 8:00 a.m. to 5:00 p.m., Monday through Friday. Noise associated with facility operations would be maintained within state-approved environmental noise regulations by installing all pumps and generators in sound-enclosures.

3.12 Socioeconomics

3.12.1 Affected Environment

The general area for socioeconomic effects includes Chelan and Okanogan counties. The acclimation sites in both basins are primarily rural and widely distributed in the upper portions of the Wenatchee and Methow watersheds. Cashmere, Peshastin and Leavenworth are the nearest towns to the Wenatchee acclimation sites. Twisp and Winthrop are the nearest towns to the acclimation sites in the Methow basin. Wenatchee is largest municipality in the area.

The per capita income of the area is low compared to Washington in general (Table 3-37). Although county unemployment rates are stable and comparable to the statewide average, they may be higher within the small communities (Washington State Data Book 2008) primarily due to changes in the viability of the tree fruit industry and agriculture in the area (B. Brammer, Crane & Crane, and E. Parisel, Brewster Heights Packing, personal communications, October 2005 as reported in Chief Joseph Hatchery Program EIS, BPA 2010). Employment opportunities are better in Wenatchee and East Wenatchee, which have more diversified economies.

Table 3-37. County income and employment

Sector	Chelan Co.	Okanogan Co.	Washington
Per Capita Income (2006)	$29,657	$25,850	$38,067
Employment (2008)	36,230	16,930	3,200,000
Unemployment Rate (2010)	7.7%	9.1%	9.1%

Source: Washington State Data Book 2008: Unemployment data from US Bureau of Labor (http://www.bls.gov/lau/home.htm) for August 2009-September 2010, not seasonally adjusted

3.12.2 Impacts of the Proposed Action

3.12.2.1 Construction Effects

Costs

Capital costs include land purchase, facility construction, and equipment that is considered an integral part of the program. The total future estimated project capital cost is $6,730,000. Of this total, $4.5 million is programmed for the construction of the proposed Dryden hatchery, and $2.2 million for construction at the acclimation sites. Included in these amounts are $1.2 million for land purchase. All the capital costs are expected to be incurred in 2012, one year before facilities for the Natural Production Implementation Phase need to be operational.

Existing hatcheries that have no associated capital cost would provide the bulk of pre-smolt production. The new incubation and rearing facility proposed at the Dryden site (or George, the backup site) would require land purchase, water supply development, and facility construction.

Like other aspects of the proposed program, acclimation also relies on existing sites with little capital cost. Land purchase is not expected at acclimation sites; they are on private land where lease agreements would be developed. Acclimation site capital costs include construction activities for pond development, site facilities and water supply development at the proposed primary acclimation sites.

Population Size

Permanent human population changes are not expected from project construction. The local population may increase temporarily by a small number if a few construction workers from outside the area seek temporary accommodations rather than returning to their own homes.

Employment

Construction would provide short-term employment opportunities for local and non-local labor, based on the location of the prime and sub-contractors and the need for skilled and general laborers. Expenditures for labor, materials, and services would likely occur within the local area and throughout the State of Washington primarily at the contractor's discretion, with corresponding employment and income impacts. The number of local residents who may be employed during construction is not predictable, but the construction work force would likely range from about 3 to up to 15 full- and part-time positions at one time depending on the construction phase.

Infrastructure

The Proposed Action would place minimal demands on local utility and municipal services for transportation, power, and telephone/computer connections. Population impacts resulting from project construction and operation would not require an investment in new local services beyond those already planned for general development. The project would require no new services. Temporary increase in local demand for retail goods and services (e.g., fuel, groceries, personal supplies, and restaurants) is likely during construction but would not exceed current capacity.

3.12.2.2 Operations Effects

Costs

Operating costs for the Proposed Action (all program components), including labor, supplies, leases, travel, hardware, etc., would taper from about $4.2 million during the first year of operation to about $2.2 million in 2027 at the end of the program. Project costs are a tiny fraction of BPA's total budget and would not directly or indirectly increase electricity rates.

Employment and Income

Operation of the proposed rearing and incubation facility and the acclimation ponds would require a workforce of about 10 to 12 full-time and part-time positions. Most of these positions would be filled by Yakama Nation staff already involved in the current program. Approximately 6 new hires (3 full-time and 3 part-time) would be required. Even assuming each employee has additional family members, the effect of the increase in local population on area infrastructure is expected to be negligible. Potential population growth related to any improved salmon-related recreational opportunities is also expected to be negligible.

The Proposed Action, although not a commercial operation, could help establish tribal commercial fisheries and non-tribal commercial and recreational fisheries that would have economic value. There would be in-basin tribal and non-tribal recreational fisheries; tribal commercial fisheries in the mainstem Columbia River Zone 6 (Bonneville Dam to McNary Dam); non-tribal commercial and recreational fisheries below Bonneville Dam in the mainstem

Columbia; and non-tribal commercial and recreational ocean fisheries. Although the amount is not known and harvest seasons/quotas would be determined in federally recognized harvest forums, the fisheries would generate recreational expenditures and income throughout the region.

Cultural Benefits

Restoration of coho has been a long standing goal of the Columbia River Tribes, as expressed in *Wy-Kan-Ush-Mi Wa-Kish-Wit* (CRITFC 1995). This plan was developed by the four Columbia River Treaty Tribes (Nez Perce, Umatilla, Warm Springs, and Yakama). It is a comprehensive plan put forward by the Tribes to restore anadromous fishes to rivers and streams that support the historical cultural and economic practices of the tribes. The Proposed Action has the potential to enhance the culturally significant tribal ceremonial and subsistence fishery for coho salmon in the Wenatchee and Methow rivers and in the Columbia River below McNary Dam.

3.12.3 Impacts of the No Action Alternative

Under the No Action Alternative, no construction would occur, and the program would decrease from its current size. If the program were to be converted to a segregated hatchery program, its sole purpose would be for harvest, so that benefit could occur under this alternative. However, no other social or economic benefits would accrue; and Yakama Nation employment likely would be reduced by at least 11 full-time positions and up to 10 seasonal positions (3 months each spring and fall), half of which are filled by tribal members.

3.12.4 Mitigation for the Proposed Action

Because the impacts of the Proposed Action have primarily beneficial socioeconomic impacts, no mitigation measures are proposed.

3.13 Cultural Resources

3.13.1 Affected Environment

Cultural resources include prehistoric and historic archaeological sites, historic structures, and traditional cultural properties (places that may or may not have human alterations, but are important to the cultural identity of a community or Indian tribe). Laws and regulations protecting cultural resources are described in Chapter 4, Section 4.4).

Staff from BPA's cultural resources consultant, Historical Research Associates (HRA), reviewed the Washington Department of Archaeology and Historic Preservation's (DAHP) online database for archaeological site records, cultural resource survey reports, cemetery records, Historic Property Inventory (HPI) forms, and nominations to the National Register of Historic Places (NRHP) and Washington Heritage Register (WHR). DAHP's statewide predictive model was analyzed for probability estimates for prehistoric cultural resources, and to aid in developing the field strategy. Relevant environmental, archaeological, ethno-historic, and historical reports at the Spokane Public Library's Northwest Room were also reviewed. In addition, HRA research staff examined General Land Office (GLO) plats available online through the U.S. Department of the Interior's Bureau of Land Management website to locate nearby historical features that might have left archaeological remains.

3.13.1.1 Pre-contact Overview

The Columbia Plateau region, with its large, north-south trending river systems, has seen prehistoric settlement and subsistence throughout the Holocene[18]. The culture of the Plateau peoples focused on the mass harvesting and long-term preservation and storage of three key resource groups: fish (particularly salmon), roots, and large ungulates. Settlement patterns focused on lower elevations in the winter, with forays into higher elevations and places with key fish runs along rivers during warmer weather (Walker 1998).

Although it is uncertain when people first arrived in the area, it is thought that it was somewhere between 12,000 and 11,000 B.P. It is likely that the structure of settlement consisted of small, highly mobile bands of hunter-gatherers.

By the beginning of the Windust Phase (11,000-8,000 Before Present [B.P.]), small, highly mobile bands sparsely populated the developing grasslands and gallery forests. Sites adjacent to rapids, particularly along the Columbia and Snake Rivers, contain an abundance of fish remains and associated artifacts, such as grooved net sinkers and gorges (Ames et al. 1998; Cressman et al. 1960), which indicates increasing use of anadromous fish populations in the Columbia and its tributaries. In drier, upland sites there is often a predominance of milling stones, suggesting that seed gathering was also an important aspect of subsistence.

During the Vantage Phase (8,000-4,500 B.P.), inhabitants of the region restricted their range to river and some upland mountain environments. Inhabitants were probably organized as highly mobile, opportunistic foragers (Chatters 1989; Galm et al. 1985).

At the beginning of the Frenchman Springs Phase (4,500-2,500 B.P.) increased precipitation significantly altered the nature and distribution of land use. Non-riverine environments gradually became more productive. In addition to open sites and rock shelters, pit houses are found in riverine and some non-riverine environments.

Toward the end of the period, at least on the mid- and upper Columbia River, it is believed that habitations became more functionally distinct (Chatters 1986), and included hunting camps, shellfish processing camps, fishing camps, and plant-processing camps (Chatters 1989). It was toward the end of the Frenchman Springs Phase that local inhabitants intensively exploited seasonally available resources, such as salmon, bulbs and roots, and they increased their food storage activity (Ames et al. 1998).

The beginning of the Cayuse Phase (2,500-250 B.P.) is marked by a return to drier conditions. Resources became concentrated into fewer productive patches as resource productivity and diversity decreased. Along the Columbia River, a decrease in the number of sites was associated with an increase in the density of pit houses and longhouses after 1,500 B.P. Large villages were situated on islands or on the downstream portion of sandbars. Later, the more-portable mat house became important at upland camps, and it appears that upland hunting, plant gathering, and quarrying of rock or stone increased during this phase (Ames et al. 1998).

3.13.1.2 Ethnographic Overview

This period is generally regarded as the transition from late prehistory to the time when Native Americans were moved to reservations. The groups traditionally inhabiting the project area were part of a regional grouping known as the Middle Columbia River Salishans, and included the

[18] The Holocene is a geological epoch which began approximately 11,700 years ago and continues to the present.

Wenatchee, Entiat, Chelan, Methow, and Sinkaiuse, also called the Columbia, Moses Columbia, and Middle Columbia (Bruce et al. 2001; Miller 1998; Ray 1974; Relander 1956; Spier 1936; Teit 1928).

Estimates of populations for the Columbia group, prior to the outbreak of epidemics, range from 10,000 to as low as 2,200 (Creighton 2001; Teit 1928; Mooney 1928). Population counts of Ethnographic Period groups are estimates at best. Early epidemics, such as the 1801 smallpox epidemic, may have eradicated entire groups of people, and are estimated to have generally cut population counts in half (Boyd 1985; Walker, Jr. and Sprague 1998).

During ethnographic times, Columbia Plateau groups continued the traditional seasonal round that developed in the previous millennia. The yearly cycle centered on the Columbia River, though upland locations were also well-used. A staple of subsistence, and some would argue society along the Columbia River, was the salmon. The major fishing season for anadromous and freshwater fish lasted from early spring until late fall. One of the prime fishing areas for the Wenatchee was at the junction of the Wenatchee River and Icicle Creek (Miller 1998).

Fall was the prime season for deer and elk. In addition to hunting and fishing, the Columbia Plateau groups relied on gathering roots and vegetables to eat, as well as medicinal plants for a variety of ailments. Root digging was undertaken in the spring in the uplands, away from the permanent river villages.

3.13.1.3 Historic Overview

With the onset of the fur trade industry and such expeditions as that of Lewis and Clark in 1805-1806, the increase in Euro-American settlers expanded in the nineteenth century. In 1811, representatives of the North West Company explored down the Columbia River and established depots among the Colville and Lakes groups, while the Astor Company established Fort Okanogan (Kennedy and Bouchard 1998; Miller 1998). Fort Colvile was established in 1825 after a verbal agreement between the Hudson's Bay Company and the Kettle Falls chief (Kennedy and Bouchard 1998). Religious missionaries soon followed, expanding from missions built in the Plains. A mission was built near Cashmere in 1872 to serve the Wenatchee, and by 1898 a Jesuit boarding school was established at St. Mary's Mission in Omak (Raufer 1966).

Pressure from the United States government was exerted in the mid-1850s, when Territorial Governor Isaac Stevens was ordered to conduct treaty negotiations with Native American tribes and to place these groups onto reservations, in order to free up land for settlers heading west. In May of 1855, the Walla Walla Council was held. Native Americans from several areas on the Interior Plateau convened. Three reservations were established as a result, including the Yakama Reservation.

Tensions ran high between the indigenous populations and the Euro-American settlers (Kennedy and Bouchard 1998). War between the Native populations and Euro-Americans erupted in the late 1850s. Miners and other settlers actively opposed the vast Colville reservation, and in 1886 it was reduced to its present-day size.

By the end of the nineteenth century, hostilities had died down and gold was found on the Colville Reservation, and in other areas like Peshastin Creek and the Methow Valley. The Homestead Act of 1862 encouraged Euro-American settlement in the region. Soon after, logging and mining became large scale industries. By the late 1860s, there was an estimated 300-400 Chinese immigrants mining along the Columbia River and its tributaries (Ficken and LeWarn

1988). Mines previously abandoned by Euro-Americans on the bars of the Columbia, Okanogan, and lower Similkameen Rivers were taken over by Chinese immigrants in the 1870s (Schlegel and Mauser 2008). Placer operations could be found along the Columbia and Methow River, and gold strikes occurred in the Methow Valley in the 1880s.

Farming pursuits increased in the 1880s; farmers and stockmen began to settle in the Methow and Okanogan valleys as soon as 1886 (Roe 1980). The agricultural industry grew in the mid to late twentieth centuries (McKenney and Stevens 2005). By 1893, the Great Northern Railroad built a line across Stevens Pass and the area increased in population and industry as a result.

3.13.2 Impacts of the Proposed Action

Section 106 of the National Historic Preservation Act of 1966 (U.S.C. 470 et seq., as amended) requires federal agencies to consider the effect of any proposed undertakings on properties listed in, or eligible for listing in, the NRHP. BPA's cultural resources consultant, HRA, determined the Proposed Action to have a moderate probability of affecting archaeological resources that may be eligible for listing in the NRHP. This assessment is primarily due to the project's proximity to several water sources, such as the Twisp River, Methow River, and Wenatchee River, as well as to smaller tributaries. Anticipated cultural resources that could be identified in the project area of potential effect could consist of materials associated with prehistoric, ethnographic, or historic-period Native American groups. Historic period-Euro-American resources could include remnants of homesteads, railroad grades, wagon roads, and refuse dumps. Sites, features, and artifacts such as springboard notches, skid roads, and metal implements or machinery associated with logging may also be in the area.

The following proposed or backup acclimation and hatchery sites that require some form of ground disturbance or alteration of the site have previously recorded cultural resources within a half mile:

- Wenatchee basin: Butcher, Chickamin/Minnow, Tall Timber, and Dryden (primary sites); Squadroni (backup site)
- Methow basin: Gold and Twisp Weir (primary sites); Newby, Chewuch AF, and MSRF Chewuch (backup sites).

Features include cabins, a homestead and school site; wagon roads and trails; irrigation, mining, transportation and communication features; a prehistoric campsite and burial; a pithouse depression; and lithic scatters.

In spring of 2011, an on-site survey by HRA would be completed at each primary and backup acclimation and hatchery site where ground disturbance is proposed in order to determine the existence of cultural resources that could be affected and their potential eligibility for listing on the National Register of Historic Places. Several of the proposed project areas do not have any proposed ground disturbance. Therefore, implementation of the project in these areas would have very little chance of affecting any previously unrecorded cultural resources. BPA would consult on the results of these findings following the requirements of the regulations implementing section 106 of the National Historic Preservation Act (36 CFR 800). If cultural resources are identified by these studies, BPA would comply with the requirements of the National Historic Preservation Act in determining their eligibility, modifying the proposed action to minimize effects, and mitigating for any unavoidable adverse effects if necessary. Additional laws, regulations, and executive orders could affect how any potential cultural resources are addressed. (See Chapter 4, Section 4.4).

3.13.3 Impacts of the No Action Alternative

If the No Action Alternative is selected, no new facilities would be constructed, nor would existing facilities be modified; therefore, there would be no potential to affect cultural resources.

3.13.4 Mitigation for the Proposed Action

The following measures are proposed to mitigate potential impacts of the Proposed Action to cultural resources:

- Areas where ground would be disturbed during construction would be inventoried for cultural resources prior to publication of the Final EIS.
- To the greatest degree possible, facilities would be designed to avoid impacting any cultural resources identified in project areas.
- In consultation with the Washington Department of Archaeology and Historic Preservation, the Yakama Nation, and the Confederated Tribes of the Colville Reservation, a mitigation plan would be developed for any significant cultural resources identified in any of the project areas where impacts cannot be avoided. The mitigation plan would be developed before facilities are constructed.
- BPA would prepare a plan of action to be taken in the event of an unanticipated discovery of cultural resources during construction.

3.14 Public Health and Safety

3.14.1 Noise

3.14.1.1 Affected Environment

Washington State Administrative Code defines categories of properties based on their sensitivity to noise. "EDNA" means the environmental designation for noise abatement: an area or zone (environment) within which maximum permissible noise levels are established. The project area contains many sites that could fall into Class A or Class B EDNAs. Classes of property potentially affected by the Proposed Action are defined below (not all examples from the code are listed) (WAC 173-60-040).

Class A EDNAs are lands where human beings reside and sleep. Typically, Class A properties include single- and multiple-family residences, and recreational and entertainment properties where people sleep, such as camps, parks, camping facilities, and resorts. Many of the proposed acclimation sites would fall into this category.

Class B EDNAs have uses requiring protection against noise interference with speech—generally commercial establishments such as office buildings, restaurants, and entertainment facilities not designed for human habitation, such as fairgrounds and amusement parks.

Class C EDNAs are lands involving economic activities for which higher noise levels than experienced in other areas would normally to be expected, including warehouses and distribution centers, agricultural lands raising crops or livestock, and manufacturing facilities. A few sites could fall into this category, e.g., the Two Rivers acclimation site.

Table 3-38. Maximum permissible noise levels (dBA) at three classes of property [19]

EDNA of Noise Source	EDNA of Receiving Property		
	Class A	Class B	Class C
Class A	55 dBA	57 dBA	60 dBA
Class B	57 dBA	60 dBA	65 dBA
Class C	60 dBA	65 dBA	70 dBA

These noise limits have a few modifications or exceptions that are relevant to this project:

- In general, between the hours of 10:00 p.m. and 7:00 a.m. the noise limitations shown in the table must be reduced by 10 dBA for receiving properties within Class A EDNAs.
- Noise limits may be exceeded at any time during the day or night for brief periods of from 1.5 to 15 minutes, depending on the decibel level.
- Construction noise from temporary construction sites may exceed noise limits except between the hours of 10 p.m. and 7 am. at Class A EDNAs.

3.14.1.2 Impacts of the Proposed Action

The decibel (dB) is a measure of sound intensity; that is, the magnitude of the fluctuations in air pressure caused by sound waves. The decibel scale is logarithmic, not arithmetic. This means that a doubling of sound intensity is not represented as a doubling of the decibel level. Rather, an increase of 3 dB means twice as much sound, and an increase of 10 dB means ten times as much sound.

A sound pressure level of 0 dB represents the threshold of hearing for a young, healthy ear, while painful sensations in the ear occur at about 120 to 130 dB. The perception of loudness by the human ear is not directly proportional to the decibel level. For example, a sound 10 dB greater than another is not perceived as being ten times as loud but only about three times as loud.

Construction Impacts

The sound produced by conventional construction equipment typically ranges from about 75 to 90 decibels (dB), 78 dB for a dump truck, 80 dB for an excavator, 85 dB for a backhoe, and 87 dB for a bulldozer (LHSFNA 2009).

The intensity of sound attenuates, or diminishes, by about 7.5 dB as distance doubles, where vegetation is present to absorb noise. Atmospheric conditions and topography also strongly influence attenuation. The zone of effect is considered to extend from the source of the noise to the point at which the noise attenuates to ambient levels. Ambient noise levels at the project sites are unknown; however, rural areas typically have an ambient noise level of 35 to 40 dB (WSDOT 2007). A variety of site conditions would contribute to noisier than typical background noise for rural areas, such as the presence of roads or highways and streams and rivers located near or adjacent to all of the sites. In addition, adjacent land use activities such as farming, ranching, and recreational activity (e.g., snowmobiling) would include machinery that would influence ambient noise levels.

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[19] "dBA" means the sound pressure level in decibels measured using the "A" weighting network on a sound level meter. Decibels are usually measured with a filter that emphasizes sounds in certain frequencies. The "A" filter (dBA) is the one most frequently used. The "C" filter (dBC) puts more weight on low-frequency sounds such as the bass in amplified music.

Based on the WSDOT spreading noise model for attenuation over distance, assuming an ambient noise level of 40 dB, a bulldozer operating at a site (87 dB) could be heard above ambient noise ranging from about 600 to 1,000 feet away. However, the actual extent of disturbance around the sites would likely be much smaller, because most of the sites have hillsides or topographic changes near the sites that would contain noise.

Construction would take place for a few days to 5 months, depending on the site, from May through September in 2012. At all sites, construction activity would be limited to the hours between 8 a.m. and 5 p.m., Monday through Friday. Therefore, while some sites with residences or campgrounds might experience noise above ambient levels during the day for the construction period, noise levels during evenings, nights, and early mornings would return to normal.

Operations Impacts

Disturbance associated with operation at the sites would include vehicle noise associated with accessing the sites and crews walking the sites. Each of the sites would require regular, daily human presence during the acclimation period (6 weeks to 6 months, depending on the site). Crews of two people would be responsible for several sites and would drive between them during the course of the day. These types of operation activities would likely be consistent with average ambient noise levels.

Operational noise also would include generators at 3 primary Wenatchee sites and 4 primary Methow sites; and at 2 backup sites in the Wenatchee and one backup site in the Methow. The size of the generators depends on the size of well pumps which depends on depth to water which would not be known until test wells have been drilled. The generators would either operate continuously during acclimation or only during power outages, depending on the capacity and presence of existing line power. Noise muffling enclosures would be used to ensure that generator noise does not exceed decibel limits at noise-sensitive properties.

3.14.1.3 Impacts of the No Action Alternative

Because no new facilities would be constructed, there would be no construction noise. In the Wenatchee basin, operational noise would continue or be reduced from current conditions, depending on how many currently used sites would be operated. In the Methow basin, the potential use of two sites not now used by the current program could minimally increase operational noise; or operational noise levels would remain the same or be reduced, depending on the number of sites used.

3.14.1.4 Mitigation for the Proposed Action

To avoid or minimize impacts, all construction activity would be limited to normal workday hours of 8:00 a.m. to 5:00 p.m., Monday through Friday. Noise associated with facility operations would be within state-approved environmental noise regulations (WAC Chapter 173-60 of the Noise Control Act of 1974) by installing all pumps and generators in sound-enclosures.

3.14.2 Air Quality

3.14.2.1 Affected Environment

The Environmental Protection Agency (EPA) and the Washington Department of Ecology (WDOE) both have responsibility for air quality in the State of Washington. The EPA has established National Ambient Air Quality Standards (NAAQS) to protect the public from air pollution. The NAAQS focus on "criteria pollutants," which are pollutants of particular concern for human health. The NAAQS are shown in Table 3-39. In addition to the NAAQS, the WDOE has established State Ambient Air Quality Standards (SAAQS) that are at least as stringent as the NAAQS. These are also listed in Table 3-39.

The project areas under evaluation in this EIS are all in areas that are in attainment with the NAAQS (EPA 2010c). This means that the concentrations of criteria pollutants in the area are historically below (in attainment with) the thresholds described in the NAAQS. Attainment status is a federal designation determined by the EPA based on the NAAQS. Washington does not determine or define attainment for areas based on the SAAQS. Sources of criteria pollutants in the vicinity of the project sites include vehicles on state and local highways, residential home heating (particularly wood burning), agricultural practices (particularly outdoor burning and re-suspension of dust and fine particles), and re-suspension of road dust from traffic on unmaintained roadways.

Table 3-39. National and state ambient air quality standards

Pollutant	Measurement Period	Maximum Concentration	
		NAAQS	SAAQS
Carbon Monoxide	8 hour average[a]	9 ppm	9 ppm
	1 hour average[a]	35 ppm	35 ppm
Lead	Calendar quarter	1.5 μg/m^3	1.5 μg/m^3
Ozone	1 hour average	—	0.12 ppm
	8 hour average[b]	0.075 ppm	—
Nitrogen Dioxide	Annual arithmetic mean	0.053 ppm	0.05 ppm
Sulfur Dioxide	Annual arithmetic mean	0.03 ppm	0.02 ppm
	24 hour average	0.14 ppm	0.10 ppm
	3 hour average	0.5 ppm	0.50 ppm
Particulate Matter (PM_{10})	Annual arithmetic mean	—	50 μg/m^3
	24 hour average	150 μg/m^3	150 μg/m^3
$PM_{2.5}$	Annual arithmetic mean[c] 24 hour average[d]	15 μg/m^3 35 μg/m^3	— —

Sources: EPA Office of Air Quality Planning and Standards (OAQPS) (EPA, 2010a) and the Washington Administrative Code (WAC 173, Sections 470, 474, 475)

Note: ppm = parts per million; μg/m^3 = micrograms per cubic meter; PM_{10} = particulates with an aerodynamic diameter of less than or equal to 10 micrometers; $PM_{2.5}$ = particulate with an aerodynamic diameter of less than or equal to 2.5 micrometers.

[a] Not to be exceeded more than once per year

[b] To attain this standard, the 3 year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm (effective May 27, 2008) to meet the federal standard.

[c] To attain this standard, the 3 year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 μg/m^3.

[d] To attain this standard, the 3 year average of the 98th percentile of 24 hour concentrations at each population-oriented monitor within an area must not exceed 35 μg/m^3. This standard replaces the 24 hour $PM_{2.5}$ standard of 65 μg/m^3 as of December 17, 2006.

3.14.2.2 Types of Impact

Construction projects are established as sources of air pollution and are subject to the provisions of WAC 173-400-040, General Regulations for Air Pollution Sources. Typical air pollutants from construction sites include fugitive dust, vehicle emissions, and particulate emissions from activities such as burning of cleared vegetation. In significant amounts, these pollutants can be a public health hazard, especially for people with respiratory ailments; and can reduce visibility on roads, highways, and in scenic areas, to the detriment of public safety or enjoyment.

In addition, vehicle emissions and combustion of fossil fuels during project operations as well as during construction can contribute to climate change. Potential climate change impacts are discussed separately in Section 3.14.3.

3.14.2.3 Impacts of the Proposed Action

Construction

Other than vehicle emissions (see Section 3.14.3), the primary potential air quality impact from construction of project facilities would be fugitive dust. Cleared vegetation would not be burned; it would be disposed at approved landfills, so smoke and particulate pollution would not be created by the proposed project. Impacts of fugitive dust would be limited to those sites requiring substantial excavation—a total of 8 primary acclimation sites, 6 backup sites, and the proposed and backup hatchery sites.

Construction activity at the proposed hatchery at Dryden is the most likely to create noticeable amounts of fugitive dust, because it is located in a drier part of the Wenatchee basin than other sites requiring construction, and because it also requires the most significant amount of construction (a total disturbance of approximately 4 acres) during the driest part of the year. At Dryden, dust could affect visibility on Highway 2 or Highway 97 or other nearby roads, depending on the amount of dust and wind direction and speed. It could also be a nuisance to nearby residences and the gun club.

Pond excavation at other sites in both basins could also cause fugitive dust problems, most noticeably those with nearby recreation or vacation property or that are otherwise currently in use, such as Tall Timber, Gold, and Twisp Weir.

Use of the proposed mitigation measures would keep impacts of dust from construction activities to a minimum.

Operations

A number of existing and new sites are accessed via unpaved roads. Project vehicles would travel to and from each site once a day during the acclimation period, which could be for periods of 6 weeks in March through early May or 6 months from November through early May. Roads at some sites could be snow-covered during some of this period, so dust would not be an issue. Later in the spring, after roads dry out, dust from vehicle travel could be noticeable to nearby residences but, with only one round-trip a day at each site, is not expected to impact air quality or be a nuisance to neighbors.

3.14.2.4 Impacts of the No Action Alternative

No new facilities would be constructed, so the No Action Alternative would not affect air quality with additional dust beyond what is created by current activities, primarily vehicles travelling on unpaved roads.

3.14.2.5 Mitigation for the Proposed Action

- Burning of cleared vegetation or other debris would not be done. All such material would be transported to an approved landfill.

- Water supplies and dust suppression equipment would be employed at the Dryden hatchery site and at all acclimation sites requiring excavation or road improvement to ensure that dust does not create visibility problems on nearby roads and highways and does not become a nuisance to neighbors.

3.14.3 Climate Change

3.14.3.1 Affected Environment

Greenhouse gases (GHG) are chemical compounds in the earth's atmosphere that absorb and trap infrared radiation (heat) that is reflected or emitted from the surface of the earth. The trapping and subsequent build-up of heat in the atmosphere creates a greenhouse-like effect that maintains a global temperature warm enough to sustain life (EIA 2009). Some forms of GHG can be produced either by natural processes or as a result of human activities. However, the current scientific consensus is that anthropogenic (human-made) sources are increasing atmospheric GHG concentrations to levels that could raise the earth's average temperature by up to 7.2 degrees Fahrenheit within the 21st century (EPA 2010a).

The United States Global Climate Research Program (USGCRP) has found that since the 1970s, average U.S. temperatures and sea levels have risen and precipitation patterns have changed (USGCRP 2009). These conclusions are further supported by the Intergovernmental Panel on Climate Change (IPCC) that found similar patterns on a global climate scale (IPCC 2007). Climate models indicate that atmospheric concentrations of all GHG would continue to increase over the next century, but the extent and rates of change are difficult to predict, particularly on a global scale.

Human activities result in the emission of four main forms of GHG that are implicated in climate change (EPA 2010b):

- Carbon dioxide (CO2) constitutes 81% of all anthropogenic GHG emissions in the U.S., primarily due to the combustion of fossil fuels (coal, oil, gasoline, natural gas, and other fuels) and wood products (EPA 2010a, 2010b; Houghton 2010). Changes in land use and management can also increase CO2 emissions into the atmosphere (e.g., conversion of forests into croplands, application of synthetic fertilizers, and development of grasslands into residential settlements). Some industrial activities (e.g., cement manufacturing) have also been identified as contributing significantly to U.S. CO2 emissions.
- Methane (CH4) is emitted during the production and transport of fossil fuels, through intensive animal farming, and by the decay of organic waste in landfills.
- Nitrous oxide (N20) is emitted during agricultural and industrial activities, and during the combustion of fossil fuels and solid waste.
- Fluorinated gases, such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6), are synthetic compounds emitted from industrial processes. These gases are created and emitted solely through human activities (not naturally produced). Although emission levels of these compounds are relatively small, these gases have a much higher capacity for trapping heat than other GHG and are considered to have a high potential for contributing to climate change. Activities that emit fluorinated gases are not proposed as any part of this project, and thus are not included in the analysis of impacts.

To assess the potential impacts of the Mid-Columbia Coho Restoration Program on climate change, BPA considered the potential GHG emissions associated with construction and operation activities at all proposed project locations in the Wenatchee and Methow basins. Many sites proposed for use by the project already exist and/or are already operating. Sites that would not change due to project implementation would not be expected to have any impact on GHG emissions or climate change, and are not included in the analysis.

In the event any of the primary sites are determined infeasible, a backup site would be used; however, the total number of project sites would remain constant and activities at backup sites would be similar in scope and duration. Therefore, it is reasonably certain that GHG emissions from project activities would be relatively similar regardless of which (if any) backup sites would need to be used.

3.14.3.2 Types of Impact

In a general sense, all combustion of fossil fuels contributes to CO2 concentrations in the atmosphere that may contribute to significant long-term effects on the climate. In response, the EPA established the Mandatory Reporting of Greenhouse Gases Rule in 2008 (74 FR 5620), which requires reporting of GHG emissions data for sources that emit 25,000 metric tons or more per year, roughly equivalent to the CO2 emitted by 4,545 passenger vehicles per year (EPA 2005). The rule requires federal reporting of GHG emissions, but does not require any other action (40 CFR Parts 86, 87, 89 et al.).

Although the proposed project is reasonably certain to fall well below the federal reporting threshold, BPA evaluated the most significant sources of GHG emissions that would result from project implementation. Direct GHG emissions from hatchery projects are primarily due to vehicle and equipment activity (both during construction and operation activities). The proposed project would involve the operation of vehicles and generators at many locations, which would emit CO2 from the combustion of fossil fuels and contribute to atmospheric GHG levels.

GHG emissions were calculated based on methodology provided by the EPA, IPCC and the Energy Information Administration (EIA) using estimates of multiple variables including, but not limited to, the number of project vehicles, number of trips per day, distance traveled, other sources of fossil fuel combustion (e.g., generators), and duration of activities.

Changes in land cover (e.g., tree removal) due to the construction of facilities may also increase GHG emissions; however, the effects of land use change are not well understood and there are currently no accepted methodologies for quantifying impacts of land use changes on GHG emissions. Furthermore, the total acreage of land that would be impacted by project construction would be less than 5 acres, and the majority of impact would either result in an insignificant change in land cover (e.g., installation of wells, expansion of acclimation ponds) or potentially an improvement to existing conditions (e.g., conversion of an existing gravel pit to a 2.5 acre wetland). Therefore, due to the inability to quantify the impacts of land use changes, and the likely insignificant level of project-related land use changes that may elicit such impacts, this variable was not included in the analysis.

Soil disturbance may also result in GHG emissions, but research has shown that effects are temporary and return to background levels within several hours (Kessavalou et al. 1998, IPCC 2006). Therefore, soil disturbance was not included in the analysis.

In an effort to compensate for any potential GHG emissions due to soil disturbance, land use changes, or other unidentified mechanisms not included in the analysis, BPA conservatively estimated vehicle and equipment emissions. The calculated GHG estimate is therefore likely higher than actual vehicle and equipment emissions, and therefore may capture residual emissions from other sources.

The thresholds used to describe the intensity of climate change impacts are as follows:

- **Minor**: Impacts would result in the release of GHG well below the annual level required for reporting. Contributions to regional GHG amounts may be extremely difficult to determine. The contribution to national GHG emissions would be impossible to quantify.
- **Moderate**: Impacts would result in the emission of 25,000 metric tons or more per year of GHG and require annual reporting to the EPA. Contributions to regional GHG amounts would be quantifiable. Contributions to the national GHG emissions would be substantial.
- **Major:** Impacts would require annual reporting and be of an amount and nature that they would be a key component of national GHG emissions.

3.14.3.3 Impact of the Proposed Action

According to BPA's calculations (Table 3-40), the project could emit up to 502 metric tons of GHG as a result of five months of construction activities (roughly equivalent to the annual emissions from 89 passenger vehicles), and up to 1,050 metric tons of GHG per year as a result of operations activities (roughly equivalent to the annual emissions from 187 passenger vehicles).

Table 3-40. Estimated annual greenhouse gas emissions from the Mid-Columbia Coho Restoration Program [a]

Activity	CO_2 Emissions (metric tons)	CH_4 Emissions (CO_2-e metric tons)	N_2O Emissions (CO_2-e metric tons)	Total CO_2-e Emissions in Metric Tons
Construction (total for 5-month period)	241.0	37.3	223.2	502
Operations and maintenance (annual emissions)	920	7.5	123.1	1,050

[a] CH_4 and N_2O emissions have been converted into units of CO_2 (CO_2equivalent = CO_2-e) using the IPCC global warming potential factors of 21 for CH_4 and 310 for N_20.

Construction Impacts

Proposed construction activities associated with one new incubation and rearing facility and nine new or expanded acclimation ponds would result in direct GHG emissions from the operation of project vehicles and construction equipment (e.g., bulldozers, augers, backhoes). Emissions from construction vehicles and equipment would impact atmospheric GHG concentrations incrementally because construction equipment and vehicles would be fueled by gasoline and diesel combustion motors.

Considering the low level of GHG emissions (502 metric tons of CO2-e) and the brief duration of the impact (5 months), project-related construction activities would have a minor short-term adverse impact on atmospheric GHG concentrations and an unquantifiable, likely insignificant, impact on climate change.

Operations Impacts

The proposed project would involve the year-round operation of the hatchery, and seasonal operation of the acclimation sites and traps. Many of the acclimation sites and all but one each of the adult and juvenile traps are already in operation and would not change due to project implementation. The primary sources of GHG emissions would be from the operation of project vehicles between sites (46% of all operations-related GHG emissions) and the use of diesel generators as primary power at two acclimation sites for six weeks of the year (35% of all operations-related GHG emissions). It is likely that diesel generators would be switched to propane in the near future, potentially reducing annual GHG emissions by approximately 380 metric tons per year.

The calculated estimate of operations-related annual GHG emissions is relatively low (1,050 metric tons of CO2-e), and is likely very conservative considering the calculations were based on estimates of the maximum number of vehicles, miles, trips, etc., that would be involved in operational activities. Therefore, the operation of facilities and sites would constitute a minor adverse impact on atmospheric GHG concentrations and an unquantifiable impact on climate change.

Location of a small hatchery in the Wenatchee basin might reduce the number of trips necessary to transport fish to and from the Bonneville Dam area beginning in 2013; it is unclear if that reduction would be offset by more trips to in-basin acclimation sites.

3.14.3.4 Impacts of the No Action Alternative

The No Action Alternative would require no new construction or operation activities that would involve combustion of fossil fuels, and therefore no GHG would be emitted. The sites would remain in their current state, and the current hatchery programs would continue unchanged. With no new in-basin hatchery, any potential reduction in emissions resulting from reducing the number of long trips to lower Columbia hatcheries would not be achieved, because they would continue as they are under the current program. No direct or indirect effects to atmospheric GHG concentrations or climate change would result from the No Action Alternative.

3.14.3.5 Mitigation for the Proposed Action

The following measures could be implemented to reduce or eliminate project-related GHG emissions and potential impacts on climate change:

- Use gravity-flow water supplies and existing ponds wherever possible.
- Use measures that minimize vehicle and equipment emissions (e.g., reduce vehicle and equipment idling, use driving techniques that increase fuel economy, perform regular maintenance and upkeep of vehicles and equipment, use the most efficient vehicle or equipment available, etc.).
- Encourage carpooling and the use of shuttle vans among construction workers and operations staff to minimize vehicle trips and associated emissions.
- Locate construction staging areas in previously-disturbed or graveled areas to minimize soil and vegetation disturbance where practicable.
- Use propane generators at all sites as soon as feasible.
- Submit a plan for approval to recycle or salvage non-hazardous construction and demolition debris.
- Use locally sourced supplies as much as possible.

3.15 Cumulative Effects

Cumulative impacts are the environmental effects that result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions regardless of which agency (federal or non-federal) or person undertakes such other actions.

3.15.1 Surface Water Quality

Proposed Action

The timing of acclimation nutrient discharges, in relation to annual flow patterns, is important to the evaluation of cumulative project impacts on water quality. The Wenatchee and Methow rivers have peak average flows in early June. Acclimation ends in early May just as spring runoff begins. Data collected from the basins (see Appendix 6, Water Quality Data) demonstrate that river phosphorous concentrations and loads peak along with river flows, as accumulated nutrients and attached algae that have been suspended are flushed from the basins. The majority of the phosphorous introduced by acclimation is included in this mechanical removal process, thereby limiting the impact of project nutrients on water quality in the critical late summer through winter period.

For the Wenatchee basin, the model simulations suggest that potential impacts of the proposed project, as defined by the criteria for DO and pH, would be negligible under foreseeable future conditions. When viewed in light of the conservative assumptions employed in establishing the translation of loads and flow conditions within the model framework, the actual impacts under average flow conditions would be much smaller than what was determined by the QUAL-2K modeling exercise. The fact that the model results indicated that much of the project load is likely to be assimilated upstream of Leavenworth suggests that existing public treatment works are not likely to be further burdened by requirements to buffer activity from the proposed project in the upper reaches.

For the Methow basin, the contribution of the project related loads relative to the cumulative basin load (Methow River at Pateros in Table 3-9) was estimated to be about 0.8%. The equivalent calculation for the Wenatchee sites resulted in a relative project contribution of 1.1% of the basin TP loading (Table 15 in Appendix 7). As described previously, modeling indicated that acclimation-related loads in the Wenatchee basin caused a negligible change in DO and pH even in the presence of sources such as public water treatment works. Given the lower estimate of nutrient loading from acclimation activity in the Methow basin and the similarity in the basin characteristics, the TP loads from acclimation activity are unlikely to cause a measurable change in DO and pH in the Methow River; thus cumulative effects of the project would be negligible.

No Action Alternative

As with the Proposed Action, the impacts of discharges from the sites in the No Action Alternative were assessed for the case when public treatment works discharge at their design capacity, contributing a phosphorus load as allocated in the WDOE TMDL (corresponding to 90 µg/L). The spatial trends in water quality parameters were similar to those predicted for the Proposed Action. As expected, the changes in minimum DO and pH range over the background conditions were predicted to be milder than for the Proposed Action, and thus cumulative effects of the project would be negligible.

3.15.2 Groundwater and Water Rights

Proposed Action

Other proposed groundwater withdrawals or surface water diversions, if not non-consumptive or water-balance neutral, could impact the stream flows in the two basins. New water supplies for residential, commercial and industrial uses and allocations for groundwater rights by WDOE are likely during the time period of the proposed project.

The proposed groundwater uses for the project would have impacts only within the drawdown cone created by groundwater withdrawals because the groundwater uses are water budget neutral. In addition, the aquifers likely to be used at the proposed sites are in hydraulic continuity with the streams, which would reduce the size of the drawdown cones. Thus, the impacts would be localized. Other future groundwater uses would also create drawdown cones and, unless these future drawdown cones intersect the drawdown cones created by the project, the project would not impact these uses. Other future surface water uses may be positively impacted immediately downstream and not impacted further downstream by the proposed discharge of groundwater into the streams.

The Proposed Action includes facilities with very minor groundwater withdrawal rates compared to the total groundwater storage capacity in the shallow aquifers in the Wenatchee River and Methow River basins. The proposed groundwater withdrawals are also small when compared to the flows in the two rivers. Operation of the proposed projects individually or collectively is not expected to have measurable impacts to stream flows or water quality in areas outside the immediate facility locations.

No Action Alternative

If existing project facilities cease using currently used groundwater, cumulative impacts to groundwater could be reduced.

3.15.3 Fish

Past and present activities that may have affected fish habitat in the Wenatchee and Methow basins include diversions and dams, agricultural activities, stream channelization and diking, roads and railways, timber harvest, and urban and rural development (Mullan et al. 1992; Chapman et al. 1994, 1995; NPCC 2004a & b). A hydropower dam constructed on the lower Methow River near Pateros in 1915 blocked upstream anadromous fish passage until it was removed in 1929 (Mullan et al. 1992; Peven 1992; Andonaegui 2000). Humans have altered habitat primarily in the lower gradient, lower reaches of the basins (Andonaegui 2000, 2001); these alterations have blocked access to habitat and reduced habitat complexity, off-channel habitats, and large, deep pools. Extensive use of rip rap to stabilize stream banks has decreased the channel sinuosity and recruitment of large woody debris (LWD). Chronic sedimentation from land and water management activities has degraded habitat in some areas. In contrast, upper reaches of these basins are in relatively good condition (Andonaegui 2000, 2001; NMFS et al. 1998).

Habitat conditions have improved in recent years and further improvements are expected in the future. Some of the factors that have affected habitat of ESA-listed fish have been partially addressed through changes in land use practices (UCSRB 2007). These include improving fish passage at dams, installing irrigation diversion screens, culvert replacement, riparian buffer strips, and improved livestock management. Two major habitat restoration efforts are being been funded by BPA in the Wenatchee and Methow basins. The Yakama Nation will be receiving 6-7 million dollars annually over ten years for habitat restoration in these basins. In addition, the Upper Columbia Salmon Recovery Board will be receiving about 3.5 million dollars for habitat restoration projects beginning in 2011. These efforts should result in substantial habitat improvements over the next decade.

Proposed Action

The Proposed Action could add to the cumulative benefits that all these actions are providing to the ecological balance in the two basins; and with the improvements and increases in habitat, any potential adverse interactions between coho and other species are not likely to measurably add to the other stressors on ESA-listed fish.

The Proposed Action would result in reduced seasonal access to a very small amount of existing off-channel habitats used for acclimation and rearing of hatchery coho salmon, and potential short-term acute delivery of additional sediment from bank disturbance and pond construction. Because these off-channel habitats are not preferred by spring Chinook, steelhead and bull trout, the impacts from the proposed seasonal use of small areas for acclimation and rearing purposes would not be additive to cumulative effects of past, present, and anticipated future human-caused impacts to habitat. The amount of habitat excluded during acclimation and rearing activities or added through additional sites under the proposed alternative is not likely to have a measureable impact compared to past and current impacts and those likely to occur.

Permit conditions would require that sediment be strictly controlled during construction; and in the small areas affected, any unforeseen increased sediment delivery is likely to be minimal and highly localized. Construction is not expected to result in conditions that cause chronic increases in sediment loads. Therefore, although the project could add to the cumulative effects of basin-wide sources of sediment in streams, the contribution would be small, localized, and would not persist more than 1-2 weeks past construction.

No Action Alternative

The cumulative impacts of the No Action Alternative on fish would be mixed. Fish would not be excluded from habitat they currently use because no new facilities would be constructed, and there would be no temporary small increase in sediment in streams due to construction; thus the alternative would not add to such impacts that are otherwise occurring in the basins. On the other hand, given that a naturally reproducing population of coho would not be established, any additional benefit to ongoing and future ecological improvements from such populations in the basins would not occur.

3.15.4 Priority Habitat, Plants, and Wildlife

Proposed Action

Residential development is anticipated in the Wenatchee and Methow basins over the next several years, and would likely contribute to cumulative impacts to native vegetation communities, which could disturb priority habitats and species. Clearing and construction at the project sites contributes in very minor ways to cumulative regional fragmentation and net loss of native vegetation and habitats. Impacts from continued growth in the region will occur regardless of whether the proposed project is implemented, and is likely to contribute to loss of habitat in significant ways, unlike the proposed project. However, some project activities would create additional aquatic habitat for native species in the region, adding a small area (about 1 acre) to other habitat protection and enhancement being undertaken in the basins.

Operation of the project would result in an increase in human activity at the sites. While the sites are primarily located in rural areas, most of the sites are associated with residential property and with associated existing human activity and vehicle traffic. Also, the program is proposed to end in 2027. The human disturbance impacts associated with the Proposed Action would also then end. No significant cumulative impacts associated with operation of the project are anticipated.

No Action Alternative

The cumulative effects of No Action on priority habitat, plants, and wildlife, when added to other development effects undertaken in the two basins, would be undetectable.

3.15.5 Wetlands

Proposed Action

Development projects are anticipated to occur in the Wenatchee and Methow basins in the vicinity of the project sites over the next several years, and would likely contribute to cumulative impacts to wetland habitats. Clearing and construction at the project sites contributes to cumulative regional fragmentation and net loss of wetland habitat. However, construction activities associated with the project are anticipated to result in low permanent impacts to wetland habitats (approximately 3200 square feet of permanent impact), with the potential to add about 52,000 square feet of new wetland. Due to the relatively small area of potential wetland impacts relative to the amount of wetland area present in the Wenatchee and Methow basins associated with the multiple project sites, project impacts to wetlands would not significantly contribute to cumulative impacts to wetlands.

No Action Alternative

With no construction of new acclimation sites or a hatchery, the project would add nothing to the cumulative loss of wetlands in the basins.

3.15.6 Floodplains

Proposed Action

Activities in the two basins other than this project that could exacerbate flooding include diking, road development, and residential/urban development.

Because construction activities associated with the project are anticipated to result in very minor conversion of forested lands compared to the watershed as a whole, because the some acclimation sites would provide additional floodplain storage, and because new construction would be in accordance with floodplain development codes, the cumulative effects of these actions are not considered a significant impact. Additionally, many proposed county and state-funded road improvement projects include culvert replacements on existing roads having the potential to mitigate or reduce the effects of existing flooding. The known road improvement projects are identified in the following sections.

Habitat improvement projects are also proposed throughout the project area. These projects are funded by federal and state dollars under multiple programs and implemented by local stakeholder groups, counties, and conservation districts. Habitat improvement projects that re-establish floodplain access to undeveloped floodplain habitat have the potential to further mitigate or reduce the effects of existing flooding. Habitat improvement projects funded and proposed for implementation in the Wenatchee and Methow basins using Washington State Salmon Recovery Funding Board (SRFB) grants can be tracked at the Upper Columbia Salmon Recovery Board's salmon habitat implementation website (http://uc.ekosystem.us//). Habitat improvement projects funded in the Wenatchee and Methow basins using Chelan County PUD and Douglas County PUD Habitat Conservation Plan (HCP) Tributary Fund dollars can be found at the Chelan County PUD HCP website (http://www.midcolumbiahcp.org/). Other projects could be implemented by other public agencies or private parties that are not known at this time.

Wenatchee Basin Road Projects

Planned projects in the basin include road improvement projects throughout the watershed that could have localized effects on nearby creeks. These projects are Chelan County projects: CRP636-North Road and CRP612-Eagle Creek Road that could impact Chumstick Creek, CRP597-Old Blewett Highway that could impact Peshastin Creek; and Washington State Department of Transportation (WSDOT) projects: US 2 bridge over Chiwaukum Creek, US 2 Wenatchee River bridge at Tumwater, and road improvements along US 97 that could impact Peshastin Creek. It is anticipated that Chelan County and WSDOT would implement mitigation measures and best management practices (BMPs) according to the Highway Runoff Manual (WSDOT 2008) to minimize floodplain impacts from any of these projects. Consequently, the cumulative effects of the Proposed Action and other known projects in the Wenatchee basin are not considered to be a significant cumulative impact.

Methow Basin Road Projects

In the Methow basin, other known planned projects include road improvement projects throughout the watershed that could have localized effects on nearby creeks. These projects are Okanogan County and WSDOT road improvement projects such as Twisp River Road (affecting Twisp River), and Twin Lakes Road (affecting Methow River). It is anticipated that Okanogan County and WSDOT would implement mitigation measures and BMPs according to the Highway Runoff Manual (WSDOT 2008) to minimize floodplain impacts from any of these projects. Consequently, the effects of the Proposed Action combined with the effects of other known projects in the Methow basin are not considered to create a significant cumulative impact.

No Action Alternative

Because no new development would take place in floodplains as part of this alternative, there would be no impacts to floodplains and thus no cumulative effects with other floodplain development projects in the basins.

3.15.7 Visual Quality and Recreation

Proposed Action

The Proposed Action would not noticeably change visual quality or affect recreational uses, so would not contribute to other visual quality and recreational impacts occurring in the basins.

No Action Alternative

There would be no change to current conditions, so there would be no cumulative effects.

3.15.8 Socioeconomics

Proposed Action

The Proposed Action would add relatively few permanent jobs to the region, so the incremental effects on area population and income, and the need to change infrastructure and services, would be negligible. Expenditures and income associated with the terminal fishery are minor and not expected to measurably affect local or regional economies. The numerous federal, state, local, and tribal efforts to improve fish populations, river flow, and aquatic habitat in the region, of which this program is a small part, should result in salmon population increases which, together, should provide economic and cultural benefits.

No Action Alternative

The No Action Alternative would not add noticeably to adverse economic and social effects in a regional sense. Any loss of employment due to lack of funding of the project would be significant to individuals but would be an incrementally minor impact on current unemployment levels in the region. The incremental lost opportunity impacts on the economic, social, and cultural benefits of future coho harvests could be noticeable, although unquantifiable, if other regional efforts to improve fish populations and habitat are similarly curtailed and if the current Mid-Columbia coho program is not converted to a harvest augmentation program.

3.15.9 Cultural Resources

Proposed Action

The cumulative effect of the Proposed Action on cultural resources is unknown until site-specific surveys are done; it is expected to be minor, however, when considered in the context of past, current, and future development that has taken place and continues to occur in the basins.

No Action Alternative

Because no new site development would take place, there would be no potential for the project to add to the past, current, or future development impacts on cultural resources in the basins.

3.15.10 Public Health and Safety

Proposed Action

The largely minor and short-term and increases in fugitive dust and construction noise would not add to the cumulative long-term impacts to air quality and noise from increased development and population levels in the two basins. Contributions of the project to climate change, while adding theoretically measurable amounts to greenhouse gas concentrations in the basins, would be unquantifiable.

No Action Alternative

The No Action Alternative would have no cumulative effects on noise, air quality, or climate change.

3.16 Unavoidable Adverse Effects and Irreversible and Irretrievable Commitment of Resources

- Short-term minor increases in sediment in water bodies near some acclimation sites, due to the need to develop water supply and discharge channels and lines.
- Short-term avoidance by wildlife of some project sites due to construction activity.
- Short-term disturbance during construction at residential and recreational sites.
- Potential loss of small numbers of listed fish to predation or competition with coho, or to trapping for juvenile or adult coho.
- Annual temporary exclusion of listed fish from a small amount of habitat.
- Potential permanent removal of less than an acre of wetland.
- Irreversible uses of fuel, office supplies, petroleum products, chemicals, and other operational supplies. Some building materials and equipment might be re-usable, but much of it would not.

3.17 Short-Term Use of the Environment and Effects on Long-Term Productivity

The proposed Mid-Columbia Coho Restoration Program is expected to greatly enhance productivity of the aquatic environment through salmon population increases, from which other aquatic and terrestrial species including humans may derive benefits. The lands developed for a small hatchery complex and for acclimation ponds would be permanently taken out of vegetative productivity. Construction activities would temporarily affect more land than would be permanently developed, but long-term productivity would not likely be adversely affected because of the measures that would be taken to restore disturbed, undeveloped areas to pre-existing condition or better (replanting with native species, weed control, standard construction BMPs, etc.). The stream reaches between the intakes and outlets of the ponds would have slightly lower total flow when water is diverted for fish acclimation, but these distances are generally 1,500 feet or less. Groundwater production in wells near some acclimation sites might be reduced. Some incremental amount of greenhouse gases would be emitted during construction and hatchery operation, which would add to global climate change, but energy efficiency considerations in project design would make this contribution insignificant at local and global scales.

The No Action Alternative would not change the aquatic environment, either positively or negatively, or alter any terrestrial sites.

Chapter 4. Consultation and Coordination

Numerous federal, state, and local environmental laws and administrative requirements must be satisfied prior to initiation of the proposed program. This chapter reviews the program's compliance with these regulatory requirements.

4.1 Environmental Policy

4.1.1 National Environmental Policy Act

The National Environmental Policy Act of 1969 as amended (42 USC 4321 et seq.) requires federal agencies to assess and disclose the effects of proposed actions on the environment before making a decision to proceed. This EIS has been compiled to meet NEPA requirements.

BPA and Yakama Nation conducted scoping meetings and informal outreach efforts with interested and potentially affected parties, who identified issues to be considered in the environmental analysis. This draft EIS is being sent to regulatory agencies and other interested organizations and individuals for review and comment (Chapter 8). After a formal public comment period on the draft EIS, BPA will consider all comments and make additions, corrections, or clarifications to the analysis for the final EIS. The final EIS will be used by BPA to determine if the agency will proceed with approval and funding of the Mid-Columbia Coho Restoration Program. BPA will document its final decision in a record of decision after the Final EIS has been issued.

4.1.2 State Environmental Policy Act

The State Environmental Policy Act (SEPA), Washington State's most fundamental environmental decision-making law, was enacted in 1971 as chapter 43.21C Revised Code of Washington. Much like the federal National Environmental Policy Act, SEPA is designed to provide decision-makers and the public with impartial information about a project and analyze alternatives to the proposal, including ways to avoid or minimize adverse impacts or to enhance environmental quality. The purpose of SEPA is to encourage harmony between the citizenry and the environment, to promote efforts that will prevent or eliminate damage to the environment, to stimulate human health and welfare, and to enrich understanding of the ecological systems and natural resources that are important to Washington State. Information provided during the SEPA review process helps decision makers understand how a proposal would affect the environment and identify measures to reduce likely effects, or deny a proposal when adverse effects are identified. This EIS may be adopted by Okanogan County as the lead state agency to fulfill the SEPA requirement.

4.2 Northwest Power Act

Provisions of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (6 USC 839 et seq.) are intended to protect, mitigate, and enhance fish and wildlife of the Columbia River and its tributaries. This project is proposed in part to meet BPA's need to return naturally spawning, locally adapted populations of coho salmon to the Wenatchee and Methow basins as a way to help fulfill its obligations under the Act (16 U.S.C. § 839 et seq., Section 4(h)(10)(A)).

In April 1996, the project was one of the 15 high-priority supplementation projects recommended for funding by the Northwest Power Planning Council (NPPC) [now Northwest

Power and Conservation Council] and was incorporated into the Fish and Wildlife Program (program measures 7.1H, 7.4A, 7.4F, and 7.4O).

In the FY 1998 Annual Implementation Work Plan, the Council recommended funding for completion of the environmental review of the first phase (feasibility studies). Because this phase of the project was initiated prior to the Council's Three-Step Review Process and was experimental in nature, no step review was necessary (M. Fritsch, NPPC, memorandum to Council, July 12, 2000).

The Yakama Nation submitted a Master Plan for the proposed program in fulfillment of Step 1 of the Northwest Power and Conservation Council's 3-step process to review projects proposed under its Columbia River Basin Fish and Wildlife program (see Chapter 1, Section 1.4). The Master Plan (YN 2010), developed with review and assistance by a number of scientists (including the ISRP) and fish and wildlife agencies, detailed the approach and biological rationale to realize the YN's long term vision for coho in the region. The Council and its Independent Science Review Panel reviewed drafts of the Master Plan, and on March 9, 2010, the Council recommended that BPA implement the program as described in the plan. The program described in the Master Plan provided the basis for the Proposed Action evaluated in this EIS (see Chapter 2). The EIS would provide the basis for the Council's review under Step 2 of the process. Should the project proceed, final designs would be developed that would be reviewed by the Council under Step 3 of the process.

4.3 Wildlife and Habitat

4.3.1 Endangered Species Act

The Endangered Species Act of 1973 and its amendments (ESA, 16 USC 1531 et seq.) require federal agencies to ensure that their actions do not jeopardize endangered or threatened species or their critical habitats. The effects on species listed under ESA are discussed at length in Chapter 3 of this EIS: Section 3.7 (Fish) and Section 3.8 (Priority Habitat, Plants, and Wildlife). Based on the information in these sections, a Biological Assessment is being prepared and will be submitted to USFWS and NOAA Fisheries for formal consultation under Section 7 of the ESA.

4.3.2 Fish and Wildlife Conservation

The Fish and Wildlife Conservation Act of 1980 (16 USC 2901 et seq.), encourages federal agencies to conserve and promote conservation of game and non-game species and their habitats. This project is designed to promote the restoration of coho salmon in areas from which it was extirpated, and to contribute to the ecological balance of the Methow and Wenatchee basins by providing a source of nutrients to other species at the onset of the critical winter period. See Chapter 3, Section 3.7.

The Fish and Wildlife Coordination Act of 1934 (16 USC 661 et seq.) also requires federal agencies to consult with the USFWS and state fish and wildlife agencies when "waters of any stream or other body of water are proposed or authorized, permitted or licensed to be impounded, diverted…or otherwise controlled or modified" by permit or license. The USFWS and WDFW will be sent copies of this EIS, and their comments will be addressed in the final EIS.

The proposed action would divert waters of rivers and streams in the Wenatchee and Methow basins to rear and acclimate coho salmon. This use would not consume the water, but would use it briefly and then discharge it back into the river. This use would enhance the potential to restore naturally reproducing populations of coho, increasing their abundance, productivity, distribution, and diversity.

4.3.3 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (16 USC 703-711) prohibits the taking, killing, or possession of migratory birds except as allowed by the Secretary of the Interior. The list of migratory birds is found in 50 CFR 10, and permit regulations are found in 50 CFR 21. This project would not take, kill, or possess migratory birds. See Chapter 3, Section 3.8.

4.3.4 Bald Eagle Protection Act

The federal Bald Eagle Protection Act (16 CFR 668-668c) prohibits the taking, possession, purchase, sale, barter, transport, export, or import of any bald or golden eagle or any part, nest, or egg of a bald or golden eagle, except for certain scientific, exhibition, and religious purposes. Eagle permit regulations are found in 50 CFR 22.

Washington state wildlife law is contained in Title 77, Revised Code of Washington (RCW). This title contains several sections generally applicable to the EIS process. Bald eagles and protection of their habitat are addressed in RCW 77.12.650 and 77.12.655. Taking protected wildlife and destroying eggs, including removal of raptor nest trees, are prohibited under RCW 77.16.120.

Bald eagles would not be taken or otherwise harmed by this project. The most likely effect would be beneficial, by increasing a source of food—coho salmon. See Chapter 3, Section 3.8.

4.3.5 Magnuson-Stevens Fishery Conservation and Management Act of 1976

NOAA Fisheries is responsible for ensuring compliance with the Magnuson-Stevens Fishery Conservation and Management Act of 1976. Public Law 104-297, the Sustainable Fisheries Act of 1996, amended the Magnuson-Stevens Act to establish new requirements for evaluating and consulting on adverse effects to essential fish habitat (EFH).

The facilities associated with the Mid-Columbia Coho Restoration Program are located within EFH Habitat for Pacific salmonids (coho and Chinook salmon). As discussed in Section 3.7, changes to Chinook salmon habitat would be unlikely, and juvenile Chinook would be excluded from at most approximately 3 acres of habitat they might currently use for a period of 6 weeks to 6 months each year. The Biological Assessment would detail conservation measures intended to avoid and minimize impacts to essential fish habitat of federally managed fish species.

4.4 Heritage Conservation and Cultural Resources Protection

The National Historic Preservation Act of 1966 as amended (16 USC 470) requires federal agencies to take into account the potential effects of their undertakings on properties that are listed or eligible for listing on the National Register of Historic Places (NRHP). Consultation must occur with the State Historic Preservation Office, Indian tribes that attach religious and cultural significance to historic properties that may be affected by an undertaking, and additional consulting parties regarding the inventory and evaluation of properties potentially eligible for National Register nomination; and to determine whether the project would adversely affect them.

Cultural resource surveys will be conducted at each proposed project site where ground disturbance may occur (Chapter 3, Section 3.13). Findings would be consulted upon with the

Washington State Historic Preservation Office, the Yakama Nation, and the Confederated Tribes of the Colville Indian Reservation. If surveys identify the potential for adverse effects, additional consultation to determine how to avoid or mitigate the effects would take place if the Proposed Action is implemented.

Facilities proposed on federal or Tribal land would follow the requirements of the Archaeological Resource Protection Act (16 USC 470 et seq.). Currently, the Proposed Action includes no alterations to sites on federal properties. Only one site is on Tribal land; it is currently being used by the Mid-Columbia Coho Restoration Program, and no new construction is proposed under the Proposed Action.

The Archaeological and Historic Preservation Act (16 USC 469 et seq.) directs federal agencies to notify the Secretary of the Interior if they find that a federal action might cause the destruction of significant scientific, prehistoric or archaeological data. Chapter 3, Section 3.13.2, discusses the likelihood of encountering cultural materials at the proposed construction sites.

Executive Order 13175, Consultation and Coordination with Indian Tribes, states that the U. S. government will continue to work with Indian Tribes on a government-to-government basis to address issues concerning tribal self-government, trust resources, and Indian tribal treaty and other rights. The Mid-Columbia Coho Restoration Program (sponsored by the Yakama Nation) would contribute to the spirit of intergovernmental cooperation, and if implemented, has the potential to enhance the culturally significant tribal ceremonial and subsistence fishery for coho salmon in the Wenatchee and Methow rivers and in the Columbia River below Wells Dam.

4.5 Floodplain/Wetlands Assessment

Executive Orders 11988, Floodplain Management and Executive Order 11990, Protection of Wetlands, require the protection of these areas. If either would be affected or altered by project facilities, the effects must be disclosed. Sections 3.9 and 3.10 of this EIS describe the effects of the proposed program on wetlands and FEMA-mapped floodplains. Section 4.5 is the Floodplain and Wetland Assessment required under the Executive Orders.

4.5.1 Project Description and Impacts

Floodplains

Most, if not all, of the 26 proposed sites are in or near a floodplain. Appendix 8 provides details of the FEMA flood insurance rate maps (FIRMs) that apply to each site. However, not all sites require construction that would potentially affect the floodplains. Table 4-1 identifies all the proposed acclimation and hatchery sites, both primary and backup, and the kind of construction activity that would take place in floodplains. The total amount of ground disturbed during construction of all the primary sites is proposed to be less than 5 acres and would include four new water intake structures, seven new wells, and 650 feet of unpaved road. New ponds are proposed for the Dryden hatchery, three primary acclimation sites, and three backup sites. The construction details for each site are described in Appendices 1, 2, and 3. The new ponds would remove material from floodplains, slightly increasing floodplain storage capacity and potentially decreasing flood elevations.

Proposed clearing and grading during construction is limited to small areas relative to total floodplain areas. At each site, impacts to flooding would be avoided or compensatory floodplain storage would be created to offset facilities located above ground in the floodplain.

Table 4-1. Acclimation and hatchery sites with development activities in floodplains

Wenatchee River Basin, in Chelan County, Washington		
Primary Site	**Activities in Floodplain**	**Floodplain Development Permit Required**
Butcher	Excavation of an open channel	Yes
Tall Timber	Excavation of Napeequa River bank intake and pipeline corridor	Yes
Chikamin	Excavation of a pond, Chikamin Creek bank intake, open channel, and pipeline corridor	Yes
Minnow	Excavation of bed and banks of Minnow Creek	Yes
Scheibler	Excavation of bed and bank of Chumstick Creek	Yes
Coulter	None	No
Rohlfing	None	No
White River Springs	None	No
Dirty Face	None	No
Two Rivers	None	No
Clear	None	No
Beaver	None	No
Brender	None	No
Leavenworth NFH	None	No
Dryden Hatchery	Possible development of water quality treatment wetlands	Maybe
Backup Site	**Activities in Floodplain**	**Floodplain Development Permit Required**
Allen	None	No
Coulter/Roaring	None	No
McComas	None	No
Squadroni	Excavation of pond and open channels	Yes
George Hatchery	Excavation and construction of a fish hatchery and associated facilities	Yes
Methow River Basin, in Okanogan County, Washington		
Primary Site	**Activities in Floodplain**	**Floodplain Development Permit Required**
MSWA Eightmile	None	No
Mason	None	No
Twisp Weir	Excavation of pond and pipeline corridor, new water intake	Yes
Gold	None	No
Goat Wall	None	No
Heath	None	No
Parmley	None	No
Pete Creek Pond	None	No
Lower Twisp	None	No
Hancock	None	No
Winthrop NFH	None	No
Backup Site	**Activities in Floodplain**	**Floodplain Development Permit Required**
MSRF Chewuch	Excavation of a pond and open channels	Yes
Chewuch AF	Excavation of the Chewuch River bank, pond and pipeline corridors	Yes
Utley	Excavation of outlet channel to the Twisp River	Yes
Newby	Excavation of pond and pipeline corridors	Yes
Poorman	None	No
Biddle	None	No
Balky Hill	None	No

Implementation of the Proposed Action would probably have little or no effect on flood elevations. Where there is an effect, it is likely to be beneficial, as the acclimation ponds would provide some small amount of additional floodplain storage (difference between the existing land surface elevation and the working water surface elevation). The spoil materials from construction activities such as excavation of ponds and ditches, grading of roads to improve winter access, or installation of buried water supply pipes would be disposed of outside the 100-year floodplain in accordance with the local grading and floodplain management ordinances. Consequently, there are not likely to be changes in grades that could direct or divert flood flows affecting properties either upstream or downstream of the individual project sites.

New wells, although providing additional flow through the acclimation sites, would withdraw water from shallow aquifers that are typically hydraulically connected to the adjacent creek or river. Therefore, there is no real gain or loss of water (see Section 3.6). Additionally, the well discharge would be very minor compared to flood flows (Section 3.6), so there would be no impact on floodplains from construction or operation of wells. Site-specific discussions can be found in Chapter 3, Section 3.10.3.

There would be little to no effect on lives or property from the proposed actions that are located in floodplains. As discussed above, the overall effects on flooding may be slightly beneficial due to the excavation of ponds and ditches.

Wetlands

Wetlands were identified primarily from existing information and some site visits for a number of project acclimation sites and for the backup hatchery site. The site-specific maps in Appendix 4 show the types of wetlands identified at each project site. However, not all sites requiring construction would affect wetlands, and at the Dryden site, the project would create new wetlands where none now exist. Table 4-2 summarizes the types of wetlands identified at primary and backup sites in the two basins where construction is proposed, and the amount of disturbance, removal, or newly created wetland currently estimated. Wetland delineations would be done in spring 2011 to determine more precisely the amount of wetland affected.

Table 4-2. Estimated wetlands effects at project sites: temporary, permanent, and new created

Site Name	Wetlands Observed During Site Visits	Wetlands Identified With Existing Information	Potential Wetland Impacts
Wenatchee Primary			
Dryden	None observed	PSS wetland habitat mapped along riparian habitat a few hundred feet from the site	- No wetland impacts identified in proposed construction area. - New wetland potentially created: 52,272 sq ft
Minnow	None observed	PFO, PSS, and PEM wetland habitat mapped along riparian habitat a few hundred feet from the site	No wetland impacts identified in proposed construction area.
Scheibler	PFO, PSS, and PEM wetland habitat associated with riparian habitat	PSS and PEM wetland habitat mapped along riparian habitat at the site	Permanent: 3,049 sq ft.
Tall Timber	PSS and PEM wetland habitat associated with side channels	PSS and PEM wetland habitat mapped along riparian habitat more than 1,000 feet from site	Potential impact from filling of side channel with water seasonally during acclimation
Wenatchee Backup			
George (backup hatchery site)	Wetlands observed associated with the side channel (high-quality PSS and PAB wetland) and the Wenatchee River (PFO and PSS wetlands).	NWI PFO, PSS, and PAB identified associated with the Wenatchee River and the side-channel at the site.	- Temporary: 11,500 sq ft (0.26 acres) - Permanent: 1,075 sq ft (0.03 acres)
Methow Primary			
Twisp Weir	None observed	NWI PFO and PEM wetland habitat identified along the Twisp River at the site.	- Temporary: 1,350 sq ft (0.03 acres) - Permanent: 130 sq ft (0.003 acres)
Methow Backup			
MSRF Chewuch	PFO, PSS, and PEM wetland habitat associated with riparian habitat	PFO, PSS, and PEM wetland habitat mapped along riparian habitat at the site	New open channels could encroach into PFO, PSS, and PEM wetland habitat near the Chewuch River; amount to be determined.
Utley	- Potential patches of riverine wetlands along the Twisp River east and northeast of existing pond. - A large PSS NWI wetland north of the pond may be connected to the ditch that drains the pond.	- PSS NWI wetland approx. 250 ft north of the existing pond. - PFO NWI wetland approx. 400 ft southwest of the pond but outside of construction areas.	Temporary: 150 sq ft (0.003 acres)

NWI – National Wetlands Inventory
PAB – Palustrine aquatic bed (wetland)
PEM – Palustrine emergent (wetland)
PFO – Palustrine forested (wetland)
PSS – Palustrine scrub-shrub (wetland)

Table 4-3 summarizes the amount of wetland area affected in both basins.

Table 4-3. Total estimated square feet of temporary and permanent wetland impacts

	Temporary Impacts	Permanent Impacts	Construction of New Wetland Habitat
Wenatchee sites			
Primary acclimation			
Scheibler		3,049	
Tall Timber	undetermined	undetermined	
Primary hatchery			
Dryden			52,272
Backup hatchery			
George	45,000	1,075	
Methow sites			
Primary acclimation			
Twisp Weir	1,350	130	
Backup acclimation			
Utley	150		
MSRF Chewuch	undetermined	undetermined	
Total wetland impacts primary sites	**1,350**	**3,179**	**52,272**
Total wetland impacts backup sites	**45,150**	**1,075**	

4.5.2 Alternatives and Mitigation

Proposals for construction in floodplains have been limited by using existing natural and human-made ponds for acclimation as much as possible; of the 25 primary sites proposed in both basins (including the proposed hatchery site), only 7 require construction in floodplains. Water supply intakes and hatchery/acclimation pond outlets are water dependent uses, and it is not feasible to locate these facilities outside of the floodplain and riparian areas. It is essential that the ponds be located to use the river waters for imprinting and acclimation of juvenile salmon and to allow smolts to eventually volitionally release into the rivers for out-migration.

In the Wenatchee basin, 6 of the 15 proposed primary sites, including the proposed Dryden Hatchery, require some work in floodplains. Up to 3 sites might require excavation of ponds in floodplains, and the Dryden work would be to create a water treatment wetland. The other two sites would be water discharge channels or intakes and pipelines only. In the Methow basin, only one of eleven primary sites requires work in floodplains—Twisp Weir would construct a new pond and pipeline corridor in a floodplain.

The project includes alternative or backup sites for acclimation and the hatchery, in the event that one or more primary sites are infeasible. In the Methow, 4 of the 7 backup sites require construction in floodplains. In the Wenatchee, only one of the four backup acclimation sites requires construction in floodplains. At the George backup hatchery site, permanent hatchery facilities would be near the edge of the floodplain but outside the 100-year floodplain boundary. As this is a backup site, detailed engineering studies have not been completed. Because the project is near the edge of the floodplain, at an elevation similar to the BFE, it is not expected that the project would measurably obstruct flood flows or reduce floodplain storage. Development of the site would have not have a substantial adverse effect on flooding.

Measures that would be implemented to minimize potential impacts to flooding include:

- Compensatory storage is incorporated in the project design where aboveground facilities are located within the floodplain.
- Spoil materials would be removed and disposed of in uplands or at offsite locations outside of the floodplain.
- Infrastructure buried below grade would not be placed in elevated road prisms, preventing diversion or rerouting of floodwaters.

Wetlands

Where new construction is proposed, facilities would be sited to avoid wetlands, if possible. Specific locations would be defined once wetlands are delineated. At this point, only 3 of the proposed 24 primary acclimation sites would require construction in wetlands; the proposed hatchery site at Dryden would not affect wetlands, but its water treatment proposal could create over 52,000 square feet of new wetland. While only two of the backup sites require construction in wetlands, the backup hatchery site would require significant work in wetlands. Wetland delineations to be conducted before the Final EIS is prepared would help ensure facilities are sited to avoid wetlands as much as possible.

Measures that would be implemented to avoid, minimize, and mitigate potential impacts to wetlands and wetland buffers include:

- No development features such as buildings or paved surfaces are proposed in wetlands.
- Clearing and grading would be designed to avoid wetland areas to the greatest extent possible.
- Disturbed areas would be re-vegetated with native vegetation.
- Staging areas for construction would be located outside wetland buffers and re-vegetated with native vegetation as necessary.
- Construction permits issued to the project would include detailed measures for protecting wetland habitats. The conditions included in the permits would be met during construction.

4.6 State, Area-wide, and Local Plans and Permits

4.6.1 Wenatchee and Methow Subbasin Plans

The proposed Mid-Columbia Coho Restoration Program is consistent with and supports the vision and goals of both the Wenatchee and Methow subbasin plans. The vision for the Wenatchee subbasin includes restoring extirpated fish and wildlife and natural habitats that perpetuate native wildlife and fish populations into the foreseeable future. The vision for the Methow subbasin is to support self-sustaining, harvestable, and diverse populations of fish and wildlife.

Restoring extirpated fish and wildlife is a specific goal and priority to advance the vision of the Wenatchee Subbasin Plan, and is also a specific goal of the Methow Subbasin Plan: "The goal for coho salmon includes re-establishment of run sizes that provide for species recovery, mitigation of hydro-system losses, and harvestable surpluses." (NPCC 2004b)

In both the Wenatchee and Methow subbasin plans, coho salmon are listed as a focal species. Many of the prioritized habitat restoration actions in the subbasin plans are aimed at supporting continued restoration of coho populations. Coho salmon prefer and occupy different habitat types than the other focal species, selecting slower velocities and greater depths. Habitat complexity and off-channel habitats such as backwater pools, beaver ponds, and side channels are important for juvenile rearing, making coho salmon a good biological indicator for habitat recovery prioritized in the subbasin plans.

The following excerpts from the two subbasin plans are a sample of how coho have been incorporated into the plans. Emphasis within the quotations was added to highlight issues.

Methow Subbasin Plan excerpts:

Page xxi, Section 1 Fisheries Management: This section provides the Methow Subbasin Plan goals for focal species. "**The goal for coho salmon includes re-establishment of run sizes that provide for species recovery, mitigation of hydro-system losses, and harvestable surpluses.**"

Page 33, Section 3.3.1 Fish Focal Species: Population Characterization and Status: "A focal species has special ecological, cultural, or legal status and represents a management priority in the Methow subbasins and, by extension, in the Columbia Cascade Eco-province. Focal species are used to evaluate the health of the ecosystem and effectiveness of management actions." The inclusion of coho salmon as a "focal species" in the Methow Subbasin Plan indicates that continued coho restoration is consistent with the Plan, and that coho can be used as an indicator species for select habitat types.

Page 79 Section 3.4.6 Fish Focal Species, Rationale for Selection – Coho: "Historically the Methow River produced more coho than Chinook or steelhead (Craig and Suomela 1941). Mullan (1984) estimated that 23,000-31,000 coho annually returned to the Methow River. Upstream of the Yakima River, the Methow River and Spokane River historically produced the most coho, with lesser runs into the Wenatchee and Entiat (Mullan 1984)..."

"Coho salmon prefer and occupy different habitat types, selecting slower velocities and greater depths than other focal species: Habitat complexity and off-channel habitats such as backwater pools, beaver ponds, and side channels are important for juvenile rearing making coho good biological indicators of these areas."

Page 79 Section 3.4.6 Fish Focal Species, Coho – Representative Habitat: "Currently, coho salmon returning to the Methow Basin are spawning in the mainstem Methow River and small tributaries such as Gold Creek. **As the recovery program continues, reintroduction of coho to tributaries within the Methow Basin will aid in species dispersal.**" This statement indicates that continued coho reintroduction is expected in the Methow Subbasin Plan to ensure adequate species dispersal within the Methow subbasin.

Page 81 Section 3.4.6 Fish Focal Species, Coho – Population Management Regimes and Activities: "**The ideal result would be to restore coho populations in these basins [Methow and Wenatchee] to their historic levels. Because of varying degrees of habitat degradation in each of these basins, historical numbers are unlikely ever to be achieved but remain a goal towards which to strive.**"

Pages 301-353 Section 5.5 Assessment Unit Summaries: In section 5.5, coho salmon are specifically listed as a focal species for the following Assessment Units: Lower Methow, Middle Methow, Upper-Middle Methow, Upper Methow/Early Winters/Lost River, Black Canyon/Squaw Creek, Gold/Libby Creeks, Beaver/Bear Creeks, Lower Twisp River, Upper

Twisp River, Upper Chewuch River, Lower Chewuch River, Goat/Little Boulder Creeks. The proposed geographic distribution of coho under the Proposed Action is consistent with the identification of coho as a focal species for specific Assessment Units in the Subbasin Plan.

Wenatchee Subbasin Plan excerpts:

Page xxi, Section 2.5.2 Key Findings: Aquatic: "Limiting factors are defined as a habitat element that limits the biological productivity and/or life history diversity of a focal species. **The focal species selected for this assessment include spring chinook salmon, late-run chinook salmon, sockeye salmon, coho salmon,** steelhead trout, bull trout, westslope cutthroat trout, and pacific lamprey." As defined in the plan, "focal species will be used to evaluate the health of the ecosystem and the effectiveness of management actions."

Page 27, Section 3.3.3 Guiding Principle 10: "**Restoration of individual populations may not be possible without restoration of other fish and wildlife populations with which they co-evolved."** This statement from the 10th guiding principle directly applies to the reintroduction of coho salmon (extirpated species) which co-evolved with all the other focal species in the basin. The plan acknowledges that restoration of ESA species may not be possible unless the ecosystem and co-evolved fish assemblage is restored.

Page 29, Section 4.1 Focal Species – Aquatic/Fish: "Fish focal species were defined that a) have special cultural significance, b) fulfill a critical ecological function, c) serve as an indicator of environmental health, d) are locally significant or rare as determined by applicable state or federal resource management agencies and/or are federally listed. Eight anadromous and resident fish species were chosen as focal species. Each of these species is considered to be culturally important, three of the species are listed under ESA and each species uniquely represent different and important habitat characteristics." Coho salmon are a focal species in the Wenatchee Subbasin Plan.

Page 29 Section 4.1 Focal Species – Table 12: In Table 12, coho are shown as a focal species with a representative habitat of "lower mid-elevation mainstem and tributaries, side channel and backwater environments." Lower and mid-elevation mainstem includes the Wenatchee River from the mouth to the Lake. Tributaries include Nason Creek, Chiwawa River, White River, and Little Wenatchee.

Page 70 - Figure 11: The figure on page 70 shows the **current** distribution of coho in the Wenatchee subbasin. At the bottom of the figure the following note is found – "**Note: Coho presence and spawning information is dynamic and is expected to change significantly each year as reintroduction efforts continue."** The Wenatchee Subbasin Plan expects coho reintroduction to continue.

Page 305 Section 7.8.16 Summary of Near-term Opportunities by Focal Species – Coho Salmon: "**Continued development of a locally adapted broodstock is essential to ensure future populations of naturally spawning coho salmon in the Wenatchee River."**

4.6.2 County Comprehensive Plans

Both counties have comprehensive plans in place. Sites in the Wenatchee basin are for the most part in areas designated as Rural in the Chelan County Comprehensive Plan, although a few might not be. In these areas, the rural character is to be preserved. Rural character is defined as follows:

> *1. In which open space, the natural landscape, and vegetation predominate over the built environment;*
> *2. That foster traditional rural lifestyles, rural-based economies, and opportunities to both live and work in rural areas;*
> *3. That provide visual landscapes that are traditionally found in rural areas and communities;*
> *4. That reduce the inappropriate conversion of undeveloped land into sprawling, low-density development;*
> *5. That generally do not require the extension of urban governmental services; and*
> *6. That are consistent with the protection of natural surface water flows and ground water and surface water recharge and discharge areas.*

Proposed project sites appear to be consistent with this definition, as well as with goals and policies in the plan. The EIS will be submitted to Chelan County for its review.

The Okanogan County Comprehensive Plan is currently being amended, with adoption of amendments by the Okanogan County Planning Commission pending. Most (if not all) of the proposed project sites are in lands designated Rural. While fish acclimation sites are not a specifically permitted activity in either High or Low Density Rural Lands, they are not a prohibited use. The project would not affect the county's transportation network by over-burdening it with traffic or by requiring new infrastructure. The project is consistent with plan policies on private property rights and water rights.

Most of the project sites in the Methow basin are in the Upper Methow Valley subarea of the Okanogan County Comprehensive Plan. The subarea developed its own subset of visions and policies, which are incorporated as Appendix B in the Comprehensive Plan (Upper Methow Valley Comprehensive Plan, an update of the Community Master Plan, Methow Valley Planning Area Sub Unit A. Adopted on March 6, 2000, by the Okanogan County Board of Commissioners).

This EIS will be submitted to Okanogan County for review, consistent with the comprehensive plan's Policy #4, which recognizes that federal agencies must coordinate their proposed actions with local governments, and in the county's role as the lead agency for review under SEPA.

4.6.3 Permitting Issues

Various federal, state, tribal, and local permits and approvals would be required to implement the Mid-Columbia Coho Restoration Program.

Action on property owned by the Yakama Nation would require approval by the tribal government. Currently, only one backup site, Coulter/Roaring, is on Yakama Nation property (see Chapter 3, Section 3.3.1.2.); it would require no construction.

The hatchery and acclimation ponds are water-dependent uses, so water rights and in-water work permits are required. Elements would be incorporated into project design to assure consistency with the appropriate authorizations once they are known.

In-stream construction requires a Hydraulic Project Approval from Washington State, which would specify when in-water work can occur and what measures would be needed to protect channels, riparian zones and water quality. In addition, a Shoreline Substantial Development Permit may be required from Okanogan County and Chelan County (under authority delegated by WDOE) for working within 200 feet of a waterway. These permits would stipulate conditions for near-water construction activities. Both counties may also require an approval to allow construction within a designated floodplain to assure that appropriate design measures are included. On state-owned aquatic lands, Washington Department of Natural Resources (WDNR) has review and approval authority for any new structures.

4.7 Clean Water Act

The Clean Water Act of 1977 (33 U.S.C. 1251 et seq.) is the principal federal law governing water pollution control. It regulates discharges into waters of the United States. Two of the primary instruments for implementing this act are the National Pollutant Discharge Elimination System (NPDES) and the state water quality certification program, both of which are delegated by the federal government to WDOE to administer.

The NPDES would be required to operate hatchery facilities while the water quality certification program would define specific construction-related mitigation measures that contractors must follow. Applications would be made to WDOE for both permits when final facility design is developed, including firm construction schedules and quantities and quality of hatchery discharges. Effects of proposed facilities on surface water quality are discussed in Chapter 3, Section 3.5; and on groundwater quality in Chapter 3, Section 3.6. In addition, a Section 404 permit would be sought from the U.S. Army Corps of Engineers for work in wetlands.

The Washington Department of Ecology (WDOE) is charged both with administering state water rights laws and the federal Clean Water Act. Chapters 90.54 and 90.22 RCW require WDOE to maintain in-stream flows sufficient to protect and preserve fish and wildlife habitat, scenic and aesthetic values, navigation and other environmental values (WDFW and WDOE 2004). The Washington Department of Fish and Wildlife (WDFW) recommends in-stream flows to be conditions of water rights or Clean Water Act Section 401 certification (issued by WDOE). When a major water project is planned, WDFW and WDEC request that the project proponent conduct an in-stream flow study to provide adequate information on which to base an in-stream flow recommendation or requirement. WDFW defines a major water project as a project that:

a) diverts at least 1.0 cubic feet per second (cfs), and

b) changes flow by at least 10% of the monthly 90% exceedence flow (the flow that is equaled or exceeded 90 percent of the time) at any point along the stream channel.

The proposed surface water withdrawals for this project are greater than 1.0 cfs, but less than 10% of the monthly 90% exceedance flows, and are therefore not considered major water projects.

4.8 Farmland Protection Policy Act

The Farmland Protection Policy Act (7 U.S.C. 4201 et seq.) directs federal agencies to identify and quantify adverse effects of federal programs on farmlands. The purpose of the act is to minimize the number of programs that unnecessarily contribute to the conversion of agricultural land to non-agricultural purposes.

All sites proposed for construction were evaluated for the presence of designated Farmland; results are listed in Table 4-4. The location and ratings of Prime Farmlands were obtained from the Natural Resources Conservation Service (NRCS) Web Soil Survey website application (NRCS 2011). Farmlands of statewide or unique importance were obtained from the Washington State Department of Ecology (WSDOE) farm soil maps for Chelan and Okanogan counties (WSDOE 2011). Farmland status was identified for a total of two primary sites and two backup sites in the Wenatchee basin (maximum of up to 4.2 acres), and two primary sites and two backup sites in the Methow basin (maximum of up to 0.4 acres).

Table 4-4. Construction sites (primary and backup) designated as farmland [a]

Basin	Site Type – Primary or Backup	Site Name	Soil Classification (NRCS)	Farmland Designation (NRCS, WSDOE)	Affected area (acres)
WEN	Hatchery – Primary	Dryden	Beverly gravelly fine sandy loam	Prime Farmland if irrigated	Up to 4
WEN	Hatchery – Backup	George	Alluvial land	Prime Farmland if irrigated	Up to 2.5
WEN	Acclimate – Primary	Scheibler	Leavenworth fine sandy loam	Prime Farmland if irrigated	Negligible (expand existing pond)
WEN	Acclimate – Backup	Squadroni	Aeric Fluvaquents	Not Prime Farmland; Farmland of statewide/unique importance (WSDOE)	0.2
MET	Acclimate – Primary	MSWA Eightmile	Boesel fine sandy loam	Prime Farmland	Negligible (well only)
MET	Acclimate – Primary	Twisp Weir	Boesel fine sandy loam	Prime Farmland if irrigated; Farmland of statewide/unique importance (WSDOE)	0.2
MET	Acclimate – Backup	Newby	Boesel fine sandy loam	Prime Farmland if irrigated	0.2
MET	Acclimate – Backup	Utley	Boesel fine sandy loam	Prime Farmland if irrigated; Farmland of statewide/unique importance (WSDOE)	Negligible (expand existing pond)

[a] Gray rows are backup sites that would be constructed only if a primary site is infeasible.

Only one site where construction is proposed is designated as Prime Farmland. The MSWA Eightmile primary acclimation site on the Chewuch River in the Methow basin would require the installation of one new well and a water delivery system. The site is managed for wildlife conservation and public recreation, and the proposed well would be located in a privately-owned field just east of the existing side channel. The installation of the well and water delivery system would impact a very small area and would not convert any land to non-agricultural purposes; therefore, no Prime Farmland would be adversely affected.

The primary and backup hatchery sites (Dryden and George, respectively) are both designated as Prime Farmland if irrigated; however, neither site has been irrigated, nor have they been developed for agricultural purposes. The Dryden site has been used in the past by the WSDOT as a gravel pit and storage site, and is currently used for access to Dryden Dam and for recreational access to the Wenatchee River. The George site has been logged in the past and is currently undeveloped. Therefore, since neither site has been irrigated or developed for agriculture, construction of a new hatchery facility at either location would not convert agricultural land to non-agricultural purposes, and no Prime Farmland would be adversely impacted.

The remaining sites with some level of designated farmland status are not irrigated and are not developed for agriculture in the areas that would be impacted by construction. Further, these sites would require only minimal construction that would impact an insignificant amount of land. Therefore, it is reasonably certain that program activities would not convert land from agricultural to non-agricultural purposes and thus would not adversely affect any protected farmlands.

4.9 Noise Control Act

The Noise Control Act of 1972 (42 U.S.C.490 et seq.) promotes an environment free from noise that jeopardizes human health and welfare. Federal and state regulations establish guidelines that implement the intent of the act. No local noise standards exist for areas that would be affected by the proposed action, although county comprehensive plans have policies related to noise. No noise in excess of state or federal standards is expected from this project (Section 3.14.1). Temporary construction noise during daylight hours is exempt from state and federal standards.

4.10 Clean Air Act

Emissions produced by construction and operation of the proposed project facilities must meet standards of the Clean Air Act and the amendments of 1970 (42 USC 741 et seq.). In Washington, the authority for ensuring compliance with this act is delegated to WDOE. The Proposed Action would not violate current clean air standards, as described in Section 3.14.2.

4.11 Resource Conservation and Recovery Act (RCRA), Toxic Substances Control Act (TSCA) and Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)

The federal Resource Conservation and Recovery Act (42 USC 692 et seq.) regulates the disposal of hazardous wastes. The Toxic Substances Control Act (15 USC 2601) gives authority to the EPA to regulate substances that present unreasonable risks to public health and the environment. The federal Insecticide, Fungicide and Rodenticide Act (7 USC 136 et seq.) authorizes the EPA to prescribe conditions for use of pesticides.

Construction, operation, and maintenance of the proposed facilities would meet the guidelines for use, handling, storage, and disposal of hazardous substances. Necessary permits would be obtained if regulated pesticide products are used.

Chemicals used at the proposed new hatchery may include chlorine, formalin, iodaphor, and sodium thiosulphate. Staff would be trained in their proper use, transport, handling and storage to minimize dangers of over-exposure or accidental release to the environment. Appropriate safety equipment would be provided, and chemicals would be stored in areas designed to contain the chemical in the event of a spill according to the Washington Industrial Safety and Health Administration regulations, the Uniform Fire Code, and other applicable regulations. Any used absorbent materials containing controlled chemicals would be disposed consistent with the Material Safety Data Sheet and applicable federal, state, and local regulations.

The types and amounts of chemicals used at a hatchery or rearing facility depend upon site-specific conditions, fish culture practices, species of fish, and types of parasites or disease organisms being treated. The types and amounts of chemicals that would be used at the proposed hatchery facility and acclimation ponds is not currently known. However, all chemical handling, application, and disposal would adhere to U.S. Department of Agriculture (USDA), state, and other federal regulations to protect human and environmental health.

4.12 Environmental Justice

Executive Order 12898 directs federal agencies to consider the effects of their programs, policies and activities on minority and low-income populations. Federal agencies are required to assess environmental justice concerns in the NEPA analysis. The potential for the Mid-Columbia Coho Restoration Program to affect low-income communities and minority populations is discussed below.

- Population: no change to minority or low income populations is expected.
- Income/employment: some additional jobs and income may be available to local minorities and low income families during project construction and operations, but no substantial long-term change to employment or income is expected. Most full or part-time positions for project operations likely would be filled by Yakama Nation staff already involved with the program.
- Housing: no changes to housing availability, costs, or quality in the local communities would occur as a result of Mid-Columbia Coho project.
- Local services: during construction (less than one year), an increase in demand for local services is likely, but demand would be temporary and would not exceed current capacity.
- Power rates: BPA wholesale power rates would not change due to the proposed action, and it is expected that local PUD rates would similarly be unaffected.
- Ceremonial and subsistence and recreational fisheries: the value (non-monetary) of an improved tribal ceremonial and subsistence fishery could increase the quality of life of tribal members in general. An improved recreational fishery for the general public could also benefit other local minorities and low income families.

The Yakama Nation has enacted a Tribal Employment Rights Ordinance (TERO) requiring all employers subject to the Tribe's jurisdiction to give preference in employment, training, and subcontracting to Indians. Yakama TERO Contacts provide contact lists for Indian-owned construction and construction-related companies, facilitating the employment of these companies for project work. Jobs created by construction of the project could benefit individual Native Americans, but the effect would be short-term and minor.

4.13 Energy Conservation at Federal Facilities

Executive Order 13514 states that federal agencies should "*[identify] and [analyze] impacts from energy usage and alternative energy sources in all Environmental Impact Statements and Environmental Assessments for proposals for new or expanded Federal facilities under the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.).*" BPA is proposing to fund the construction, operation, and maintenance of one new small hatchery and a number of acclimation sites. The final designs have not been completed for these facilities;

however we have made the following general assessment of energy usage and the potential for using alternative energy sources.

Ground and surface water pumps would use the majority of the energy required for this project. Energy requirements have been minimized in the conceptual design of the project through the use of gravity flow water supplies at as many of the sites as possible. Where pumps would be needed, the primary power source would be nearby power lines, with generators to be used for emergency backup. Energy sources other than electrical power are not likely to be feasible due to the size of the requirement and the constant demand cycle. The use of propane rather than diesel fuel for the generators is being considered, as propane would emit fewer greenhouse gases that would contribute to climate change. Energy efficiency would also be considered in the sizing of the pumps and pipelines. BPA would encourage the Yakama Nation to use and promote energy-efficient designs and operations in the new hatchery buildings; to use incentives for energy conservation from local Public Utility Districts wherever feasible; and where practical, to supply their power needs from existing renewable sources or install on-site renewable power generation such as solar panels.

The Yakama Nation would own and operate the facilities, so the Tribe would ultimately make final decisions for the facility designs and operations. However, BPA would use contractual mechanisms through the funding agreement to encourage design and operation practices in the manner described in EO 13514.

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Chapter 6. Definitions and Acronyms

6.1 Definitions

Alevin: The third stage of the salmonid life cycle, between eyed eggs and fry. Alevin are larval salmonids, typically about one inch long, that have hatched from the egg but have not yet fully absorbed their yolk sac, and generally have not emerged from the spawning gravel (redd). Alevins remain in the redd for approximately one month until their yolk sac is completely digested, and then emerge from the gravel as fry to hunt for food on their own.

Confined aquifer: A confined aquifer has limited continuity with other aquifers and surface waters.

Domestication selection: In a hatchery, fish are selected for genetic traits (growth, behavior, physiology and survival) that increase their survival in the hatchery (domestic) environment.

Drawdown cone: Area beyond a groundwater well that, when in use, could cause other wells in the vicinity to have more than one foot of reduction in water level; the area of influence of a groundwater well.

Escapement: The proportion of an anadromous fish population that escapes the commercial and recreational fisheries and reaches the freshwater spawning grounds.

Eutrophic/Eutrophication: Refers to water that has a high level of nutrients (e.g., nitrogen, phosphorous) that stimulate the excessive growth of plant life with a high demand for oxygen (e.g., algae), resulting in the depletion of dissolved oxygen content in the water and potentially lethal conditions for fish and other aquatic organisms.

Excursion: The word used to indicate that a water quality limit has been exceeded.

Extirpation: The loss of a local or regional population of a species (local extinction).

Eyed eggs: The second stage of the salmonid life cycle, between embryos and alevin. Eyed eggs develop approximately one month after eggs have been fertilized when the embryo inside the egg develops an eye. This stage typically lasts for one month until the eyed eggs hatch and alevin emerge.

Fry: The fourth stage of a salmonid life cycle, between alevin and parr. Fry move in schools and actively feed in the river on zooplankton until they grow large enough to eat aquatic insects and other larger food. Some species begin their downstream migration to the ocean as fry, while other species stay in the freshwater for up to three years.

Green eggs: Eggs that have been harvested from an adult female salmon or steelhead in a hatchery but have not yet been fertilized.

Hydraulic continuity: A scientific term that describes how easily water flows between groundwater and surface water (streams, rivers, lakes, and wetlands).

Integrated Hatchery Program: A hatchery program that manages wild and hatchery fish as one gene pool (natural-origin fish are included in the broodstock and hatchery-origin fish are allowed to spawn in the wild). Integrated hatchery methods are most appropriate for programs with conservation goals or when the risks of naturally spawning hatchery-origin fish need to be minimized.

Local adaptation: The process of naturalization that addresses the loss of fitness that occurs with hatchery stocks by emphasizing selection in the natural environment; the population becomes adapted to habitats within each basin.

Mitchell Act: Enacted in 1938 and amended in 1946 (16 USC 755-757; 52 Stat. 345). Authorizes the Secretary of the Interior to implement activities for the conservation of fishery resources in the Columbia River Basin, and specifically directs the establishment of salmon hatcheries, ongoing engineering and biological surveys and experiments, and installation of fish protective devices. It also authorizes agreements with State fishery agencies (Oregon, Washington, and Idaho) and the construction of facilities on State-owned lands. Federal activities in the Columbia River Basin are carried out by the Department of Commerce (NOAA).

Montane: A category of biogeographic zones for regions located in the highlands below the sub-alpine zone. Montane regions are typically forested and have cooler temperatures and higher rainfall than the adjacent lowland regions, and support distinct communities of plants and animals.

Parr: The fifth stage of the salmonid life cycle, between fry and smolt. Parr have distinct markings (parr marks) to camouflage them from predators as they feed on aquatic insects and other larger prey in a stream environment.

Passerine birds: Perching birds or songbirds.

pH: The level of acidity/alkalinity of a solution, on a scale from 0 (most acidic) to 14 (most alkaline or basic), with 7 being neutral. Each point on the scale equals a 10-fold change in the magnitude of acidity or alkalinity. Source: http://en.wiktionary.org

Redd: The nest dug in the gravel substrate of streams for egg deposition during spawning by salmonids.

Recharge boundary: Where the drawdown cone (area of influence of a groundwater well) intersects a stream. The drawdown cone cannot spread beyond the recharge boundary.

Recruits: Fish that have survived long enough to become part of (i.e., recruited into) a population at a defined age (e.g., a natural-origin fish that survives to spawn in the wild is a natural-origin recruit). The number of recruits per spawner is a method of analyzing population productivity.

Riparian: Adjacent to or living on river banks.

Salmonid: A fish belonging to the family Salmonidae, which includes salmon, trout and chars. Some species of salmonids are anadromous (e.g., coho salmon, Chinook salmon, steelhead trout), and some species remain in freshwater throughout their life cycle (e.g., rainbow trout, bull trout).

Scale analysis: The process of counting annual growth bands on scales collected from fish in order to estimate the age of the fish.

Segregated Hatchery Program: A hatchery program that manages hatchery-origin fish as a reproductively distinct population. Only hatchery-origin adults are used for broodstock and are not allowed to spawn in the wild.

Smolt: The sixth stage of the salmonid life cycle, between parr and ocean-stage adult. Smolts undergo physiological and behavioral transformations as they migrate downstream that prepare them for the transition to the saltwater environment.

Supplementation: The generally accepted definition of supplementation was developed by the Regional Assessment of Supplementation Project (RASP): *"Supplementation is the use of artificial propagation in the attempt to maintain or increase natural production while maintaining the long-term fitness of the target population, and keeping the ecological and genetic impacts on non-target populations within specified biological limits"* (RASP 1992).

Transmissivity: A measure of the ability of groundwater to flow in a horizontal direction.

U.S. v. Oregon: A 1969 federal court decision that legally upheld the reserved fishing rights of the Columbia River treaty tribes (Nez Perce, Umatilla, Warm Springs and Yakama tribes) and ruled that the tribes had reserved rights to fish at "all usual and accustomed" places whether on or off reservation. In 1975, the ruling was amended to quantify the "fair and equitable share" of the resource as 50% of all harvestable fish destined for the tribes' traditional fishing places.

6.2 Acronyms and Abbreviations

7Q10: lowest or highest stream flow for 7 consecutive days that occurs on average once every 10 years

AHA: All H Analyzer (analyzes impacts of hatcheries, habitat, harvest and hydroelectric systems on salmon and steelhead populations)

BPA: Bonneville Power Administration (under the Department of Energy)

CCPUD: Chelan County Public Utility District - funds WDFW to operate the Rock Island Hatchery Complex among other facilities

cfs: cubic feet per second (a measure of water flow)

CRFMP: Columbia River Fish Management Plan

CWT: Coded Wire Tag

DAHP: Department of Archaeology and Historic Preservation (Washington State)

DCPUD: Douglas County Public Utility District - funds WDFW to operate the Wells and Methow hatcheries, and the Methow, Twisp and Chewuch acclimation ponds (among other hatchery facilities)

DO: Dissolved Oxygen (the amount of gaseous O^2 in an aqueous solution)

EDT: Ecosystem Diagnosis and Treatment (system for rating the quality, quantity and diversity of habitat along a stream relative to the needs of a specific species)

EIS: Environmental Impact Statement (an analysis of the environmental effects of major federal actions as required under the National Environmental Policy Act of 1969)

ESA: Endangered Species Act of 1973

FH: Fish Hatchery (non-federal program)

GCPUD: Grant County Public Utility District - funds WDFW to operate the Wells and Methow hatcheries, and the Nason and White acclimation ponds (among other hatchery facilities)

gpd/ft: gallons per day per foot (a measure of the ability of groundwater to flow in a horizontal direction [transmissivity]).

gpm: gallons per minute (generally a measure of the rate at which groundwater can be pumped, but also relates to water flow)

HCP: Habitat Conservation Plan

HSRG: Hatchery Scientific Review Group

ISEMP: Integrated Status & Effectiveness Monitoring Program (BPA project #2003-017-00)

ISRP: Independent Science Review Panel

m^3/s: cubic meters per second

µg/m: micrograms/meter

mg: milligrams

mg/L: milligrams per liter

M&E: Monitoring and Evaluation

MSRF: Methow Salmon Recovery Foundation

MSWA: Methow State Wildlife Area

NFH: National Fish Hatchery (federal hatchery program). The 12 NFHs in the Columbia River Basin are Eagle Creek, Carson, Little White Salmon, Willard, Spring Creek, Warm Springs, Leavenworth, Entiat, Winthrop, Dworshak, Kooskia, and Hagerman NFHs.

NHPA: National Historic Preservation Act of 1966

NOAA: National Oceanic and Atmospheric Administration (in the Department of Commerce)

NOAA Fisheries/NMFS: NOAA's National Marine Fisheries Service

NPDES: National Pollutant Discharge Elimination System

NEPA: National Environmental Policy Act of 1969

NOR: Natural-Origin Recruits

NPCC: Northwest Power and Conservation Council; formerly known as Northwest Power Planning Council (NPPC)

NRHP: National Register of Historic Places

NTTOC: Non-Target Taxa of Concern

ODFW: Oregon Department of Fish and Wildlife pHOS: Proportion of Hatchery-Origin fish on Spawning grounds

PIT tag: Passive Integrated Transponder tag

PNI: Proportion of Natural-origin Influence in the population

pNOB: Proportion of Natural-Origin fish in Broodstock

POTW: Publicly-Owned Treatment Works (i.e., municipal water and sewage treatment plants)

PUD: Public Utility District

SHPO: State Historic Preservation Office; State Historic Preservation Officer

TMDL: Total Maximum Daily Load

TP: Total Phosphorus

TWG: Technical Work Group

USFWS: United States Fish and Wildlife Service (under the Department of the Interior)

USGS: United States Geological Survey (under the Department of the Interior)

WAC: Washington Administrative Code

WDFW: Washington Department of Fish and Wildlife

WDOE: Washington State Department of Ecology

YN: Yakama Nation

Chapter 7. List of Preparers and Reviewers

Preparers

Name	EIS Section or Appendix	Experience and Education
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Calvin Douglas, Anchor QEA	Wetlands, endangered species, aquatic habitat	11 years in natural resources analysis B.S. Wildlife Biology
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Marcelle Lynde, GeoEngineers	Wetlands, priority species & habitats	25 years' experience in natural resource management B.S., Fisheries, M.M.A. Marine Resource Management
Fiona McNair, GeoEngineers	Wetlands, priority species & habitats	14 years' experience in environmental analysis M.S. Resource and Environmental Management
James A. Miller, GeoEngineers	Geologic and hydrogeologic review, groundwater impact evaluation	35 years' experience in geotechnical and environmental projects B.S. Geological Engineering; M.S. Environmental Geology
Pradeep Mugunthan, Anchor QEA	Water quality impacts of discharges	10 years' experience in water quality and contaminant fate and transport modeling and analysis; TMDL and nutrient issues Ph.D. Civil and Environmental Engineering
Simon Page, Anchor QEA	Floodplain analysis	23 years environmental analysis and NEPA document preparation B.S. Soil and Water Science
James Rhea Anchor QEA	Water quality	20 years water quality analysis Ph.D., Civil & Environmental Engineering
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Lisa Wright, Contract Environmental Protection Specialist, BPA	Project coordination Visual quality, recreation, climate change, farmlands	10 years as Fishery Biologist for USGS, NOAA Fisheries, Corps of Engineers B.S. Biology

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Chapter 8. List of Agencies, Organization and Persons Contacted

Tribes or Tribal Groups

- Columbia River Inter-Tribal Fish Commission
- Confederated Tribes and Bands of the Yakama Nation
- Confederated Tribes of the Colville Reservation

Federal Agencies

- Advisory Council on Historic Preservation
- Environmental Protection Agency
- US Department of Agriculture - Forest Service
- US Department of Commerce – National Oceanic and Atmospheric Administration Fisheries Service
- US Department of Defense – Army Corps of Engineers
- US Department of the Interior - Fish and Wildlife Service; Bureau of Indian Affairs; Bureau of Land Management; National Park Service

Washington Public Officials

- Office of Governor Gregoire
- State Senator Cantwell
- State Senator Murray
- Washington State Representatives of Districts 12 and 14

Washington State Agencies

- Department of Ecology
- Department of Fish & Wildlife
- Department of Natural Resources

Local Governments

- Chelan County PUD No. 1
- County of Chelan
- County of Okanogan
- Douglas County PUD
- Grant County PUD
- Cities of Cashmere, Chelan, Leavenworth, Okanogan, Wenatchee and Yakima

Libraries

- Cashmere Public Library
- Chelan Public Library
- Colville Tribe Library
- County of Okanogan Public Library
- Entiat Community Library
- Leavenworth Public Library

- North Central Regional Library, Wenatchee
- Okanogan Community Library
- Peshastin Community Library
- Wenatchee Public Library
- Wenatchee Valley College Library
- Winthrop Community Library
- Yakama Nation Library

Business, Special Interests and Organizations

- AAA Auto Club of Washington
- Alpine Lakes Protection Society
- American Fisheries Society
- American Forestry Association
- Apple Company Snowmobile Club
- Apple Valley Kiwanis Club
- Audubon Society
- Back Country Bicycle Trail Club
- Backcountry Horsemen Association
- Backcountry Horsemen of Washington
- Burlington Northern & Santa Fe Railroad Company
- Cascade Orchards Irrigation
- Cashmere Valley Bank
- Chelan County Conservation District
- Ellensburg Cross Country Ski
- Environmental Law Support Association
- Ephrata Sportsmen’s Association
- Grays Electric Inc.
- Kahler Glen Golf & Ski Resort
- KOHO Radio
- Methow Valley Sports Trail Association
- Nature Conservancy
- NCW Audubon
- Northwest Power & Conservation Council
- Pine River Ranch #2
- Round Mountain Corporation
- Strutzel's Sportsman LLC
- Trout Unlimited
- Washington Trout
- Wenatchee Outdoors
- Wenatchee World
- White River Lodging
- WICO

BONNEVILLE POWER ADMINISTRATION

DOE/BP-4302 ▪ June 2011

APPENDIX 1

REARING AND BROOD CAPTURE SITE DESCRIPTIONS

Prepared by: Greg Ferguson, Sea Springs Co.

May 2011

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1. Summary

For the natural production phases of the project, the program plans to rely on existing adult traps as close to spawning habitat as possible. Several tributary traps have been discussed by other fishery agencies but do not yet exist. These are shown as “Proposed” on Figure 1-1. The Yakama Nation does not plan on constructing any additional, permanent trapping facilities for the coho program.

The emphasis for hatchery rearing is proposed to be on existing facilities—Winthrop National Fish Hatchery (NFH), Willard NFH, and Cascade Fish Hatchery (FH)—that have reared MCCRP coho in the past (Figure 1-2). A small hatchery is proposed for the Dryden site. If Dryden is not a feasible location for the proposed new hatchery, the George site would be used as an alternate location.

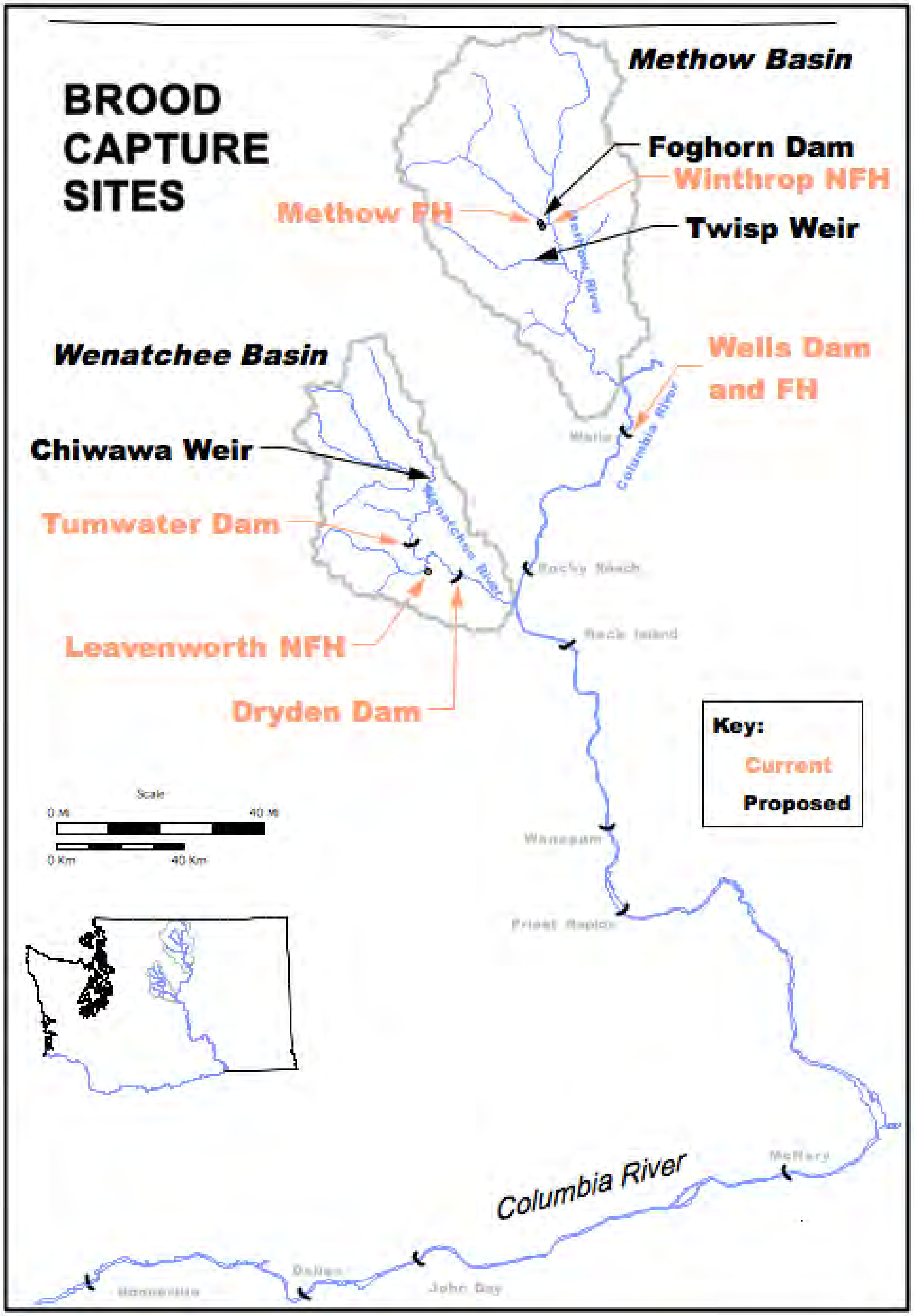

Figure 1-1. Brood Capture Site Map

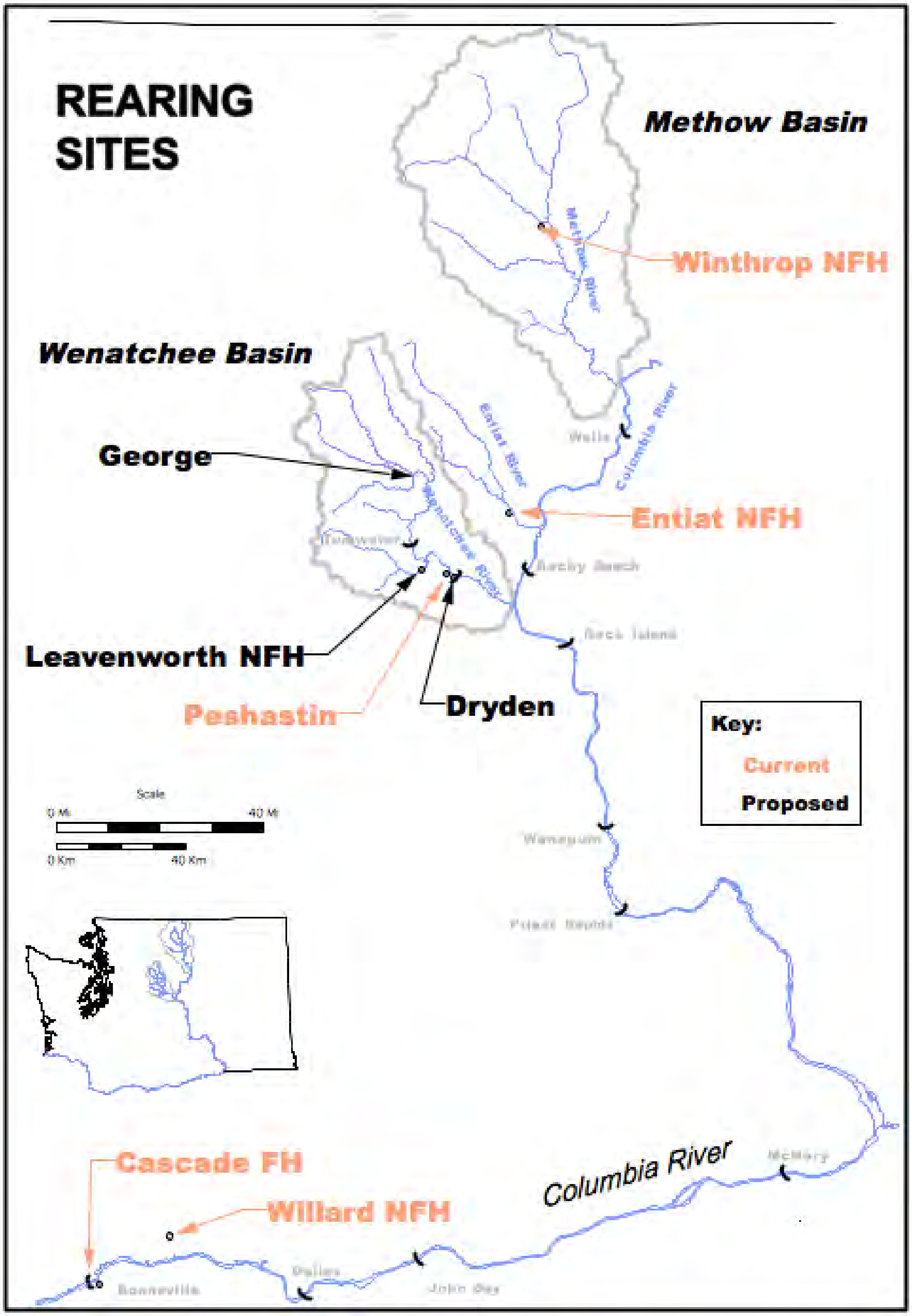

Figure 1-2. Rearing Site Map

Construction is proposed only at Dryden. A surface water intake at Dryden Dam, an infiltration gallery or wells, a hatchery building, rearing units, and an effluent treatment system are planned.

Project construction impacts are summarized in Table 1-1 below.

Table 1-1. Brood Capture and Rearing Construction Impacts at Dryden

Rearing	Dryden
Snow plowing for fish delivery (ft)	No
New road construction (ft)	No
New intake construction	Yes
Surface water removal distance (ft)	0
New groundwater supply	Yes
Existing well	No
Volume excavated (ft^3/1000) - new hatchery construction	131
Volume excavated (ft^3/1000) - existing pond	No
Surface disturbance (acres) - new hatchery construction	1.5
Surface disturbance (ft^2) - water systems, intakes	0
Surface disturbance (ft^2) - water systems, open channel	0
Buried water pipelines (ft)	1,500
Buried power lines (ft)	500
Surface disturbance (acre) - total	4
Period of operation (mo.)	12
Generator	Yes

2. Site Descriptions – Brood Capture

The project proposes to use broodstock capture facilities that currently exist or are planned for future development by other agencies. Trap operation protocols for the existing facilities may need to change to meet broodstock collection goals for the coho program.

Broodstock Development Phase 1 (BDP1) emphasized adult capture at locations low in the watersheds, such as at Dryden and Wells dams (Figure 1-1). As the program transitioned to Broodstock Development Phase 2 (BDP2) and the natural production phases, trapping locations closer to spawning habitat increased in importance.

2.1. Wenatchee

The primary locations for capture of adults during the BDP1 were Dryden Dam and Leavenworth NFH in the Wenatchee watershed. The primary BDP2 and natural production adult capture facilities are proposed to be Tumwater Dam and the Chiwawa Weir. Leavenworth NFH and Dryden Dam would continue to be used during both the broodstock development and natural production phases as needed, acting as back-up locations if collection goals are not met at the primary capture facilities.

Other trapping facilities, such as tributary weirs, have been recommended for other species. These collection facilities have been proposed by fisheries agencies in the region but may not be built. If the facilities are constructed, the MCCRP project would likely use them, particularly those being considered for Nason Creek and White River.

2.1.1. Dryden Dam

The Dryden Dam collection facility is located at river mile (rm) 17.4 on the Wenatchee River. This facility is owned and maintained by Chelan County Public Utility District (CCPUD). YN and WDFW are co-operators collecting steelhead, summer Chinook and coho broodstock for various supplementation and reintroduction programs. Dryden has been a key site for coho broodstock collection since the program's inception.

There are two trapping facilities within the Dryden Dam structure: left bank and right bank. The left bank trap is located on the north shore of the river and operates passively. As fish enter the trap, a series of ladders provide upstream passage into the collection area. Once through the ladder system, an in-line, V-trap weir collects fish in the holding area. While in operation, the left bank trap is checked at least once a day to provide brood collection and/or upstream passage of adult fish. Past years have required multiple daily checks at this facility due to large numbers of summer Chinook and coho encountered.

Dryden right bank is located across and upstream of the left bank facility and is also a passive trap. A small concrete apron spans approximately half the Wenatchee River. An expandable/retractable, water-filled bladder is positioned atop the apron to provide blockage for migrating fish. This bladder is monitored daily and adjusted to account for changing flow regimes encountered during the trapping seasons. Fish entering the right bank facility are shunted into a holding area via a V-trap weir. When it is operating, the trap is checked daily to either pass or collect fish.

On non-operating days, holding areas are closed to provide unimpeded, upstream movement through the facilities. Collection efficiencies during operation depend on Wenatchee River flows. Higher flows result in reduced trapping efficiencies due to an accessible portion of river located between the right bank and left bank traps.

Figure 2-1. Dryden Dam Aerial

2.1.2. Leavenworth NFH

The Leavenworth NFH volunteer ladder would be used for broodstock collection on Icicle Creek when trapping goals at other locations are not met. This collection facility is owned and operated by the US Fish and Wildlife Service (USFWS) and is located at Icicle Creek km 2.8 on the left bank shore. Broodstock migrate through a series of ladders until they enter a V-trap weir downstream of the hatchery adult holding ponds. This trap allows coho to be collected while juvenile spring Chinook are being reared in the adult holding ponds. If needed, the Leavenworth NFH ladder trap could operate 7 days a week, 24 hours a day, October through the end of November.

Figure 2-2. Leavenworth NFH Adult Ladder

2.1.3. Tumwater Dam

Tumwater Dam is located at rm 30.4 on the Wenatchee River. The facility is owned and maintained by CCPUD; YN and WDFW are co-operators. Tumwater Dam can be actively or passively operated, depending on fish numbers and available personnel. In 2004, YN entered into a cost-share with CCPUD to modify and update the trapping facility. These modifications improved functionality for multiple species.

Passive trapping operations allow migrating fish to move through a series of ladders and enter a holding facility. Once in the holding facility, fish migrate up a steep pass Denil ladder where they are shunted into a holding chamber. Prior to working up the fish, the chamber is de-watered and a hopper hauls fish out of the holding area where they are sorted, identified, and either kept for broodstock or passed upstream. YN and/or WDFW check the trap at least once a day during passive operation.

Active operation follows the same procedures except that once fish move up the steep pass Denil, staff are present to shunt fish to various holding tanks. During large salmon runs, it is necessary to actively trap at Tumwater Dam to prevent overloading the hopper/holding area. For non-trapping days, Tumwater Dam is opened for passage while a video monitoring system records all migrating fish species.

In the Wenatchee subbasin, BDP1 is complete. During BDP2, fish could be trapped at Tumwater Dam up to 7 days a week, 16 hours a day from mid-September through mid-December, which is an increase from current practice (3 days a week, 16 hours a day) and with the understanding that appropriate permitting would be in-place. Tumwater Dam is currently operating under the extended trapping periods through WDFW's steelhead/spring Chinook adult management programs. During trap operations, YN personnel would check the trap at least once a day.

Figure 2-3. Tumwater Ladder

2.1.4. Chiwawa Weir

The Chiwawa weir is located adjacent to the Chiwawa Acclimation Facility on the Chiwawa River (rm 1.2). It is currently being operated by Washington Department of Fish and Wildlife (WDFW) for multiple supplementation programs. This tributary trap would be important for collections during natural production phases because it selects adults that have traveled nearly the full distance back to the spawning grounds.

The weir spans the entire width of the river. It is angled slightly to move migrating fish towards the right-bank shore where a holding facility is located. Operation is proposed for up to 7 days a week, 24 hours a day, with YN personnel checking the trap a minimum of once a day. Multiple checks per day would be warranted if large numbers of coho return and would be coordinated with on-station hatchery staff. Trapping would begin in September and run through the middle of December.

Figure 2-4. Chiwawa Weir

2.1.5. Nason Weir (proposed)

The Nason Creek adult trap being proposed is a semi-permanent, floating weir near the mouth of Nason Creek. If constructed, this facility would be funded by Grant County Public Utility District (GCPUD) as a part of their spring Chinook mitigation obligations. Preferred operations, if used for coho, would be 7 days a week, 16 hours a day from September to the middle of December but would depend on permitting.

2.1.6. White Trap (proposed)

The White River adult trap is another proposed facility that may be located somewhere in the lower two kilometers of the river. The trapping method, location, and operation are undetermined at this time. This weir or trap would also be funded by GCPUD.

2.2. Methow

The primary facilities used for adult capture during BDP1 in the Methow subbasin were Wells Dam and the Winthrop NFH. The primary BDP2 and natural production adult capture facilities are proposed to be Winthrop NFH, the Twisp Weir, and Wells Dam.

Additional Methow trapping facilities have been proposed by other fisheries agencies in the region but may not be built. If they are constructed, the MCCRP project would likely use them, particularly those being considered on the mainstem Methow at Foghorn Dam and on the Chewuch River.

2.2.1. Wells Dam

Wells Dam is located at rm 515.7 on the Columbia River. Unlike the Wenatchee subbasin, the Methow does not have a lower river trapping facility, so this Columbia River mainstem location is used to supplement collections at Winthrop NFH and to collect naturally produced adults.

Initial dam trapping operations begin in late September for 3 days a week, up to 16 hours a day, until mid-October. The reduced trapping effort prior to mid-October is intended to minimize impacts to steelhead adults migrating through the system. After mid-October, YN has the ability to trap 7 days a week, up to 16 hours a day, through November 30. Trapping duration would depend on the number of swim-ins encountered at Winthrop NFH.

There are three trapping facilities at Wells Dam, the east and west fish ladders and the volunteer ladder. All facilities are owned and maintained by Douglas County Public Utility District (DCPUD) and are operated by WDFW and YN.

For the west ladder, adults negotiate a chute where they are either shunted into a holding area at Wells FH or bypassed back to the ladder on the upstream side of the collection point. Coho are removed from the holding area daily and the WDFW removes and samples steelhead on a daily basis. Once sorted, adult coho are either placed directly into a transport truck and sent to Winthrop NFH or placed into net pens for temporary holding until a transport truck is available.

Fish using the east ladder trap ascend a series of pools to the trap. Fish negotiate a steep-pass Denil, then swim down a chute where they are either passed to an anesthetic tank or returned to the ladder. Fish collected in the tank are identified, baseline biological information is collected, and then they are placed in a transport truck for delivery to Winthrop NFH. On non-trapping days, the trapping weirs are closed and gates that block the ladder passage are re-opened.

Wells Fish Hatchery (FH) is situated adjacent the Wells Dam west ladder. This hatchery, funded by DCPUD and operated by WDFW, raises summer Chinook and steelhead for mitigation and restoration purposes. Wells FH has also been contracted by YN in the past to acclimate coho juveniles. This production has been viewed as a supplemental brood source if needed in low return years. The volunteer trap is located at the lower portion of the facility and is the primary brood collection source for Wells summer Chinook. This trapping facility has been discussed by WDFW and YN as a supplemental trapping location, if other trapping locations fail to produce sufficient collection numbers. This trap would be operated on an as-needed basis during the months of October and November.

Figure 2-5. Wells Dam

2.2.2. Twisp Weir

The adult weir is located at rm 3.7 on the Twisp River. Beginning with BDP2, trap operations are proposed to be 7 days a week, 16 hours a day from September to mid-December; however, effects on steelhead and bull trout spawning migration would need to be evaluated. Bi-weekly quotas would be developed in annual broodstock protocol documents, written by June 30 each year, in cooperation with DCPUD and the members of the HCP Hatchery Committee. Shortfalls at this and other tributary trap locations would require increased collections at Wells Dam and/or Winthrop NFH.

The Twisp River weir is funded by DCPUD and operated by WDFW. Improvements to the weir were made in 2007 to improve trapping efficiency at all flow conditions.

Figure 2-6. Twisp Weir Trap

2.2.3. Winthrop NFH

Winthrop NFH is located at rm 49.7 on the Methow River and is operated by the USFWS. Fish volitionally enter the hatchery adult pond through Spring Creek, a tributary to the Methow River. A secondary collection source, a temporary weir trap, may also be used for broodstock collections. The weir trap is installed within the outlet infrastructure of the back-channel acclimation pond, adjacent to the entrance of the hatchery ladder. Adults collected in the weir are transported to the hatchery holding pond. Coho collected at both locations are held until spawning. Trap operations would be 7 days a week, 24 hours a day, mid-September through mid-December.

Figure 2-7. Winthrop NFH Adult Ladder

2.2.4. Methow Fish Hatchery

Terms of the Wells hydropower Habitat Conservation Plan guide activities at the Methow Fish Hatchery and daily operation is conducted by WDFW. Some adult coho straying from the Winthrop NFH outfall attempt to enter the Methow Hatchery. A V-notch weir structure exists on the hatchery discharge that can be lowered into place in order to trap fish. Douglas PUD and WDFW have offered to provide the YN access to this collection weir. Trapped coho will be transported to the Winthrop NFH for ripening and spawning.

2.2.5. Foghorn Dam

Foghorn Dam is a rock structure dam just above the Methow Valley Fish Hatchery on the Methow mainstem at rm 50.3. It has been ineffective at collecting spring Chinook broodstock for other mitigation programs. Should improvements be made that allow more efficient trapping at the current right bank trap, this location may also be suitable for adult coho collection.

2.2.6. Chewuch Weir (proposed)

The Chewuch River Weir is a trap proposed for spring Chinook supplementation that may be funded by DCPUD. It is currently undergoing feasibility evaluations.

3. Site Descriptions – Primary Rearing Sites

The plan emphasizes the use of existing hatcheries due to cost considerations. Hatcheries that would continue to provide long-term rearing (eyed-egg to pre-smolt) through the natural production phases are Cascade FH and Willard NFH on the lower Columbia River, as well as Winthrop NFH in the Methow subbasin. A new facility with adult holding, incubation, and rearing capabilities is proposed for the Wenatchee subbasin at Dryden Dam.

3.1. Early Incubation

In addition to the rearing facilities described below, early incubation (from green to eyed) would continue to occur at the Peshastin Incubation Facility and the Leavenworth NFH. The Dryden hatchery would take over the majority of this function after it is built, although either or both facilities may be used into the future for back-up purposes. After eying at Peshastin and/or Leavenworth, eggs are transferred to Lower Columbia River (LCR) facilities for rearing.

Peshastin Incubation Facility

This Wenatchee basin facility was set up as a temporary facility for the Mid-Columbia Coho Feasibility Studies on property owned by Peshastin Hi-Up, a fruit cooperative in the town of Peshastin. The water source is non-chlorinated city water from Peshastin Water District, one of the only cities in the region where water does not need chlorination. Supplemental groundwater is available through Peshastin Hi-Up and has been used in the past as a back-up water supply. Incoming water is run through charcoal and crushed coral filter beds for conditioning. Three deep-trough incubation systems can rear eggs to the eyed stage.

Facility Production

- Incubation: up to 800,000 to the eyed stage.

Site Information

- Location, elevation: Near the town of Peshastin at Wenatchee rm 20.5; in T24N, R18E, SE ¼ of S17 in Chelan County; elevation 310 meters.
- Ownership: Peshastin Hi-Up.
- Flood designation: Above the 100 year flood elevation.
- Land use: The incubation room is inside an existing fruit storage warehouse.
- Access: Plowed, paved roads.

Water Supply

- Groundwater: Up to 20 gallons per minute (gpm) is available from the City of Peshastin and an existing well inside the warehouse is a back-up supply.

Figure 3-1. Peshastin Incubation Facility

Leavenworth NFH

An isolated incubation area in the existing hatchery building is dedicated to coho. Twelve vertical stack incubators with approximately 5 gpm running through each stack were available for incubation. To alleviate fish health concerns of spreading disease, splash curtains were installed in addition to a UV treatment system and regular formalin treatments. This system was renovated in 2010 to accommodate the transition of the coho program from Entiat NFH to Leavenworth NFH.

Facility Production

- Incubation: up to 750,000 to the eyed stage.

Site Information

- Location: Leavenworth NFH
- Ownership: U.S. Fish and Wildlife Service, funded by Bureau of Reclamation.
- Flood designation: Above the 100 year flood elevation.
- Land use: The incubation room is inside the existing hatchery building designated for egg incubation/early juvenile rearing.
- Access: Plowed, paved roads.

Water Supply

- Groundwater: Up to 70 gpm of chilled well water is available during egg incubation.

3.2. Cascade FH

The Cascade FH is used to rear coho destined for release in the Wenatchee subbasin. It is operated by the Oregon Department of Fish and Wildlife (ODFW) and is located on Eagle Creek, near Bonneville Dam. The number of coho proposed for rearing at Cascade changes throughout the life of the program.

Cascade FH was authorized under the Mitchell Act and began operating in 1959 as part of the Columbia River Fisheries Development Program. The hatchery is supplied with surface water from Eagle Creek and has full rearing capability, with the following facilities (IHOT 1996):

- Adult holding: 1 concrete adult holding pond - 22,500 cubic feet
- Incubation: vertical stack incubators
- Raceways: 30 concrete raceways at 16 feet by 78 feet by 2.5 feet deep; 3,120 cubic feet each.

In 2006, production goals for Cascade FH were 700,000 coho for the MCCRP, 1,000,000 coho for the Confederated Tribes of the Umatilla Nation, and 600,000 coho for the Clatsop Economic Development Commission. The MCCRP proposed future production from Cascade FH will remain consistent with current production levels (up to 700,000).

Water is supplied through a gravity-fed system from Eagle Creek. The total water right is 20,200 gpm at 45 cubic feet per second (cfs) with an actual average water usage of about 7,000 gpm (16 cfs). Eagle Creek water temperatures typically fluctuate between 2° C in December/January to 17° C in July/August. High summer temperatures create some disease problems but the large natural fluctuations may help produce smolts that survive to adulthood in increased numbers.

Predicted fish sizes for the February/March transport dates for the MCCRP are 23-25 fish/lb, depending on release location and rearing strategy. Volume densities in the raceways will range from 0.6 - 0.7 pounds per cubic feet (ft^3).

In 2005, a predator net system consisting of wires and netting enclosing the coho raceways allocated for the YN program was constructed. This structure has reduced avian predation significantly (pers. comm., Mark Traynor, ODFW, 2007).

Figure 3-2. Cascade Hatchery

3.3. Willard NFH

Willard NFH would be used to rear coho destined for release in both Wenatchee and Methow subbasins. The proposed numbers of fish produced at Willard NFH would change throughout the life of the program.

Willard NFH is located on the Little White Salmon River near Cook, Washington. It was authorized by the Mitchell Act in 1946 and constructed in 1952. The facility was originally planned as a fall Chinook hatchery but changed to spring Chinook and coho because of cold water temperatures, and then switched completely to coho in the mid-1960s. Currently, this facility has reverted back to rearing coho, spring and fall Chinook. It operates on surface water and has full rearing capability, with the following facilities (IHOT 1997):

- 24 vertical stack incubation trays (16 trays per stack, 384 trays total)
- Early rearing: 52 concrete starter tanks - 91 cubic feet each
- Raceways: 50 concrete raceways – 8 feet by 73 feet by 2.4 feet; 1,408 cubic feet each

The 1997 hatchery production goal was 2,500,000 coho smolts, or 166,600 pounds. Current production is much lower and is focused on supporting tribal programs. In 2007, the hatchery reared approximately 500,000 coho for the MCCRP. In 2009 and 2010, production was closer to 650,000 for the Wenatchee and Methow programs. This production is expected to rise to 1,000,000 during the NPIP phase, if space is available.

The Willard NFH concrete raceways are narrow and shallow, which may have a negative impact on smolt quality. A-frame, overhead covers were installed in 2005 in order to provide effective shade, predator control, and crew working space. The general condition of the hatchery is good. A recent intake rebuild has improved water supply reliability.

The hatchery is exempt from a National Pollutant Discharge Elimination System (NPDES) discharge permit because the effluent disappears into porous lava before reaching the Little White Salmon River. Cold water disease has been an issue in the past but has recently been controlled with improved fish culture techniques. As with Cascade FH, fish produced from Willard NFH need to be trucked long distances to acclimation sites on the Wenatchee and Methow rivers.

Figure 3-3. Willard NFH

3.4. Dryden

A small, new hatchery is proposed on the Wenatchee River, to be operational by 2013. This facility would provide a centrally located site for handling and spawning local broodstock, incubating eggs, and rearing some juveniles.

The benefits of having an in-basin facility include reduced inter-watershed disease transmission, improved logistics, reduced transportation stress, additional program control, and added in-basin juvenile imprinting.

The preferred location for this facility is near Dryden Dam at the mouth of Peshastin Creek. The potential availability of both ground and surface water supplies and low environmental impacts make this an attractive hatchery location. However, the land near the proposed hatchery has been determined to be contaminated with lead from a nearby gun club. Environmental surveys will evaluate the extent of contamination and will help guide clean-up efforts. The site is owned by the Washington State Department of Transportation (WSDOT).

Design guidelines, basic site data, and the draft design are described below.

Facility Production

- Adult holding: 1,300.
- Incubation: 1,400,000 to the eyed stage.
- Fish production: 200,000 pre-smolts.

Site Information

- Location, elevation: Near the mouth of Peshastin Creek at Wenatchee rm 18.6; in T24N, R18E, SW ¼ of S22 in Chelan County; adjacent to Dryden Dam; elevation 300 meters.
- Ownership: The 24-acre Washington State Department of Transportation (WSDOT) property is lot number 241822745006, zoned Commercial Agricultural Lands (AC).
- Flood designation: Zone X500 (between 100- and 500-year floods).
- Land use: Used in the past by WSDOT for storage of highway sand. The site currently provides access to Dryden Dam and Fishway, portage for river rafters, and fishermen's access to the Wenatchee River.
- Access: Plowed, paved roads.
- Utilities: 3-phase power is available at the nearby Dryden right bank ladder facility.

Water Supplies

- Groundwater availability: Drill logs for nearby wells and the geology of the site suggest productive groundwater conditions. Historic gravel deposition at the Peshastin alluvial fan may have left layers of clean gravel.
- Groundwater withdrawal: Shallow wells near the river are proposed, minimizing impacts to deeper wells in the vicinity and producing water with a temperature variation closer to that of the river than deep groundwater. The production goal is 3.3 cfs (including a 50% safety factor).
- Surface water supply: Wenatchee River water is proposed to be pumped from the Dryden fishway. An intake would be built into the existing concrete structure, at location A on the drawing below. This location allows water to be pumped at all river flow conditions without impacting fishway

operation and does not require excavation in the river bank for construction. Water would be delivered to the hatchery in an 850' long buried pipeline. The hatchery model shown below estimates that a minimum flow of 3.1 cubic feet per second (cfs) is needed. Applying a 50% safety factor results in a water requirement of 4.7 cfs.

- Water Return. The option of returning water (and fish) upstream of the removal location in Peshastin Creek, at the dam, or just downstream of the dam would be possible by installing various return pipelines.

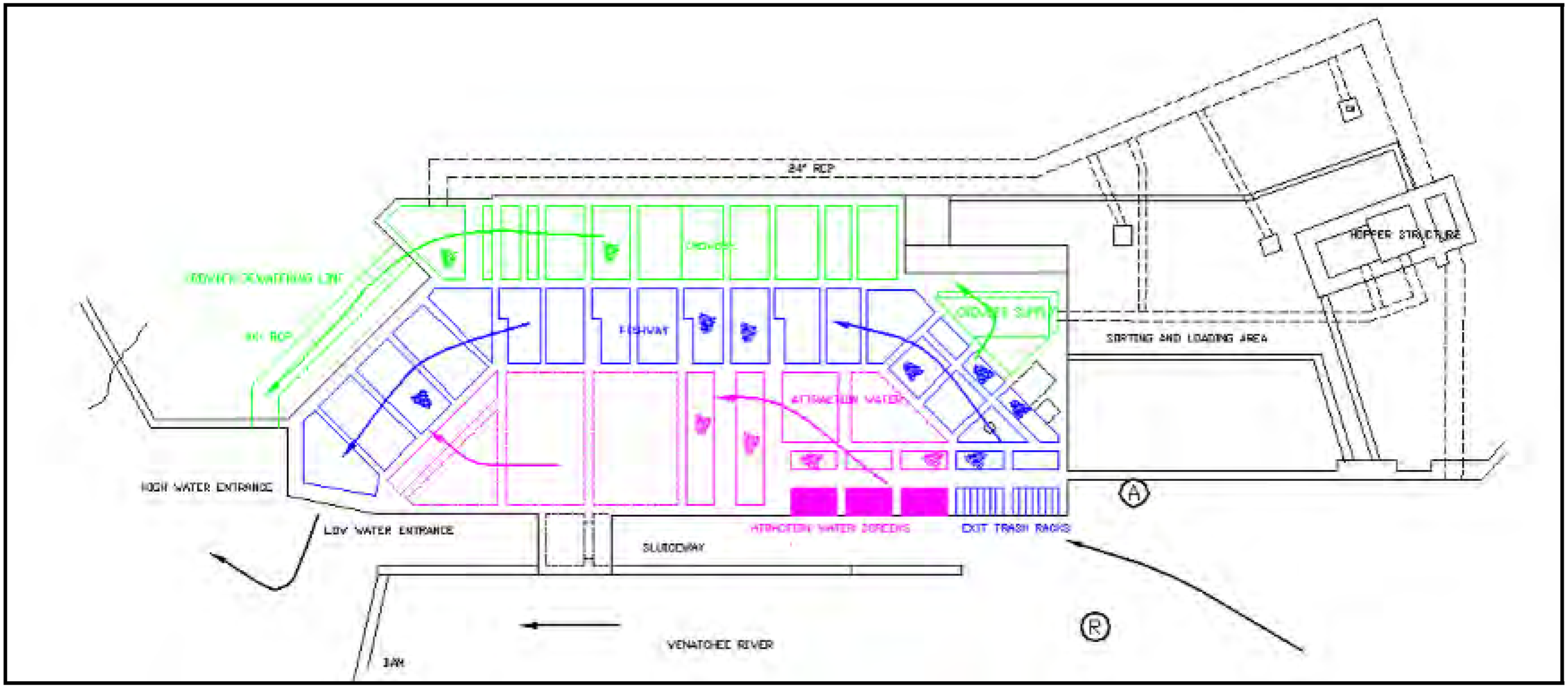

Figure 3-4. Dryden Surface Water Intake

Period	Rearing Unit	Water Source	Water Temp. (^0F)	Mort. #/mo.	Removed/ Released	Number at Hatchery	Fish Size lbs	Fish Size #/lb	Fish Size inch	Flow Density lbs/gpm	Volume Density lbs/cft	Total Weight lbs	Min. Flow gpm	Min. Flow cfs	Min. Volume cft	Rearing Units
Sep	Adult	Ground	47	81		1,085							1,085	2.4	10,847	3
Oct	Adult	Ground	42	76		1,009							1,009	2.2	10,090	3
Nov	Inc	Ground	42	49,733		1,375,938							174	0.4		29
Dec	Inc	Ground	42	47,935		1,326,205							168	0.4		28
Jan	Inc	Ground	42	20,955		1,278,270							162	0.4		27
Feb	Inc	Ground	42	20,612	1,000,000	1,257,315							162	0.4		27
Mar	RW	Ground	42	1,568		236,703	0.0010	1000	1.50	1.5	0.2	237	158	0.4	1,262	1
Apr	RW	Ground	43	1,557		235,135	0.0018	556	1.83	1.8	0.2	423	232	0.5	1,855	1
May	RW	Surface	45	1,547		233,578	0.0030	333	2.16	2.2	0.27	701	324	0.7	2,590	1
Jun	RW	Surface	49	1,537		232,031	0.0049	204	2.55	2.5	0.32	1,137	446	1.0	3,569	2
Jul	RW	Surface	57	1,526		230,495	0.0064	156	2.79	2.8	0.35	1,475	530	1.2	4,236	2
Aug	RW	Surface	62	1,516		228,968	0.0088	114	3.10	3.1	0.39	2,015	650	1.4	5,203	2
Sep	Pond	Surface	61	1,506		227,452	0.0159	63	3.77	3.8	0.23	3,616	959	2.1	15,975	2
Oct	Pond	Surface	51	1,496		225,946	0.0238	42	4.32	4.3	0.26	5,380	1,246	2.8	20,771	2
Nov	Pond	Surface	45	1,486	110,000	224,449	0.0290	34	4.61	4.6	0.28	6,509	1,412	3.1	23,533	2
Dec	Pond	Surface	40	748		112,963	0.0320	31	4.76	4.8	0.29	3,615	759	1.7	12,647	1
Jan	Pond	Surface	38	743		112,215	0.0330	30	4.81	4.8	0.29	3,703	769	1.7	12,824	1
Feb	Pond	Surface	37	738		111,472	0.0340	29	4.86	4.9	0.29	3,790	780	1.7	12,995	1
Mar	Pond	Surface	40	733	110,000	110,733	0.0370	27	5.00	5.0	0.30	4,097	819	1.8	13,658	1
Apr	Pond	Surface	43	0		0	0.0420	24	5.22	5.2	0.31	0	0	0.0	0	0
May	Pond	Surface	45	0		0	0.0500	20	5.53	5.5	0.33	0	0	0.0	0	0
Jun						0										
					1,220,000											

SPREADSHEET INPUTS:

ADULTS

Adult mortality:	15%	
Adult mortality/mo.:	7.5%	
Eggs per female:	3,000	
Adult vol. density:	10	ft^3/adult
Adult flow density:	1	gpm/adult
Adult pond volume:	3,500	cft

INCUBATION

Fert. to eyeing mort.:	15%	
Fert. to eyeing mort./mo:	3.8%	
Eyed to ponding mort.:	5%	
Eyed to ponding mort./mo.:	1.7%	
Eggs/Heath tray:	3,000	
Eggs/stack:	45,000	
Water flow/full stack	6	gpm

REARING

Pond. to release mort.:	10%	
Pond. to release mort./mo.:	0.7%	
Raceway density index:	0.125	lbs/ft^3/in
Pond density index:	0.06	lbs/ft^3/in
Flow density index:	1.00	lbs/gpm/in
Raceway volume:	3,500	cft
Pond volume:	14,400	cft

Figure 3-5. Dryden Hatchery Model

Proposed Hatchery Design

Draft site plans are shown on the following figures.

- Adult holding: Four concrete raceways (100 ft by 10 ft by 4 ft), with multiple divisions in the raceways to allow sorting.
- Incubation: Vertical stack incubators and deep troughs inside a hatchery building would be fed with aerated, chilled ground water.
- Rearing: The four concrete raceways would be used for fish production when adults are not present. Also, two ponds measuring 40 ft by 120 ft by 3' deep would add low density rearing space.
- Predator control, cover: The site would be fenced and an overhead net system installed over the rearing units.
- Waste treatment: Discharge water treatment would likely require a high degree of nutrient removal to meet conditions of the Total Maximum Daily Load restrictions in place for the Wenatchee River. Two treatment systems are being proposed. An off-line treatment tank measuring 10' by 20' by 4' will hold and settle wastes vacuumed from the rearing units. Water from the hatchery will be directed to a 2 acre constructed wetland for additional nutrient removal.
- Support systems: A 3,000 square-foot (ft^2) hatchery building will enclose the incubators, rearing troughs, offices, and a small shop. Generators will provide back-up power. Parking will be provided for up to 10 vehicles.
- Site footprint: The hatchery site will require 1.5 acres of land. The full hatchery facility, including pipelines, water supply construction, the constructed wetland, and hatchery facilities, will require that a total of 4 acres of land will be disturbed during construction.

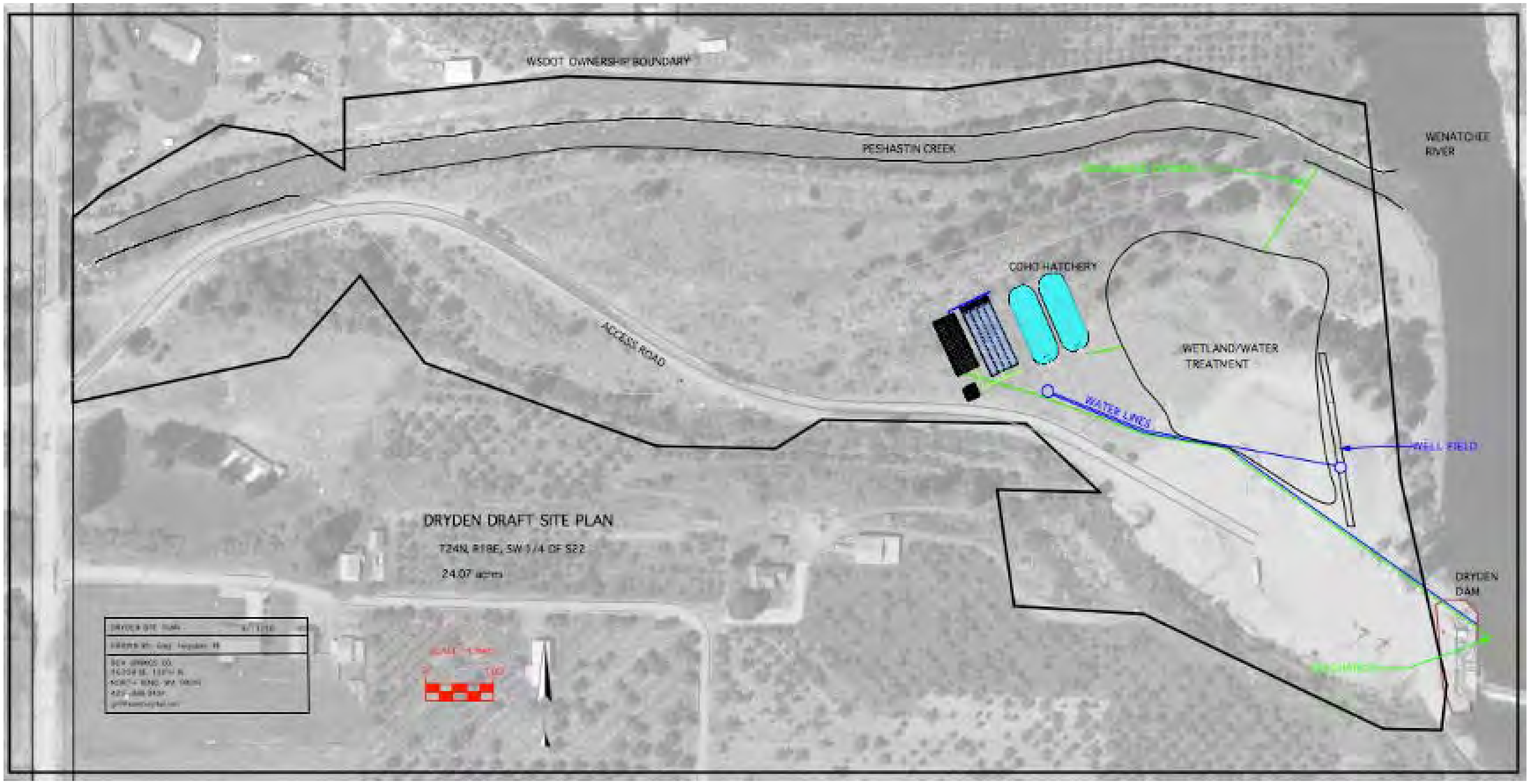

Figure 3-6. Dryden Draft Site Plan with Aerial Photo

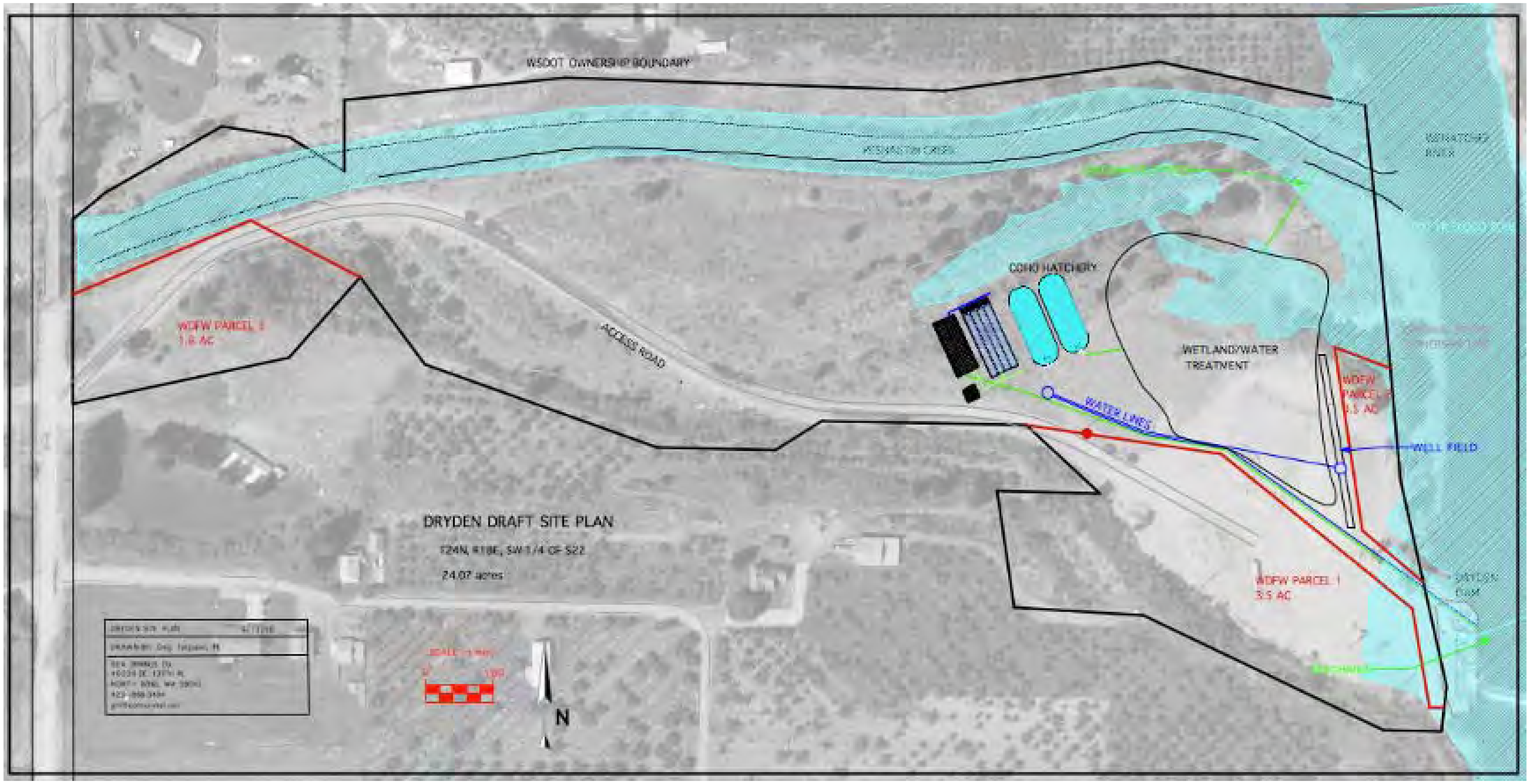

Figure 3-7. Dryden Draft Site Plan with Flood Boundaries

3.5. Winthrop NFH

The proposed plan calls for the continued production of 300,000 - 350,000 pre-smolts from the Winthrop NFH (approximately 250,000 on-station and 100,000 in the hatchery back-channel), starting with BDP2. Plans also call for Winthrop NFH to hold all captured Methow broodstock. With minor modifications planned by the USFWS to the water delivery system, adult holding area, and incubation system, this facility would hold a maximum of 1,300 adults and 1,300,000 eggs. A large proportion of the eggs would be transferred to lower river hatcheries at the eyed stage.

Winthrop NFH was originally authorized as part of the Grand Coulee Fish Maintenance Project. It began operation in 1942 to compensate for fish losses in the upper Columbia River drainage caused by the construction of Grand Coulee Dam. The funding agency is the U.S. Bureau of Reclamation and the operating agency is the USFWS.

The following information is from Integrated Hatchery Operations Team (IHOT 1998) and the Hatchery and Genetics Management Plan (HGMP 2002) and represents current conditions at the hatchery. The hatchery has water rights totaling 29,930 gpm from the Methow River, Spring Branch Spring, and two infiltration galleries (6,000 gpm). Water use ranges from 8,500 to 27,700 gpm. Rearing systems include:

- Adult Holding Ponds: 2 concrete ponds at 25,000 ft^3 each that currently are unused.
- Incubation: 150 iso buckets, 150 vertical stack trays, and bulk incubators.
- Early Rearing Tanks: 34 fiberglass, 16 feet x 2 feet x 2.8 feet.
- Raceways: 30 at 80 feet x 8 feet x 2.3 feet — 1,470 ft^3 each (design flow of 300 gpm).
- Raceways: 7 at 100 feet x 12 feet x 1.8 feet — 2,200 ft^3 each (design flow of 350 gpm).
- Foster-Lucas Ponds: 7 at 2,750 ft^3 each (design flow of 350 gpm), currently not used for fish production.

Figure 3-8. Winthrop NFH

4. Site Descriptions – Back-up Rearing Sites

An alternative to the Dryden hatchery is being evaluated. It has the same facility production requirements and same water and space needs.

4.1. George

Site Information

- Location, elevation: Downstream of Lake Wenatchee at Wenatchee rm 51.6; T27N, R17E, NW ¼ of S26 in Chelan County; elevation 570 meters.
- Ownership: The 150 acre parcel is currently in private ownership. The Yakama Nation is considering buying the site for habitat restoration.
- Flood designation: Most of the site is in Zone A3, in the 100 year flood hazard area. The Base Flood Elevation near the proposed hatchery site is 1,875'.
- Land use: The site is undeveloped and has been logged in the past. It is zoned RR20, rural residential with a minimum lot size of 20 acres.
- Access: Unpaved, primitive roads provide limited access.
- Utilities: 3-phase power is 4,000 ft away.
- Soils: The Natural Resources Conservation Service classifies soils on the site as adfluvial (NRCS, 2010).

Proposed Facilities

- Rearing units: Four 100' by 10' by 4' concrete raceways for adult holding and rearing, egg incubators with a capacity for 1,400,000 eggs, early rearing troughs, and two rearing ponds measuring 120' by 40' by 3' are proposed.

- Support systems: A 3,000 ft^2 hatchery building will enclose the incubators, rearing troughs, offices, and a small shop. Generators will provide back-up power. Parking will be provided for up to 10 vehicles.
- Discharge treatment: An off-line treatment tank measuring 10’ by 20’ by 4’ will hold and settle wastes vacuumed from the rearing units. Water from the hatchery will be directed to a large, disconnected side channel for additional treatment and nutrient removal prior to reaching the Wenatchee. Water would be removed from the mainstem Wenatchee for a distance of 3,800 ft.
- Site footprint: Hatchery facilities will require 1.5 acres of land. An additional 1.0 acres will be disturbed by power conduit and pipeline burial.

Water Supply

- Groundwater supply: A preliminary evaluation of the potential for developing groundwater on the site is planned. Two or more wells are proposed to produce the required 3.3 cfs.
- Surface water supply: 4.7 cfs of surface water will be pumped from the Wenatchee River. A submerged intake screen will be built into an existing rock barb in the river.
- Pipelines: Surface and ground water will be delivered to the hatchery in separate pipelines that will be approximately 1,500 ft long.

Proposed Hatchery Design

- Adult holding: Four concrete raceways (100 ft by 10 ft by 4 ft).
- Incubation: Vertical stack incubators and deep troughs inside a hatchery building would be fed with aerated, chilled ground water.
- Rearing: The four concrete raceways would be used for fish production when adults are not present. Also, two ponds measuring 40 ft by 120 ft by 3’ deep would add low density rearing space.
- Predator control, cover: The site would be fenced and an overhead net system installed over the rearing units.
- Waste treatment: Discharge water treatment would likely require a high degree of nutrient removal to meet conditions of the Total Maximum Daily Load restrictions in place for the Wenatchee River. An off-line treatment tank measuring 10’ by 20’ by 4’ will hold and settle wastes vacuumed from the rearing units. Treated water from the hatchery will be directed to the existing, 5,600 ft long, side channel on the site for further nutrient removal

prior to entering the Wenatchee River.

- Support systems: A 3,000 ft^2 hatchery building will enclose the incubators, rearing troughs, offices, and a small shop. Generators will provide back-up power. Parking will be provided for up to 10 vehicles.
- Site footprint: Hatchery facilities will require 1.5 acres of land. Including pipelines, water supply construction, and hatchery facilities, a total of 2.5 acres of land will be disturbed.

Figure 4-1. George Draft Site Plan

5. References

HGMP (Hatchery and Genetics Management Plan), Spring Chinook. 2002. Winthrop National Fish Hatchery, Leavenworth Hatchery Complex.

IHOT (Integrated Hatchery Operations Team). 1996. Hatchery Evaluation Report, Cascade Hatchery – Coho. December 1996.

IHOT. 1997. Hatchery Evaluation Report, Willard Hatchery – Coho. February 1997.

IHOT. 1998. Hatchery Evaluation Report Summary for Winthrop NFH – Spring Chinook, Summer Steelhead. February, 1998.

NRCS (Natural Resources Conservation Service). 2010. Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/).

APPENDIX 2

WENATCHEE ACCLIMATION SITE DESCRIPTIONS

Prepared by: Greg Ferguson, Sea Springs Co.

May, 2011

Table of Contents

List of Figures

1. Summary

The proposed alternative for the Wenatchee Natural Production Implementation Phase includes releases at up to 14 locations (see Fig 1-1). Ten of the locations have existing natural or semi-natural ponds, one has artificial ponds, one utilizes adult plants, and two require new pond construction. Back-up acclimation sites and methods have also been identified. Three back-up sites that do not require construction and two that do are described.

Large releases relative to habitat capacity are planned for Icicle Creek from the Leavenworth National Fish Hatchery (NFH) during Broodstock Development Phase 1 and 2 (BDP1 and BDP2). These large releases are for continued development of the local broodstock.

The proposed Chiwawa sites are important parts of the Wenatchee program, with approximately 30% of the proposed releases for the entire Wenatchee basin occurring in this one watershed. However, the majority of high quality habitat that lies within the upper watershed is inaccessible during winter months by wheeled vehicle. The uppermost acclimation locations, Chikamin and Minnow, would be managed by snowmobiles prior to snow being cleared.

The Little Wenatchee River also has winter access problems. Acclimation is proposed in the more accessible lower part of the watershed.

Winter access to some of the high quality habitat in the White River is feasible by a road that is plowed up to Tall Timber Ranch. An alternative reintroduction strategy, adult plants, has been proposed for one site on the White River. Coho would be trucked from adult collection and holding facilities to a small tributary, Dirty Face Creek, and confined there through the spawning season.

Nason Creek has an existing site at the upper end of the low gradient section of the watershed that is capable of winter operation. The purpose of the Rohlfing site is to disperse adults into downstream areas. The Coulter site is further downstream and discharges into a large wetland complex that is expected to be productive rearing habitat. The Coulter and Butcher Creek sites are very close and are planned to be used in alternating years. This may reduce in-pond losses by disrupting predator feeding patterns.

Small tributary sites and alternative acclimation strategies may be evaluated in the future for releases. Feedback from the Monitoring and Evaluation program would help determine the value of potential habitat. Techniques used to target other sites may include adult plants or in-river acclimation, along with pond acclimation.

Site activities at acclimation ponds include fish delivery, feeding, predator hazing, sampling, and release monitoring. Sites would be visited one or more times per

day to conduct these activities. Large truck access is required once at the start of acclimation at each site for fish delivery. Daily access could occur by small vehicle, foot, or snowmobile.

Proposed construction at the primary acclimation sites includes the creation of two new ponds, excavation of accumulated material in one existing pond and a new well at one site. The total area expected to be disturbed during construction is 0.7 acres.

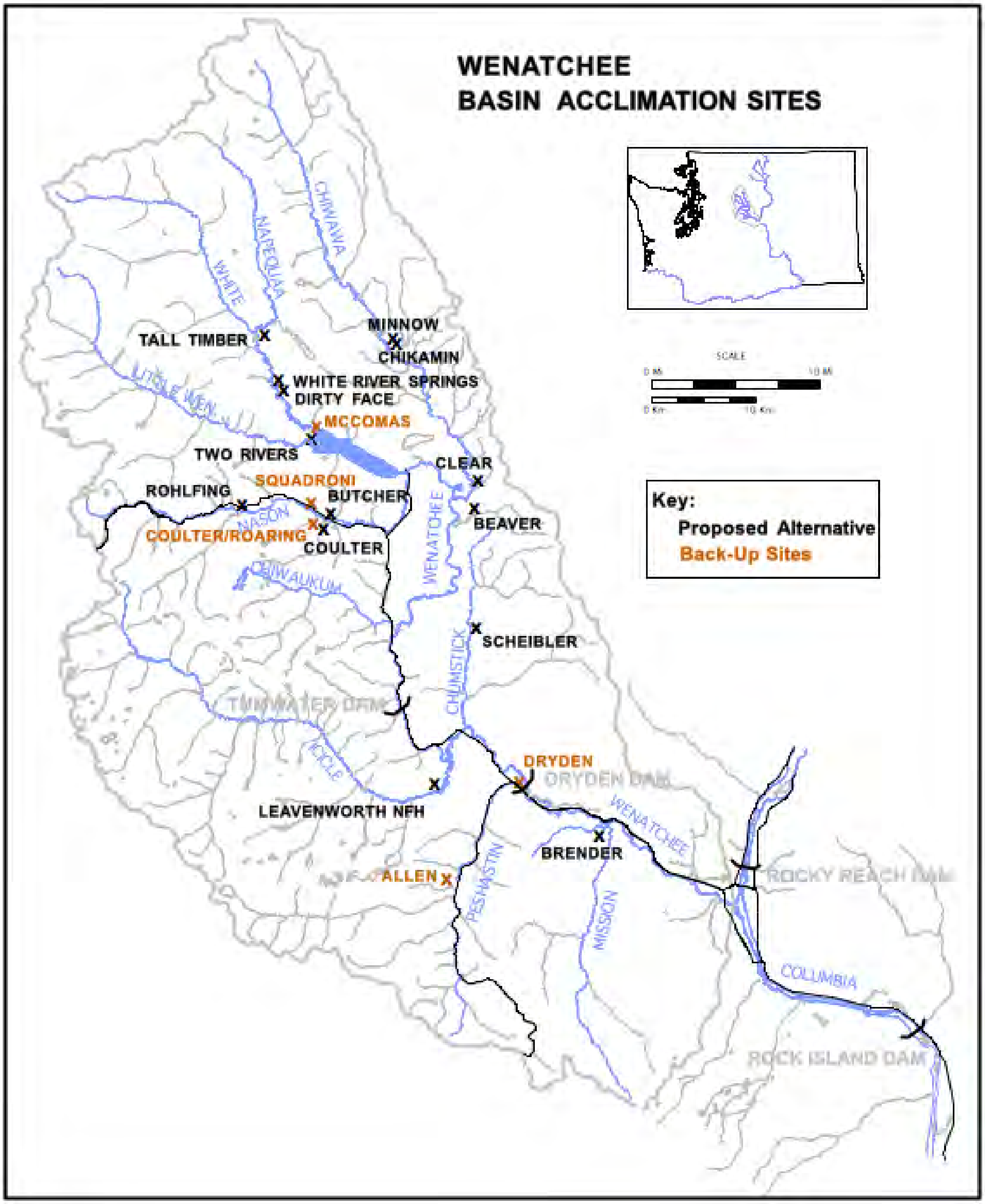

Figure 1-1. Wenatchee Subbasin Acclimation Site Map

2. Site Details

2.1. Information Tables

The tables below include specific details for each proposed Wenatchee acclimation site.

	GENERAL				LOCATION								LAND USE,/ZONING			FLOOD
	Release (1,000s)	Overwinter	Adult Trap	Previously used	Distance to Wen. mouth (rkm)	Township	Range	Section	1/4 section	Elevation (m)	Latitude	Longitude	Zoning (Comp. Plan)	Shoreline MP designation	Landuse	FEMA flood designation
Wenatchee Acc.																
Rohlfing	105	Y	T	Y	109	26	16	5	NE	685	47'08"	52'42	RR5	Co	Vacation home	None
Coulter	105		T	Y	103	26	16	11	SE	660	45'52"	48'10"	RR5	Co	Vacation home	None
Butcher	105	Y	T	Y	102	26	16	11	NE	658	46'13"	48'05"	RR5	Co	Vacation home	100 yr
Tall Timber	110		T		112	28	16	18	SW	589	55'24"	53'37"	RR20	Co	Guest ranch	NM
White River Springs	50	Y	T		108	28	16	32	SE	573	53'12"	52'21"	RR10	N	Rural residential	100 yr
Two Rivers	120	Y	T	Y	96	27	16	15	SW	575	50'10"	50'30"	RR20	N	Gravel mine	100 yr
Chikamin	100		T		99	28	17	21	SW	740	54'33"	43'12"	FC	Co	Private forestry	NM
Minnow	100		T		99	28	17	21	SW	740	54'40"	43'10"	FC	Co	Private forestry	NM
Clear	150	Y	T		80	27	18	31	NE	610	47'56"	37'48"	RRR	N	Private campground	None
Beaver	100		T	Y	75	26	17	12	NE	586	46'04"	38'58"	RR5	N	Guest ranch	None
Scheibler	65		D		51	26	18	31	SE	499	42'24"	38'15"	RR5	N	Farming	NM
Brender	50		N		18	23	19	5	NE	243	31'16"	28'58"	UGA	UGA	Urban	None
Leavenworth NFH	100	Y	L	Y	47	24	17	26	NE	344	33'31"	40'20"	P	Co	Public hatchery	None
Adult Plants																
Dirty Face			T		107	28	16	32	SE	573	52'40"	52'12"	RR10	Na	Wildlife	100 yr
Acc. Back-ups																
Coulter/Roaring	105		T		104	26	16	11	SE	659	45'59"	48'35"	RR5	Co	Vacation home	100 yr
Squadroni	105		T		106	26	16	3	SE	661	46'33"	49'27"	RR5	Co	Vacation home	100 yr
McComas	50	Y	T		96	27	16	10	SW	578	50'55"	49'56"	RR20	Na	Acclimation ponds	100 yr
Allen (Peshastin)	50		D		40	23	17	13	SE	501	28'57"	39'21"	RRR	N	Rural residential	None
Dryden	100	Y	D		29	24	18	22	NW	303	33'24"	34'25"	AC	Co	Gravel storage	None
Other																

Figure 2-1. General, Location, and Land Use Details

Key, Figure 2-1:

- Release (thousands). The proposed peak number of coho smolts to be released during the Natural Production Implementation Phase
- Overwinter. Does the site have a reasonable potential for over-winter acclimation? This requires a source of groundwater and reliable access.
- Adult Trap. The nearest downstream collection facility. T = Tumwater, D = Dryden, L = Leavenworth NFH, N = none.
- Previously used. Has the site been used by the coho reintroduction program in past years?
- Distance to mouth (rkm). The distance from the mouth of the Wenatchee to the acclimation site in river kilometers.
- Zoning. Zoning designations match the Chelan County Comprehensive Plan. RR5 = rural residential with a limit of one dwelling per 5 acres, RR10 = rural residential with a limit of one dwelling per 10 acres, RR20 = rural residential with a limit of one dwelling per 20 acres, RRR = rural residential/resource, FC = commercial forest, UGA = urban growth area, AC = commercial agriculture, P = public. Data from Chelan County.
- Shoreline Master Plan Designation. Co = Conservancy, Na = Natural, UGA = urban growth area N = None. Data from Chelan County, 2009.
- Land use. The predominant use of land surrounding the acclimation site.
- FEMA flood designation. 100 Yr. = 100 year floodplain None = not in an identified flood zone, NM = not mapped. Data from FEMA, 2009.

	MISC		WATER			SURFACE WATER		GROUND WATER		SPACE						ACCLIMATON PONDS		
	Power	Road access	New water right	Water reqrt. (cfs)	Water available (cfs)	Surface stream name	WDNR stream type	Overwinter tempering	GW needed (cfs)	Required space (cft/1000)	Required pond area (acre)	Existing space (cft/1000)	Existing pond area (acre)	New pond area added (acre)	Acclimation area/Existing pond aarea	Pond type	Free passage allowed	Pond confinement method
Wenatchee Acc.																		
Rohlfing	1P	Unsurf.	G	1.6	4.0	Unnamed	F	Y	0.3	22	0.17	22	0.17		100%	Existing man-made		Barrier
Coulter	1P	Unsurf.		1.6	>1.6	Coulter	F			22	0.17	48	0.37		100%	Existing beaver		Barrier
Butcher	3P	Surf.	G	1.6	2.0	Butcher	F	Y	0.5	22	0.17	73	0.56		100%	Existing beaver		Barrier
Tall Timber	1P	Unsurf.	S	1.7	>1.7	Napeequa	S			23	0.18	31	0.28	0.61	0%	Existing side channel	Y	Seine
White River Springs	N	Unsurf.		0.8	1.5	Unnamed	F			10	0.08	9.6	0.07		100%	Existing beaver		Barrier
Two Rivers	N	Unsurf.		1.9	1.9	None				25	0.19	23	0.17		100%	Existing man-made	Y	Screens
Chikamin	N	Unsurf.	S	1.5	>1.5	Chikamin	F			21	0.16	0	0.00	0.16	0%	New acclimation	Y	Screens
Minnow	N	Unsurf.		1.5	>1.5	Minnow	F			21	0.16	0	0.00	0.16	0%	New acclimation	Y	Seine
Clear	3P	Surf.		2.3	>2.3	Clear	F			31	0.24	68	0.52		46%	Existing man-made	Y	Seine
Beaver	N	Unsurf.		1.5	>1.5	Beaver	F			21	0.16	31	0.24		100%	Existing man-made		Screens
Scheibler	3P	Unsurf.		1.0	>1.0	Chumstick	F			14	0.10	4.5	0.03	0.10	0%	Existing man-made	Y	Seine
Brender	3P	Unsurf.		0.8	>.08	Brender	F			10	0.08	35	0.27		30%	Existing man-made	Y	Seine
Leavenworth NFH	3P	Surf.		1.5	>1.5	Icicle	S			21	0.16	>21	>.16		100%	Existing hatchery	Y	Screens
Adult Plants																		
Dirty Face	N	Surf.				Dirty Face	F									None	Y	Pickets
Acc. Back-ups																		
Coulter/Roaring	1P	Unsurf.		1.6	>1.6	Coulter,Roaring	F			22	0.17	637	5.8		3%	Existing beaver	Y	Seine
Squadroni	3P	Surf.	G	1.6	0.0	Nason	F	Y	1.6	22	0.17	0	0.00	0.17	0%	New acclimation		Screens
McComas	1P	Surf.		0.8	>0.8	White		Y		10	0.08	0	0.00	0.08	0%	New acclimation	Y	Screens
Allen	3P	Surf.		0.8		Allen	F			10	0.08	94	0.72		11%	Existing man-made	Y	Seine
Dryden	3P	Unsurf.	G,S	1.5	>1.5	Wenatchee	S	Y	0.2	21	0.16	0	0.00	0.16	0%	New hatchery	Y	Screens
Other																		

Figure 2-2. Water and Space Detail

Key, Figure 2-2:

- Power. N = None, 1P = single phase, 3P = three phase.
- Road access. Asphalt surfaced or unsurfaced (gravel).
- New water right. G = new ground water right needed, S = new surface water right needed.
- Water required (cfs). Minimum water requirements for each site are based on a flow density of 9 pounds of fish per gallon/minute (flow density index of 1.5 lbs/gpm/inch). This is an average minimum value based on approximate spring-time water temperatures and fish sizes. Actual flow rates would be higher to provide a safety margin, with the amount of margin depending on the reliability of the water supply at each site.
- Water available (cfs). The expected low flow during the acclimation period.
- Surface stream name. The name of the stream supplying water to the acclimation site.
- WDNR stream type. Washington Department of Natural Resources stream type designation, from http://fortress.wa.gov/dnr/app1/fpars/viewer.htm.
    - Type "S" = Shoreline. Streams and waterbodies that are designated “shorelines of the state”.
    - Type "F" = Fish. Streams and waterbodies that are known to be used by fish, or meet the physical criteria to be potentially used by fish.
    - Type "Np" = Non-Fish Perennial.
    - Type "Ns" = Non-Fish Seasonal.
- Overwinter tempering. Is ground water needed to control ice formation on surface water intakes?
- GW (ground water) needed (cfs).
- Required space (cft/1000). Space requirements are calculated using 0.3 pounds of fish per cubic foot of water (a volume index of 0.03 lbs/cft/inch). Sites that rely on pumped supplies without backup would require more space.
- Required pond area (acre). The pond area is calculated from the space requirement by assuming an average water depth of 3 ft.
- Existing space (cft/1000). Space is calculated by multiplying the existing pond surface area by a 3 ft assumed average depth.
- Existing pond area (acre). The total existing pond area, actual area may be less if seine nets are used.
- New pond area (acre). The amount of new area that is proposed to be added by expanding existing ponds or building new ones.

- Acclimation area/Existing pond area. The ratio of area that is proposed to be used by coho during the acclimation period to the existing pond area. The calculation is made only for existing pond area, if new pond area is built and blocked, the ratio is 0%. For barrier nets, 100% is blocked and for seine nets, some part of the existing area is blocked.
- Pond type.
- Free passage allowed. Does the presence of small ESA listed fish require that free up and downstream passage be allowed by the coho confinement net?
- Pond confinement method. A barrier net (see section 2.2) confines coho and does not allow free passage of any fish past it during acclimation. A seine net encloses a portion of a pond and allows passage around it. The seine net separates coho and other fish species during acclimation. Screens are rigid devices placed in outlet structures and pickets prevent downstream adult movement.

	Plowing for fish delivery (ft)	New road construction (ft)	New intake construction	Removal distance (ft)	New well	Existing well	Volume excavated (cft/1000) - new pond	Volume excavated (cft/1000) - existing pond	Surface disturbance (acre) - pond construction	Surface disturbance (sft) - water systems, intakes	Surface disturbance (sft) - water systems: wells, open channel	Buried water pipe line (ft)	Total area disturbed (acre)	Period of operation (mo.)	Generator
Wenatchee Acc.															
Rohlfing						Y								5	Y
Coulter														1.5	
Butcher					Y						900		0.02	5	Y
Tall Timber	250		Y	1,700						800		800	0.20	1.5	
White River Springs														5	
Two Rivers														5	Y
Chikamin			Y	380			30		0.2	800	1300	200	0.29	1.5	
Minnow	600	600					30		0.2				0.20	1.5	
Clear														5	
Beaver	1,000													1.5	
Scheibler								8						1.5	
Brender														1.5	
LNFH						Y								5	
Adult Plants															
Dirty Face														2	
Back-ups															
Coulter/Roaring														1.5	
Squadroni					Y		30		0.2		900		0.22	1.5	Y
McComas														5	
Allen														1.5	
Dryden			Y		Y		30		0.2		3500	700	0.44	5	Y
TOTALS-PRIMARY	1,850	600	2	2,080	1	2	60	8	0.4	1,600	2,200	1,000	0.72	43	3
TOTALS-BACK-UP			1		2		60		0.4	-	4,400	700	0.66	17	2

Figure 2-3. Construction and Operation Impacts

Key, Figure 2-3:

- Plowing. Roads at some sites require snow removal at least once per season to allow fish transport trucks to access acclimation ponds.
- Removal distance. The stream length impacted by new water withdrawals.
- New well. Some sites would require that new wells be drilled and developed.

- Surface disturbance – pond construction. The area impacted by new pond construction. This does not include the surface area temporarily disturbed by fill deposition.
- Surface disturbance – water systems, intakes. Excavation and installation of intake structures would involve disturbance of the work area.
- Surface disturbance – water systems: wells, open channels. Water would be delivered to and discharged from some ponds in rock-lined channels. It is assumed that a 10' wide strip of land would be disturbed during construction of the channels. Well construction would require truck access and staging areas.
- Buried water pipe line. Underground piping would deliver water to some ponds. It is assumed that a 10' wide strip of land will be disturbed during pipeline excavation. This is a temporary disturbance; the lines will be re-vegetated after work completion.
- Total area disturbed. The sum of all the area impacted by construction.
- Pond operation. The expected yearly duration of operation.
- Generator. Main or back-up power would be provided by electrical generators with automatic transfer switches. At locations where generators are the main source of power, two generators are proposed.

See Appendix 1, Brood Capture and Rearing Site Descriptions for a discussion of the Dryden Hatchery construction impacts. Impacts that would result if acclimation only were conducted on the site are listed above.

Leavenworth NFH is an existing facility and no changes are proposed by the MCCRP. The environmental impacts of the facility operation have been reviewed through past permitting processes.

The McComas site is proposed by Grant County Public Utility District and the impacts of constructing and operating the site will be analyzed during separate permitting processes.

These details are approximate and are based on schematic designs. They are for the purpose of evaluating potential environmental impacts.

2.2. Net Confinement Systems

Net systems would be used to confine coho during the acclimation period at most sites. They can be configured in one of two ways. Where loss of habitat and/or coho interaction with listed fish species is not expected to have negative impacts;

nets which fully block fish passage in the ponds (barrier nets) could be installed. They are placed perpendicular to the flow (see the figure below).

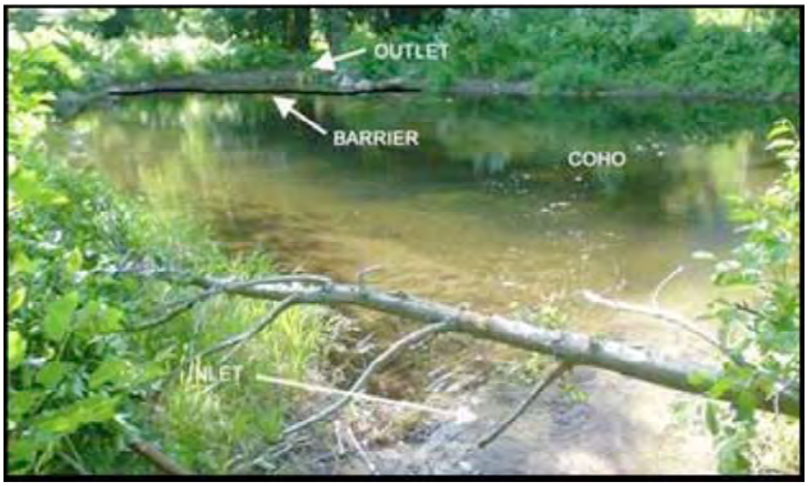

Figure 2-4. Barrier Net Example

Where impacts may be significant and free passage of fish up and downstream is required; nets that form an enclosed impoundment (seine nets) of only a portion of the pond could be used.

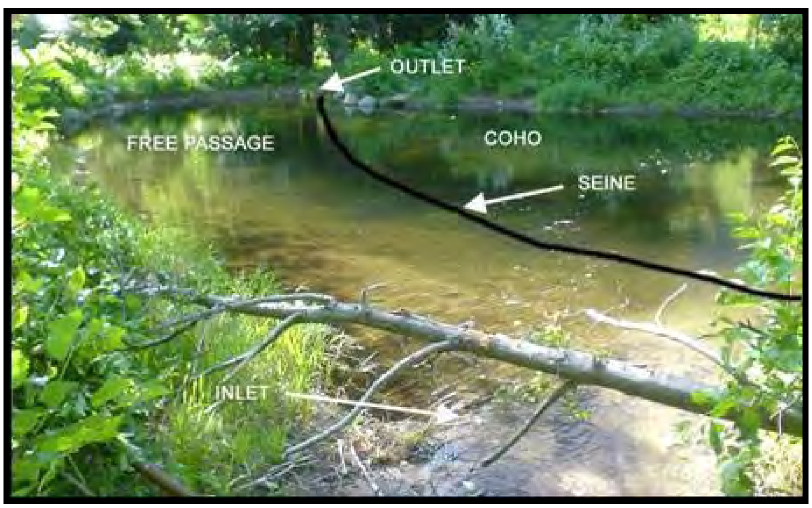

Figure 2-5. Seine Net Example

In both cases the net systems are temporary and are in place only during acclimation. They will be designed to minimize premature escape and will include jump barriers and double lead lines (see below).

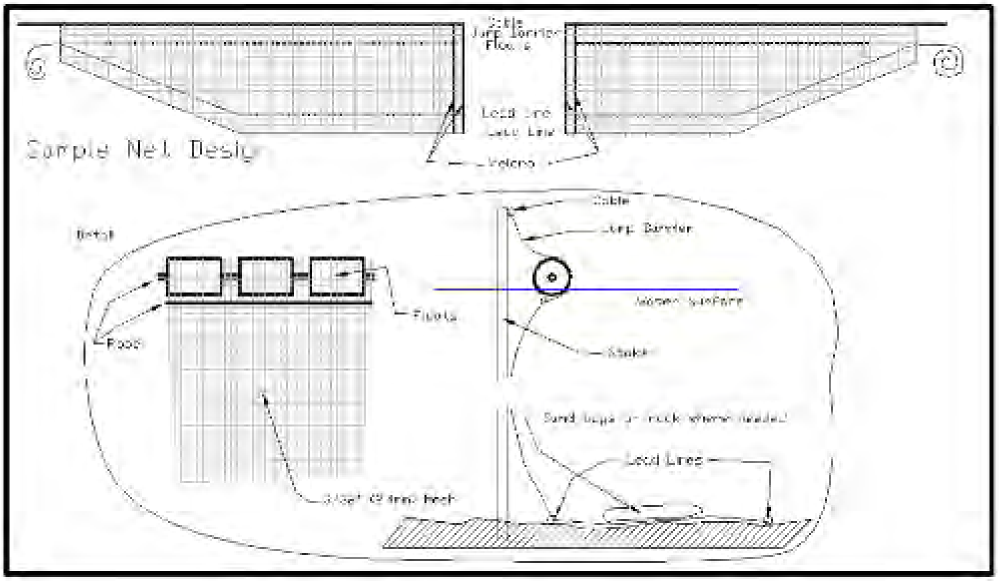

Figure 2-6. Example Net System Design

2.3. Other Site Design Features

Water effluent treatment systems outside of the acclimation ponds themselves are not planned for the small, natural sites. Relatively small numbers of fish would be held at low densities in large ponds at these locations. The minimum retention time for water flowing through the ponds be 2.5 hours and in most cases will be much longer than this. Fish waste will settle at low densities in the ponds.

The ponds are relatively effective at limiting the amount of Total Phosphorous (TP) that is being introduced in the form of fish feed to be discharged through the water supply. Fish feed rates and the amount of TP in the feed are known, along with the amount of TP leaving the pond in the discharge water (see Appendix 6) and in the fish. This data was used to perform the calculation below that estimates that 80% of the TP fed was not discharged from two of the acclimation ponds in 2009.

Rohlfing - 2009

	# of Fish	Fish Size	Total Fish Weight	Fish Feed Rate	TP Feed Rate	P not absorbed by fish
		grams	*grams*	*grams/day*	*grams/day*	*g/day*
Start	101,000	20.1	2,028,938	20,289	288	176
End	101,000	28.0	2,830,494	28,305	402	245

Average rate that TP added to pond (after fish absorbtion):	210	grams/day
Number of days of acclimation	56	days
Total TP not removed by fish through the acclimation season:	11,786	grams
TP load rate exiting pond as determined by measurement (see Section 3.2.1.1):	37.5	grams/day
Total TP exiting pond as determined by measurment:	2,100	grams
Pond P removal efficiency:	82%	

Butcher - 2009

	# of Fish	Fish Size	Total Fish Weight	Fish Feed Rate	TP Feed Rate	P not absorbed by fish
		grams	*grams*	*grams/day*	*grams/day*	*g/day*
Start	136,700	20.1	2,746,097	27,461	390	238
End	136,700	27.2	3,716,275	37,163	528	322

Average rate that TP added to pond (after fish absorbtion):	280	grams/day
Number of days of acclimation	57	days
Total TP not removed by fish through the acclimation season:	15,674	grams
TP load rate exiting pond as determined by measurement (see Section 3.2.3.1):	52.0	grams/day
Total TP exiting pond as determined by measurment:	2,964	grams
Pond P removal efficiency:	81%	

Spreadsheet Inputs	Value	Source
Fish feed rate (gram feed/gram fish/day)	1.0%	Silver Cup Feeds
Concentration of P in fish feed	1.42%	Skretting Nutra Fry diet
Amount of P in feed absorbed by fish	39%	From Flimlin, G, Sugiura, S., and Ferraris, P., 2003.

Figure 2-7. Pond Phosphorous Removal Efficiency

Avian and mammalian predation is a major consideration for remote acclimation sites. At some locations, physical barriers may be installed if predation becomes severe. Temporary fencing and overhead bird netting may be necessary. Deterrence of predation through human presence has been used effectively at sites currently operated by the MCCRP as well as at federal and state hatcheries; this technique is planned to be employed at most locations.

Many of the ponds at proposed sites could become inundated during major floods. Because spring is the natural migration period, the unplanned release of fish during snow-melt floods would be allowed and no special flood control measures will be taken.

3. Site Descriptions – Proposed, With Construction

Construction would involve the creation of new ponds and excavation of accumulated material in some existing ponds. The ponds have natural bottoms and construction includes the removal of cut material and the spreading and revegetation of fill. Fill areas have not been located, but material would be spread where environmental impacts are minimized under the conditions of construction permits.

Several wells are proposed be drilled to supply water to several sites. They would be located where high yields are most likely, near power sources, and where disturbance to existing vegetation is minimized. Water would be delivered from the wells to the ponds in buried pipelines and in rock-lined channels that will aerate the ground water. Generators provide both primary and back-up power to well pumps. They will be sized after well tests determine pump motor requirements.

North is up in all the following aerial photos, drawings, and maps unless otherwise denoted.

3.1. Butcher

This site is currently being used by the MCCRP for coho acclimation. Plans call for up to 105,000 coho to be acclimated and released every other year (alternating with the Coulter site) during the NPIP phase.

- Location: In an area of potential coho habitat on Nason Creek.
- Surface water supply: Butcher Creek flows directly into the acclimation pond.
- Ground water supply: A new well is proposed that would allow operation of the pond over the winter.
- Acclimation space: An existing pond that measures approximately 270' long by 90' wide has been created by beaver activity in a historic Nason Creek channel.
- Enclosure system: A temporary barrier net at the beaver dam is installed during acclimation to prevent premature downstream migration by coho pre-smolts.
- Land use: A vacation home is located near the pond.
- Access: A surfaced road from Highway 2 is plowed in the winter.
- Construction: The well is proposed to be located near existing roads and near Butcher Creek or the pond. The exact location will be determined with the help of geotechnical experts and with input from landowners. Water from the well would be delivered through a 50 ft. long rock-lined open

channel. Pumps would be powered by line power and a back-up generator is proposed.

Figure 3-1. Butcher Aerial

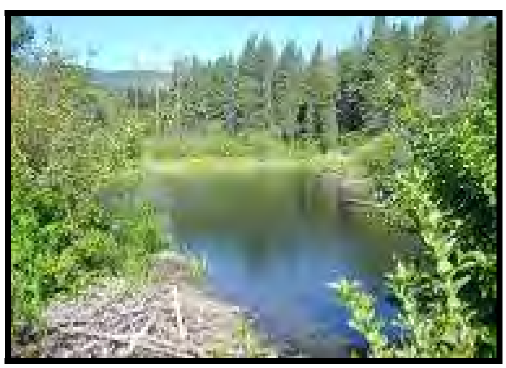

Figure 3-2. Butcher Pond

3.2. Tall Timber

Plans call for a disconnected side channel to be supplied with water from a new surface water intake.

- Location: In high quality salmon spawning habitat on the Napeequa near the confluence with the White River.
- Surface water supply: An intake on the Napeequa is proposed. A buried pipeline would deliver water by gravity-flow from the intake to an existing historic side channel. Soils encountered during excavation are expected to be Aquic cryumbrepts (NRCS, 2009).
- Ground water supply: None.
- Acclimation space: The existing, disconnected side channel is 1,000' long and averages 60' wide. Approximately 40,000 sft of the side channel would be covered by water when the intake is in operation. When not in operation, the water surface area in the channel varies depends on local conditions but will typically occupy about 8,000 sft.
- Enclosure system: A seine net in the channel would be installed during acclimation to confine coho pre-smolts while allowing movement of other fish occupying the channel. The net would be removed at release.
- Land use: Tall Timber Ranch is operated as a church camp.
- Access: The White River Road is plowed all winter.
- Construction: A screened, surface water intake is planned to be prefabricated and installed in the bank of the Napeequa. The intake structure would conform to the existing bank profile and would not impede river flow or impact flood storage capacity. It will use a fixed, sloped screen with an air or water backwash system to flush debris off the screen face and will meet agency screen criteria for sweeping flow, approach velocity, and mesh size. 800' of buried pipeline would transport water from the intake to the existing side channel. It would include a large, below grade, sand trap near the intake and several manholes for maintenance. No excavation is expected in the side channel. The existing culvert outlet may be adequate to return flow to the Napeequa with the addition of dam boards for elevation control on the culvert inlet.

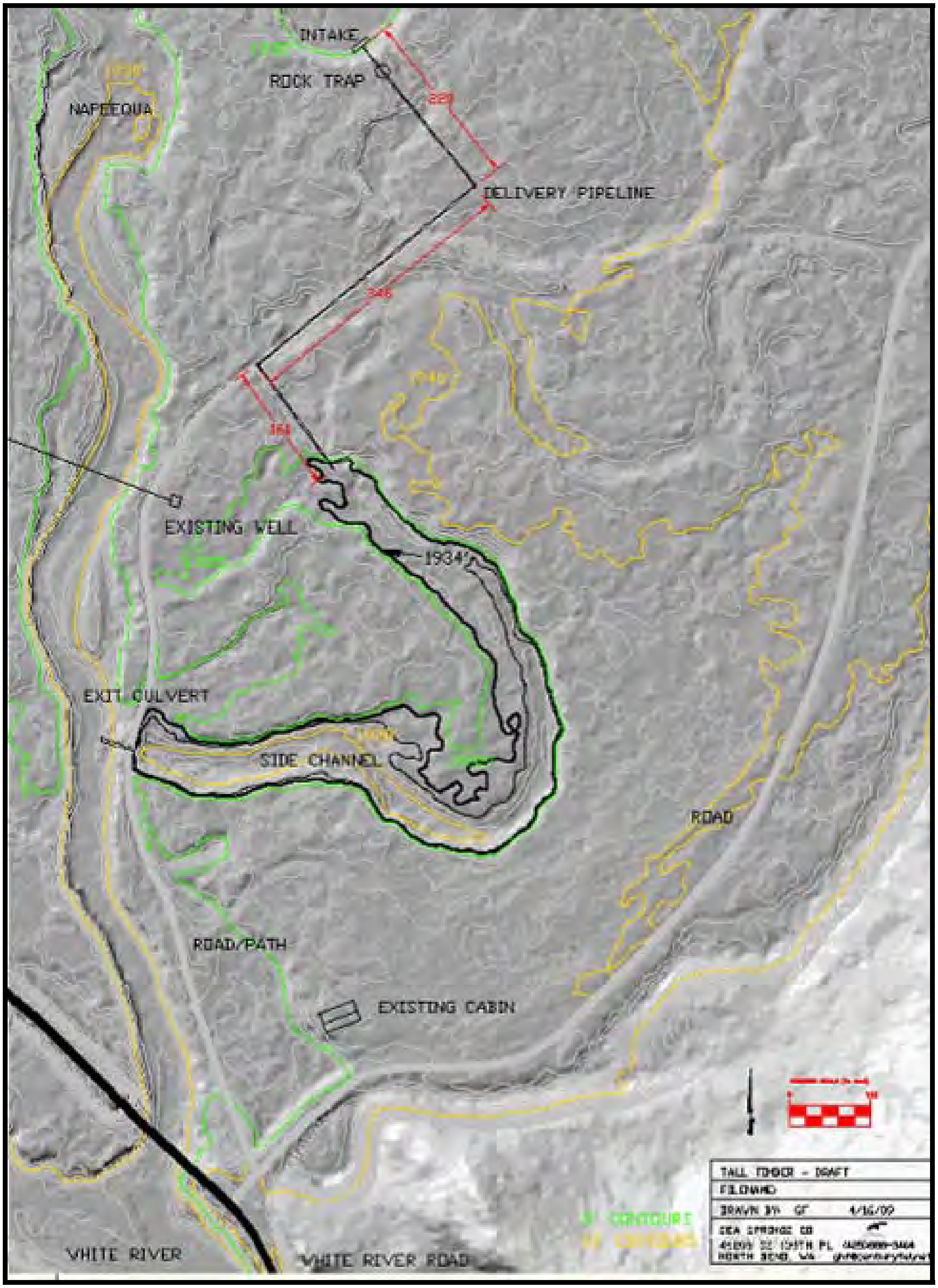

Figure 3-3. Tall Timber Site Plan

Figure 3-4. Tall Timber Pond

3.3. Chikamin

Two acclimation ponds are proposed on a single ownership; one using Chikamin Creek water and the other using Minnow Creek water (see Section 3.4). A new pond and new river intake is proposed for the Chikamin site.

- Location: This site would release fish into an area of high quality habitat in Chikamin Creek and in the middle section of the Chiwawa River.
- Surface water supply: An intake on Chikamin Creek would supply water by pipe to a constructed pond.
- Ground water supply: None.
- Acclimation space: The pond would be earthen bottom with an irregular shape. It would have inlet and outlet screens in place during acclimation to prevent other fish species from entering the rearing area. The pond would be approximately 120 ft. long and 80 ft. wide. Soil expected to be encountered during pond excavation is Kladnick cobbly fine sandy loam (NRCS, 2009).
- Land use: Timber has been harvested from the property.
- Access: The Chiwawa River Road is not plowed in winter. It is maintained for winter recreation and normally is not opened to the Chikamin site until May 1. Daily maintenance access to the acclimation site would need to be by snowmobile.
- Water supply construction: An intake structure is planned to be prefabricated and placed in the Chikamin stream bank. It would conform to the existing bank profile and would not impede river flow or impact flood storage capacity. The intake uses a fixed, sloped screen with an air or water

backwash system to flush debris off the screen face and will meet agency screen criteria for sweeping flow, approach velocity, and mesh size. Pipe (120 ft.) would be buried from the intake to a pond constructed alongside Chikamin Creek. A 70 ft. long discharge channel would return water from the pond to the creek. It would be rock lined to prevent erosion.

- Pond construction: The pond would be constructed by excavating material from a flat bench near the creek. A typical crossection through the pond is shown in Figure 3-7. Areas A and B would be cut from the existing ground contour and the fill would be spread elsewhere. No pond berms will be constructed. Although no flood elevation data is available for the area, it is likely in the 100 year flood plain, although out of the floodway. Because the pond will be below existing grade and material will be removed from the flood plain, pond construction will increase flood storage capacity (area A in Figure 3-7).

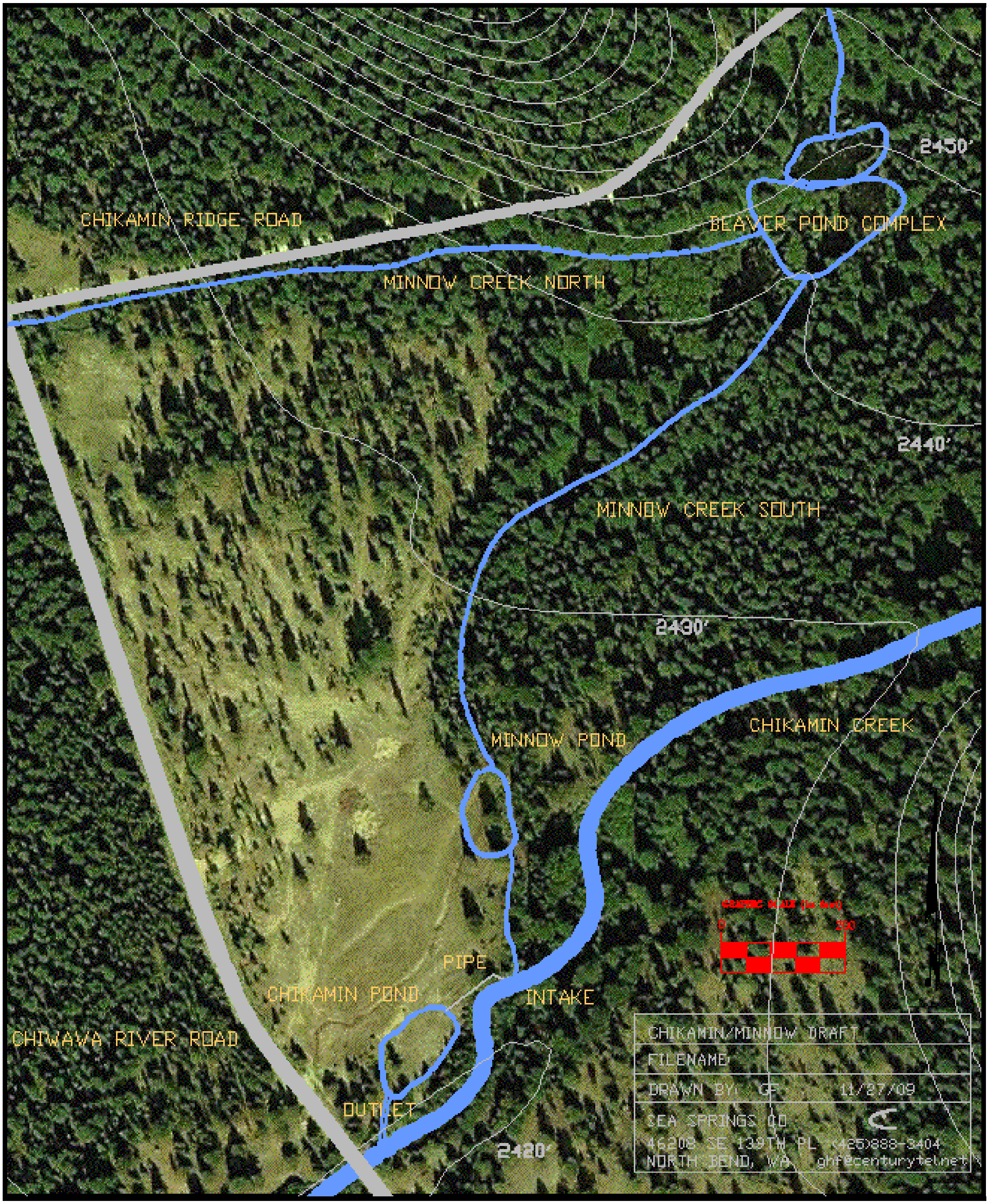

Figure 3-5. Chikamin and Minnow Site Plan

Figure 3-6. Chikamin Pond Location

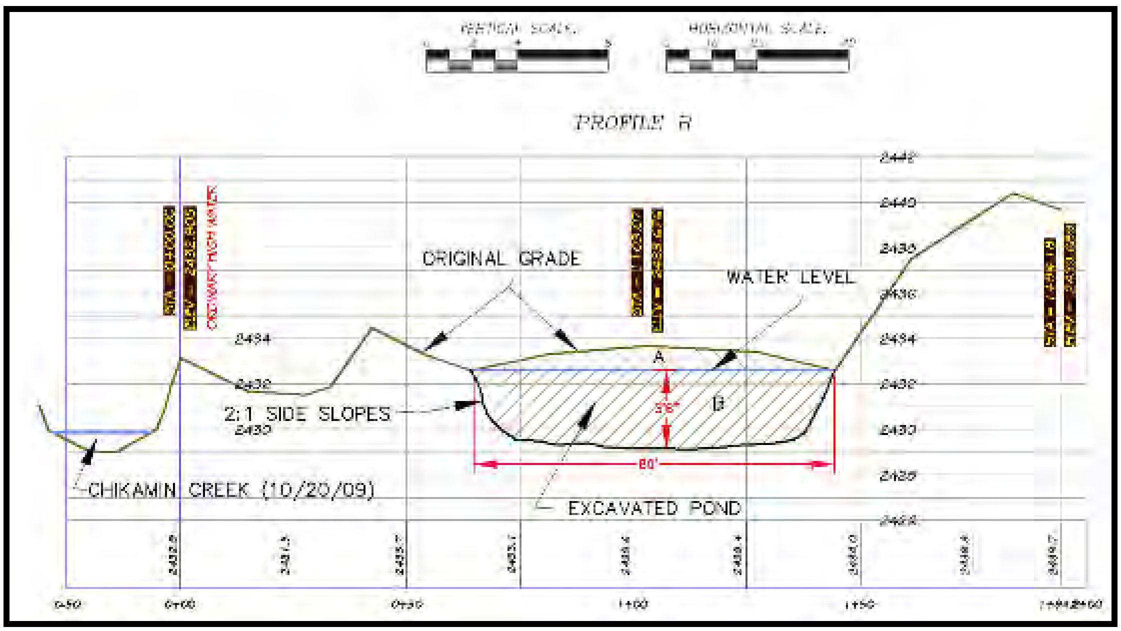

Figure 3-7. Chikamin Pond Crossection

3.4. Minnow

The Minnow pond is proposed to be constructed in the creek channel.

- Location: This site would release fish into an area of high quality habitat in Minnow Creek, a tributary of Chikamin Creek.
- Surface water supply: Minnow Creek water would flow directly into and out of a constructed pond. No water intake or diversion is planned.
- Ground water supply: None.
- Acclimation space: An earthen bottom with an irregular shape would be built in the Minnow Creek channel. Coho would be contained in pond during acclimation by temporary seines. Free passage up and downstream

by other fish would be maintained. The pond would be approximately 120 ft. long and 80 ft. wide. Soil expected to be encountered during pond excavation is Kladnick cobbly fine sandy loam (NRCS, 2009).

- Land use: Timber has been harvested from the property.
- Access: The Chiwawa River Road is not plowed in winter. It is maintained for winter recreation and normally is not opened to Chikamin until May 1. Daily maintenance access to the acclimation site would need to be by snowmobile.
- Construction: A pond would be excavated next to the current Minnow Creek stream channel (see the aerial photo in Section 3.3). After completion and stabilization of the pond bottom, Minnow Creek would be diverted into the completed pond. The pond would be constructed by excavating and removing material and would be located in the 100 year floodplain and floodway. Because the pond will be below existing grade and material will be removed from the flood plain, pond construction will increase flood storage capacity. The pond would be rock lined to prevent erosion.

Figure 3-8. Minnow Pond Location

3.5. Scheibler

An impoundment in the Chumstick Creek channel was built at some point in the past, forming a pond.

- Location: The site is located 13.0 km up Chumstick Creek, above some areas that may become coho spawning habitat. Several culverts throughout the lower and middle sections of Chumstick Creek have been removed, vastly improving salmonid passage.

- Surface water supply: Chumstick Creek flows directly into the existing pond.
- Ground water supply: None.
- Acclimation space: The existing pond is 100’ long and 15’ wide. With landowner permission, expansion of the pond will be proposed. Increasing the capacity by 14,000 cft would require the removal of 350 cubic yards of material.
- Seine net system: A temporary seine net would enclose a part of the pond. It would be positioned to allow free access to the inlet, outlet, and part of the pond habitat by other fish. The net would be removed at release.
- Land use: The surrounding property is used for farming.
- Access: The surfaced Chumstick Road provides year round access to a point close to the ponds. Three-phase power is on the property and near the pond.
- Construction: Excavation and enlargement of the existing pond would increase room for coho acclimation and would provide rearing space for other fish in the Chumstick Creek. Excavation will occur during low flow and the creek will be piped around the work area during construction. Material cut from the pond will be spread at approved areas, as dictated by permit conditions.

Figure 3-9. Scheibler Aerial

Figure 3-10. Scheibler Photo

4. Site Descriptions – Proposed, No Construction

The sites listed below would require no construction activities that result in earth-moving activities or permanent changes. Existing ponds and water supplies would be used for acclimation.

4.1. Coulter

Site function: This site is currently being used by the MCCRP for coho acclimation. Plans call for up to 105,000 coho to be acclimated and released every other year (alternating with the Butcher Creek site) during the NPIP phase. No overwinter acclimation is planned.

- Location: In an area of potential coho habitat on Nason Creek. Fish migrate down Coulter Creek from the pond into a large wetland complex owned by the Yakama Nation before entering Nason Creek.
- Surface water supply: Coulter Creek flows directly into the acclimation pond.
- Ground water supply: None.
- Acclimation space: An existing pond that measure approximately 200' wide by 80' long has been created by beaver activity.
- Enclosure system: A temporary barrier net at the beaver dam is installed during acclimation to prevent premature downstream migration by coho pre-smolts.
- Land use: A vacation home is located near the pond.
- Access: An unsurfaced road from Highway 2 is plowed in the winter, providing adequate access throughout the year.

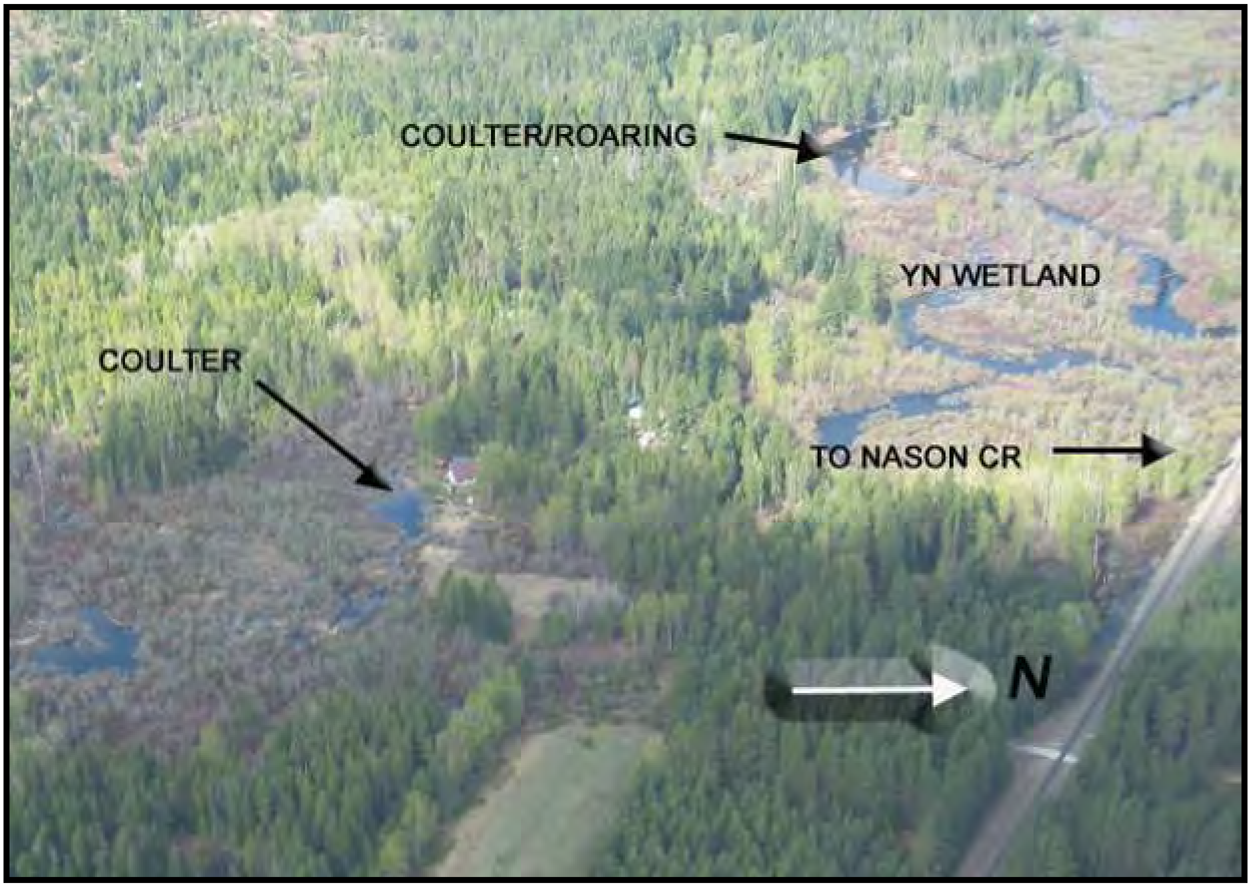

Figure 4-1. Coulter Aerial

Figure 4-2. Coulter Photo

4.2. Rohlfing

This site is currently being used by the MCCRP for coho acclimation.

- Location: Near the upstream end of accessible coho habitat on Nason Creek.
- Surface water supply: An unnamed, seasonal stream flows at over 1-4 cfs in the spring directly into the acclimation pond. Low stream flows during the

fall adult migration period may encourage coho to distribute to suitable spawning habitat in Nason Creek.

- Ground water supply: An 8" well was dug in 2003 that is estimated to produce 130 gpm (Williamson, 2003). Plans call for piping to be installed in 2010 that would deliver this water to the pond. Ground water would allow the Rohlfing site to be used for overwinter acclimation.
- Acclimation space: An existing pond was expanded in 2004. It currently measures approximately 90' long by 50' wide with an average depth of 4'. A barrier net at the pond outlet is installed during acclimation to prevent premature downstream migration by coho pre-smolts. The net is removed at release.
- Land use: A vacation home is located near the pond.
- Access: Whitepine Road is an unsurfaced US Forest Service road which is plowed in the winter, providing adequate access throughout the year. It is one mile from Highway 2 to the Rohlfing Pond. Single phase, underground power is currently in place.

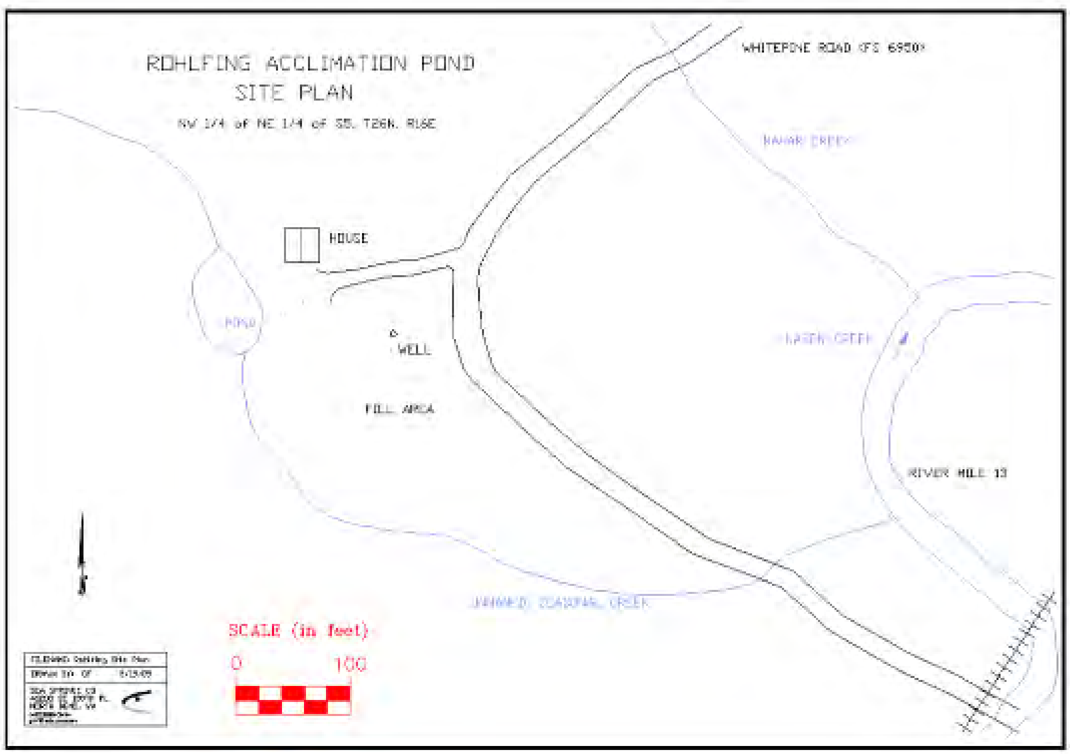

Figure 4-3. Rohlfing Site Plan

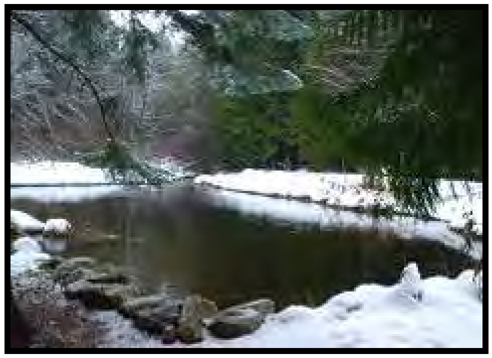

Figure 4-4. Rohlfing Photo

4.3. White River Springs

Two springs originating from talus slopes on Dirty Face Mountain combine and flow into a system of beaver ponds.

- Location: In a very low gradient section of the White River. Adults would need to migrate past the release location or into tributaries on the lower White to find suitable spawning habitat.
- Water supply: The combined springs flow is 1.5 cfs at the head of the channel during the spring period. Flow entering the White River is reduced by water leaking from the channel into the cleared field and from seepage and dispersion that result from beaver dams. It may be possible to overwinter acclimate with the temperate spring water supplies.
- Acclimation space: Existing ponds are formed by beaver dams between the cleared property and the White River. Their size depends on the location and condition of the dams.
- Enclosure system: A temporary barrier net at a beaver dam would be installed during acclimation to prevent premature downstream migration by coho pre-smolts. The net is removed at release.
- Land use: A residence is located on the property.
- Access: The surfaced White River Road is plowed in the winter.

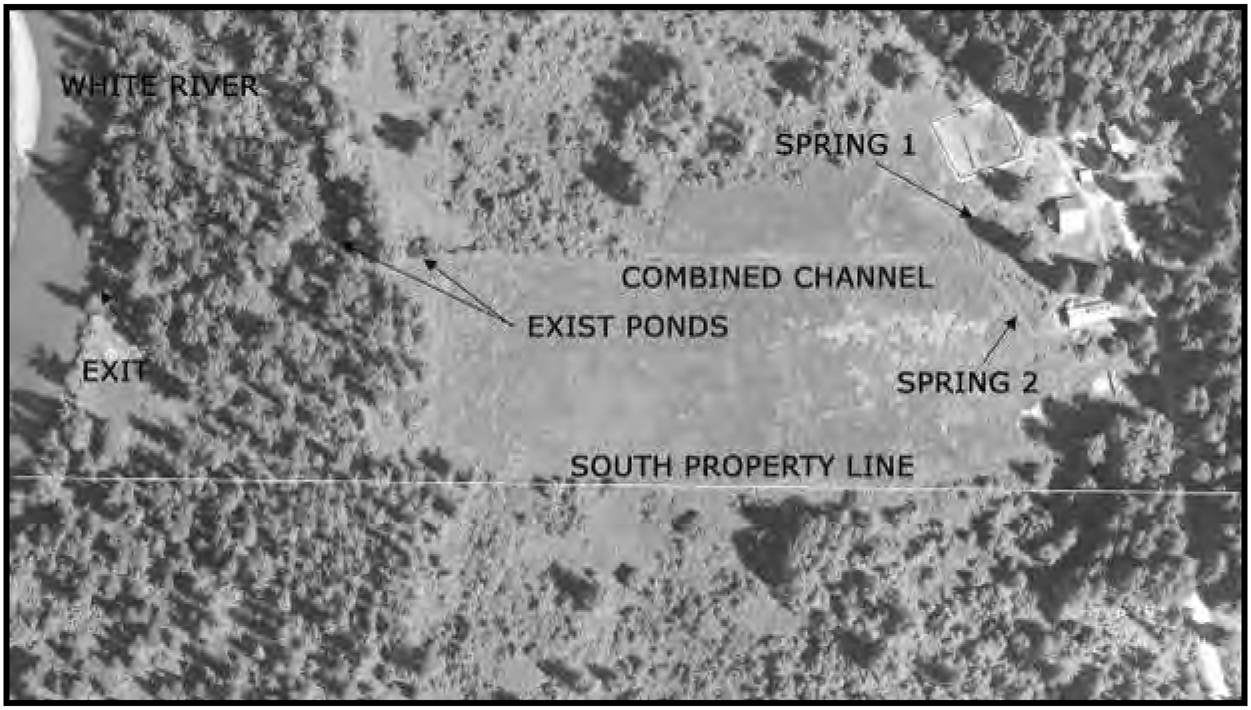

Figure 4-5. White River Springs Aerial

Figure 4-6. White River Springs Pond Photo

4.4. Dirty Face

Spring water flows through a flat, open field and then into the White River. The mouth is on publicly owned land, where adult plants are proposed.

- Location: In a very low gradient section of the White River. Adults would need to migrate past the release location or into tributaries to find suitable spawning habitat.
- Water supply: A spring originating from talus slopes on Dirty Face Mountain.
- Acclimation space: None. A temporary weir would be placed near the mouth of the creek and adults would be planted behind the weir. When spawning is completed, the weir would be removed.
- Land use: The mouth of the creek is in the Chelan Wildlife Area - White River Unit and is owned and managed by the Washington Department of Fish and Wildlife. A vacation home is located on adjacent property.
- Access: The surfaced White River Road is plowed in the winter.

Figure 4-7. Dirty Face Aerial

Figure 4-8. Dirty Face Photo

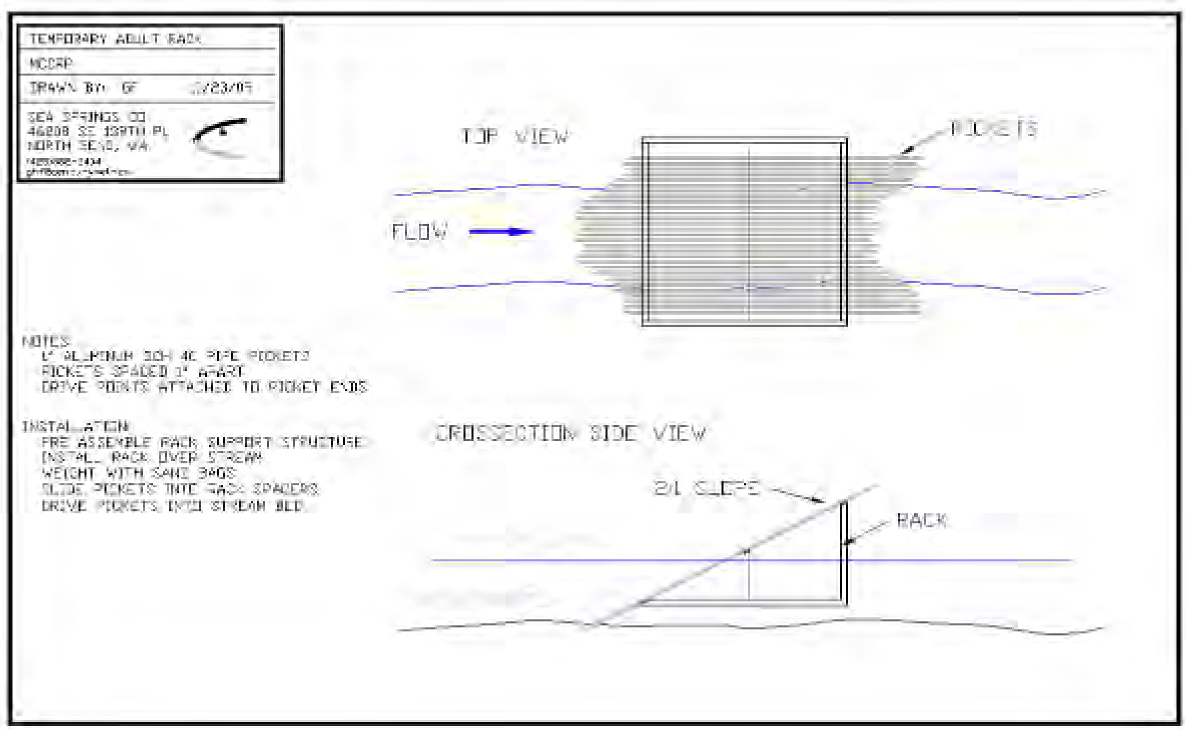

Figure 4-9. Sample Adult Barrier

4.5. Two Rivers

This site has been used in the past for coho acclimation and is on the Two Rivers gravel mine.

- Location: The site is located in the lower section of the Little Wenatchee River. Adults would need to migrate past the release location to find suitable spawning habitat.
- Surface water supply: None.
- Ground water supply: Water is pumped from a lake formed by the gravel mine to an existing acclimation pond. Gravel excavation through the winter and spring creates relatively high turbidity in the lake. To minimize sediment discharge, water is returned to the lake rather than to the Little Wenatchee River.
- Acclimation space: The existing acclimation pond is 500' long and 15' wide. An existing screened outlet structure confines the fish during acclimation.
- Land use: Gravel mining.
- Access and power: The surfaced Little Wenatchee River Road is plowed in the winter to the mine, providing adequate access throughout the year. Public power does not extend to the site and main power is produced by generators.

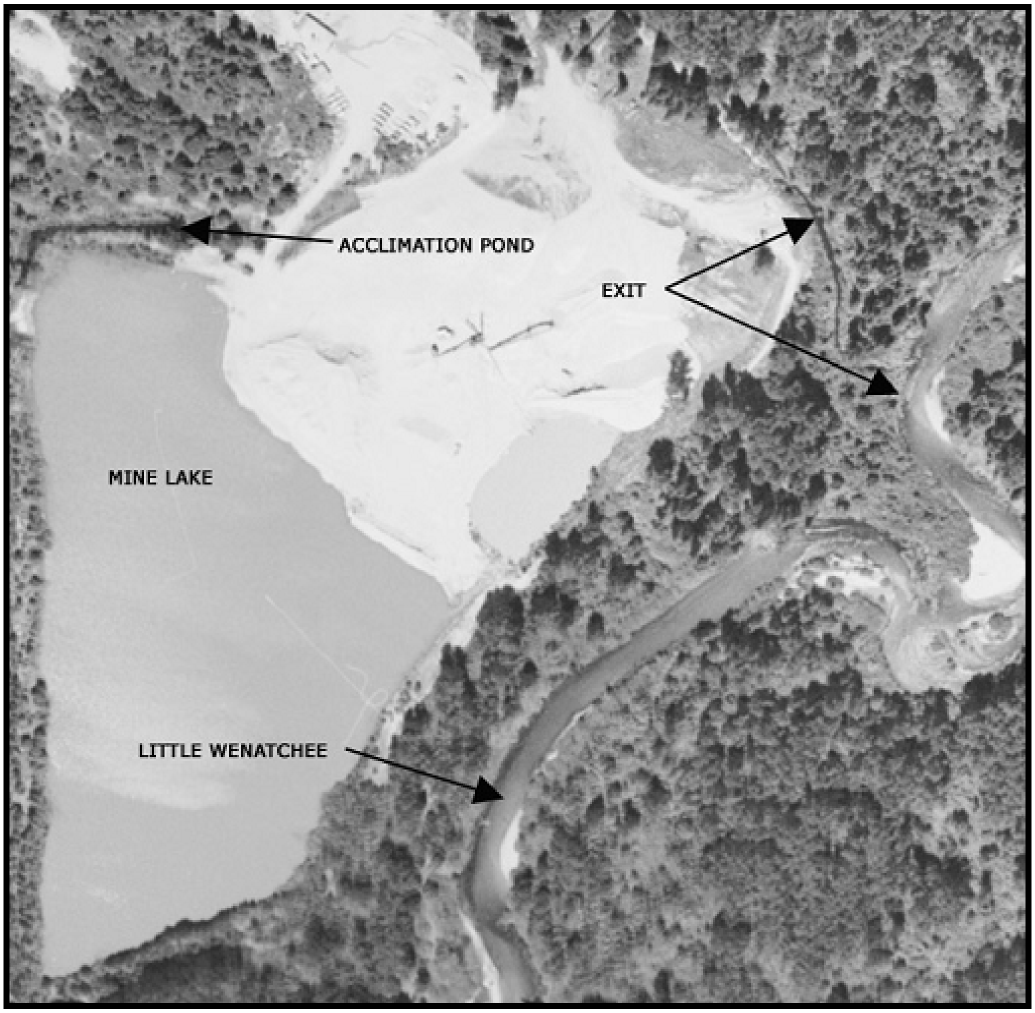

Figure 4-10. Two Rivers Aerial

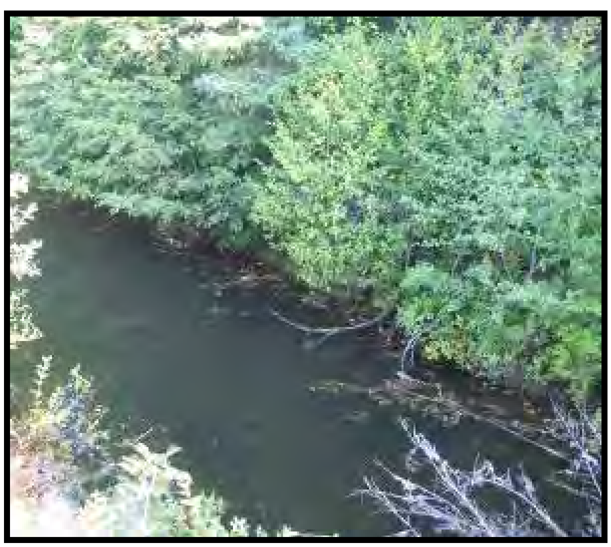

Figure 4-11. Two Rivers Pond

4.6. Clear

Several man-made ponds exist on a private campground site.

- Location: In the lower section of the Chiwawa River.
- Water supply: Clear Creek is a spring influenced water supply. It has a relatively stable flows and temperatures which may allow overwinter acclimation. Clear Creek flows into and out of the acclimation pond.
- Acclimation space: There are three ponds connected in series. The upstream pond has been proposed for coho acclimation.
- Enclosure system: A temporary seine net would enclose a part of the pond. It would be positioned to allow free access to the inlet, outlet, and to part of the pond habitat by other fish. The net would be removed at release.
- Land use: The ponds are on a Thousand Trails private campground.
- Access: Surfaced, plowed roads provide adequate access.

Figure 4-12. Clear Creek Aerial

Figure 4-13. Clear Creek Pond

4.7. Beaver

This site has been used in the past for coho acclimation.

- Location: Beaver Creek is a small direct tributary of the Wenatchee River. Coho habitat exists in the creek but to date no spawning activity has been documented. A passage barrier at the mouth may prevent coho from accessing the creek.
- Surface water supply: An existing intake on Beaver Creek diverts flow into the pond.
- Ground water supply: None.
- Acclimation space: The existing acclimation pond is 115' in diameter. Bird predation is limited to some extent by the surrounding mature tree cover, but otters are present. An existing screened outlet structure confines the fish during acclimation.
- Enclosure system: The screen prevents free passage of naturally produced fish in Beaver Creek during coho acclimation.
- Land use: The pond is owned by Mountain Springs Lodge, a recreation-oriented guest facility.
- Access: An unsurfaced road extends 1,000' from the Lodge to the pond.

Figure 4-14. Beaver Aerial

Figure 4-15. Beaver Pond

4.8. Brender

This site is the lowest and most accessible to returning adults in the Wenatchee basin. Mission and Brender creeks have low-gradient, small-stream habitat that might be used by coho. Habitat degradation is an impediment to reintroduction in these watersheds.

- Location: The site is located on Brender Creek, a tributary to Mission Creek, which in turn flows into the Wenatchee near the town of Cashmere.
- Surface water supply: Brender Creek flows directly into the existing pond.
- Ground water supply: None.
- Acclimation space: The existing acclimation pond is approximately 130’ in diameter.
- Seine net system: A temporary seine net would enclose a part of the pond. It would be positioned to allow free access to the inlet, outlet, and to part of the pond habitat by other fish. The net would be removed at release.
- Land use: The area includes some light industry, retail stores, and residences.
- Access: Surfaced roads provide adequate access and power is nearby.

Figure 4-16. Brender Aerial

Figure 4-17. Brender Pond

4.9. Leavenworth NFH

This USFWS hatchery on Icicle Creek is currently being used by the MCCRP for acclimation and release. Coho are held in second-use water in old Foster-Lucas concrete raceways. Smolts are released from the raceways and then passed through the hatchery ladder into Icicle Creek. The main purpose of the site has been for broodstock development; releases would continue during natural production phases to provide a back-up broodstock source. The hatchery might also be used in the future as an intermediate acclimation location between lower river hatcheries and upriver release sites.

5. Site Descriptions – Back-up, With Construction

5.1. Squadroni

Squadroni would be used if the other primary Nason Creek sites are not.

- Location: In an area of potential coho habitat on Nason Creek.
- Surface water supply: An existing ditch that flows seasonally would be connected to the pond. There will be some surface water flow during snow melt and rain events.
- Ground water supply: A new well is proposed.
- Acclimation space: A new pond is proposed pond that would have an earthen bottom and irregular shape. The pond would be approximately 120 ft. long and 90 ft. wide. Soil expected to be encountered during pond excavation is Aeric Fluvaquents (NRCS, 2009).
- Enclosure system: The pond would have inlet and outlet screens in place during acclimation.
- Land use: A vacation home is located near the pond.
- Access: Highway 2.
- Construction: The well is proposed to be located near existing roads, the exact location would be determined with the help of geotechnical experts and with input from landowners. Water from the well would be delivered through a 50 ft. long rock-lined open channel. Pumps would be powered by line power and back-up generators. The pond would be constructed by excavating material from a pasture area. Because it will be below existing grade and material will be removed from the flood plain, pond construction will increase flood storage capacity. A 20 ft. long discharge channel would return water from the pond to the ditch. It would be rock lined to prevent erosion.

Figure 5-1. Squadroni Aerial

5.2. Dryden

This site is a proposed hatchery (see the Adult Capture and Rearing Site Descriptions for site details). Smolt releases may also occur for several purposes. Releases above Dryden Dam may provide an alternative broodstock source, release into Peshastin Creek may help seed that stream, and releases directly into the Wenatchee may help distribute coho throughout the lower river. Facility designs would allow releases to occur in Peshastin Creek or in the Wenatchee above Dryden Dam as well as potentially provide intermediate rearing for juveniles destined for the upper watershed.

6. Site Descriptions – Back-up, No Construction

6.1. Allen

The Allen pond is used for recreation by the Valley Hi community.

- Surface water supply: A diversion from Allen Creek feeds the pond.
- Ground water supply: None.
- Acclimation space: The pond measures approximately 200’ in diameter.
- Land use: Recreation.
- Access: Year-round paved roads provide access to Valley Hi from Highway 97.

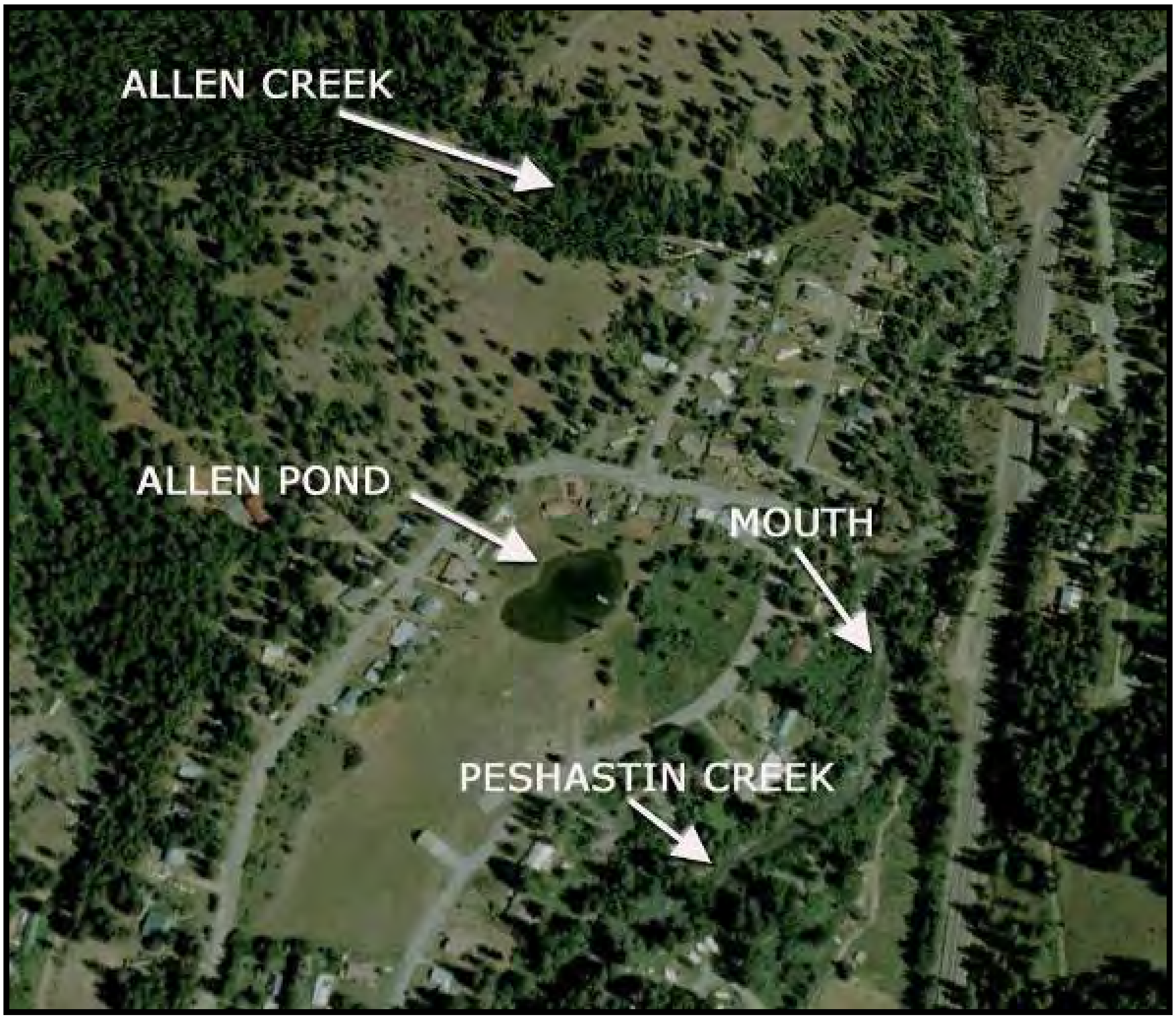

Figure 6-1. Allen Aerial

6.2. Coulter/Roaring

The Coulter/Roaring wetland is owned by the Yakama Nation, although access to potential sites is through private property. Several large ponds are formed in the wetland by beaver dams. A seine in part of a pond would allow acclimation to occur.

- Location: In an area where small tributaries may be seeded and where a wetland complex may provide rearing habitat. Smolts would migrate from the acclimation area, through the wetland, and then in to Nason Creek.
- Surface water supply: Coulter and Roaring creeks.
- Ground water supply: None.
- Acclimation space: A large beaver pond.
- Land use: Habitat preservation, recreation, and rural residential.
- Access: A gravel road from Hwy 2 is plowed in the winter.

See the aerial photo in Section 4.1.

6.3. McComas

Grant Public Utility District has proposed developing the McComas site for spring Chinook acclimation in the White River. Some coho could be acclimated at the site as a back-up to the upriver sites on the White River.

- Location: Low in the White watershed, below coho spawning habitat.
- Surface water supply: White River.
- Ground water supply: Wells.
- Acclimation space: Large, constructed ponds.
- Land use: Habitat preservation and rural residential.
- Access: The paved, plowed Little Wenatchee Road.

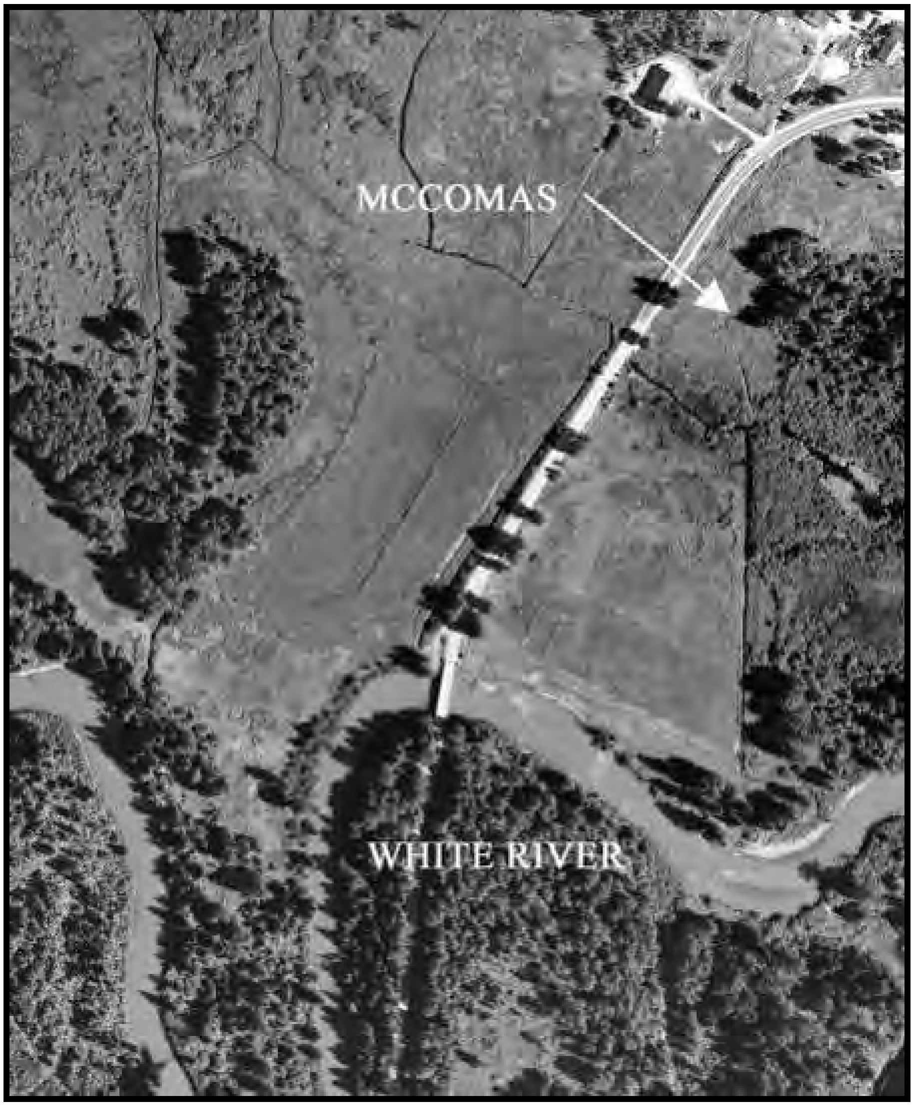

Figure 6-2. McComas Aerial

7. Other Locations and Methods

Areas where ponds do not currently exist and where pond construction is not possible may be targeted for adult plants. Procedures would be similar to those described for Dirty Face above, using a temporary adult weir to confine fish to targeted areas during spawning.

Acclimation and release of coho at existing and planned facilities that are developed for other species may also be considered in the future. Mixing coho with spring chinook and or steelhead, or acclimating in separate rearing units on the same site, may be possible.

8. References

Chelan County. 2009. Chelan county Shoreline Master Program Environment Designations. June 2009. ftp://mail.watershedco.com/Chelan%20Co%20SMP/SMP/County%20environmentdesignations.pdf

FEMA. 2009. National Flood Insurance Program, Flood Insurance Rate Maps. Various dates. http://msc.fema.gov/webapp/wcs/stores/servlet/CategoryDisplay?catalogId=10001&storeId=10001&categoryId=12001&langId=-1&userType=G&type=1

NRCS (Natural Resources Conservation Service). 2009. Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/)

Williamson & Associates. 2003. Report of Mahar Groundwater Study. Submitted to Yakama Nation, December 27, 2003.

APPENDIX 3
METHOW ACCLIMATION SITE DESCRIPTIONS

Prepared by: Greg Ferguson, Sea Springs Co.

May, 2011

Table of Contents

List of Figures

1. Summary

The proposed alternative for the Methow Natural Production Implementation Phase (NPIP) includes smolt releases at up to 12 locations in the Methow watershed (see Fig 1-1). Back-up acclimation sites and methods have also been identified.

Tributary sites where releases occur upstream of traps will be important as they would initiate production in areas where returning natural origin adults will be available for broodstock collection. Continued releases from the Winthrop National Fish Hatchery (Winthrop NFH) on the mainstem Methow have a dual purpose: 1) to distribute spawning adults throughout the Methow basin and 2) to serve as a back-up brood source.

The proposed Chewuch sites are a large part of the Methow program, with approximately 30% of the proposed releases for the Methow basin occurring in this watershed. Three primary acclimation sites and two back-ups have been identified in the Chewuch, with Methow State Wildlife Area (MSWA) Eightmile and Mason adjacent to each other and located as far upstream as access allows.

The Lincoln site on the Twisp River is at the upper end of the low gradient habitat preferred by coho salmon. It is capable of over winter operation. The Twisp weir site also releases fish above the existing trap on the Twisp River.

Two sites on the mainstem, Heath and Hancock, are located on large springs that may be productive coho spawning habitat. The Hancock location does not have a pond and adult plants would be the reintroduction technique used.

Other acclimation sites and procedures may be evaluated in the future. Small streams with potential coho habitat may be targeted for reintroduction. Feedback from the Monitoring and Evaluation program would help determine the value of such tributary habitat. Along with adult plants and pond acclimation, in-river acclimation may be tested as an alternative reintroduction strategy.

Site activities at acclimation ponds include fish delivery, feeding, predator hazing, sampling, and release monitoring. Sites would be visited one or more times per day to conduct the routine activities. Large truck access is required once at the start of acclimation at each site for fish delivery. Daily access could occur by small vehicle, foot, or snowmobile.

Proposed construction at the primary sites includes the excavation of one new pond, one new intake, excavation of accumulated material in two existing ponds and new wells at four sites. A total of 0.9 acres is expected to be disturbed by construction activities.

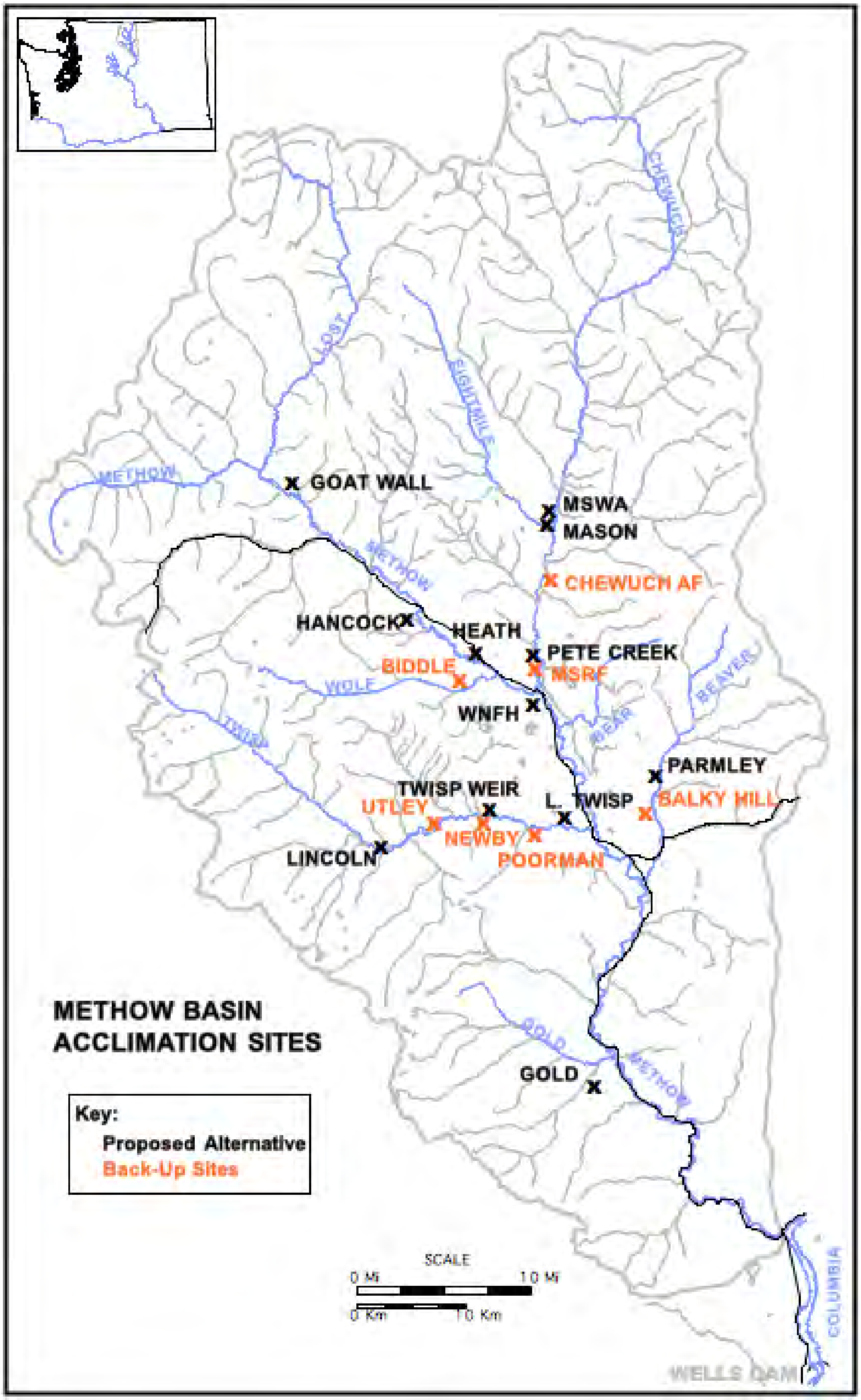

Figure 1-1. Methow Subbasin Acclimation Site Map

2. Site Details

2.1. Information Tables

The tables below include specific details for each proposed Methow acclimation site.

	GENERAL				LOCATION								LAND USE/ZONING					FLOOD
	Release (1,000s)	Overwinter	Adult trap	Previously used	Distance to Methow mouth (rkm)	Township	Range	Section	1/4 section	Elevation (m)	Latitude	Longitude	Zoning	Comprehensive Plan	Shoreline MP designation	Conservation Easement	Landuse	FEMA flood designations
Methow Acc.																		
MSWA (Eightmile)	88		W		99	36	21	24	NW	646	36'33"	09'46"	A20	FL	N	Y	Wildlife (public)	NM
Mason (Eightmile)	88	Y	W	Y	98	36	21	23	SE	652	36'18"	09'58"	R20	RL	N	Y	Vacation home	NM
Pete Creek	125		W		86	35	21	22	SE	570	30'57"	11'20"	R5	RM	RE		Rural estate	100 Yr
Goat Wall	50		W		112	36	19	9	SE	690	37'59"	28'03"	RR5	SUA	CE	Y	Rural residential	NM
Heath	100	Y	W		87	35	21	30	SW	557	30'10"	15'09"	RR5	SUA	RE	Y	Rural residential	100 Yr
Parmley	50		W		69	34	22	35	NE	711	24'28"	02'21"	A20	AL	ND		Vacation home	NM
Lincoln	110	Y	T		89	33	20	17	SE	710	21'12"	22'15"	R5	RM	N	Y	Farming/Conservation	100 Yr
Twisp Weir	110	Y	T		75	33	21	8	NW	609	22'49"	14'42"	R5	RM	N		Fish acclimation	100 Yr
Lower Twisp	30	Y	W	Y	66	33	22	18	NW	496	21'58"	08'09"	R5	RM	T		Wildlife	100 Yr
Gold	50		W		38	31	22	20	NW	470	10'47"	07'08"	R20	RL	ND		Rural Residential	NM
Winthrop NFH	100	Y	WH	Y	80	34	21	3	SE	530	28'24"	11'12"	R1	UGA	RE		Public hatchery	100 Yr
Adult Plants																		
Hancock			W		94	35	20	15	SE	590	32'02"	19'48"	RR5	SUA	CE		Ranching	100 Yr
Acc. Back-ups																		
Poorman	83		W		69	33	21	14	NW	540	22'07"	10'60"	R5	RM	N		Rural residential	100 Yr
Newby	83		T		76	33	21	8	NW	622	22'43"	15'9"	R5	RM	N		Rural residential	NM
Utley	83	Y	T		81	33	20	11	SE	664	22'18"	18'14"	R5	RM	N		Rural residential	100 Yr
Biddle	50		W	Y	86	35	21	32	SW	581	29'18"	14'47"	RR5	SUA	RE		Vacation home	NM
Balky Hill	50		W		66	33	22	2	SE	630	23'01"	02'55"	A20	AL	RE		Ranching	NM
Chewuch A.F.	125		W		93	36	21	2	NW	602	33'53"	10'33"	R5	RM	RE		Rural residential	None
MSRF - Chewuch	125	Y	W		85	35	21	27	NE	563	30'40"	11'17"	R5	RM	RE		Wildlife	100 Yr

Figure 2-1. General, Location, and Land Use Details

Key, Figure 2-1:

Release (thousands). The proposed peak number of coho smolts to be released during the Natural Production Implementation Phase.

Overwinter. Does the site have a reasonable potential for over-winter acclimation? This requires a source of groundwater and reliable access.

Adult Trap. The nearest downstream collection facility: W = Wells, T = Twisp Weir, WH = Winthrop NFH.

Previously used. Has the site been used by the coho reintroduction program in past years?

Distance to mouth (rkm). The distance from the mouth of the Wenatchee to the acclimation site in river kilometers.

Zoning. C= City, R1 = Rural 1 acre, R5 = Rural 5 acre, R20 = Rural 20 acre, RR5 = Rural residential 5, AG20 = Agriculture 20. Data from Okanogan County, 2009b.

Comprehensive Plan. SUA = Sub-Unit-A, RL = Rural Low, RM = Rural Medium, FL = Forest Lands, AL = Agricultural Lands, UGA = Urban Growth Area. Data from Okanogan County, 2009a.

Shoreline Master Plan Designation. CE = Conservancy Environment, NE = Natural Environment, N = None, RE = Rural Environment, T = Towns, ND = No Designation. Data from Okanogan County Shorelines Designations Map, 12/26/01.

Land use. The predominant use of land surrounding the acclimation site.

FEMA flood designation. 100 Yr. = 100 year floodplain, None = not in an identified flood zone, NM = not mapped. Data from FEMA, 2009.

	MISC		WATER			SURFACE WATER			GROUND WATER		SPACE						ACCLIMATION PONDS		
	Power	Road access	New water right	Water rqrt. (cfs)	Water available (cfs)	Surface stream name	New surface water intake	WDNR stream type	Overwinter tempering	GW needed (cfs)	Required space (cft/1000)	Required area (acre)	Existing space (cft/1000)	Existing pond area (acre)	New pond area added (acre)	Acclimation area/Existing pond area	Pond type	Free passage allowed	Pond confinement method
Methow Acc.																			
MSWA (Eightmile)	N	Unsurf.	G	1.4	0.5	Chewuck		F		1.8	18	0.14	84	0.64		22%	Existing side channel	Y	Seine
Mason (Eightmile)	1P	Unsurf.	G	1.4		Eightmile		F	Y	0.5	18	0.14	28	0.22		65%	Existing man-made	N	Screen
Pete Creek	3P	Surf.		1.9		Chewuck		F			26	0.20	30	0.23		87%	Existing side channel	Y	Seine
Goat Wall	N	Surf.		0.8		Cold		U			10	0.08	10	0.08		100%	Existing stream channel	Y	Seine
Heath	N	Unsurf.		1.5		Heath		F			21	0.16	95	0.72		22%	Existing man-made	Y	Seine
Parmley	1P	Surf.		0.8		Beaver		S			10	0.08	14	0.11		72%	Existing man-made	Y	Seine
Lincoln	1P	Unsurf.	G	1.7		Twisp		U	Y	2.6	23	0.18	41	0.31		57%	Existing side channel	Y	Seine
Twisp Weir	3P	Surf.	S,G	1.7		Twisp	Y	F	Y	0.5	23	0.18	0	0.00	23	0%	New pond	N	Screen
Lower Twisp	3P	Surf.	G	0.5		Twisp		U	Y	0.5	6	0.05	18	0.14		100%	Existing man-made	N	Barrier
Gold	1P	Unsurf.		0.8		S. Fork Gold		F			10	0.08	13	0.10		79%	Existing man-made	Y	Seine
Winthrop NFH	3P	Surf.		1.5		Methow		F			21	0.16	21	0.16		100%	Existing hatchery	N	Screen
Adult Plants																			
Hancock		Unsurf.				Hancock		F									None	Y	Pickets
Acc. Back-ups																			
Poorman		Unsurf.		1.4		Twisp		F			23	0.18	94	0.72		100%	Existing man-made	N	Barrier
Newby		Unsurf.	S	1.4		Newby	Y	F			23	0.18	0	0	23	0%	New pond	Y	Screen
Utley		Unsurf.		1.4		Spring		U			23	0.11	29	0.14		82%	Existing man-made	Y	Seine
Biddle		Unsurf.		0.8		Wolf		S			10	0.08	24	0.17		48%	Existing man-made	Y	Seine
Balky Hill		Surf.		0.8		Beaver					10	0.08	12	0.09		100%	Existing man-made	N	Barrier
Chewuch A.F.		Surf.		1.4		Chewuch		F			26	0.20	0	0.00	26	0%	New pond	N	Screen
MSRF Chewuck		Surf.	G	1.4		None		F	Y	1.4	26	0.20	0	0.00	26	0%	New pond	N	Screen

Figure 2-2. Water and Space Details

Key, Figure 2-2:

- Power. N = None, 1P = single phase, 3P = three phase.
- Road access. Asphalt surfaced or unsurfaced (gravel).
- New water right. G = new ground water right needed, S = new surface water right needed.
- Water requirement (cfs). Minimum water requirements for each site are based on a flow density of 9 pounds of fish per gallon/minute (flow density index of 1.5 lbs/gpm/inch). This is an average minimum value based on approximate springtime water temperatures and fish sizes. Actual flow rates would be higher to provide a safety margin, with the amount of margin depending on the reliability of the water supply at each site.
- Water available (cfs). The expected low flow during the acclimation period.
- Surface stream name. The name of the stream supplying water to the acclimation site.
- New surface water intake. Would a water intake structure need to be constructed?
- WDNR stream type. Washington Department of Natural Resources stream type designation, from FPARS ARCIMS viewer: http://fortress.wa.gov/dnr/app1/fpars/viewer.htm.
  - Type "S" = Shoreline. Streams and waterbodies that are designated “shorelines of the state”.
  - Type "F" = Fish. Streams and waterbodies that are known to be used by fish, or meet the physical criteria to be potentially used by fish.
  - U = Unknown
- Overwinter tempering. Is ground water needed to control ice formation on surface water intakes?
- New well construction. Would new wells need to be built to meet water requirements?
- GW needed (cfs).
- Required space (cft x 1000). Space requirements are calculated using 0.3 pounds of fish per cubic foot of water at sites (a volume index of 0.03 lbs/cft/inch). Sites that rely on pumped supplies without backup will require more space.
- Required pond area (acre). The pond area is calculated from the space requirement by assuming an average water depth of 3 ft.
- Existing space (cft x 1000). Space is calculated by multiplying the existing pond surface area by a 3 ft assumed average depth.

- Existing pond area (acre). The total existing pond area, actual area used may be less if seine nets are used.
- New pond area (acre). The amount of new area that is proposed to be added by expanding existing ponds or building new ones.
- Acclimation area/Existing pond area. The ratio of area that is proposed to be used by coho during the acclimation period to the existing pond area. The calculation is made only for existing pond area, if new pond area is built and blocked, the ratio is 0%. For barrier nets, 100% is blocked and for seine nets, some part of the existing area is blocked.
- Pond type.
- Free passage allowed. Does the presence of small ESA listed fish require that free up and downstream passage be allowed by the coho confinement net?
- Type of net. A barrier net (see section 2.2) confines coho and does not allow free passage of any fish past it during acclimation. A seine net encloses a portion of a pond and allows passage around it. The seine net separates coho and other fish species during acclimation.

	Plowing for fish delivery (ft)	New road construction (ft)	New intake construction	Removal Distance (ft)	New well	Existing well	Volume excavated (cft/1000) - new pond	Volume excavated (cft/1000) - existing pond	Surface disturbance (acre) - pond construction	Surface disturbance (sft) - water systems, open channel	Buried water pipeline (ft)	Buried power line (ft)	Total area disturbed (acre)	Period of operation (mo.)	Generators
Methow Acc.															
MSWA (Eightmile)	3,000				Yes					500		450	0.11	1.5	Yes
Mason (Eightmile)					Yes	Yes				250			0.01	5	Yes
Pete Creek														1.5	
Goat Wall														1.5	
Heath														1.5	
Parmley (Beaver)														1.5	
Lincoln	3,000				Yes			20		500	600	900	0.36	5	Yes
Twisp Weir		20	Yes	300	Yes		23		0.18	400	500	400	0.40	5	Yes
Lower Twisp						Yes								5	
Gold								5						1.5	
Winthrop NFH														5	
Adult Plants															
Hancock														2	
Acc. Back-ups															
Poorman (Twisp)														1.5	
Newby			Yes	220			23		0.18	400	350		0.27	1.5	
Utley	1,200									800				1.5	
Biddle (Wolf)														1.5	
Balky Hill														1.5	
Chewuch A.F.					Yes	Yes	26		0.20		300	50	0.28	1.5	
MSRF Chewuch					Yes		26		0.20	1,000		100	0.25	5	Yes
TOTALS-PRIMARY	6,000	20	1	300	4	2	23	25	0.18	1,650	1,100	1,750	0.88	36	4
TOTALS-BACK-UP	1,200	-	1	220	2	1	75	-	0.58	2,200	650	150	0.80	14	1

Figure 2-3. Construction and Operation Impacts

Key, Figure 2-3:

- Plowing. Roads at some sites would require snow removal at least once per season to allow fish transport trucks to access acclimation ponds.
- New well. Some sites would require that new wells be drilled and developed.
- Surface disturbance – pond construction. The area permanently impacted by new pond construction. This does not include the surface area temporarily impacted by fill deposition.
- Surface disturbance – water systems, open channels. Water would be delivered to and discharged from some ponds in rock-lined channels.
- Buried water pipeline. Underground piping would deliver water to some ponds.

- Generator. Main or back-up power would be provided by electrical generators with automatic transfer switches. At locations where generators are the main source of power, two generators are proposed.

Winthrop NFH is an existing facility and no changes are proposed by the MCCRP. The environmental impacts of the facility operation have been reviewed through past permitting processes.

These details are approximate and are based on schematic designs. They are for the purpose of evaluating potential environmental impacts.

2.2. Net Confinement Systems

Net systems would be used to confine coho during the acclimation period at most sites. They would be configured in one of two ways. Where loss of habitat and/or coho interaction with listed fish species is not expected to have negative impacts, the nets fully block fish passage in the ponds - **barrier** nets. They would be placed perpendicular to the flow (see the figure below).

Figure 2-4. Barrier Net Example

Where impacts may be significant and free passage of fish up and downstream is required, the nets would form an enclosed impoundment - **seine** nets - of only a portion of the pond.

Figure 2-5. Seine Net Example

In both cases the net systems are temporary and are in place only during acclimation. They will be designed to minimize premature escape and will include jump barriers and double lead lines (see below).

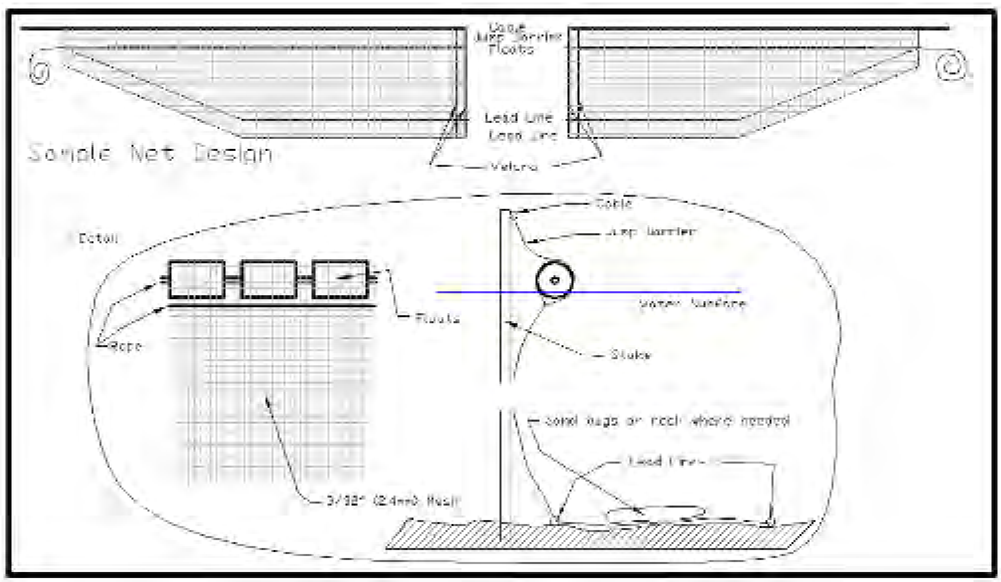

Figure 2-6. Example Net System Designs

2.3. Other Site Design Features

Water effluent treatment systems outside of the acclimation ponds themselves are not planned for the natural sites. Relatively small numbers of fish would be held at low densities in large ponds at these locations. The minimum retention time for water flowing through the pond will be 2.5 hours and in most cases will be much longer than this. Fish waste will settle at low densities in the ponds and will be effectively treated during the long periods of time through the summer and fall when coho are not being acclimated.

The ponds are relatively effective at limiting the amount of Total Phosphorous (TP) being discharged into receiving waters. Fish feed rates and the amount of TP in the feed are known, along with the amount of TP leaving the pond in the discharge water (see Appendix 6) and in the fish. This data was used to perform the calculation below that estimates that over 75% of the TP fed was not discharged from the two of the acclimation ponds in 2009.

Rohlfing - 2009

	# of Fish	Fish Size	Total Fish Weight	Fish Feed Rate	TP Feed Rate	P not absorbed by fish
		grams	*grams*	*grams/day*	*grams/day*	*g/day*
Start	101,000	20.1	2,028,938	20,289	288	176
End	101,000	28.0	2,830,494	28,305	402	245

Average rate that TP added to pond (after fish absorbtion):	210	grams/day
Number of days of acclimation	56	days
Total TP not removed by fish through the acclimation season:	11,786	grams
TP load rate exiting pond as determined by measurement (see Section 3.2.1.1):	37.5	grams/day
Total TP exiting pond as determined by measurment:	2,100	grams
Pond P removal efficiency:	82%	

Butcher - 2009

	# of Fish	Fish Size	Total Fish Weight	Fish Feed Rate	TP Feed Rate	P not absorbed by fish
		grams	*grams*	*grams/day*	*grams/day*	*g/day*
Start	136,700	20.1	2,746,097	27,461	390	238
End	136,700	27.2	3,716,275	37,163	528	322

Average rate that TP added to pond (after fish absorbtion):	280	grams/day
Number of days of acclimation	57	days
Total TP not removed by fish through the acclimation season:	15,674	grams
TP load rate exiting pond as determined by measurement (see Section 3.2.3.1):	52.0	grams/day
Total TP exiting pond as determined by measurment:	2,964	grams
Pond P removal efficiency:	81%	

Spreadsheet Inputs	**Value**	**Source**
Fish feed rate (gram feed/gram fish/day)	1.0%	Silver Cup Feeds
Concentration of P in fish feed	1.42%	Skretting Nutra Fry diet
Amount of P in feed absorbed by fish	39%	From Flimlin, G. Sugiura, S., and Ferraris, P. 2003

Figure 2-7. Pond Phosphorous Removal Efficiency

Avian and mammalian predation is a major consideration for remote acclimation sites. At some locations, physical barriers may be installed if predation becomes severe. Temporary fencing and overhead bird netting may be necessary. Deterrence of predation through human presence has been used effectively at sites currently operated by the MCCRP as well as at federal and state hatcheries; this technique would be employed at most locations.

Many of the ponds at proposed sites could become inundated during major floods. Because spring is the natural migration period, the unplanned release of fish during snowmelt floods would be allowed and no special flood control measures would be taken.

3. Site Descriptions – Primary, With Construction

Construction is proposed to involve the creation of new ponds and excavation of accumulated material in some existing ponds. The ponds have natural bottoms and construction would include the removal of cut and the spreading and revegetation of fill. Fill areas have not been located, but material would be spread where environmental impacts are minimized under the conditions of construction permits.

Wells would be drilled to supply water to several sites. They would be located where high yields are most likely, near power sources, and where disturbance to existing vegetation is minimized. Water would be delivered from the wells to the ponds in buried pipelines and in rock-lined channels that will re-aerate the ground water. Generators would provide both primary and back-up power to well pumps. They will be sized after well tests determine pump motor requirements.

North is up in all the following aerial photos, drawings, and maps unless otherwise denoted.

3.1. MSWA Eightmile

This site is an existing, disconnected side channel on the Chewuch River. It is the farthest upstream site that is easily accessible in the late winter on the Chewuch.

- Location: Upstream of the mouth of Eightmile creek in an area of potential mainstem coho spawning habitat.
- Surface water supply: Seepage through the side channel provides some flow (less than ½ cfs).
- Ground water supply: A well is proposed near the side channel on private land to supplement the existing surface flow.
- Acclimation space: The full side channel measures approximately 400’ x 70’.
- Confinement system: A temporary seine-style net would be placed in the side channel that would allow continued use of most of the channel and full passage

by other fish species. The net would be removed at release. The area near the arrow in the aerial photo below is proposed for acclimation.

- Land use: The side channel is part of the MSWA owned by the Washington Department of Fish and Wildlife (WDFW) and managed for wildlife conservation and public recreation.
- Access: Winter plowing stops ½ mile from the site on the West Chewuch River Road. Access to the side channel from the road is another 1,000' on an unsurfaced MSWA road.
- Construction: A well would be drilled just east of the side channel on private property. A rock lined open channel from the well to the side channel would deliver water while aerating it. A generator would be required to power the well pump. The soil materials in the area are Boesel fine sandy loam (NRCS, 2009).

Figure 3-1. MSWA and Mason Aerial

Figure 3-2. MSWA Side Channel

3.2. Mason (Eightmile)

The Mason site was used in 1998 for coho acclimation. It consists of three man-made ponds in series fed by water from an irrigation intake.

- Location: Near the mouth of Eightmile Creek.
- Surface water supply: An irrigation diversion on Eightmile Creek.
- Ground water supply: A domestic well exists near the ponds. Aquifer conditions may be favorable for developing more ground water.
- Acclimation space: The lowest pond measures 100' x 30', the second pond measures 70' x 40', and the third pond measures 80' by 45'.
- Confinement system: The ponds have fish proof outlet screens and natural origin fish are prevented from entering the pond system by the irrigation fish screens at the diversion intake.
- Land use: A vacation home is located adjacent to the ponds.
- Access: Winter plowing stops on the West Chewuch River Road at the site.
- Construction: A new well may be constructed to supplement Eightmile Creek water. Water would be delivered to the ponds through a rock-lined channel.

Figure 3-3. Mason Ponds

3.3. Lincoln

Two ponds are connected in series adjacent to the Methow River. A rock gabion berm separates the ponds from the river. The property includes a conservation easement, purchased by the Methow Conservancy, which divides the land into several zones. The acclimation pond and one well are proposed in the conservation zone.

- Location: Relatively high in the Twisp system, in potential coho spawning habitat and above the Twisp weir. Adults returning to the Lincoln site can potentially be captured for broodstock and for management purposes in general at the weir.
- Surface water supply: A perched culvert supplies water to the ponds at Twisp River flows greater than 200 cfs.
- Ground water supply: New drilled wells would provide ground water when the existing culvert is not flowing. Two wells would be constructed near the ponds approximately 400' apart. Water from Well 2 would be piped to Well 1 in a buried line located under an existing road. Water from both wells would be delivered to the upper pond through an open, rock-lined channel.
- Power supply. Line power and back-up generators would be needed to power the pumps. Buried lines in the existing road would deliver power from the service entrance and generators to the well pumps.
- Acclimation space: The existing Pond 2. The pond has silt, sand, gravel, and rock deposits that would be excavated to provide adequate water depths for acclimation. Approximately 10,000 cft of material is proposed to be removed.
- Enclosure system: A seine net in the pond.
- Land use: A rural home and farm are adjacent to the ponds.
- Access: The Twisp River Road is plowed in the winter to within 1/2 mile of the Lincoln site.

- Soils: Boesel fine sandy loam (NRCS, 2009).
- Construction: New wells may be drilled, water and electrical pipelines buried, the pond excavated, and generators installed.

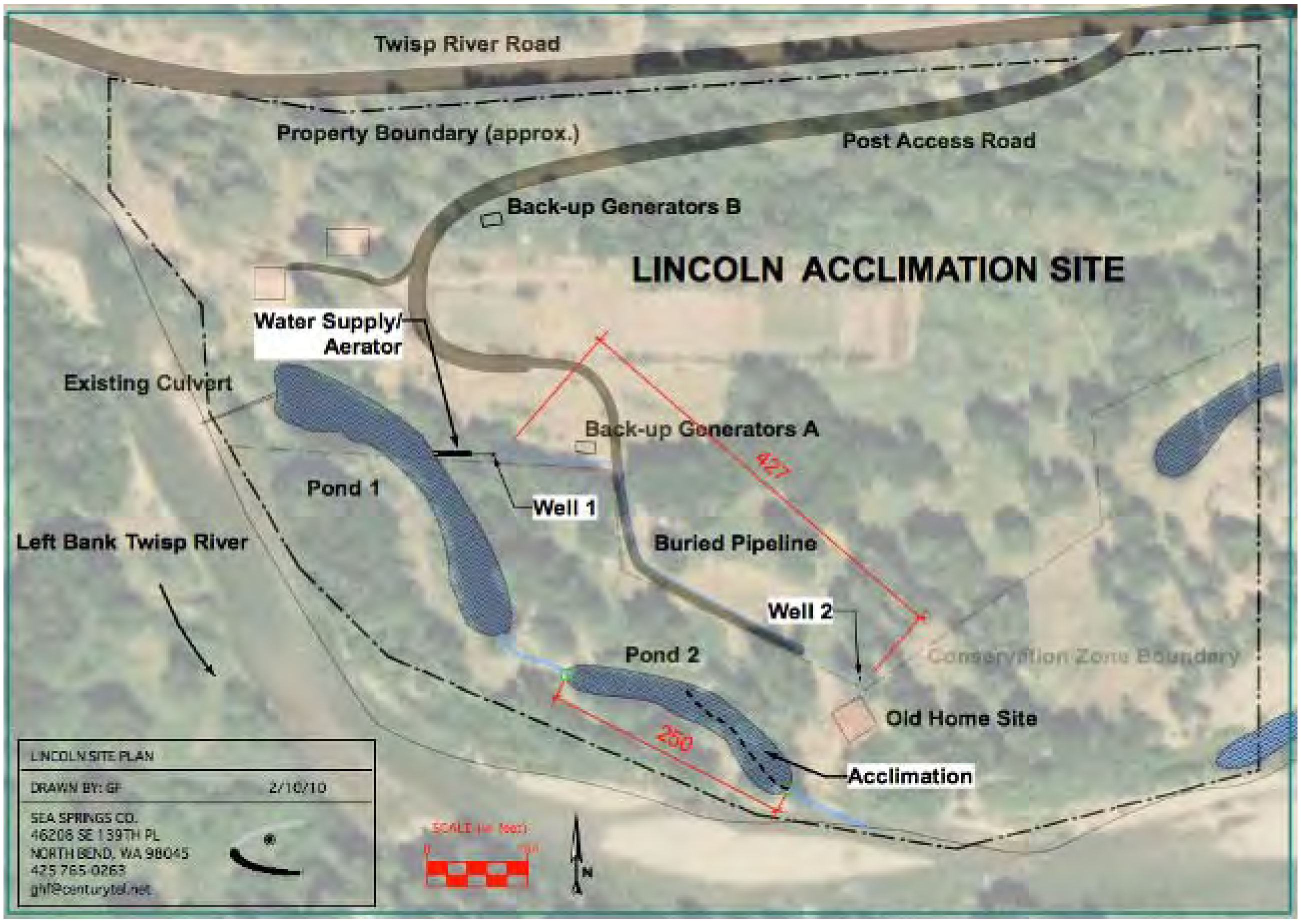

Figure 3-4. Lincoln Site Plan

Figure 3-5. Lincoln Pond 2

3.4. Twisp Weir

The Twisp Acclimation Facility has an existing pond operated by WDFW for spring Chinook acclimation. The pond is fed by Twisp River water diverted from an irrigation intake. It is proposed that a separate coho pond be constructed adjacent to the existing facility.

- Location: At the Twisp weir. Fish would be released upstream of the weir.
- Surface water supply: An upstream irrigation system diverts water from the Twisp into a ditch. A new intake, fish screen, and pipeline will remove water from the irrigation ditch and direct it to the coho pond. Another buried pipeline will return water to the Twisp. Water would be removed from the river 300 ft upstream of the point where it is returned.
- Ground water supply: Wells are proposed to be dug near the Twisp shoreline.
- Acclimation space: A 140 ft long, 50 ft wide, 3.5 ft deep, constructed, earthen pond, occupying approximately 0.2 acres. The pond will have a screened outlet structure to confine fish during acclimation.
- Confinement system: The ponds would have fish proof inlet and outlet screens.
- Land use: Part of the site is occupied by the Twisp Acclimation Facility and part is rural residential.
- Access: Roads to the site are plowed all winter.
- Soils: Boesel fine sandy loam (NRCS, 2009).
- Construction: An intake will be constructed, a pond excavated, and pipelines buried. Because the pond will be below existing grade and material will be removed from the flood plain, pond construction will increase flood storage capacity.

Figure 3-6. Twisp Weir Draft Site Plan

Figure 3-7. Twisp Weir Site

3.5. Gold

A series of small man-made ponds were dug adjacent to South Fork gold Creek.

- Location: Near the mouth of South Fork Gold Creek, in potential coho spawning habitat.
- Surface water supply: An unscreened diversion on South Fork Gold Creek.
- Ground water supply: None.
- Acclimation space: The existing ponds. They have silt, sand, and gravel deposits that would be excavated to provide adequate water depths for acclimation. Approximately 7,000 cft of material is proposed to be removed.
- Enclosure system: Seine nets in the ponds.
- Land use: Several residences are adjacent to the ponds.
- Construction: Silt, gravel, and rock that have accumulated in the ponds would be removed to increase effective rearing area.

Figure 3-8. Gold Aerial

Figure 3-9. Gold Ponds

4. Site Descriptions – Primary, No Construction

The sites listed below would require no construction activities that result in earth-moving activities or permanent changes. Existing ponds and water supplies would be used for acclimation.

4.1. Goat Wall

A disconnected side channel system on the Methow includes a pond near the mouth.

- Location: Downstream of the mouth of the Lost River. The site is in the river reach that periodically has no surface flow during some fall and winter months. The ability of coho to manage this flow regime will be carefully evaluated before and during test releases from this site.
- Surface water supply: Water from the adjacent Gate Creek is diverted into the pond.
- Ground water supply: Natural ground water seepage (Cold Creek) through the side channel provides flow at high Methow river levels.
- Acclimation space: A natural, existing pond formed in the cold Creek channel.
- Enclosure system: A temporary seine net system.
- Land use: A residence is adjacent to the pond.
- Access: The Lost River road is plowed in the winter.

Figure 4-1. Goat Wall Aerial

Figure 4-2. Goat Wall Pond

4.2. Pete Creek

Several ponds are part of a Methow River disconnected side channel system.

- Location: Returning adults from this site in the lower Methow would distribute to nearby tributary streams, and the mainstem Methow. Some spawning may occur in the discharge channel.
- Surface water supply: Future Methow Salmon Recovery Foundation plans call for reconnecting the side channel, which would result in Methow River water flowing through the acclimation pond. Pete Creek, a seasonal stream flows into the system and it may also be possible to deliver Twisp River irrigation water to the pond.
- Ground water supply: Natural ground water seepage through the side channel provides approximately 0.5 cfs of flow.
- Acclimation space: A natural pond.
- Enclosure system: A temporary seine net system would allow passage by other fish species in the side channel system.
- Land use: A large, rural estate with a 9-hole golf course is adjacent to the side channel complex.
- Access: 800' of gravel road provides access from the West Chewuch River Road.

Figure 4-3. Pete Creek Aerial

Figure 4-4. Pete Creek Photo

4.3. Heath

A series of large springs originate in the Methow valley floor. Ponds were constructed in the past to impound this water for irrigation purposes. Habitat restoration efforts are underway to provide fish passage into and past the ponds. The spring channels may provide the low gradient, small stream, spawning habitat preferred by coho and completion of the restoration work will allow access to more of this habitat.

- Location: The pond proposed for coho acclimation is the lowest in the Heath springs complex. The general site location is downstream of the section of the Methow that periodically de-waters. Returning adults would distribute to nearby small tributaries, the mainstem, and return to the Heath springs.
- Ground water supply: All the flow in the proposed acclimation pond consists of spring water.
- Acclimation space: The pond measures approximately 450’ x 70’.
- Enclosure system: A temporary seine net system would allow passage by other fish species in the spring system.
- Land use: The pond is on rural residential land. The adjacent upstream property is owned by WDFW; the Big Valley Unit of the Methow Valley Wildlife Area is managed for riparian habitat protection and wildlife conservation.
- Access: 800’ of existing gravel road provides access from SR 20.

Figure 4-5. Heath Aerial

Figure 4-6. Heath Pond

4.4. Parmley

A farm pond was dug in the past, adjacent to Beaver Creek.

- Location: Upper Beaver Creek, in potential coho spawning habitat.
- Surface water supply: An unscreened diversion on Beaver Creek.
- Ground water supply: None.
- Acclimation space: The 80' diameter, existing pond.
- Enclosure system: A seine net system.
- Land use: A rural vacation home overlooks the pond.
- Access: The Beaver Creek road provides reliable year round access.

Figure 4-7. Parmley Aerial

Figure 4-8. Parmley Pond

4.5. Lower Twisp

The Methow Salmon Recovery Foundation owned site includes several ponds in series, some of which are used for steelhead acclimation. The lowest pond in the series was used for coho acclimation starting in 2009.

- Location: The lower Twisp River.
- Surface water supply: An unscreened intake on the Twisp provides a controllable amount of water to the ponds.
- Ground water supply: An existing well can be used a back-up supply and as winter tempering water.
- Acclimation space: Coho are acclimated in the lowest pond, downstream of steelhead.
- Confinement system: A temporary barrier net is placed across the pond near the exit.
- Land use: The property is managed for salmon recovery purposes.
- Access: The Twisp River road provides reliable year-round access.

Figure 4-9. Lower Twisp Aerial

Figure 4-10. Lower Twisp Pond

4.6. Hancock

A large spring originates 1.3 km from the Methow River. Recent Yakama Nation restoration projects have replaced a road culvert, improved fencing, added woody debris, and improved flow patterns in the spring channel. It is now more accessible to salmonids and has habitat that should be attractive to spawning coho. Adult plants in the spring channel are proposed.

- Location: Upstream of Winthrop in an area where steelhead and Chinook now spawn.
- Ground water supply: Hancock Spring has the relatively stable temperature and flow patterns typical of other springs.
- Enclosure system: A temporary rack in the spring channel would hold adults while redds are constructed and spawning occurs. The rack is proposed to be pre-assembled and installed in early October. It would be held in place with sand bags and rock (see diagram below) and removed in mid-November each year.
- Land use: Farming.
- Access: The Wolf Creek road provides good access to an area near the spring mouth.

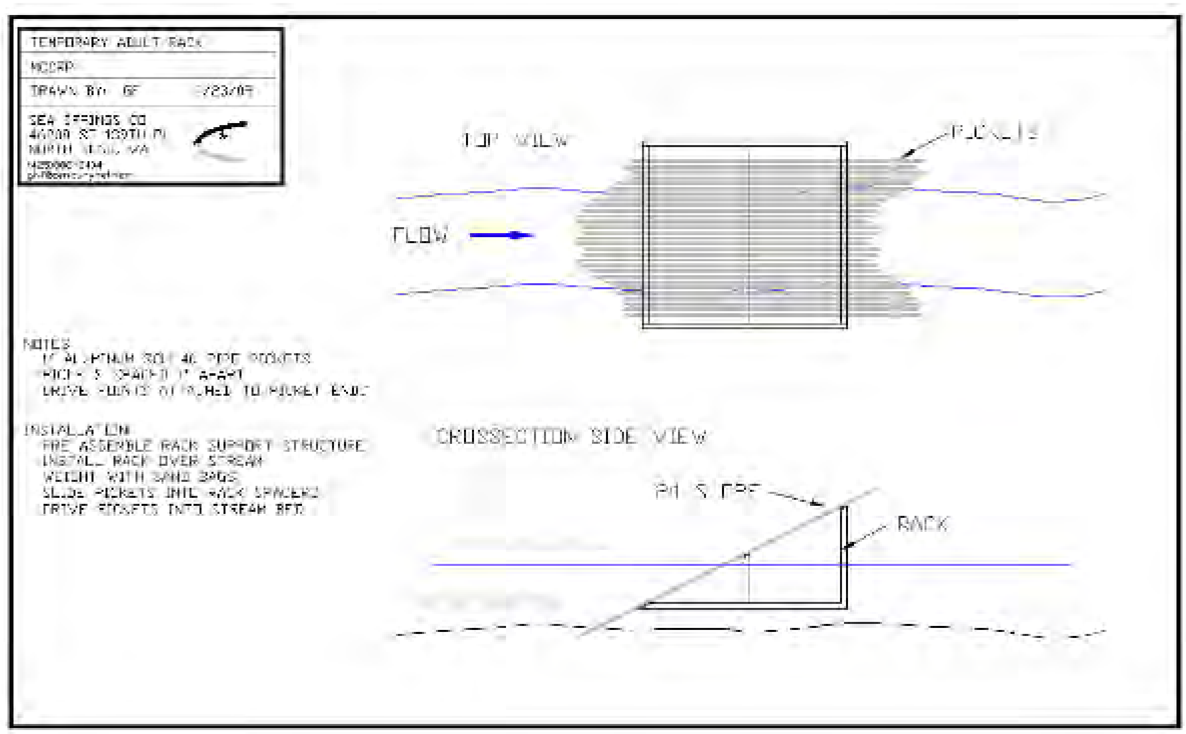

Figure 4-11. Sample Adult Barrier

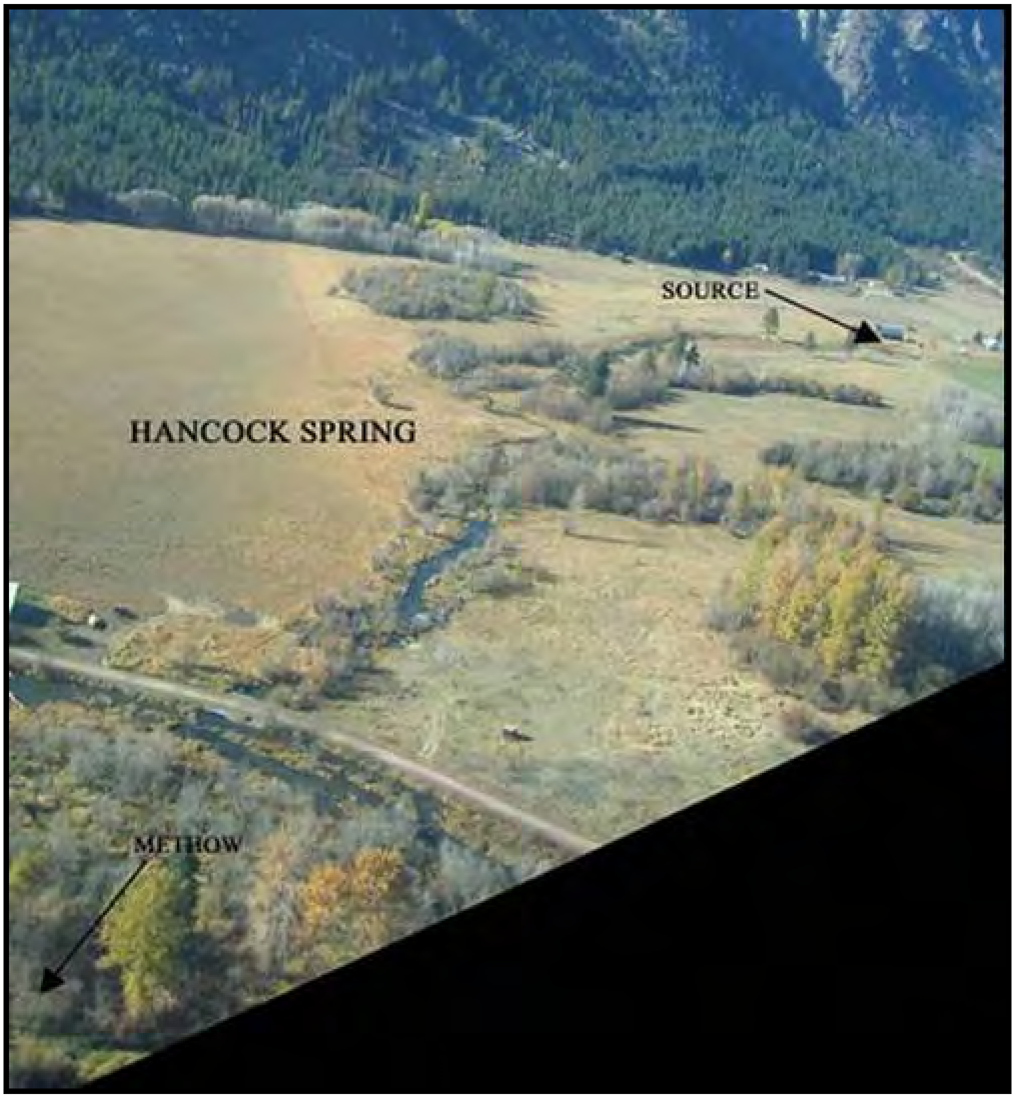

Figure 4-12. Hancock Spring Aerial

Figure 4-13. Hancock Spring

4.7. Winthrop NFH

The Winthrop NFH is operated by the US Fish and Wildlife Service. Production goals are established by the Columbia River Fisheries Management Plan and include commitments in support of tribal trust responsibilities.

- Location: Returning adults from this site in the Methow near Winthrop would distribute to nearby tributary streams, and the mainstem Methow. Adults returning to the hatchery can be trapped and used for broodstock.
- Surface water supply: Surface water is diverted from the Methow and delivered to the hatchery in an irrigation channel.
- Ground water supply: Infiltration galleries.
- Acclimation space: A pond formed in the hatchery back channel.
- Enclosure system: Fish screens in fixed outlet structures confine smolts.
- Land use: A large, public hatchery.

Figure 4-14. Winthrop NFH Aerial

Figure 4-15. Winthrop NFH Back Channel

5. Site Descriptions – Back-up, With Construction

5.1. MSRF Chewuch

The Methow Salmon Recovery Foundation (MSRF) owns a site on the lower Chewuch River that includes an existing well.

- Location: Returning adults from this site in the lower Chewuch River would distribute to nearby tributary streams, and the mainstem Chewuch River.
- Surface water supply: There is no surface water supply.
- Ground water supply: The existing well would be developed and would be the main water source. If pump tests determine that the well will not produce the required flow, another well would be built.
- Acclimation space: A 150 ft long, 50 ft wide, 3.5 ft deep, constructed, earthen pond (see figure below), occupying approximately 0.2 acres.
- Enclosure system: The pond would include outlet structures with removable screens.
- Land use: The MSRF mission is to enhance and preserve salmon habitat.
- Access: The West Chewuch road provides reliable year round access.
- Construction: A new pond would be required, along with a rock lined channel delivering water from the well(s) and another discharging water to the Methow. A back-up generator would also need to be installed on the site. The pond would be constructed by excavating material from a flat area near the creek. Because the pond will be below existing grade and material will be removed from the flood plain, pond construction will increase flood storage capacity.

Figure 5-1. MSRF Chewuch Site Plan

Figure 5-2. MSRF Chewuch Pond Site

5.2. Chewuch AF

The Chewuch Acclimation Facility (AF) is an existing pond operated by WDFW for spring Chinook acclimation. The pond is fed by Chewuch River water diverted from an irrigation intake. It is proposed that a separate coho pond be constructed downstream of the existing facility.

- Location: At the Eastside Chewuch road bridge midway between the Eightmile sites and the Lower Chewuch/Pete Creek Pond sites.
- Surface water supply: An irrigation diversion on the Chewuch River.
- Ground water supply: None.
- Acclimation space: A 150 ft long, 50 ft wide, 3.5 ft deep, constructed, earthen pond, occupying approximately 0.2 acres.
- Confinement system: The ponds would have fish proof outlet screens and natural origin fish are prevented from entering the pond system by screens on the diversion intake.
- Land use: A trailer park exists on the land proposed for pond construction.
- Access: Roads to the site are plowed all winter.
- Construction: An earthen bottom pond is proposed for the site. Water delivery pipelines from the fish screens on the irrigation intake to the pond and from the pond back to the river would also be installed. The pond is proposed to be constructed by excavating material from flat ground in the trailer park. Because the pond will be below existing grade and material will be removed from the flood plain, pond construction will increase flood storage capacity. The soils in the area are Winthrop loamy sand (NRCS, 2009).

Figure 5-3. Chewuch AF Site Plan

Figure 5-4. Chewuch AF

5.3. Utley

A large pond fed by spring water adjacent to the Twisp River.

- Location: The Utley pond is 6 km upstream of the Twisp weir. It would be used as a backup if the primary Twisp sites are not used.
- Water supply: Spring water that originates in the pond.
- Acclimation space: A large, natural pond.
- Enclosure system: A temporary seine net system or outlet structures with fish screens would confine coho during acclimation.
- Land use: A rural home is adjacent to the ponds.
- Access: The Twisp River road is plowed and there is a 1,200 ft gravel road from it to the pond.
- Construction: A 80 ft long, 3 ft wide channel from the pond to the Twisp is proposed to allow released smolts access to the Twisp River. The pond currently drains into a large swampy area and there is no direct return to the river.

Figure 5-5. Utley Site Plan

Figure 5-6. Utley Ponds

5.4. Newby

Newby is a high gradient, small tributary to the Twisp.

- Location: Newby Creek will be inaccessible to coho adults. Returnees would distribute to nearby tributary streams and the mainstem Twisp. The site is just upstream of the Twisp trap, which could be used to capture adults released from the site.
- Surface water supply: An intake constructed on Newby Creek.
- Acclimation space: A 140 ft long, 50 ft wide, 3.5 ft deep, constructed, earthen pond (see figure below), occupying approximately 0.2 acres. The pond will have a screened outlet structure to confine fish during acclimation.
- Enclosure system: The pond would include outlet structures with removable screens. The water intake system would prevent fish from entering the pond.
- Land use: The site is recreation property.
- Access: The Twisp River Road and the Newby Creek Road are plowed during winter.
- Soils: Sandy loam (NRCS, 2009).
- Construction: An earthen bottom pond and an intake on Newby Creek are proposed for the site. Buried water delivery pipelines from the intake to the pond and from the pond back to the river would also be installed. The intake would be located just upstream of a road culvert and water would be withdrawn from Newby for a distance of 220 ft.

Figure 5-7. Newby Site Plan

Figure 5-8. Newby

6. Site Descriptions –Back-up, No Construction

6.1. Poorman

Four large ponds were constructed on private land in the Twisp River valley.

- Location: Poorman is 3.4 kilometers upstream of the Lower Twisp ponds on the Twisp River. It would be used as a backup if the primary Twisp sites are not used.
- Surface water supply: Twisp River water is diverted from an irrigation intake to the ponds.
- Ground water supply: None.
- Acclimation space: Large, natural ponds.
- Enclosure system: A temporary seine net system or outlet structures with fish screens would confine coho during acclimation.
- Land use: A rural home is adjacent to the ponds.
- Access: The Twisp River road is plowed.

Figure 6-1. Poorman Ponds

6.2. Biddle

Two existing ponds are fed by a creek diversion.

- Location: Wolf Creek, in the relatively high gradient lower reach.

- Surface water supply: A diversion on Wolf Creek.
- Ground water supply: None.
- Acclimation space: One of the two existing ponds.
- Enclosure system: An outlet structure in the pond with removable screens.
- Land use: A rural vacation home overlooks the pond.
- Access: The Wolf Creek road provides reliable year round access.

Figure 6-2. Lower Biddle Pond

6.3.   Balky Hill

A pond fed by groundwater was built in the past on farm property.

- Location: Balky Hill pond is on Beaver Creek. It would be used as a backup if the Parmley site is not used.
- Surface water supply: None.
- Ground water supply: Spring water collects at the base of a hill and flows into the pond.
- Acclimation space: One earthen pond.
- Enclosure system: A temporary barrier net would prevent premature coho migration.
- Land use: A farm is adjacent to the ponds.
- Access: The Beaver Creek road is plowed.

Figure 6-3. Balky Hill Pond

6.4. Other

Acclimation and release of coho at existing and planned facilities that are developed for other species may be considered in the future. Mixing coho with spring Chinook and or steelhead, or acclimating in separate rearing units on the same site, may be possible.

Areas where ponds do not currently exist and where pond construction is not possible may be targeted for adult plants. Procedures would be similar to those described for Hancock above, using a temporary adult weir to confine fish to targeted areas during spawning.

7. References

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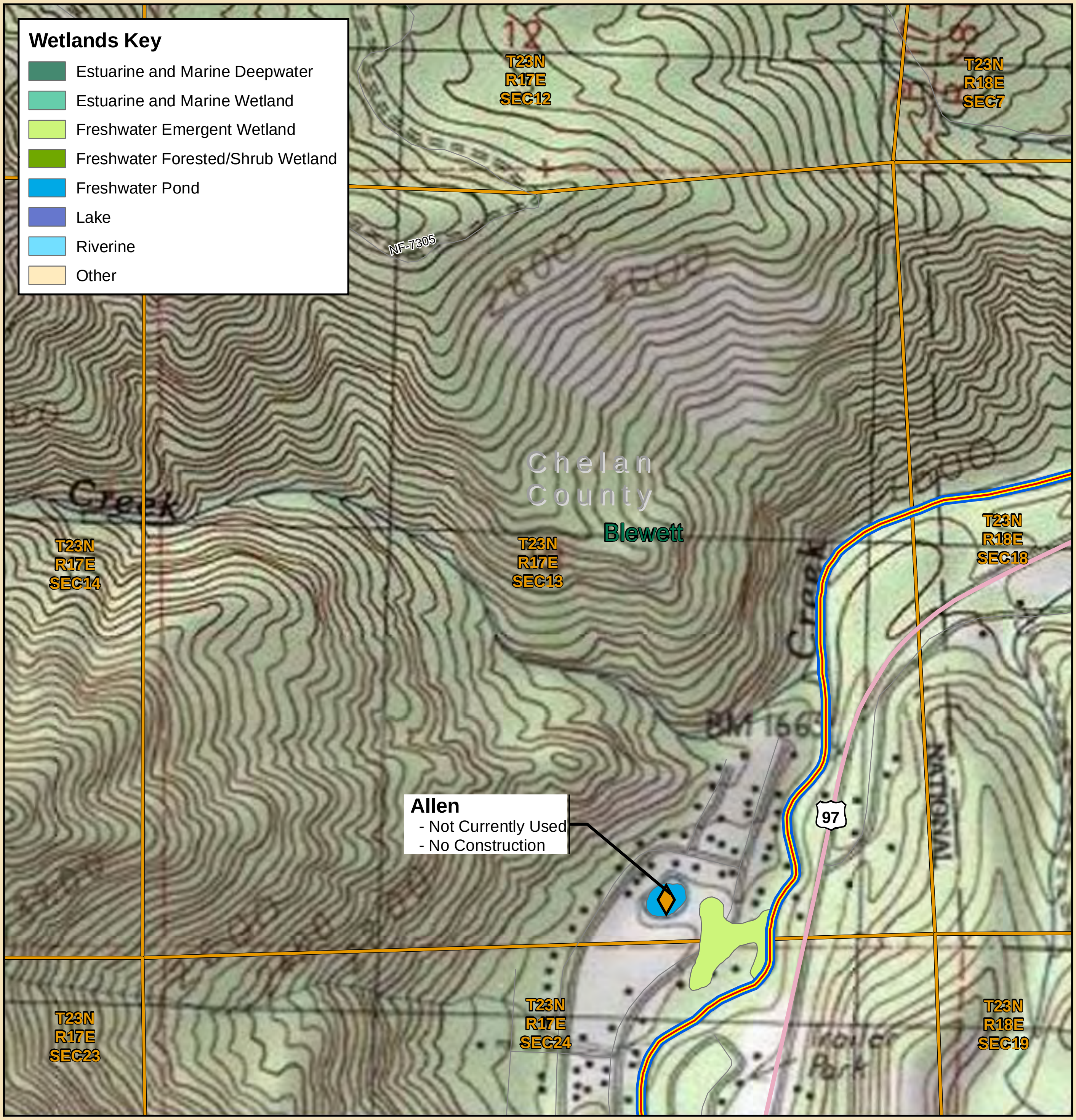


Figure 10a - Allen

Blewett Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

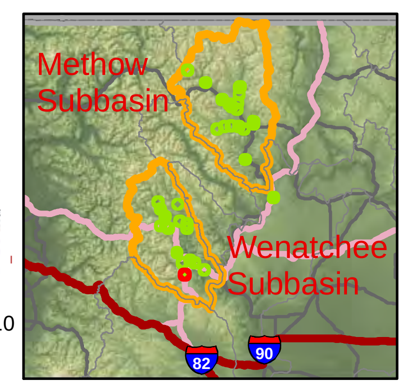
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE

November 1, 2010

0 500 1,000 2,000 Feet



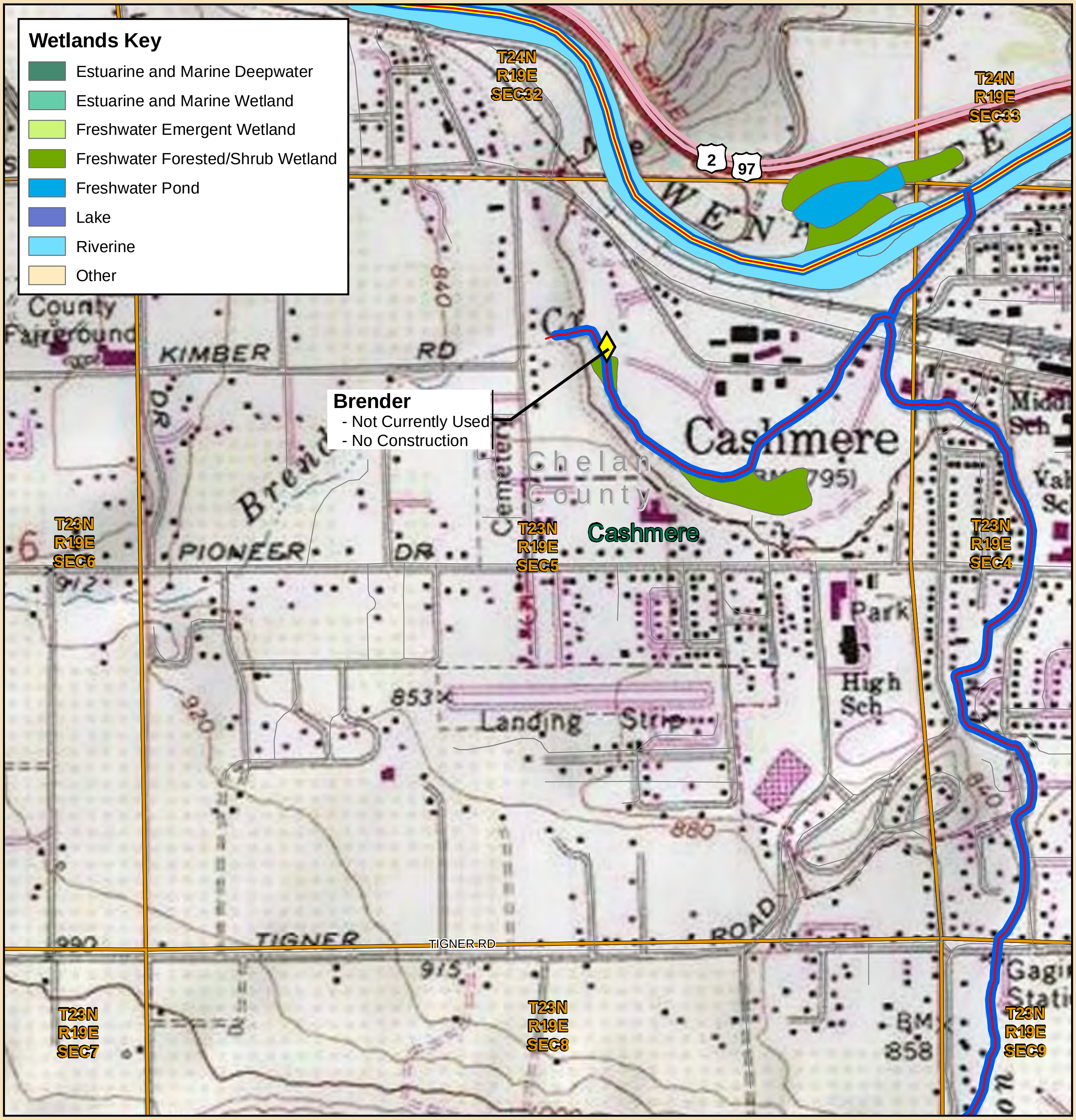


Figure 10b - Brender

Cashmere Quadrangle

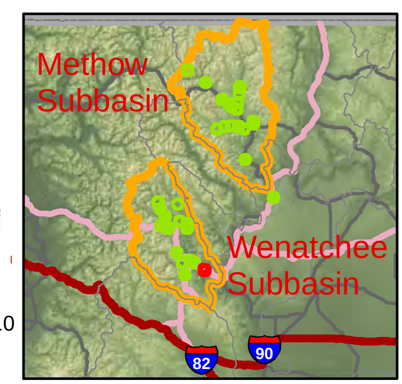
Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



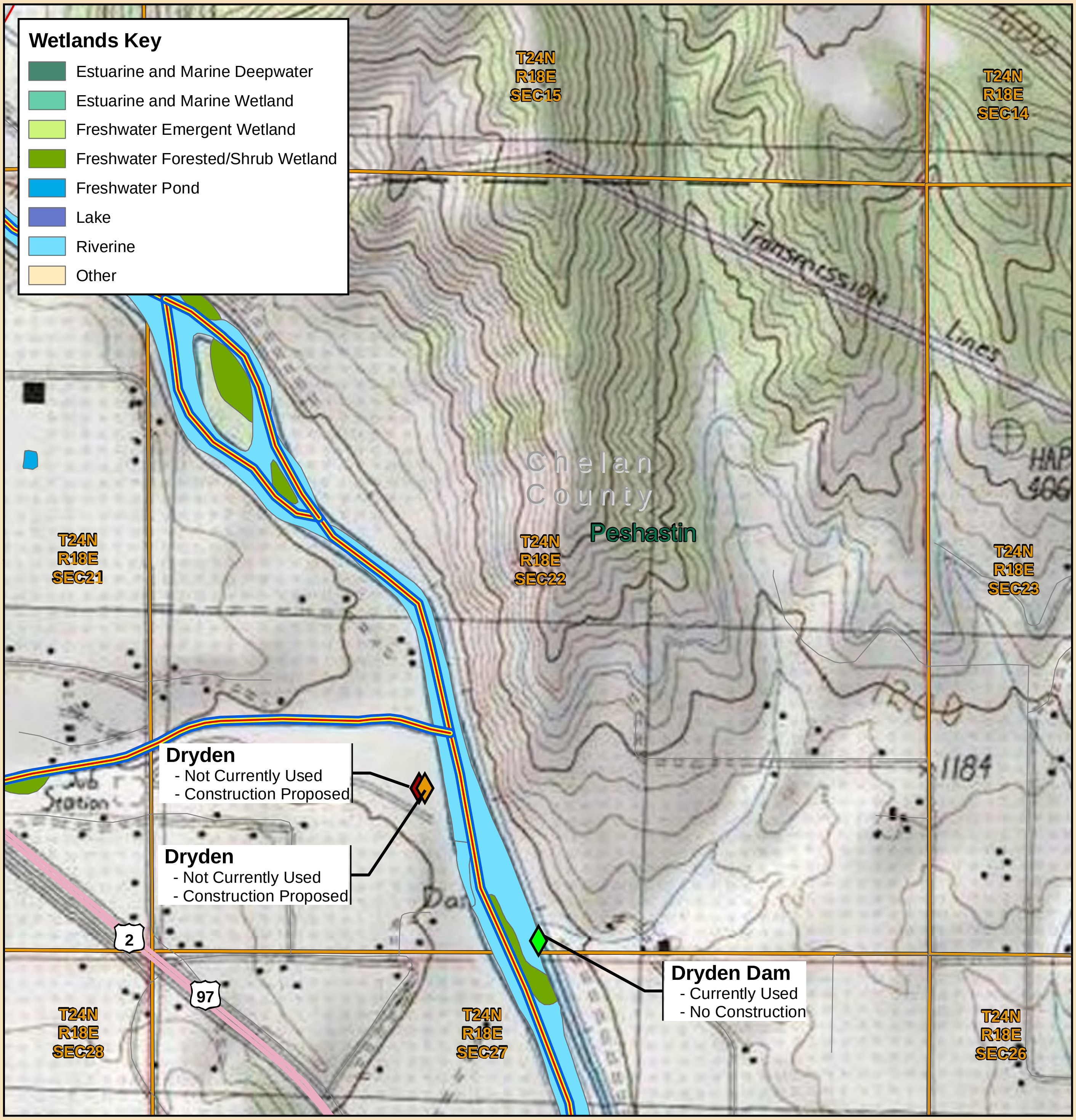


Figure 10c - Dryden and Dryden Dam

Peshastin Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

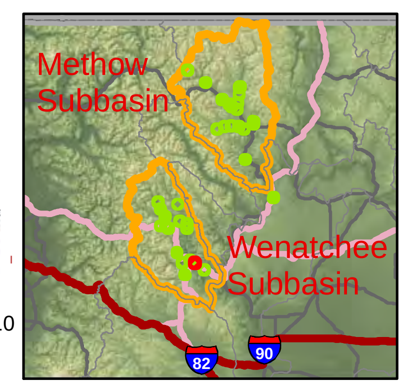
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE POWER ADMINISTRATION

November 1, 2010

0 500 1,000 2,000 Feet



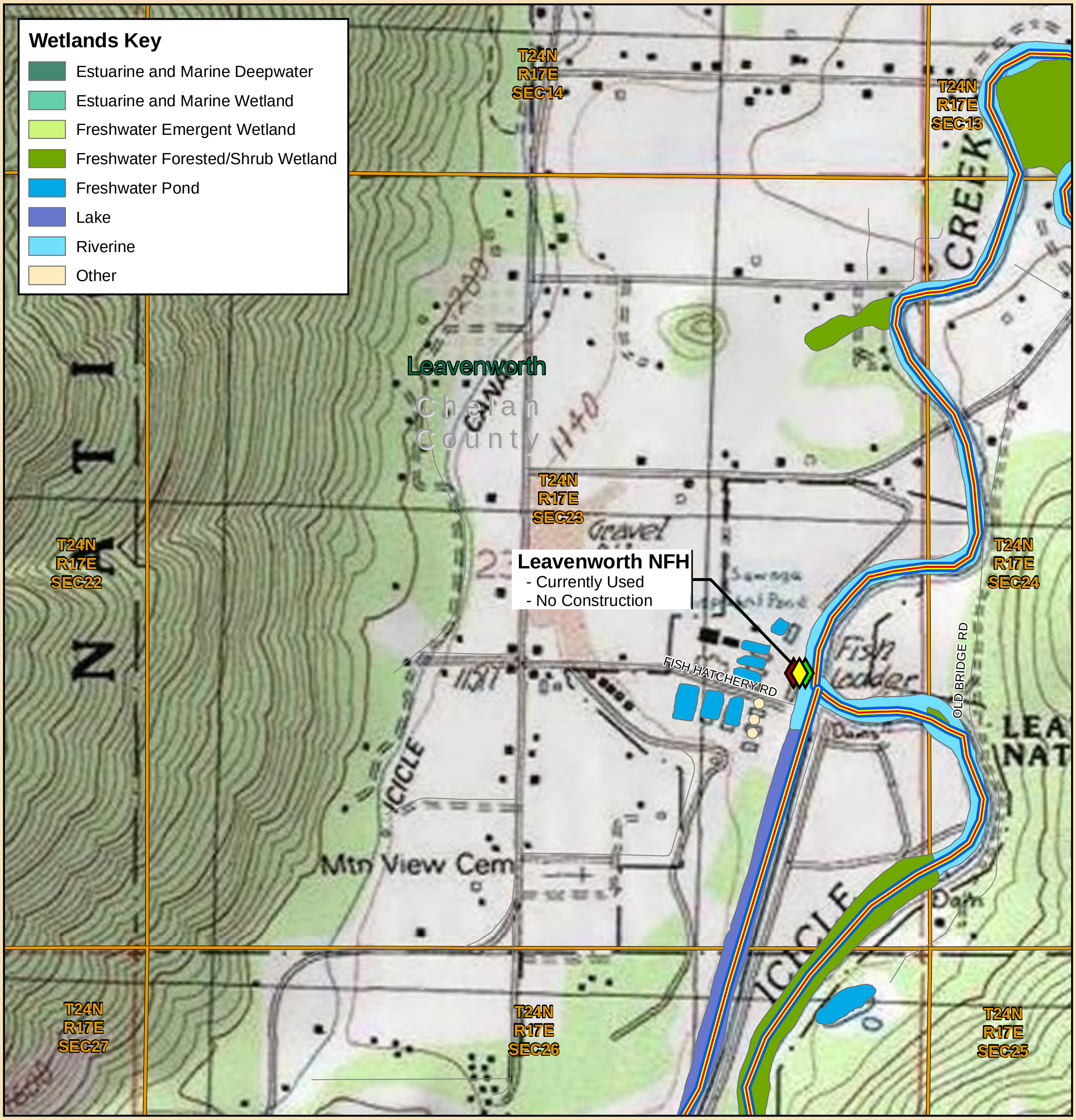


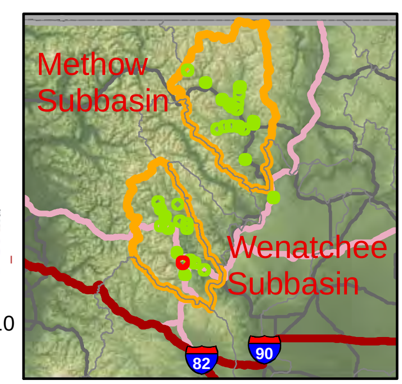
Figure 10d - Leavenworth NFH

Leavenworth Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary



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November 1, 2010

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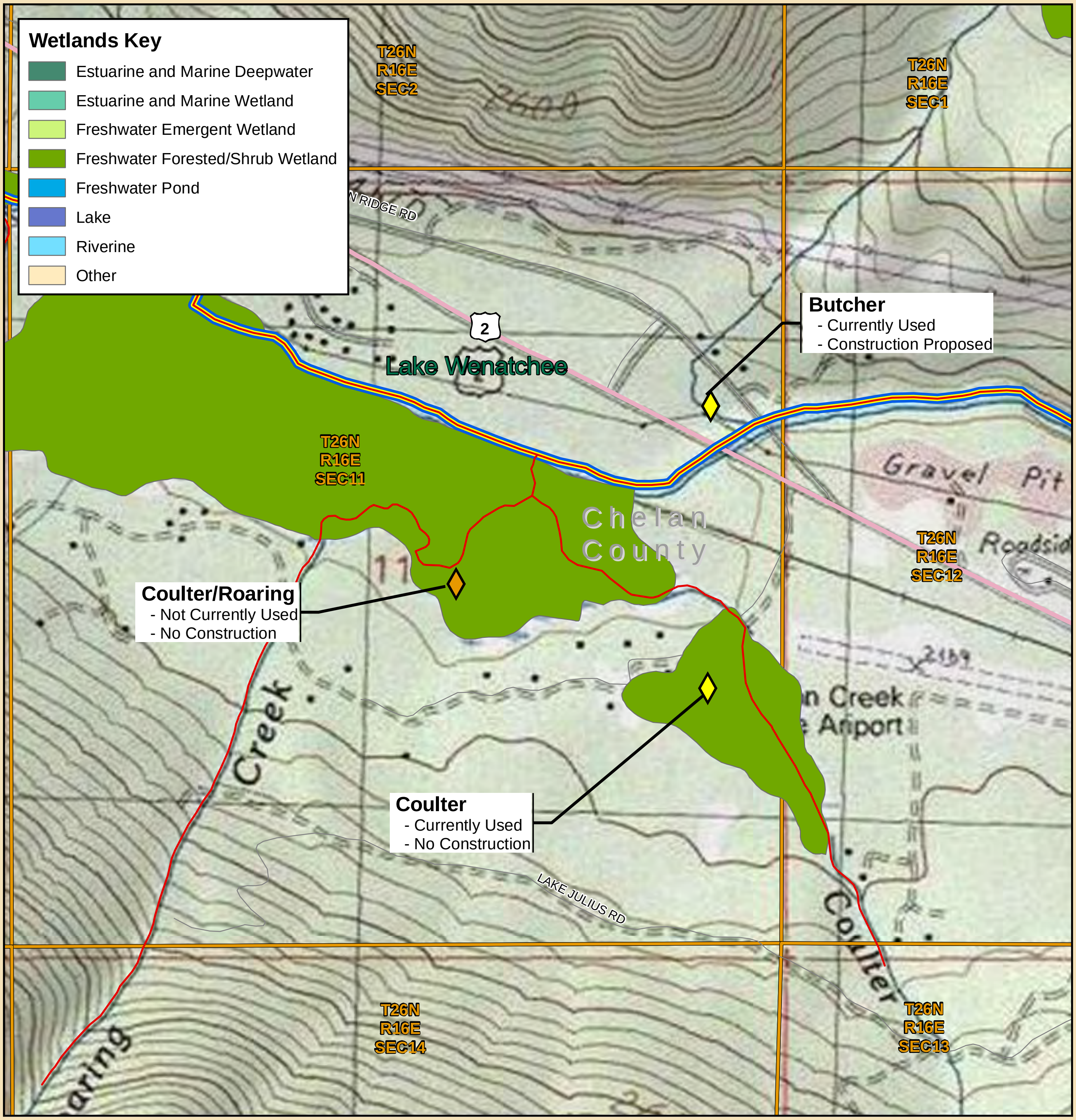


Figure 10e - Coulter, Butcher, and Coulter/Roaring

Lake Wenatchee Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

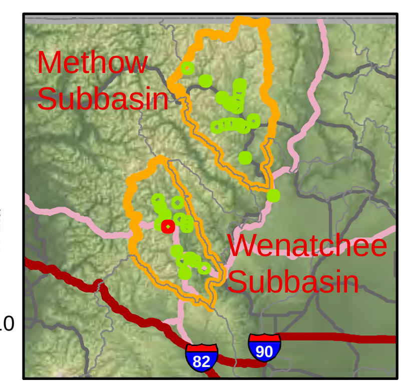
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



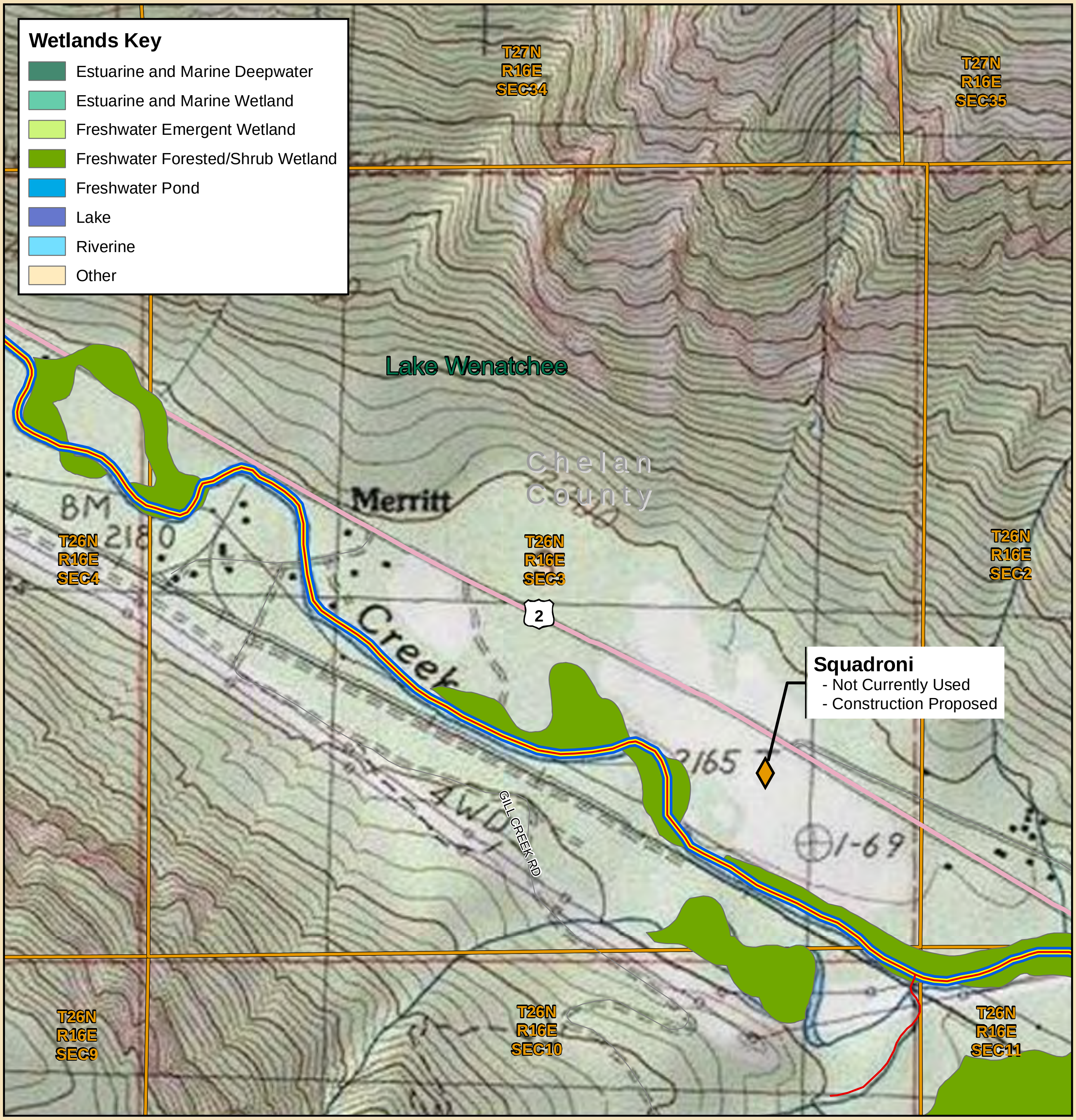


Figure 10f - Squadroni

Lake Wenatchee Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

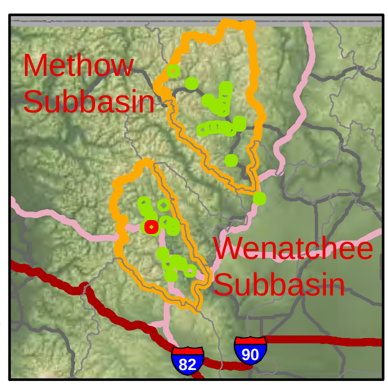
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE

November 1, 2010

0 500 1,000 2,000 Feet



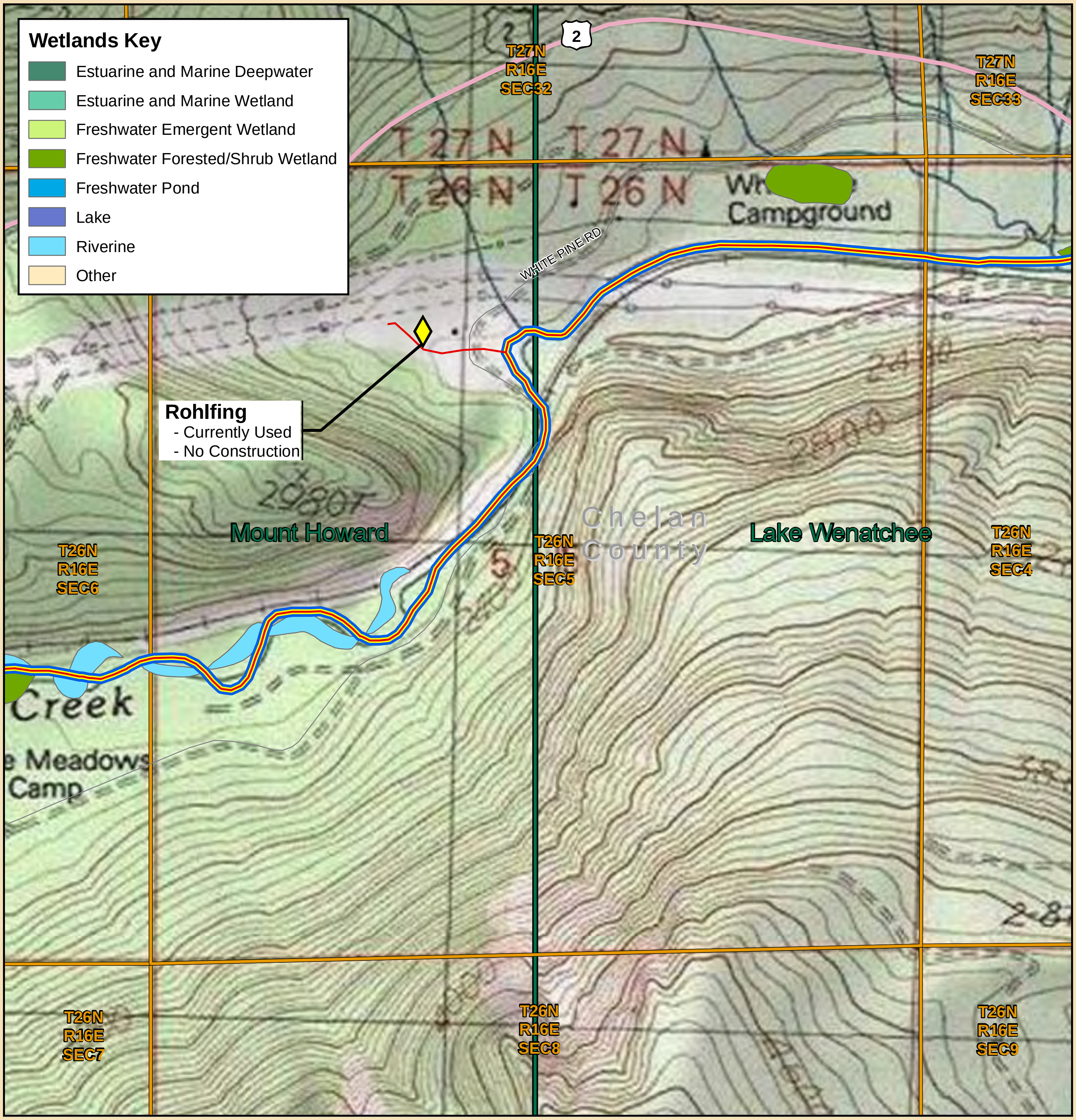


Figure 10g - Rohlfing

Lake Wenatchee Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

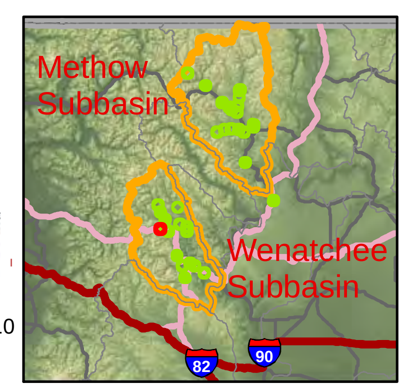
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



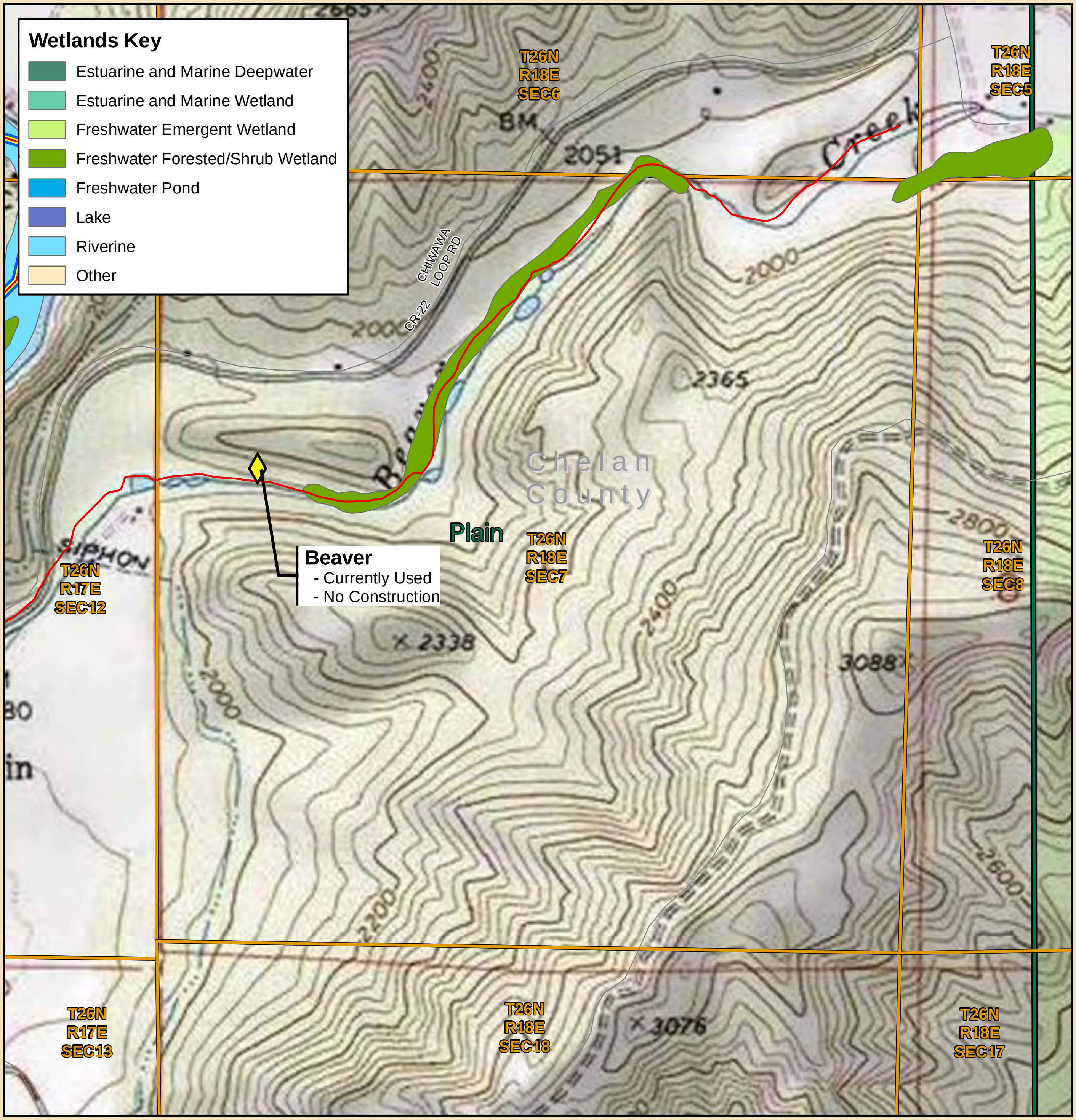


Figure 10h - Beaver

Plain Quadrangle

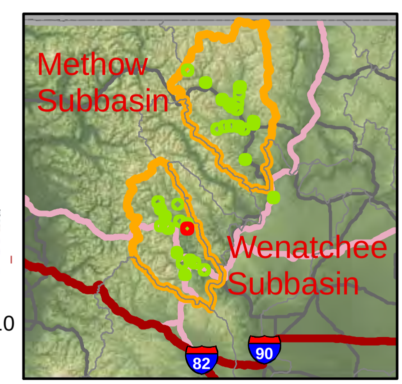
Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



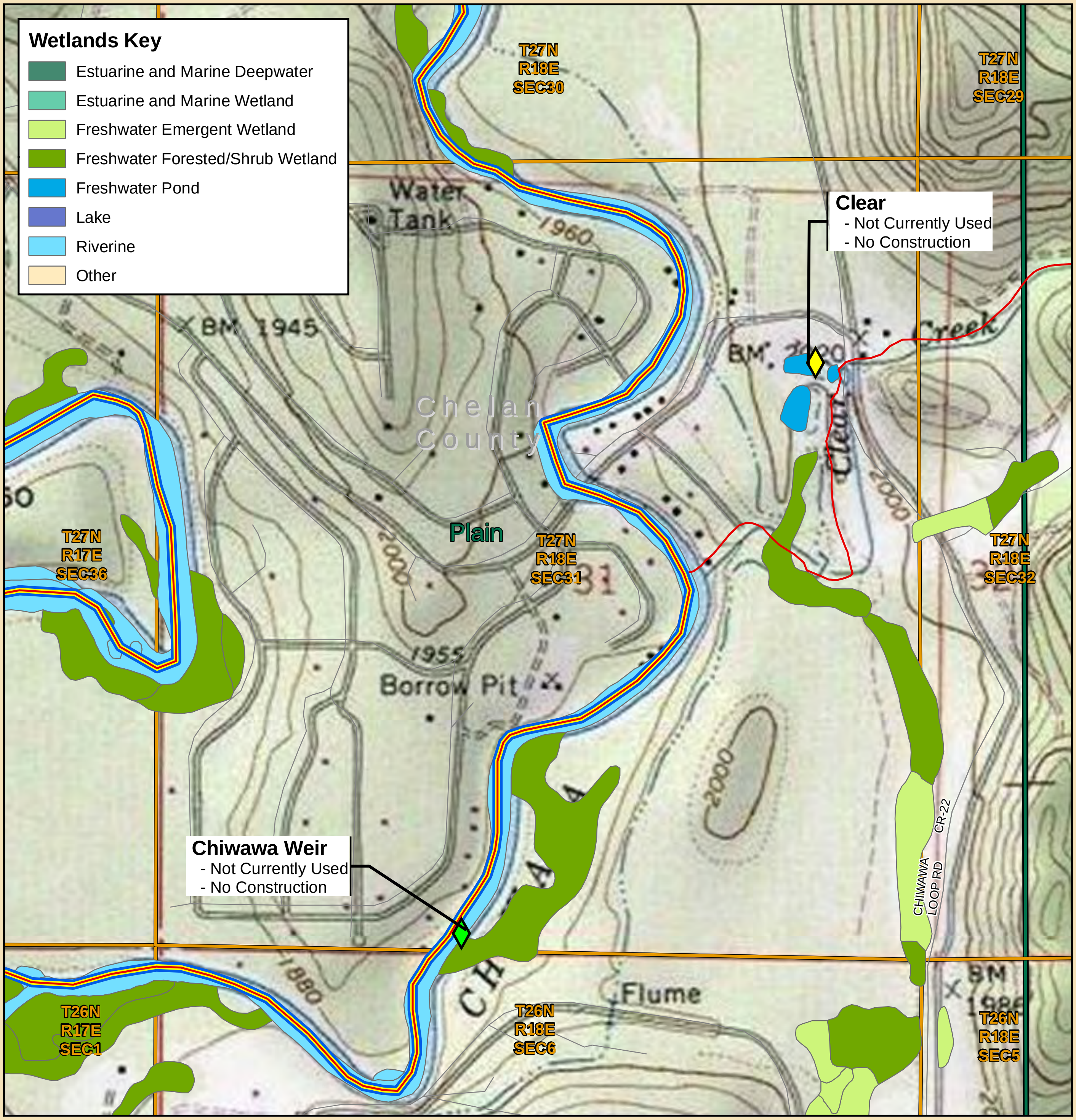


Figure 10i - Clear and Chiwawa Weir

Plain Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

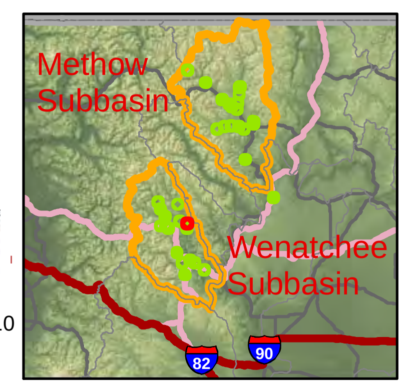
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



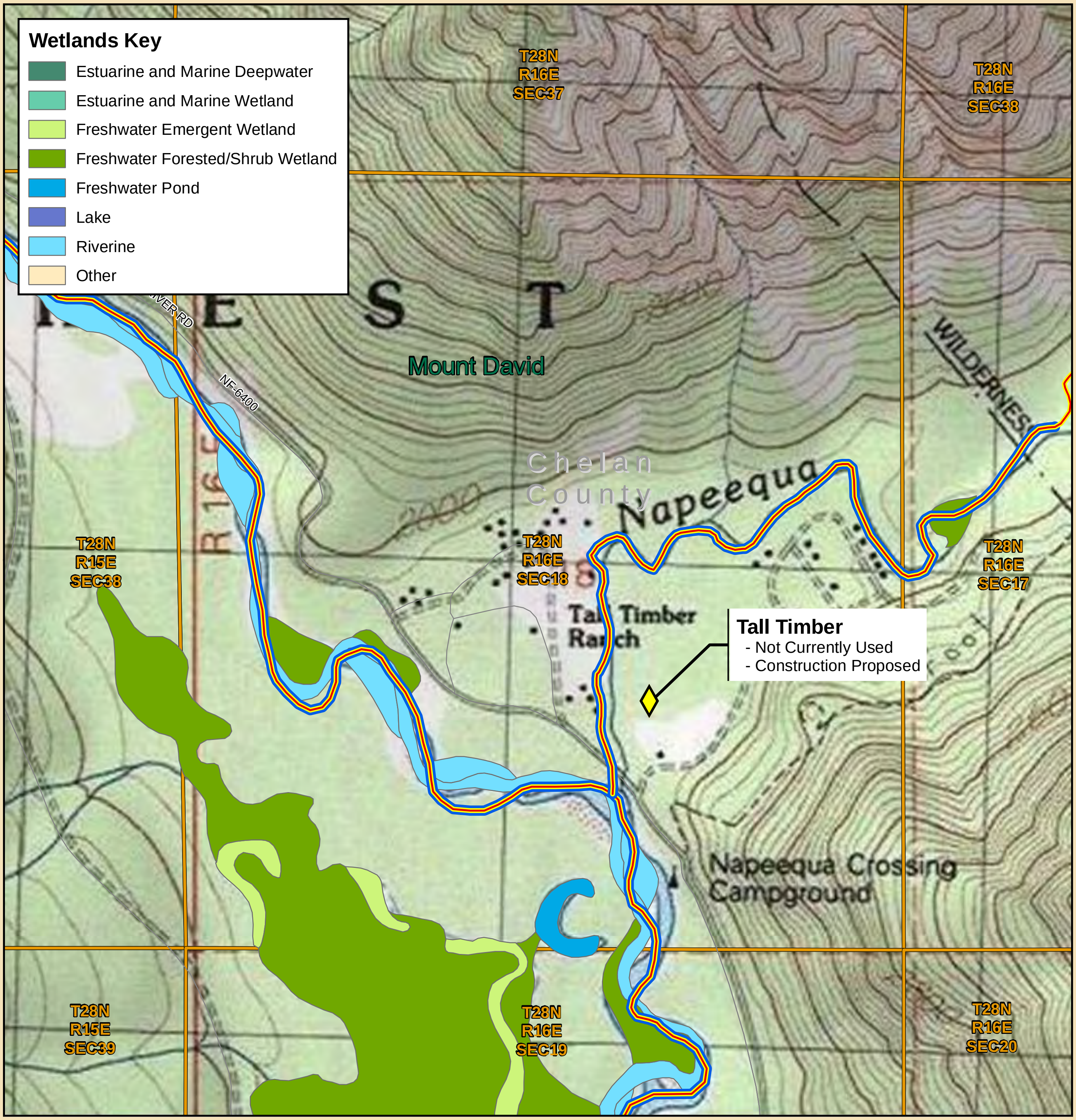


Figure 10j - Tall Timber

Mount David Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

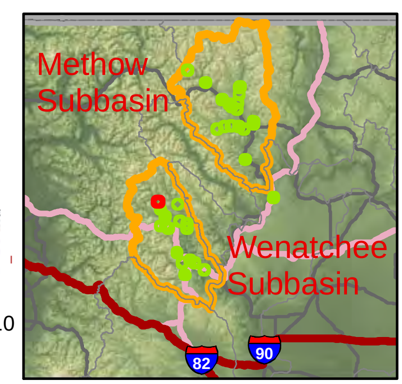
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE

November 1, 2010

0 500 1,000 2,000 Feet



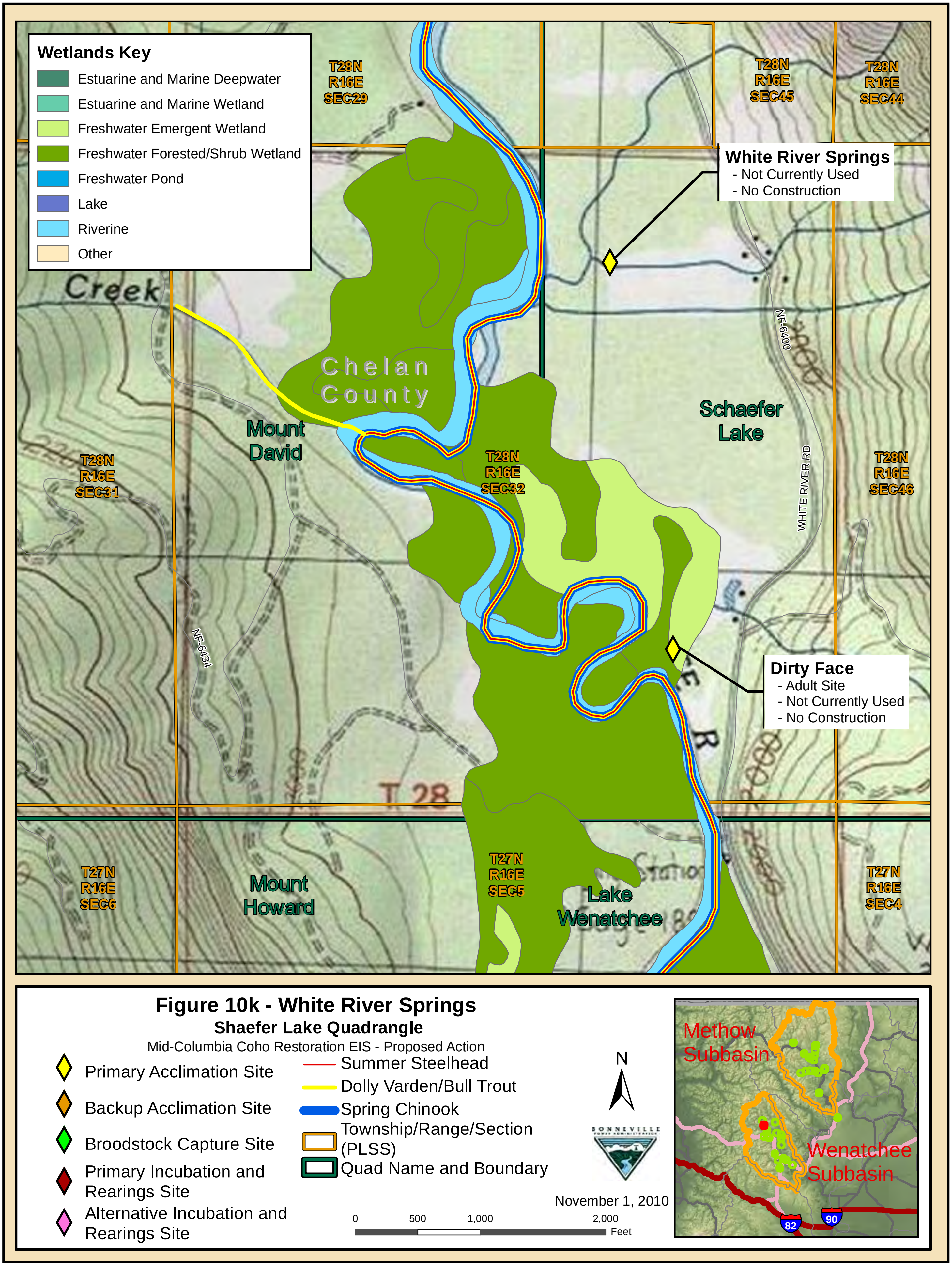


Figure 10k - White River Springs

Shaefer Lake Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

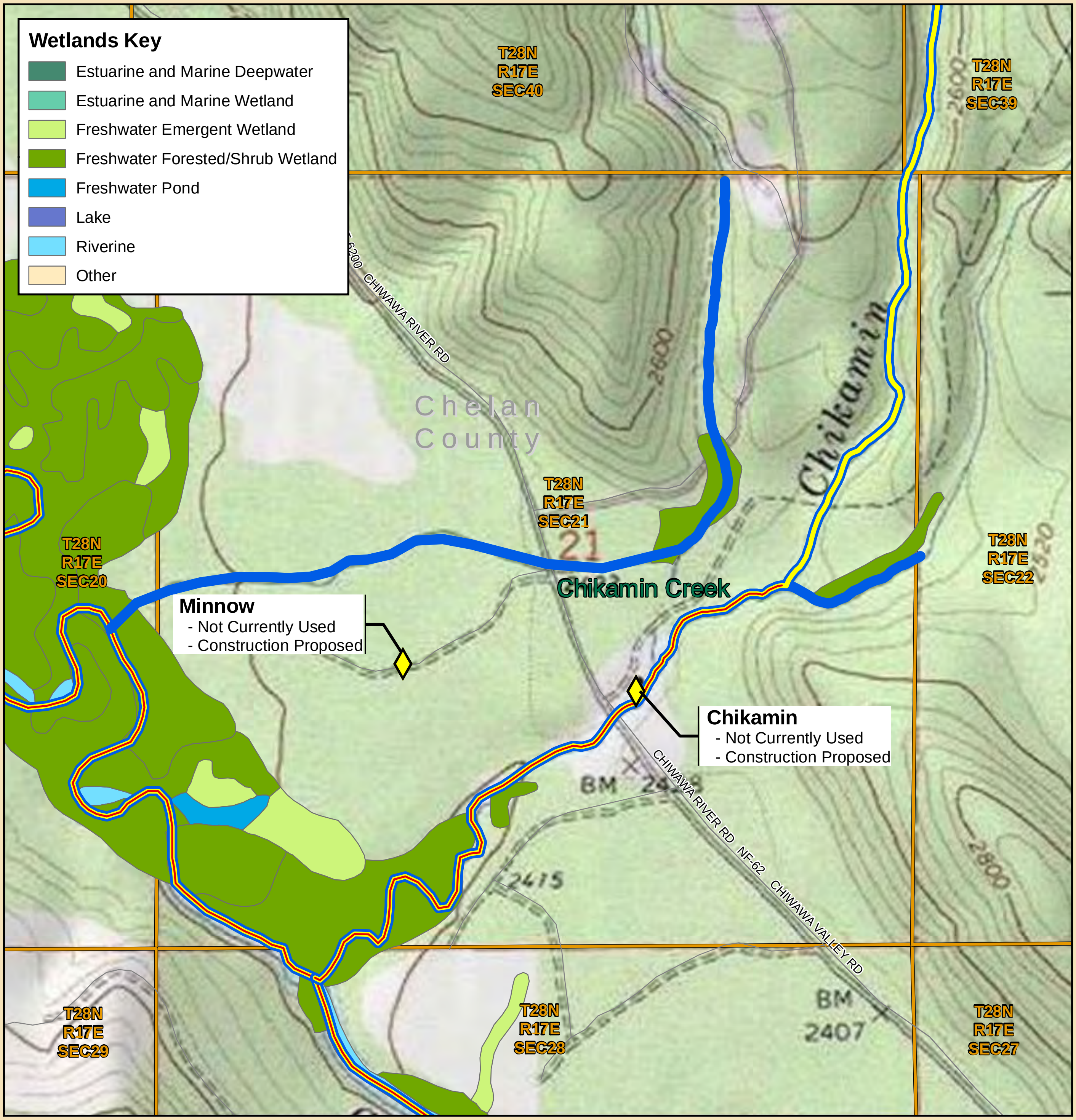


Figure 10l - Minnow and Chikamin

Chikamin Creek Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

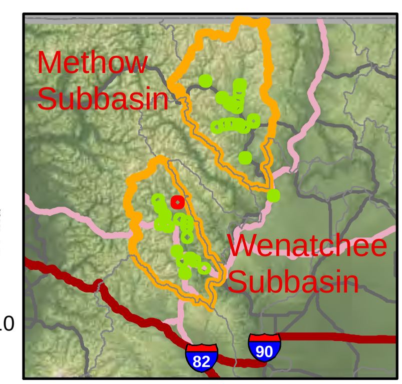
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE

November 1, 2010

0 500 1,000 2,000 Feet



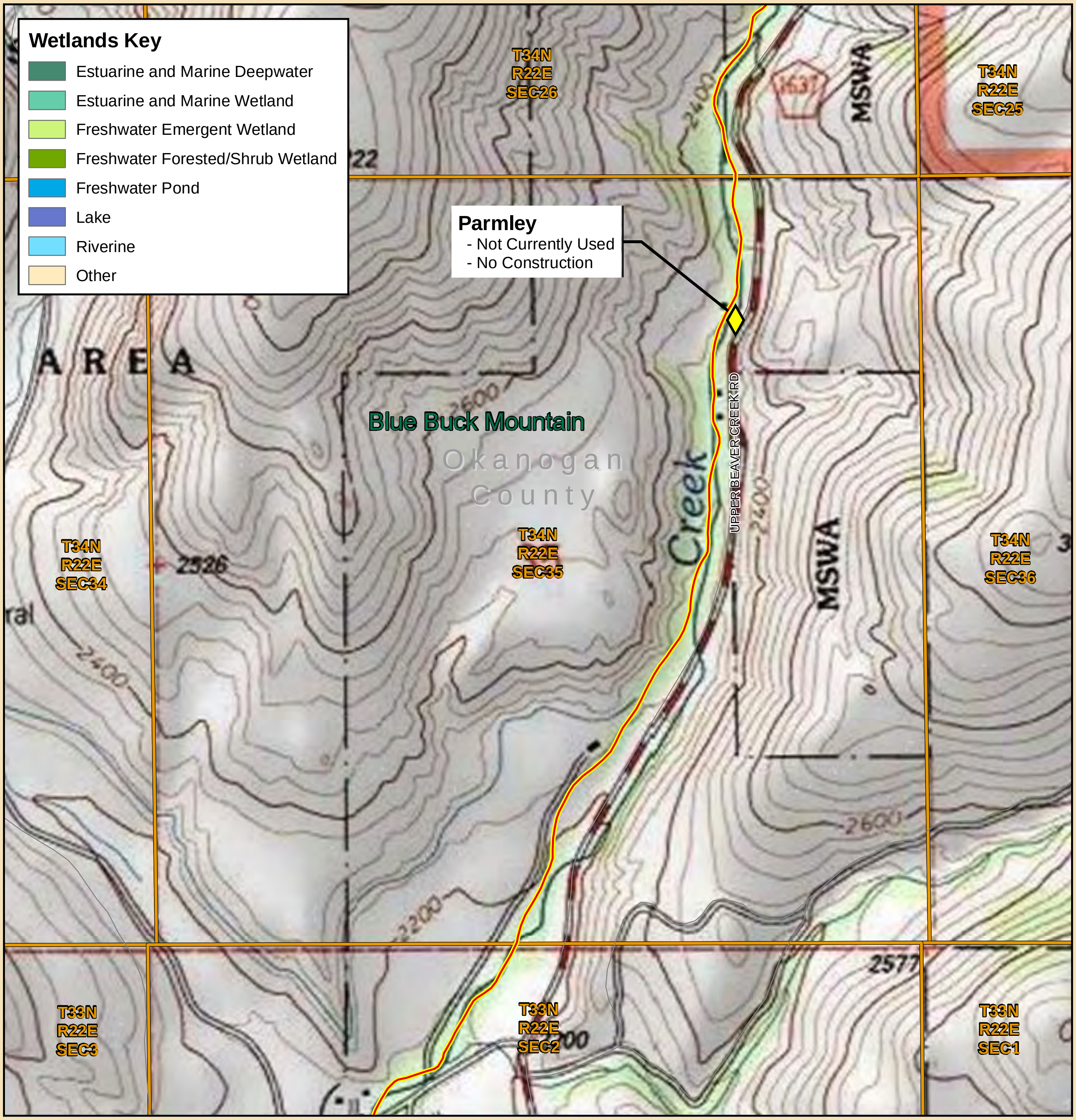


Figure 10m - Parmley

Blue Buck Mountain Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

Primary Acclimation Site
Backup Acclimation Site
Broodstock Capture Site
Primary Incubation and Rearings Site
Alternative Incubation and Rearings Site

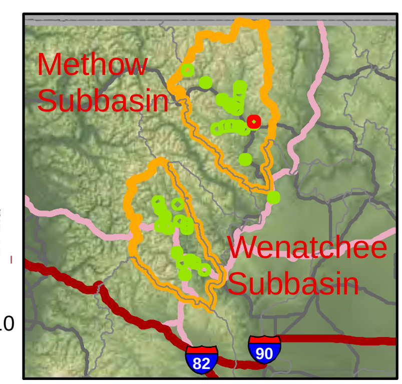
Summer Steelhead
Dolly Varden/Bull Trout
Spring Chinook
Township/Range/Section (PLSS)
Quad Name and Boundary

N

BONNEVILLE

November 1, 2010

0 500 1,000 2,000 Feet



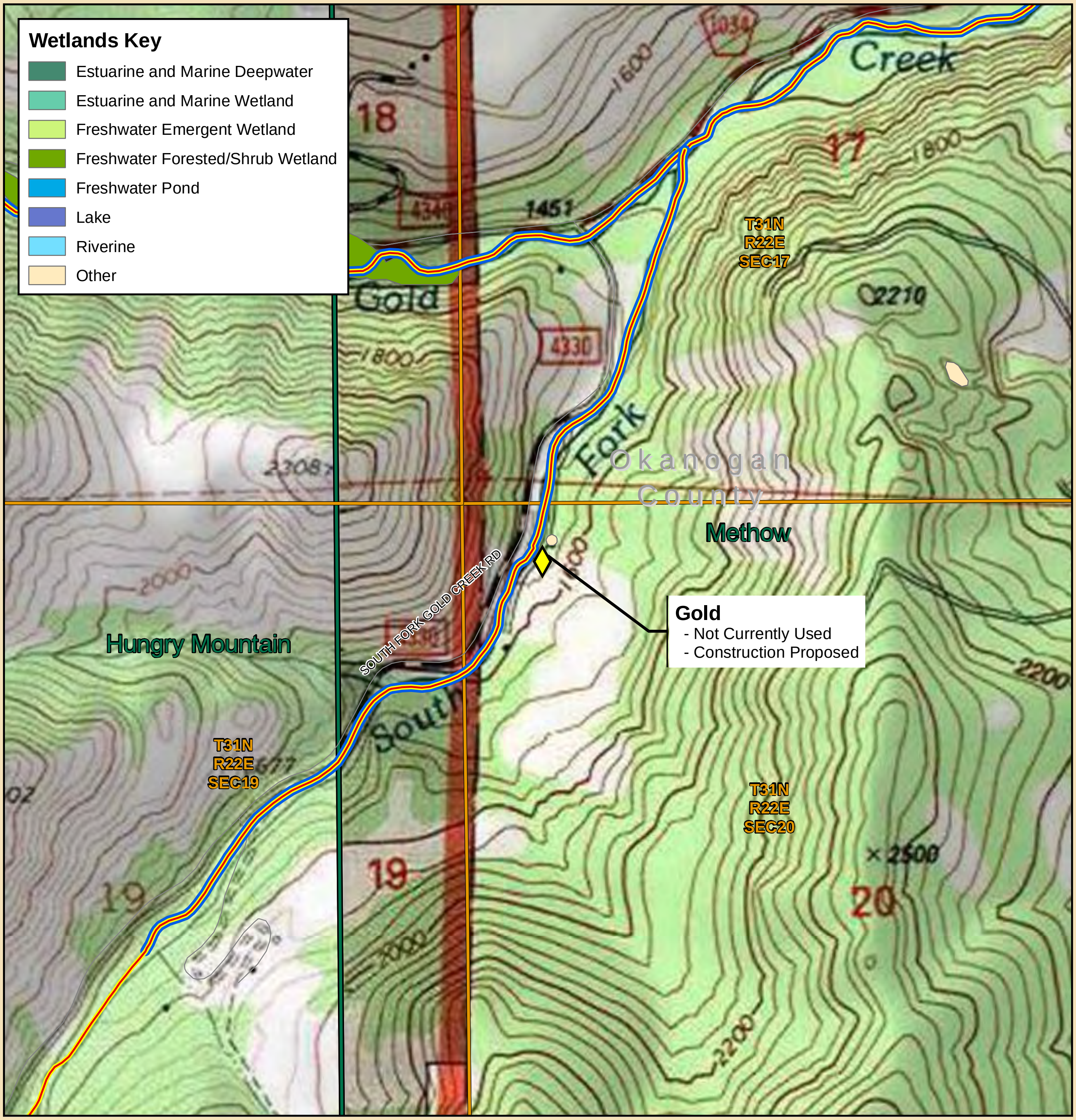


Figure 10n - Gold

Methow Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

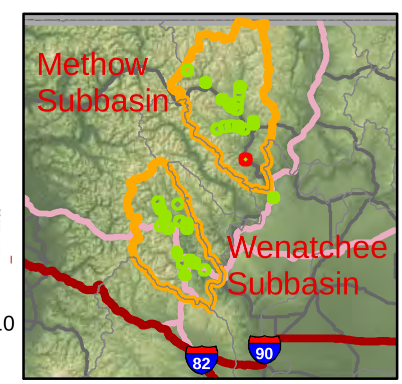
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE POWER ADMINISTRATION

November 1, 2010

0 500 1,000 2,000 Feet



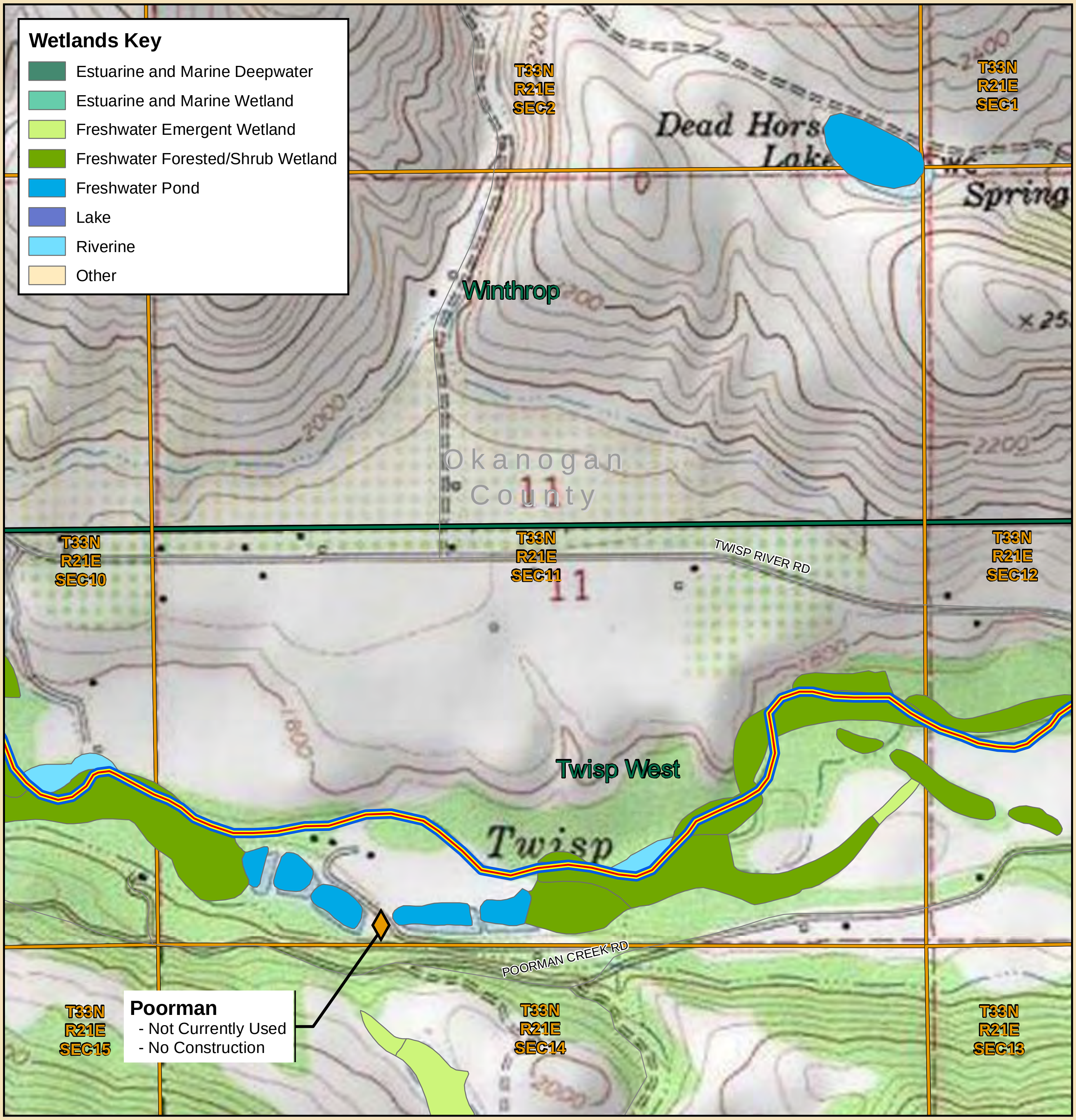


Figure 10o - Poorman

Winthrop Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

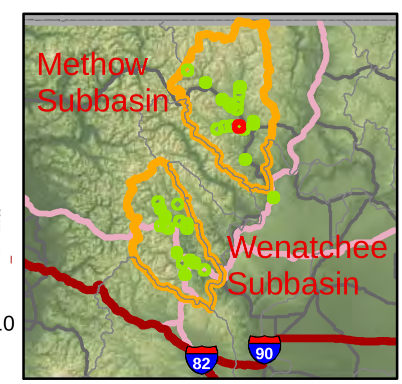
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



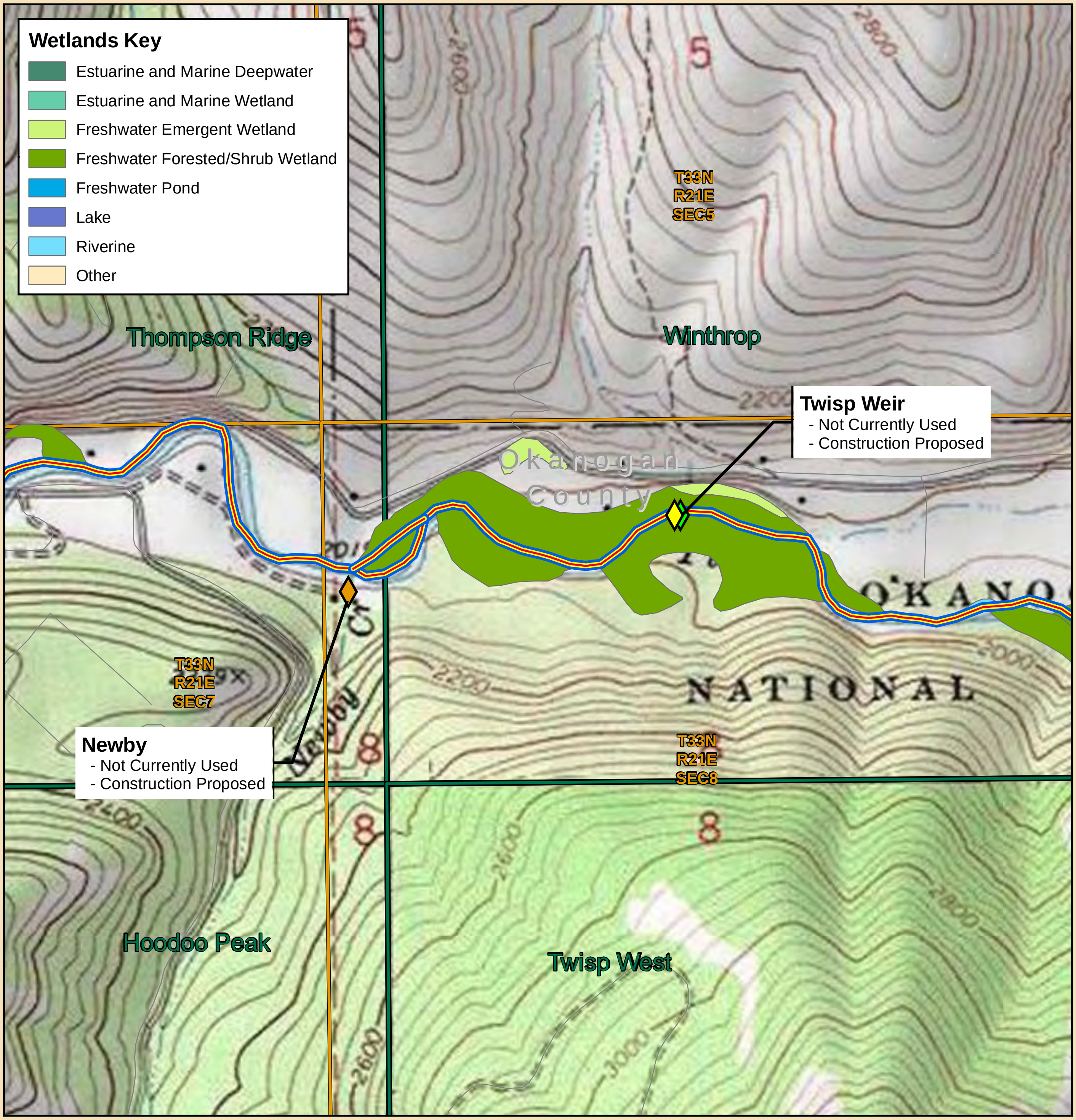


Figure 10p - Newby and Twisp Weir

Thompson Ridge Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

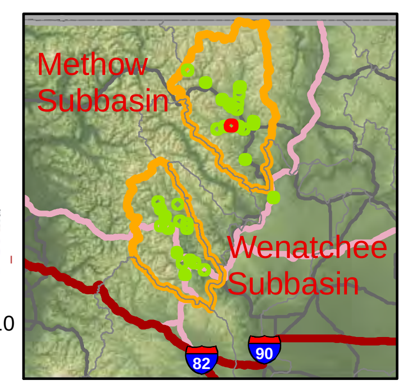
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



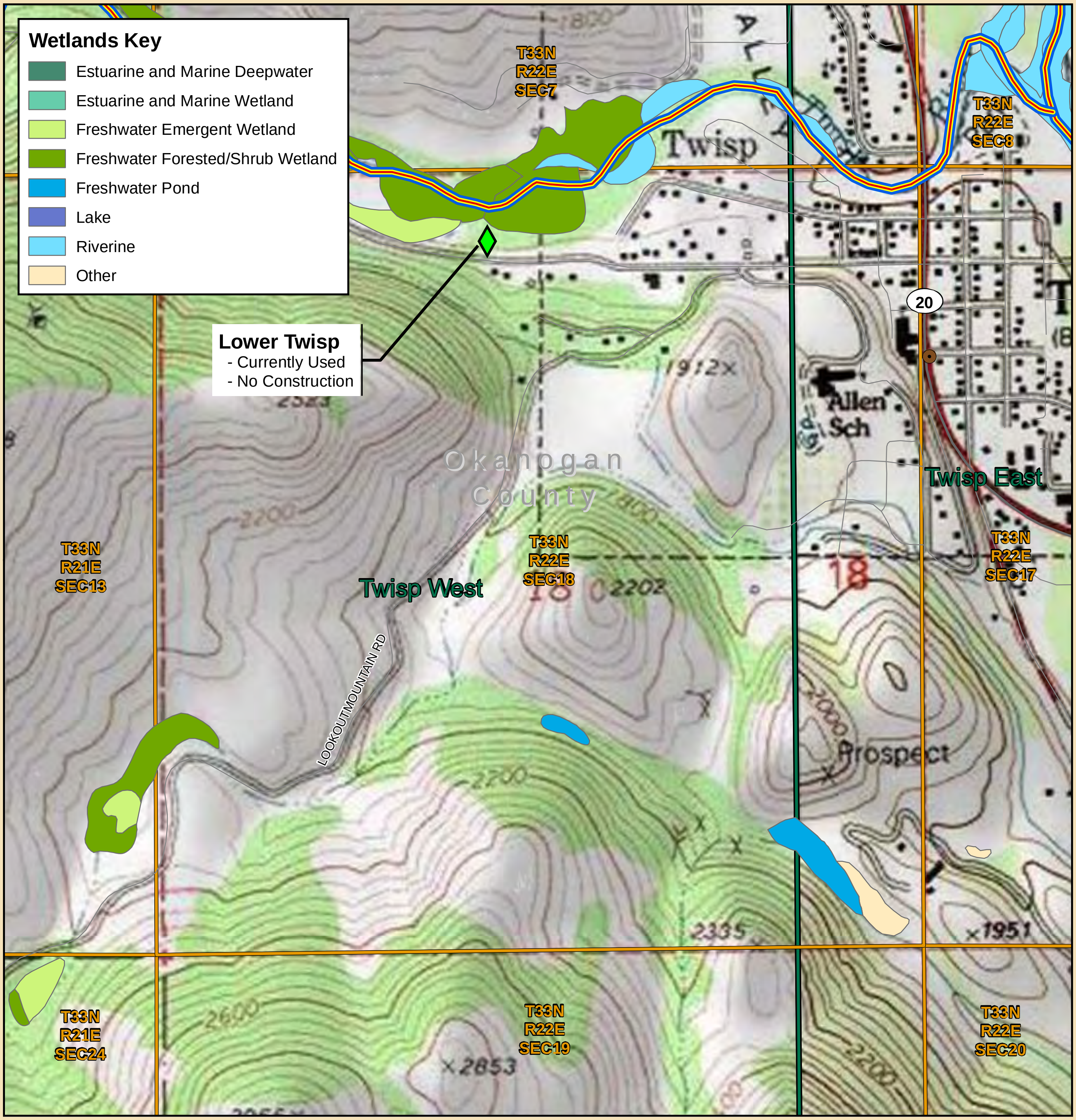


Figure 10q - Lower Twisp

Twisp West Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

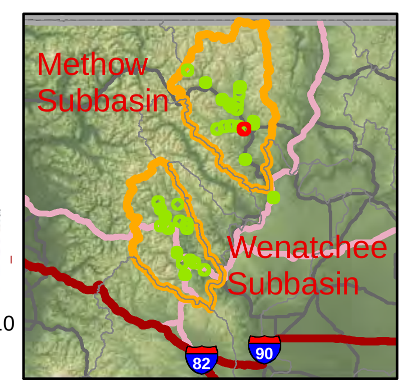
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



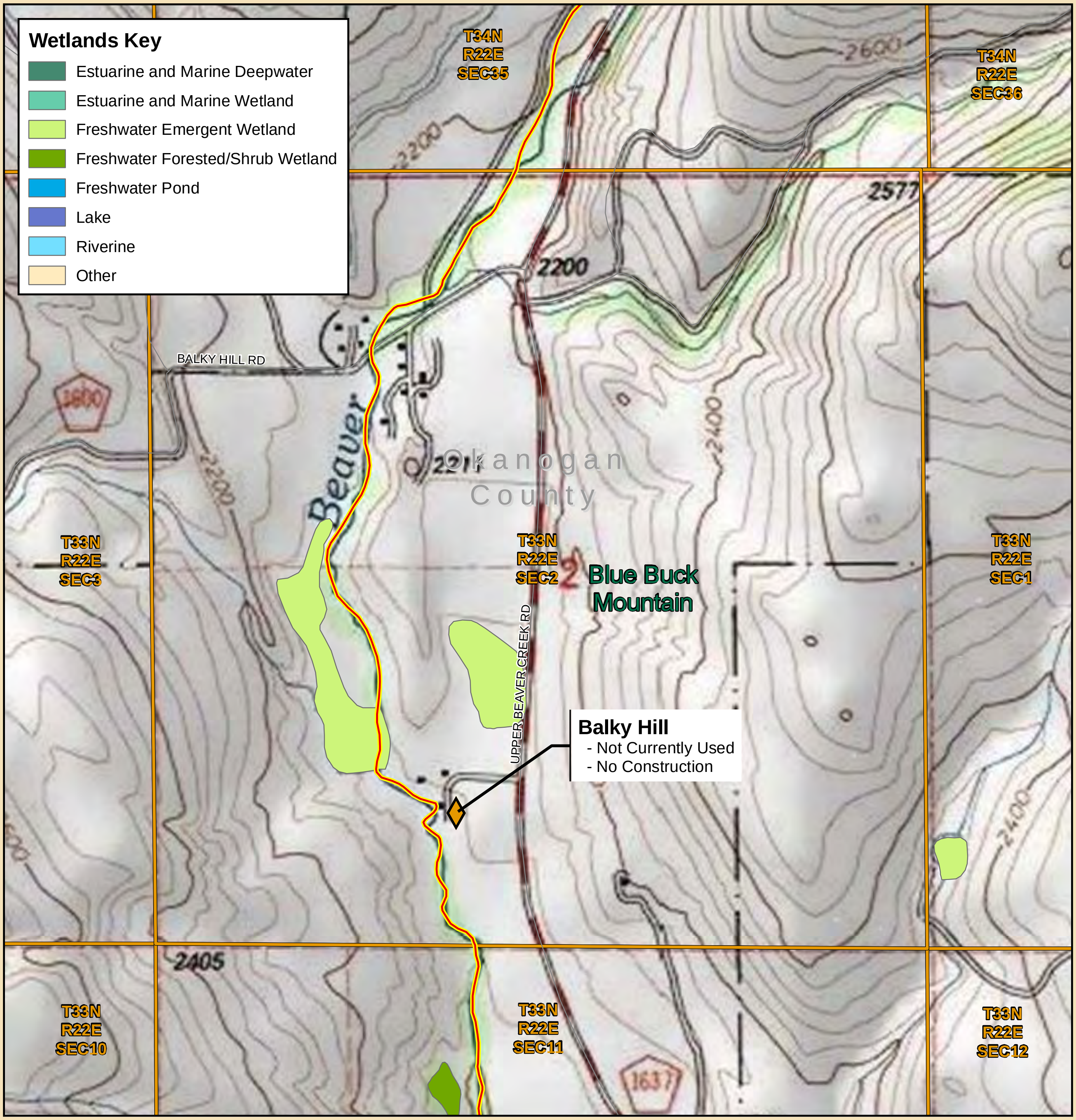


Figure 10r - Balky Hill

Blue Buck Mountain Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

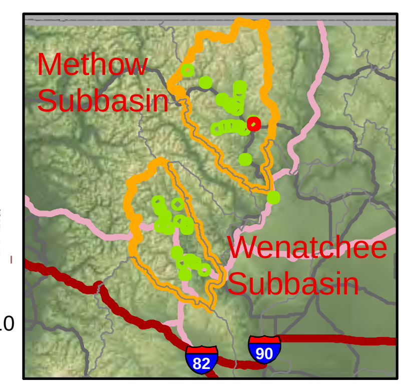
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE POWER ADMINISTRATION

November 1, 2010

0 500 1,000 2,000 Feet



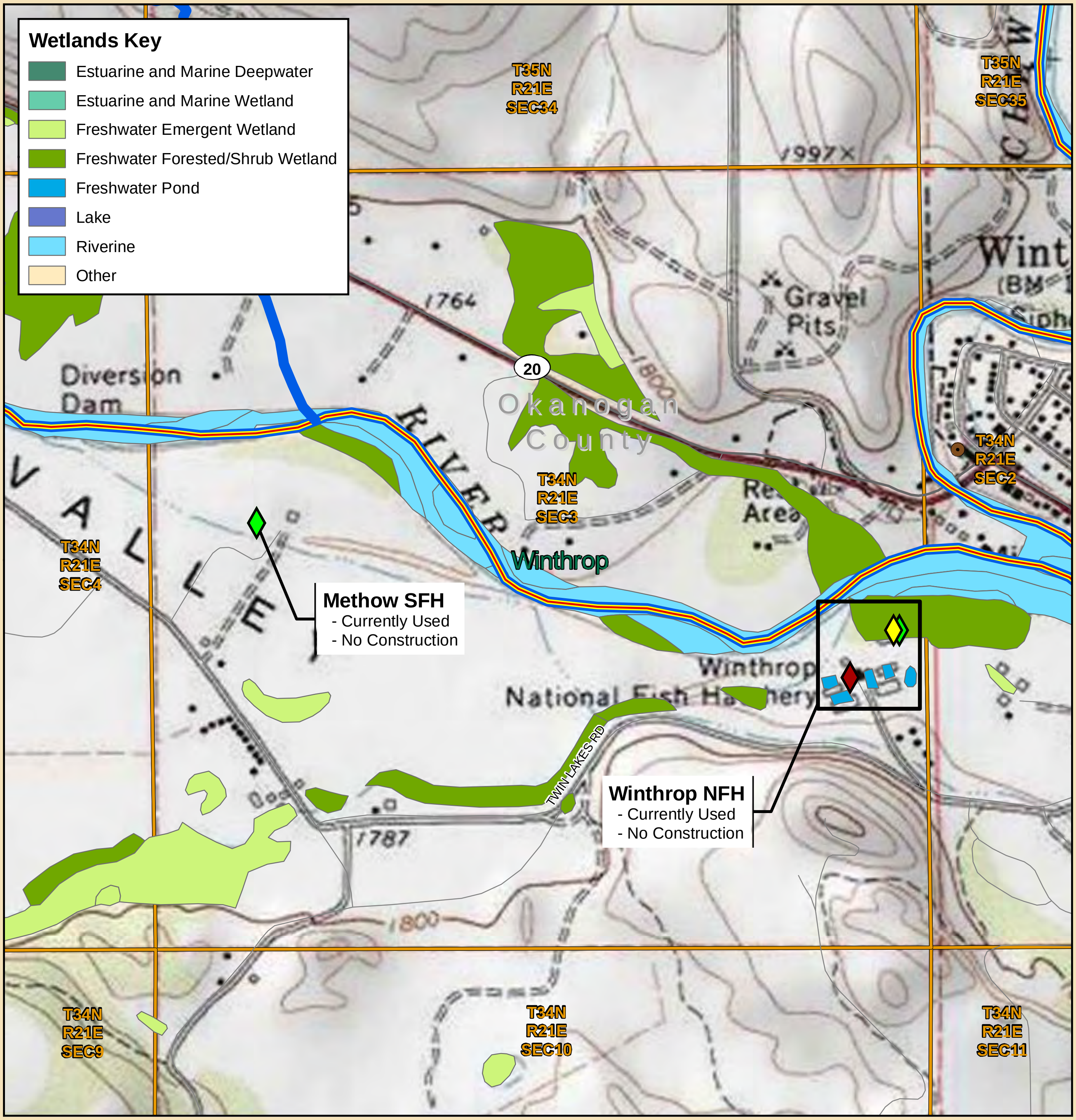


Figure 10s - Winthrop NFH and Methow SFH

Winthrop Quadrangle

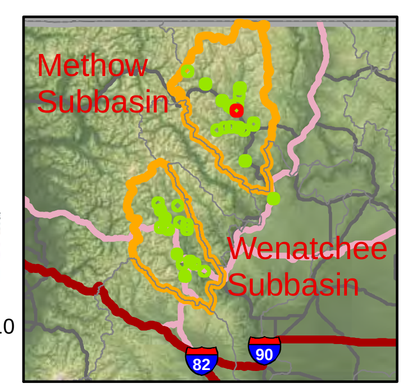
Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



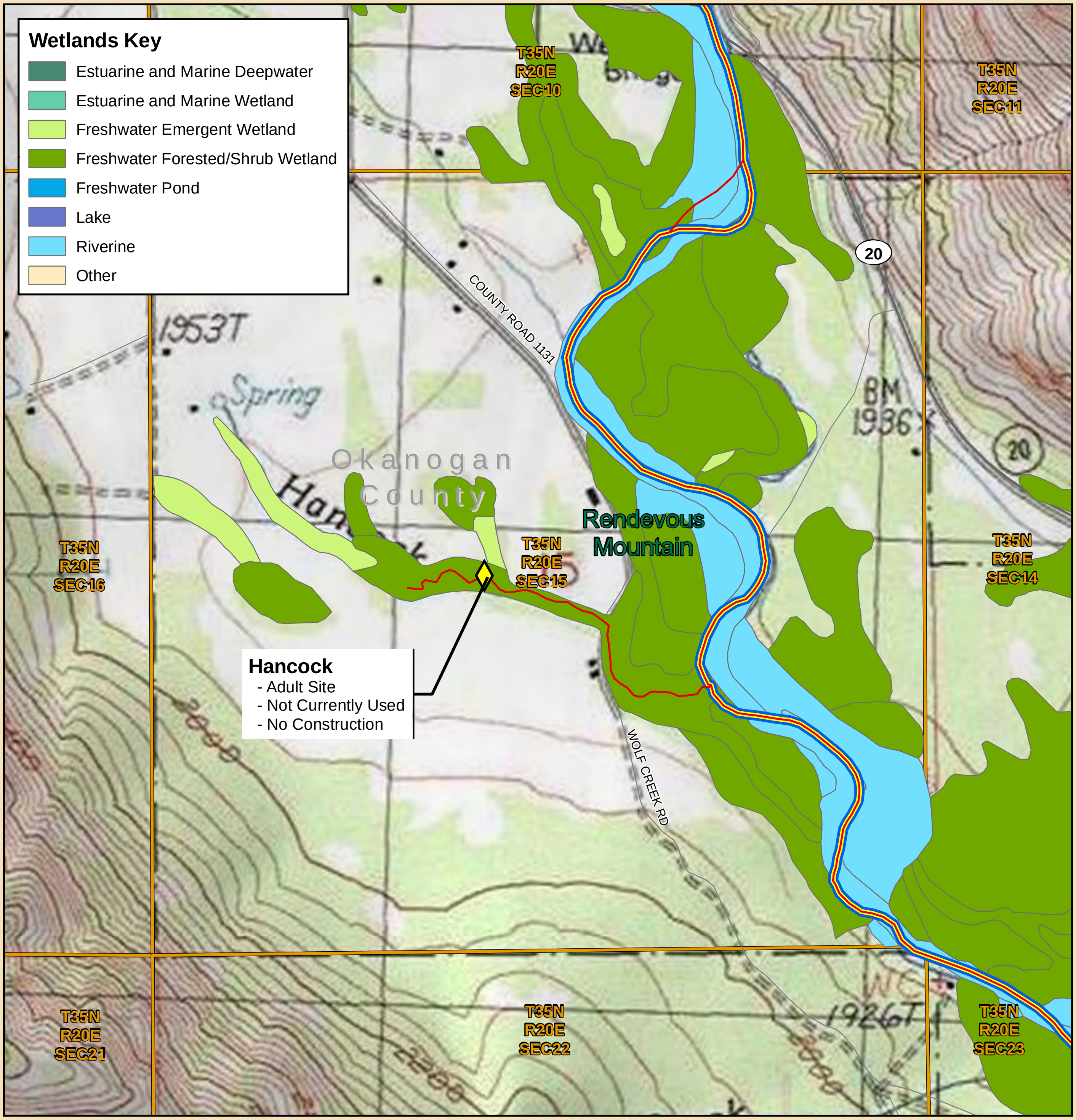


Figure 10t - Hancock

Rendevous Mountain Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

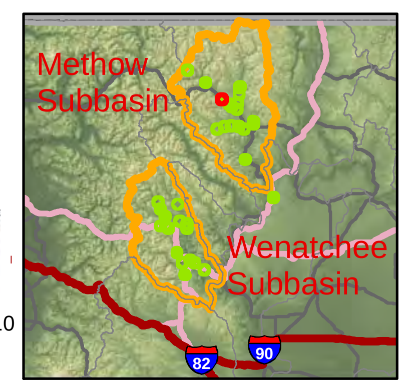
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE

November 1, 2010

0 500 1,000 2,000 Feet



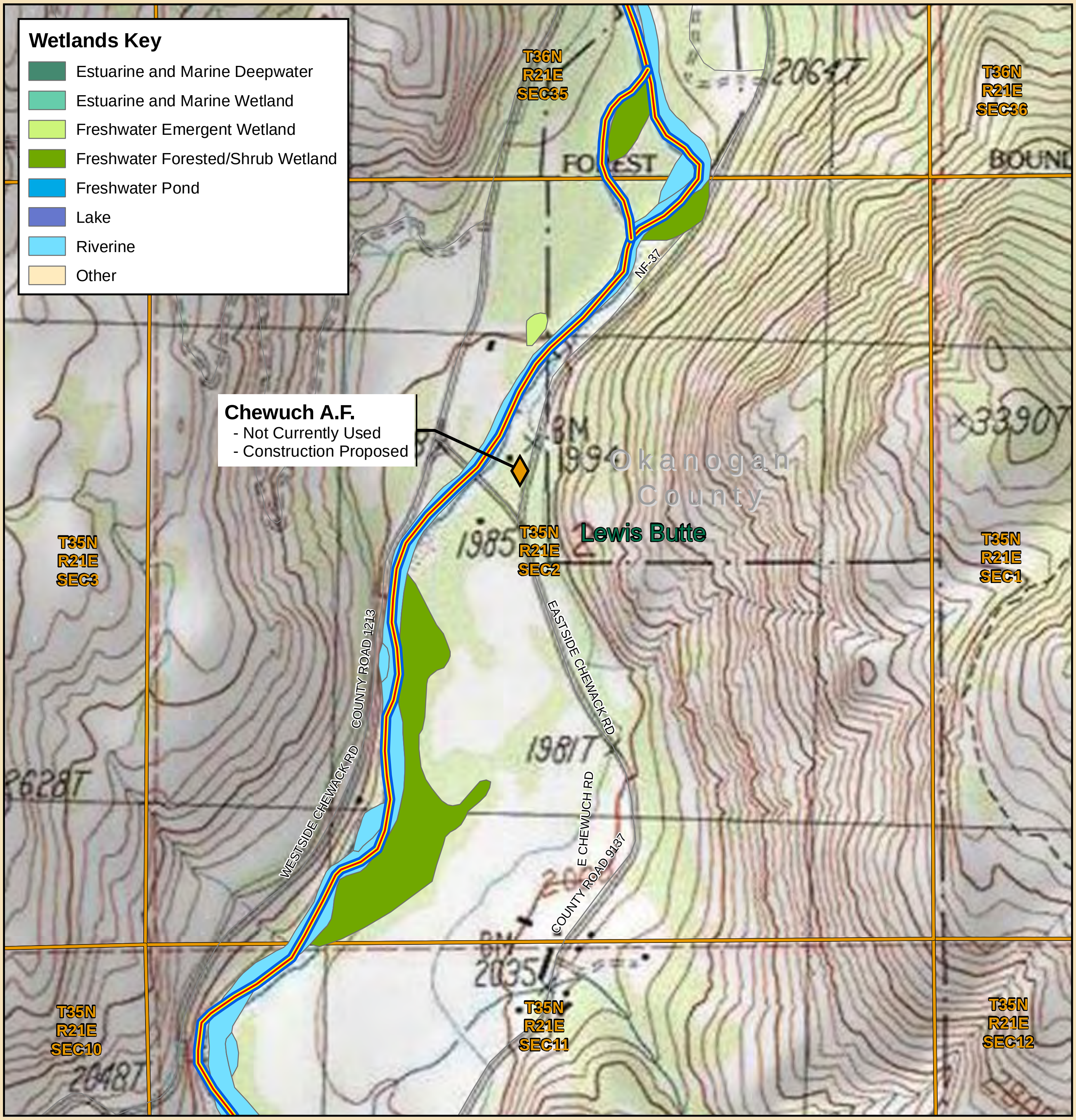


Figure 10u - Chewuch A.F.

Lewis Butte Quadrangle

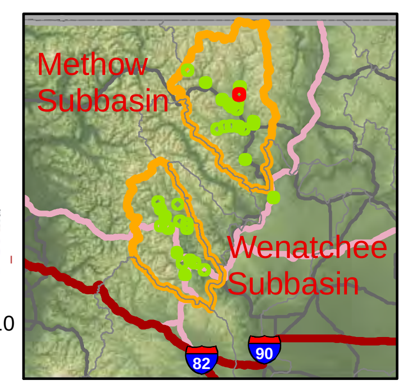
Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



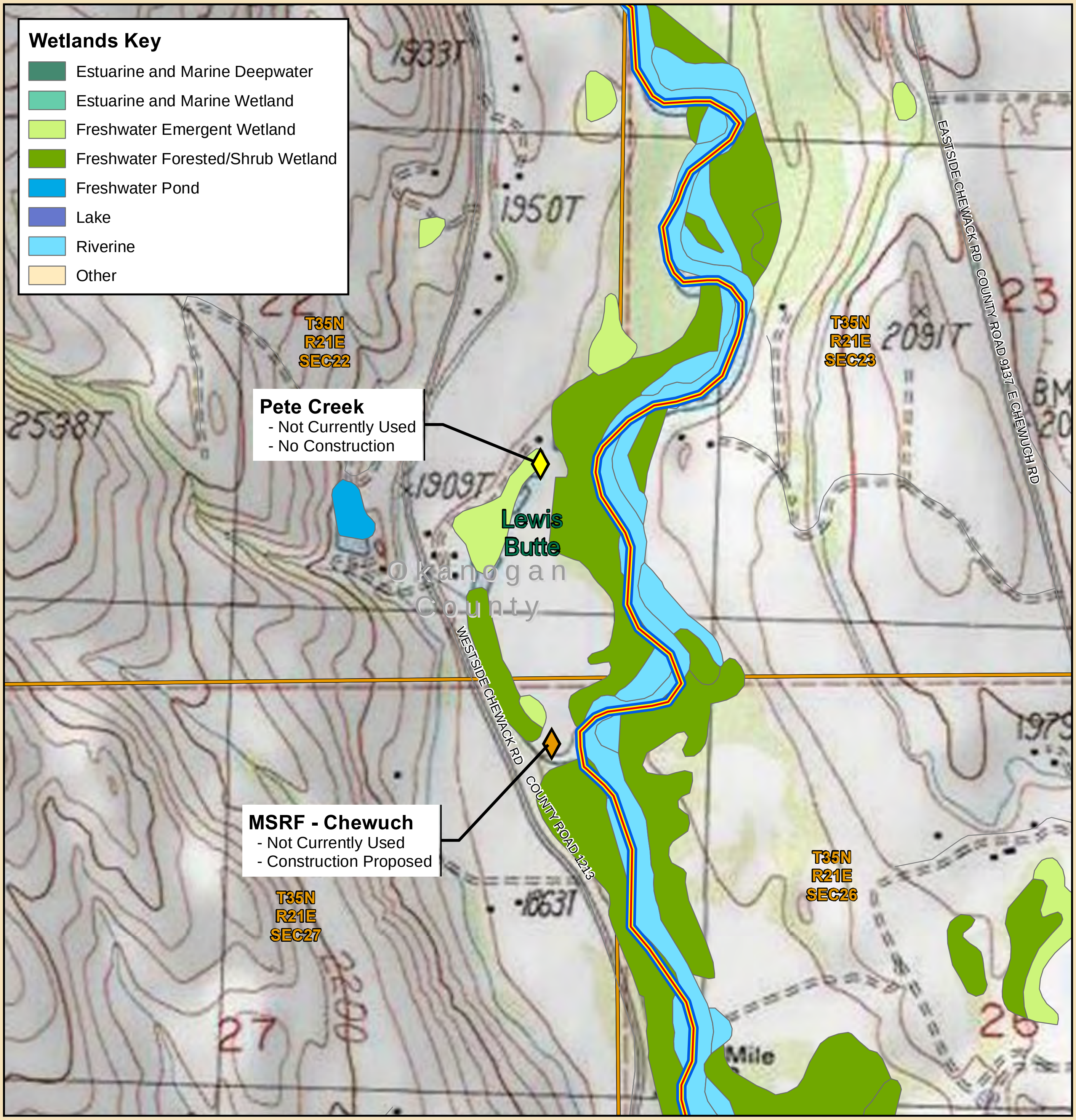


Figure 10v – MSRF Chewuch and Pete Creek

Lewis Butte Quadrangle

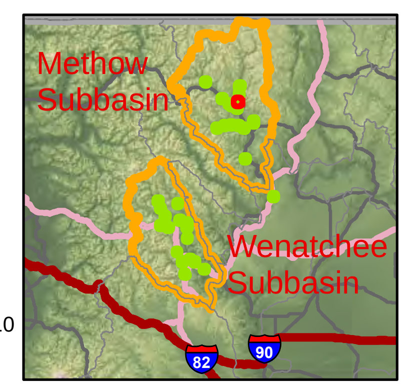
Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

0 500 1,000 2,000 Feet

November 1, 2010



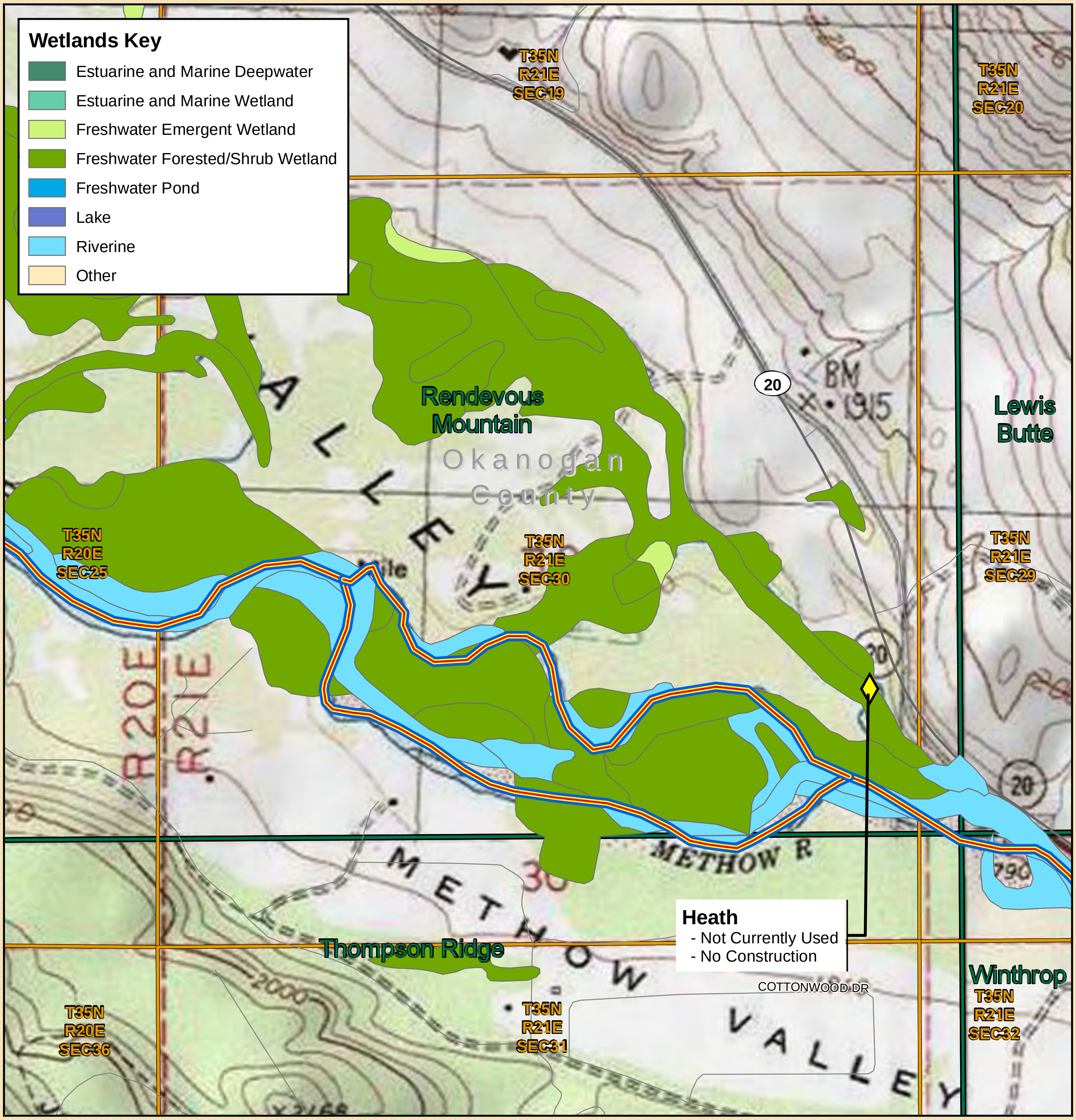


Figure 10w - Heath

Rendevous Mountain Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

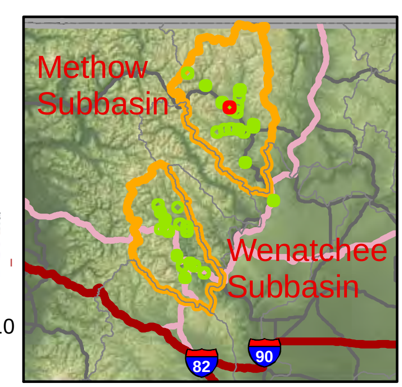
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE

November 1, 2010

0 500 1,000 2,000 Feet



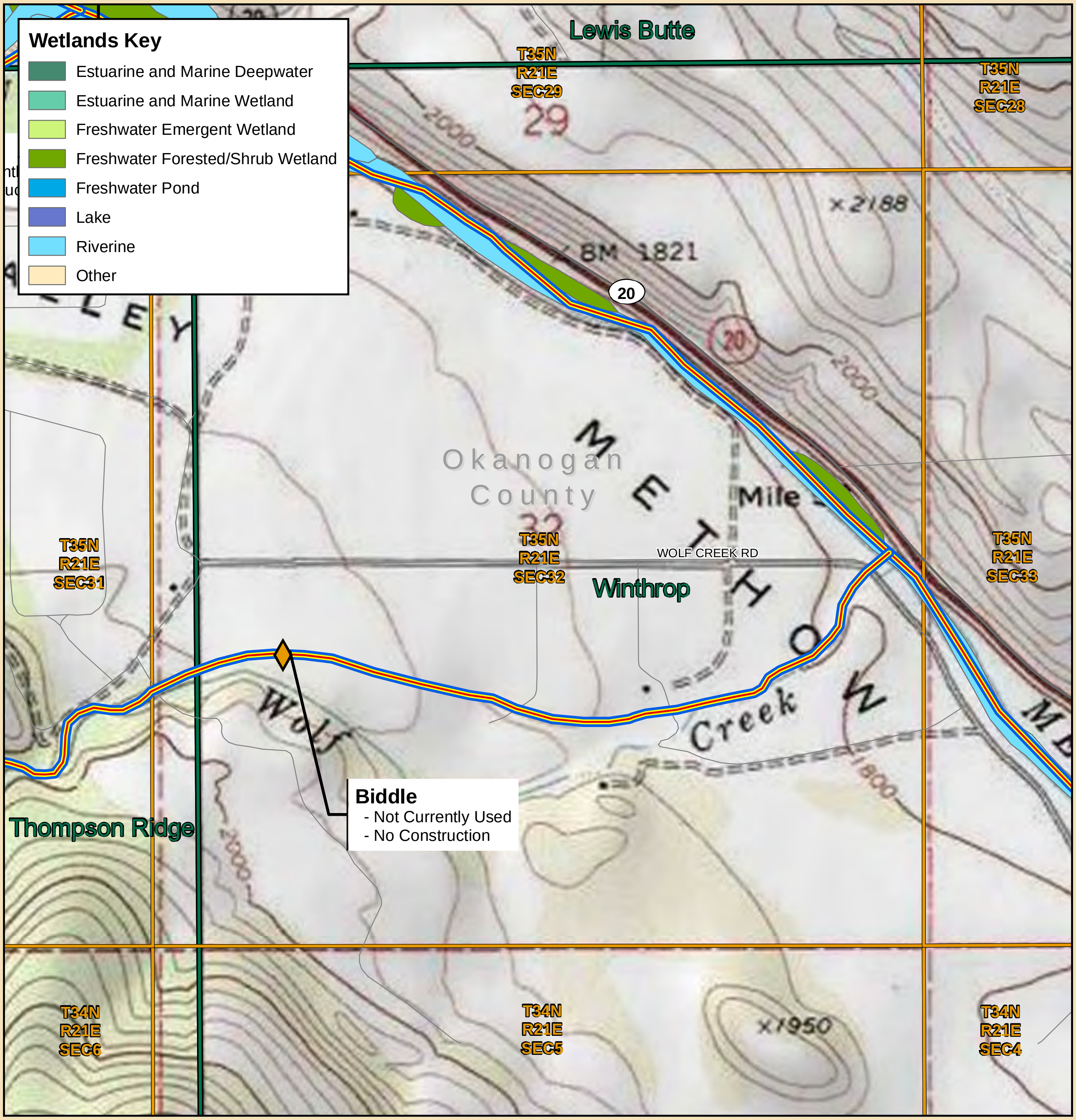


Figure 10x - Biddle

Winthrop Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

Primary Acclimation Site
Backup Acclimation Site
Broodstock Capture Site
Primary Incubation and Rearings Site
Alternative Incubation and Rearings Site

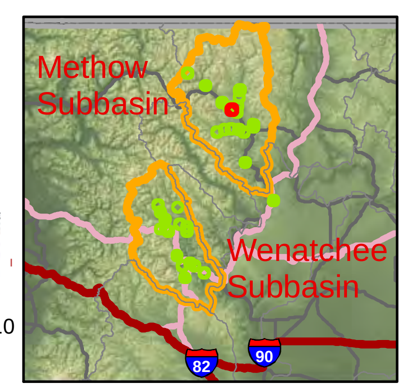
Summer Steelhead
Dolly Varden/Bull Trout
Spring Chinook
Township/Range/Section (PLSS)
Quad Name and Boundary

N

BONNEVILLE

November 1, 2010

0 500 1,000 2,000 Feet



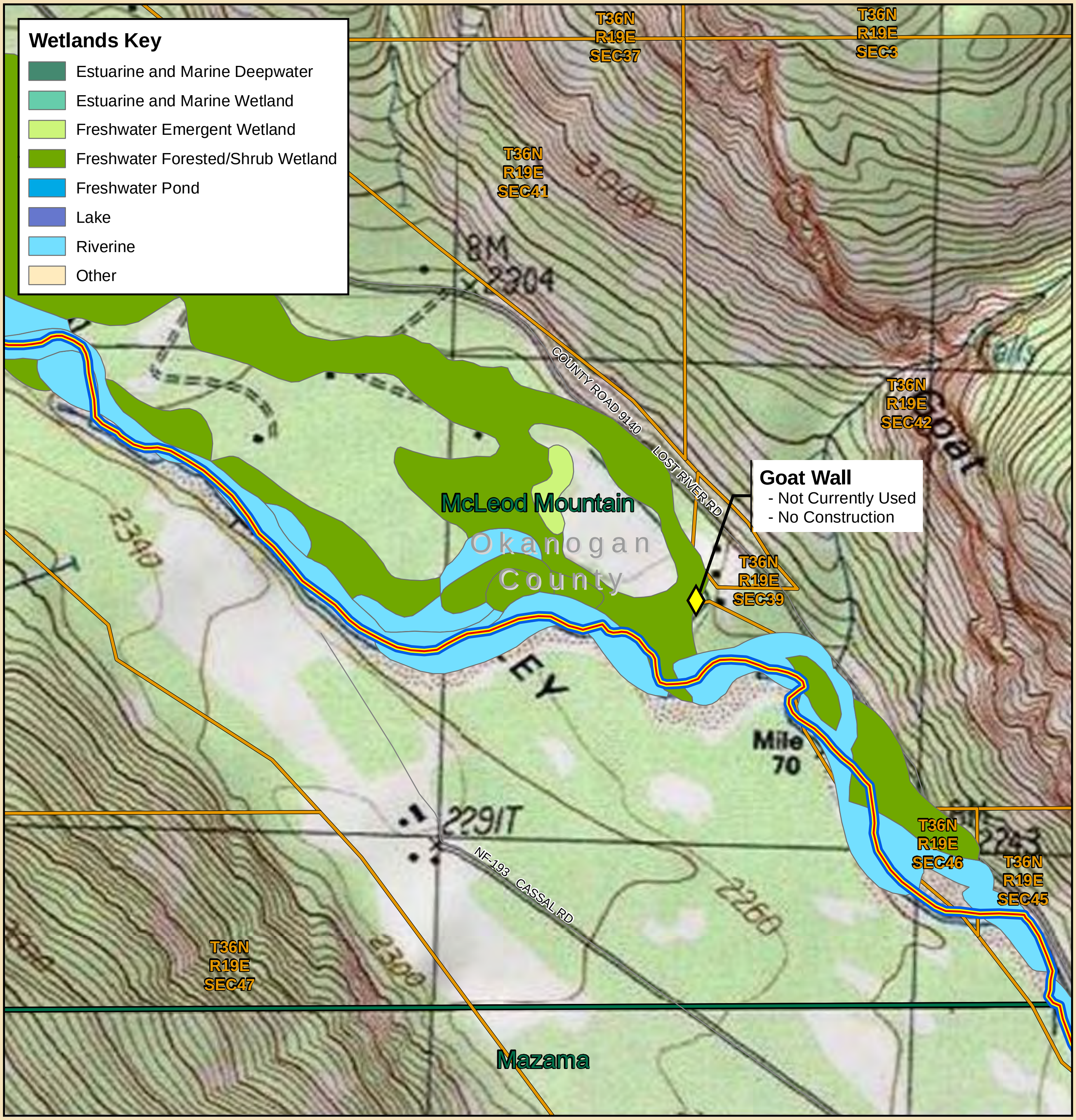


Figure 10y - Goat Wall

McLeod Mountain Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

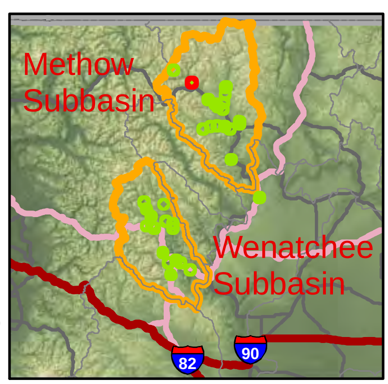
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



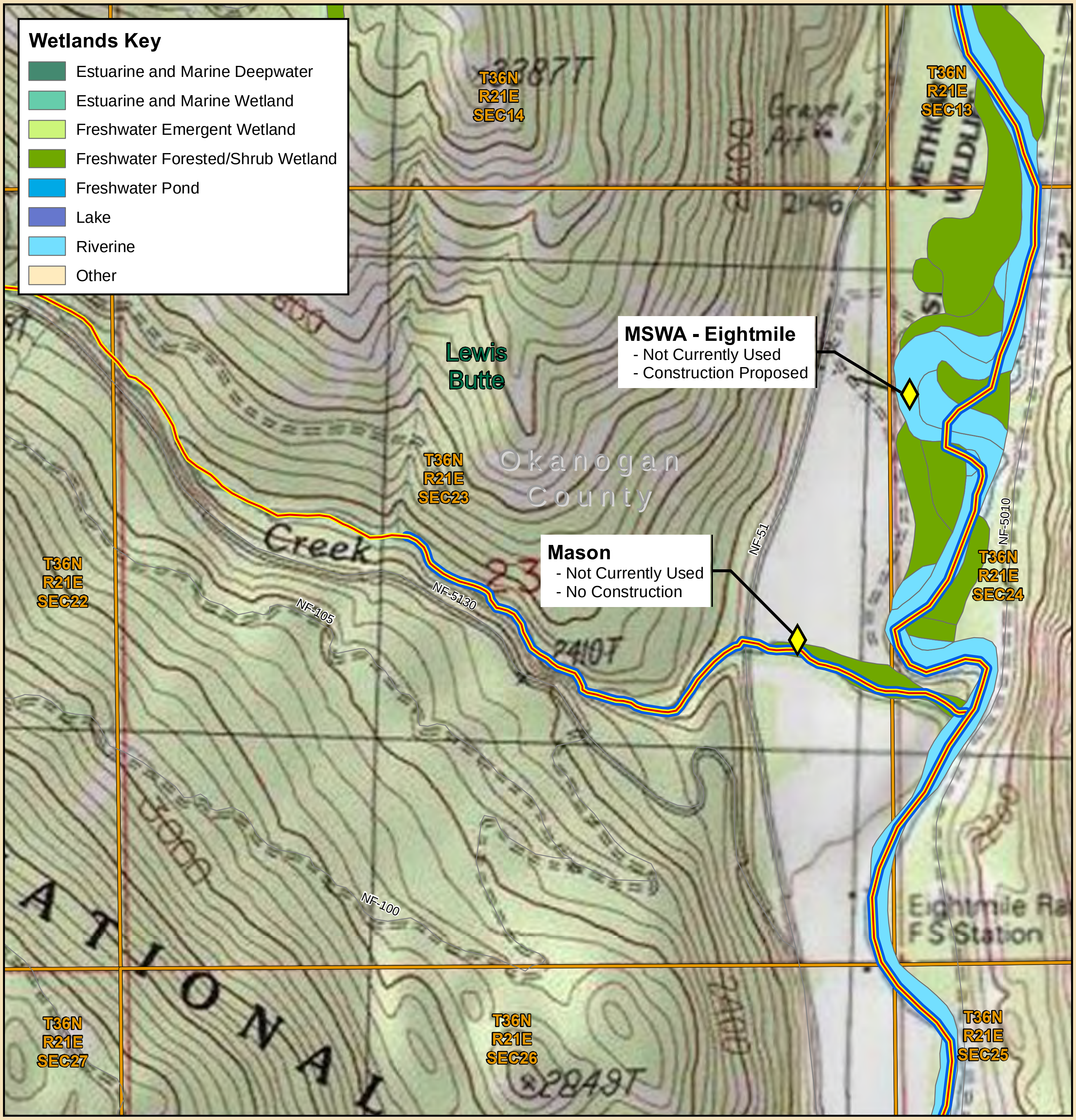


Figure 10z – Mason and MSWA Eightmile

Lewis Butte Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

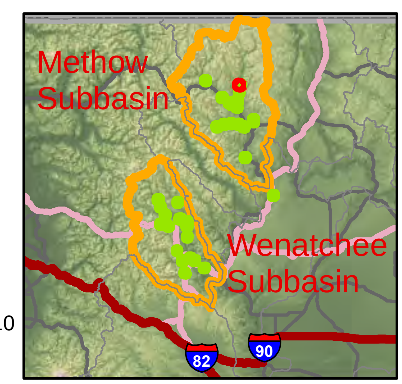
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



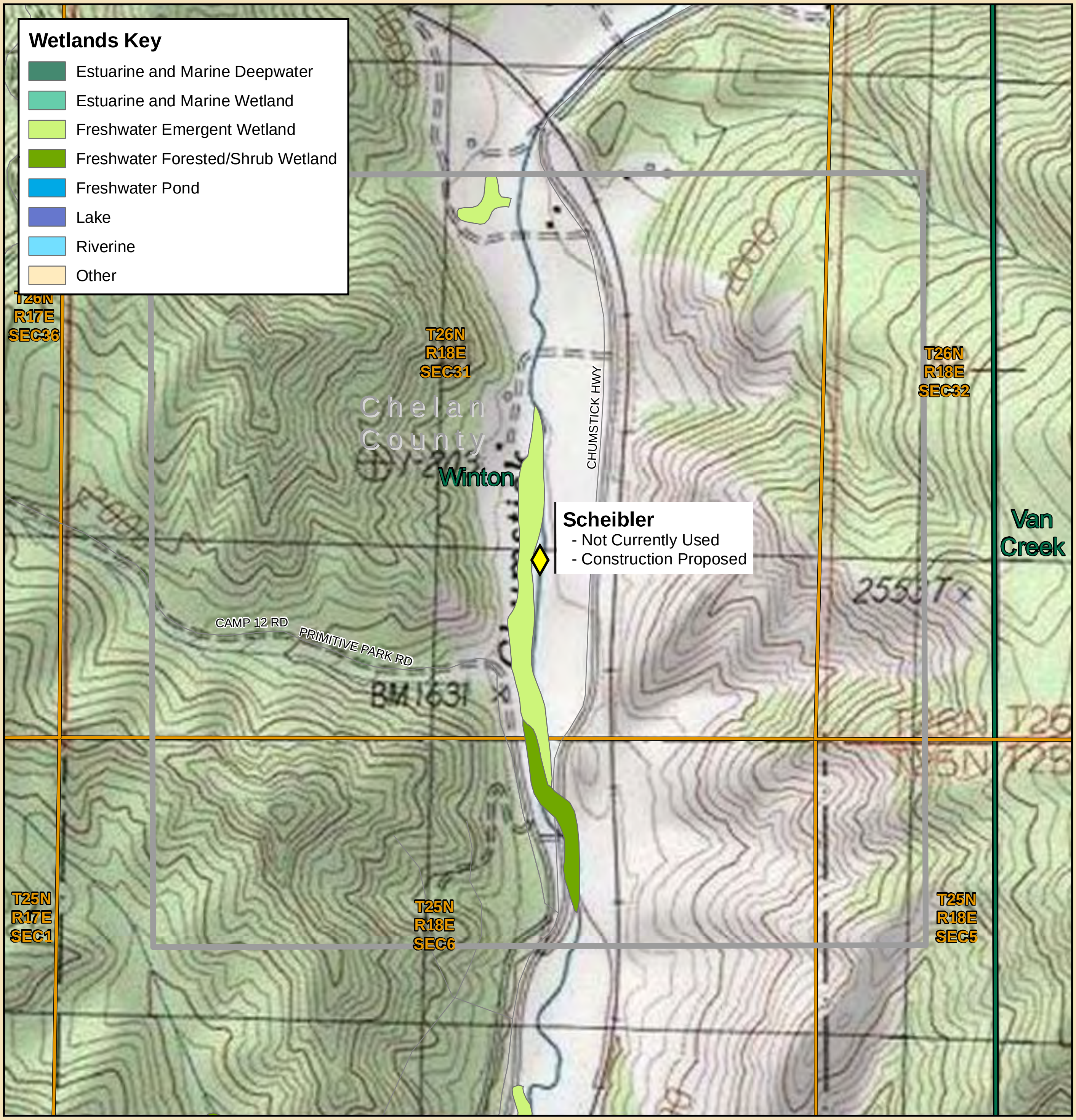


Figure 10ab - Scheibler

Slate Peak Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

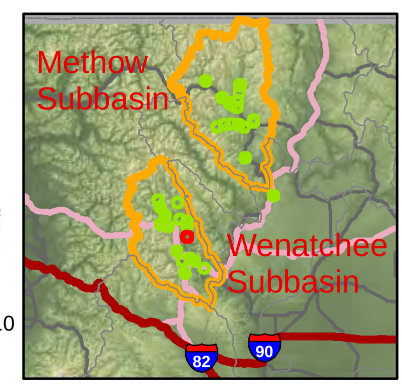
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE

November 1, 2010

0 500 1,000 2,000 Feet



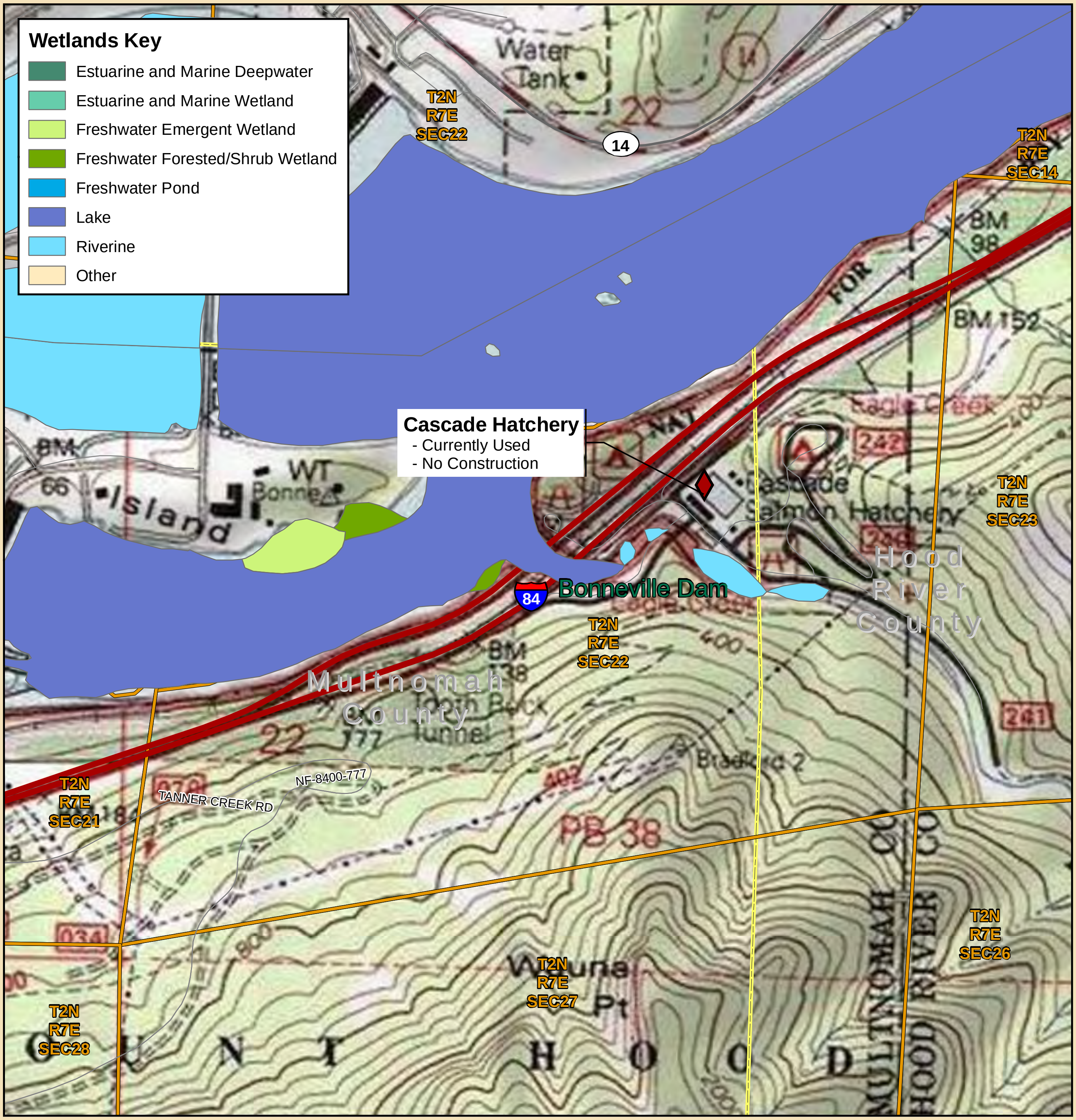


Figure 10ac - Cascade Hatchery

Bonneville Dam Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet

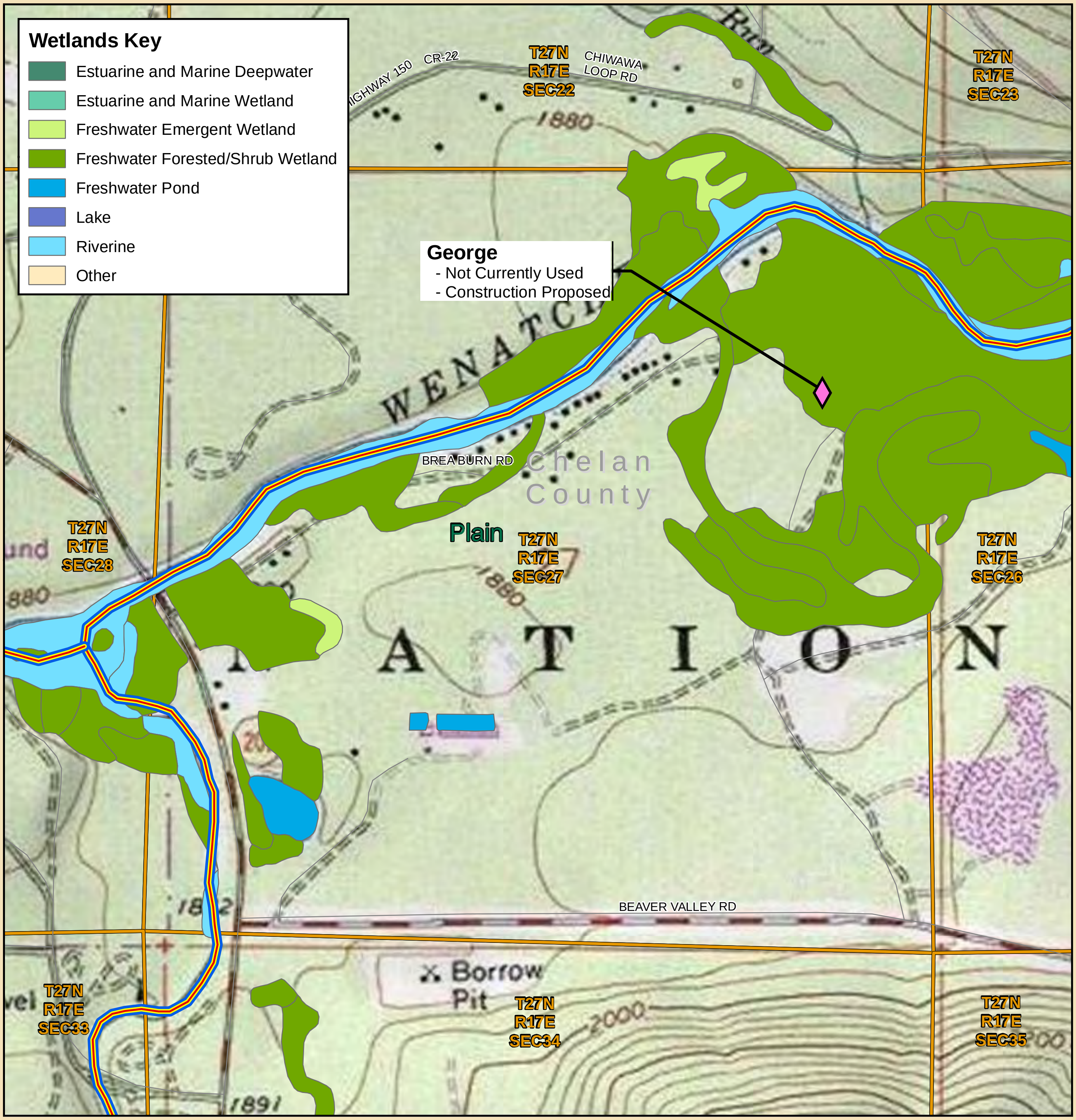


Figure 10ad - George

Plain Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

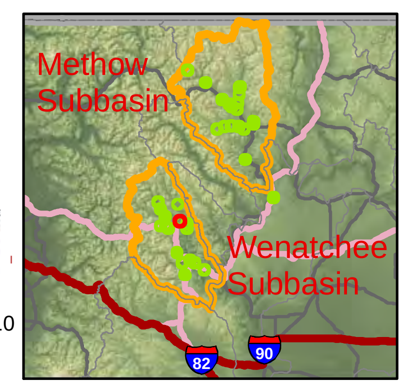
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE POWER ADMINISTRATION

November 1, 2010

0 500 1,000 2,000 Feet



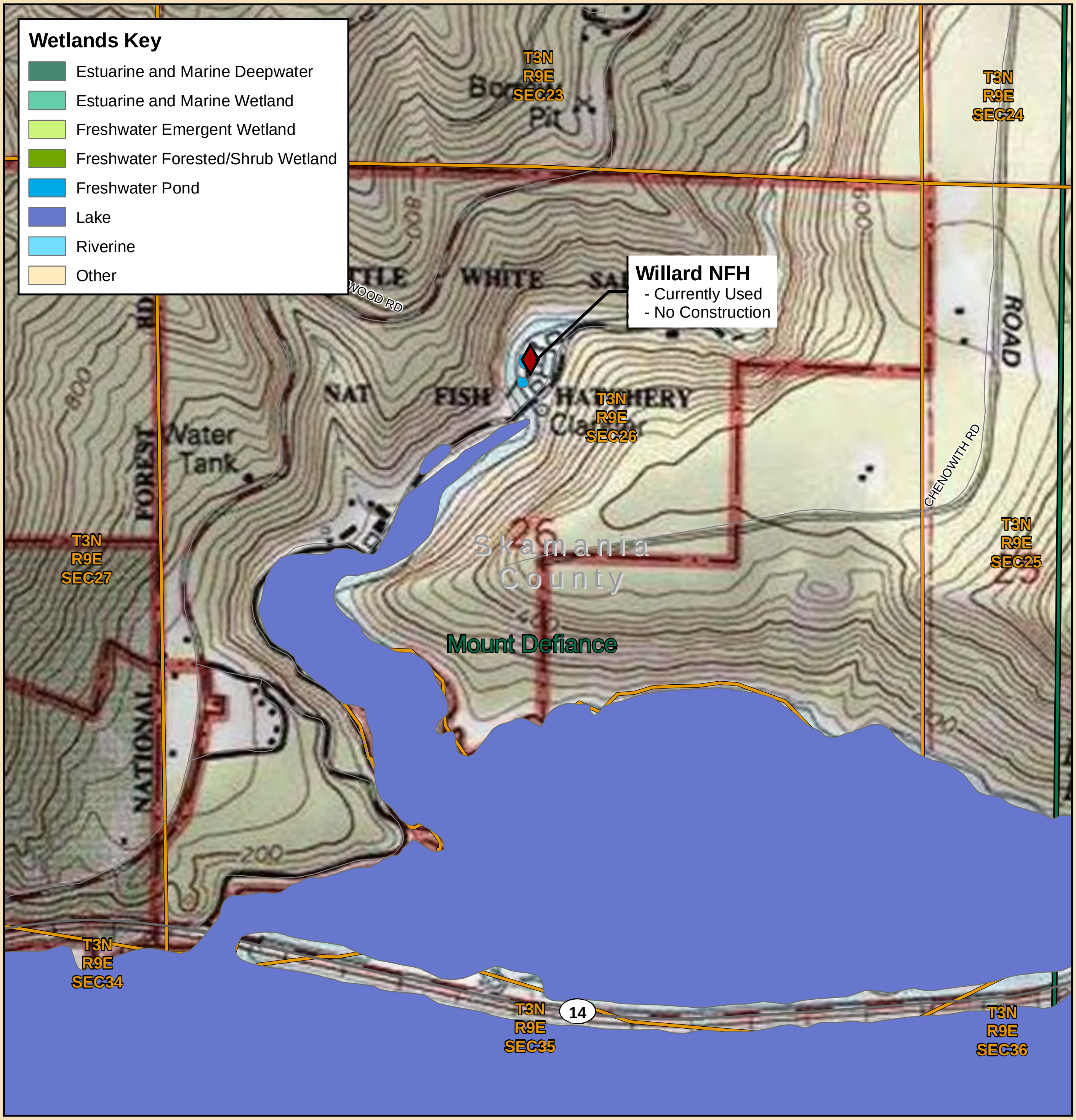


Figure 10ae - Willard NFH

Mount Defiance Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet

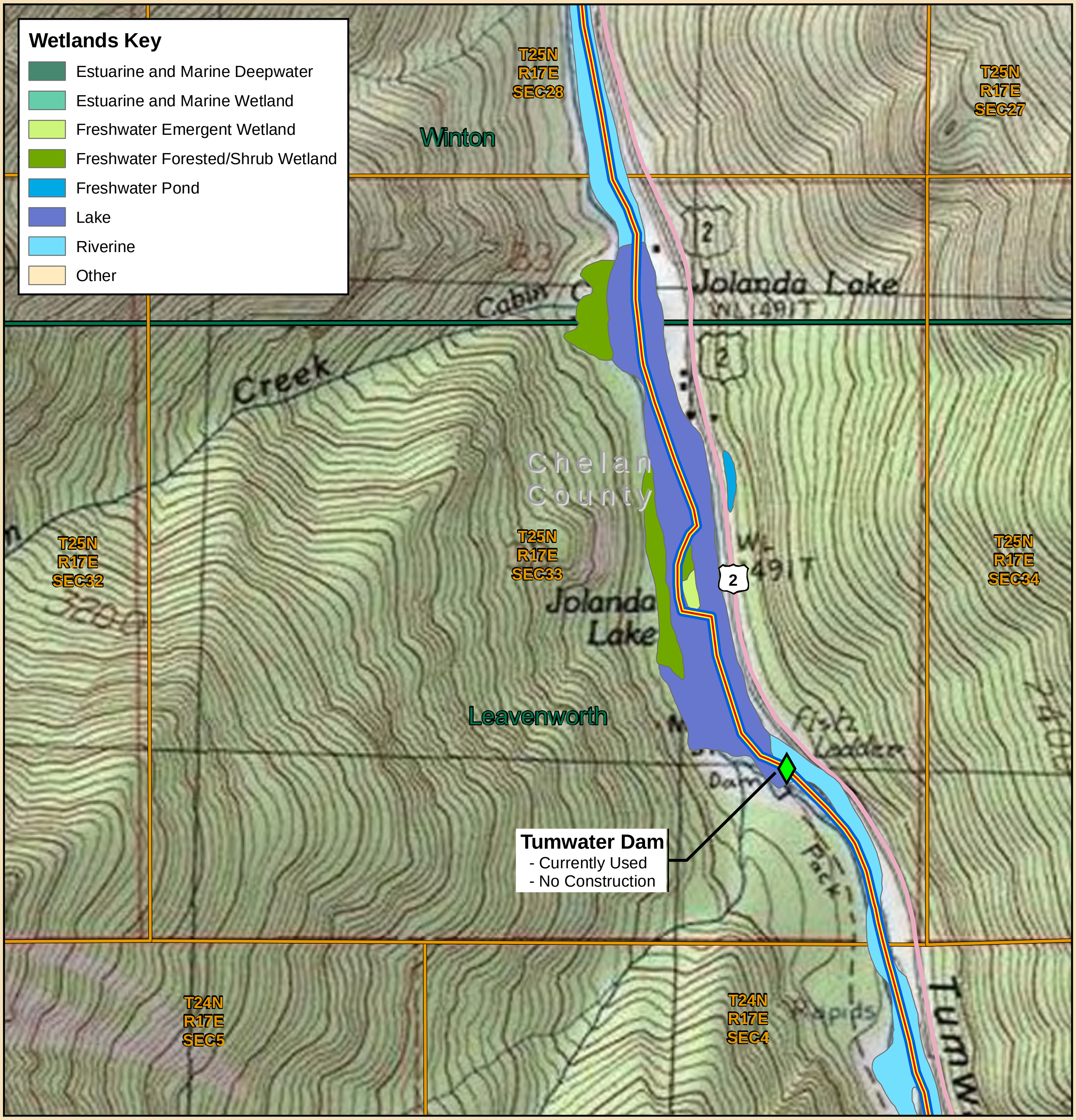


Figure 10af - Tumwater Dam

Leavenworth Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

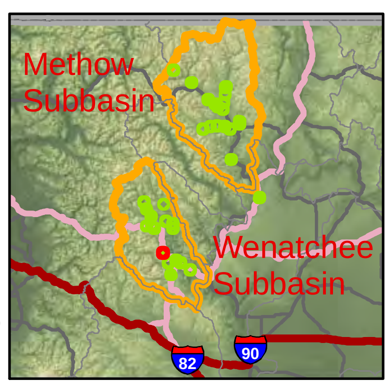
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE

November 1, 2010

0 500 1,000 2,000 Feet



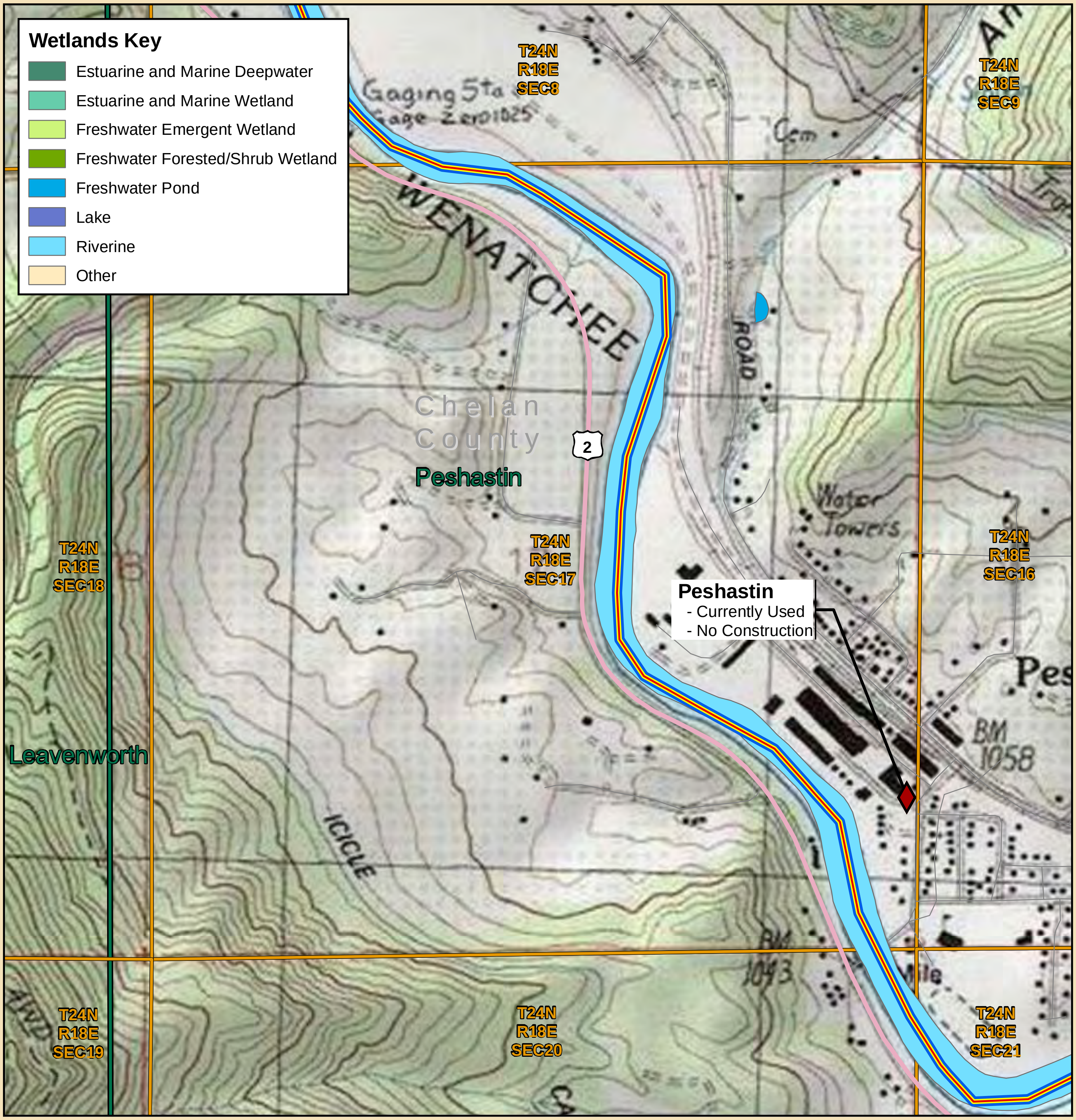


Figure 10ag - Peshastin

Peshastin Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

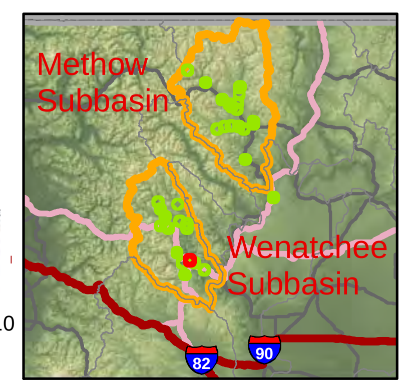
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE

November 1, 2010

0 500 1,000 2,000 Feet



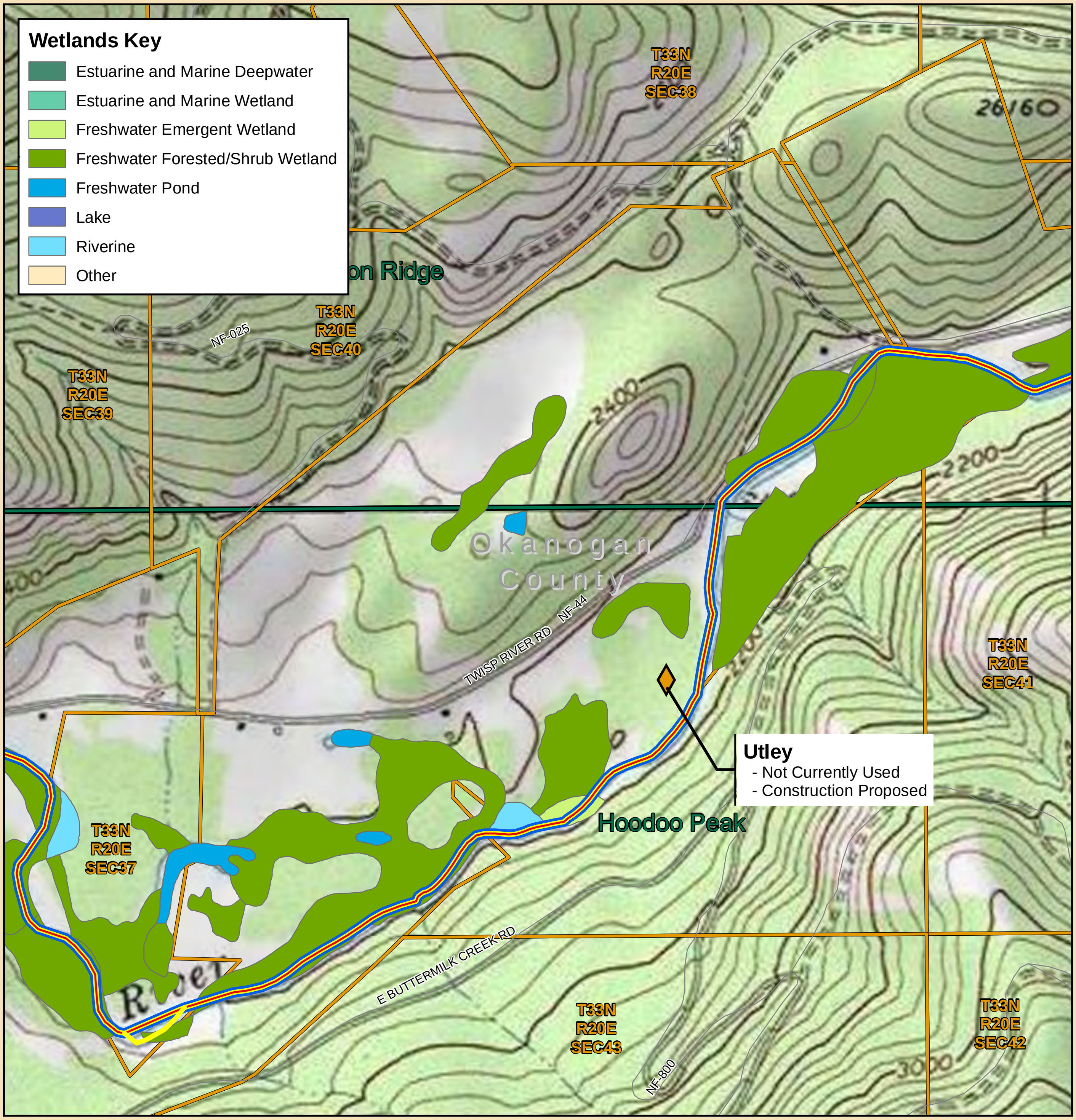


Figure 10ah - Utley

Hoodoo Peak Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

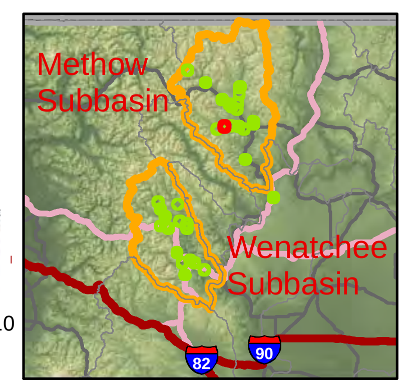
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



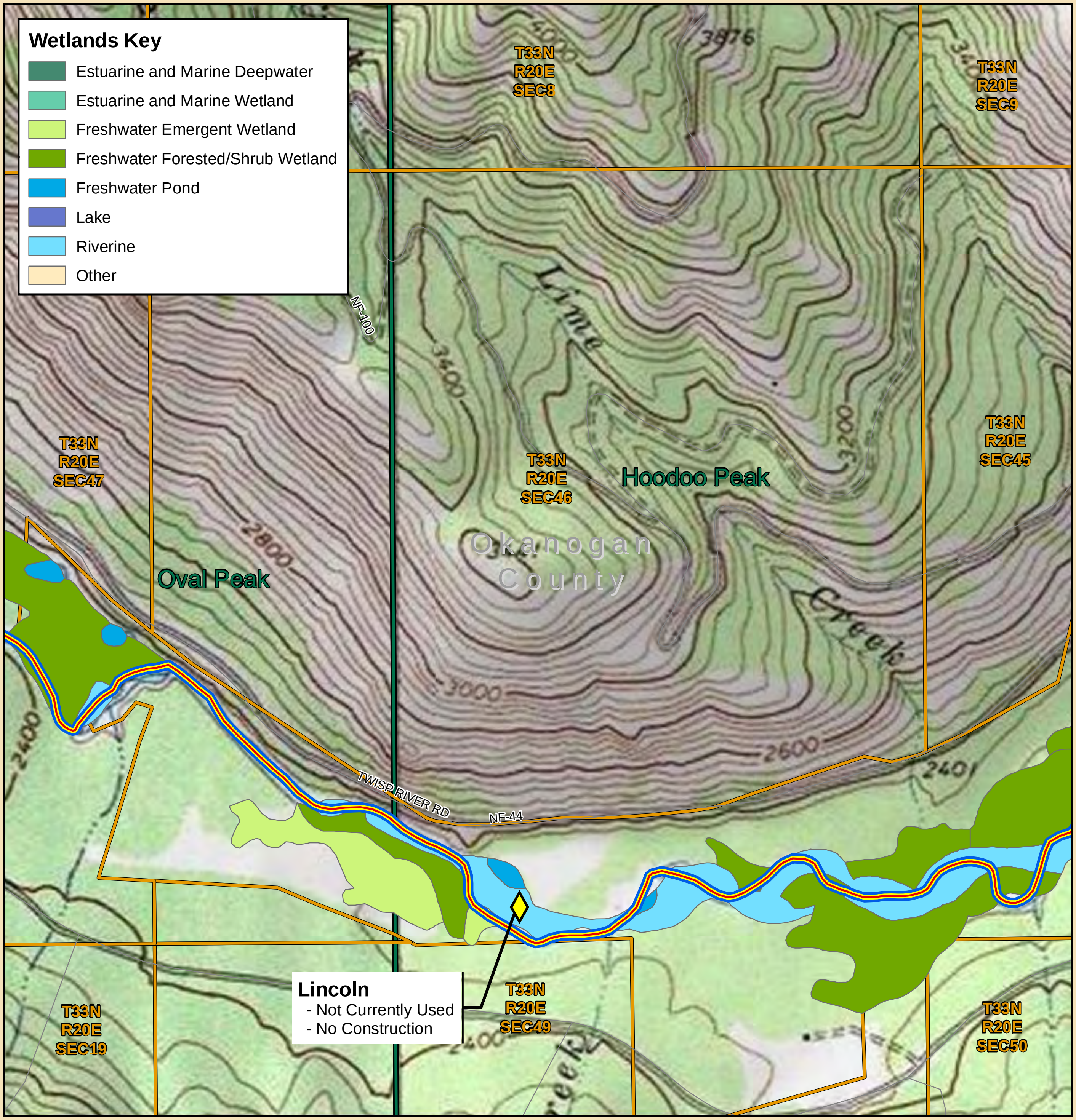


Figure 10ai - Lincoln

Hoodoo Peak Quadrangle

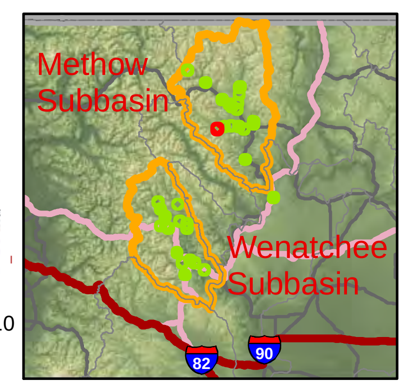
Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



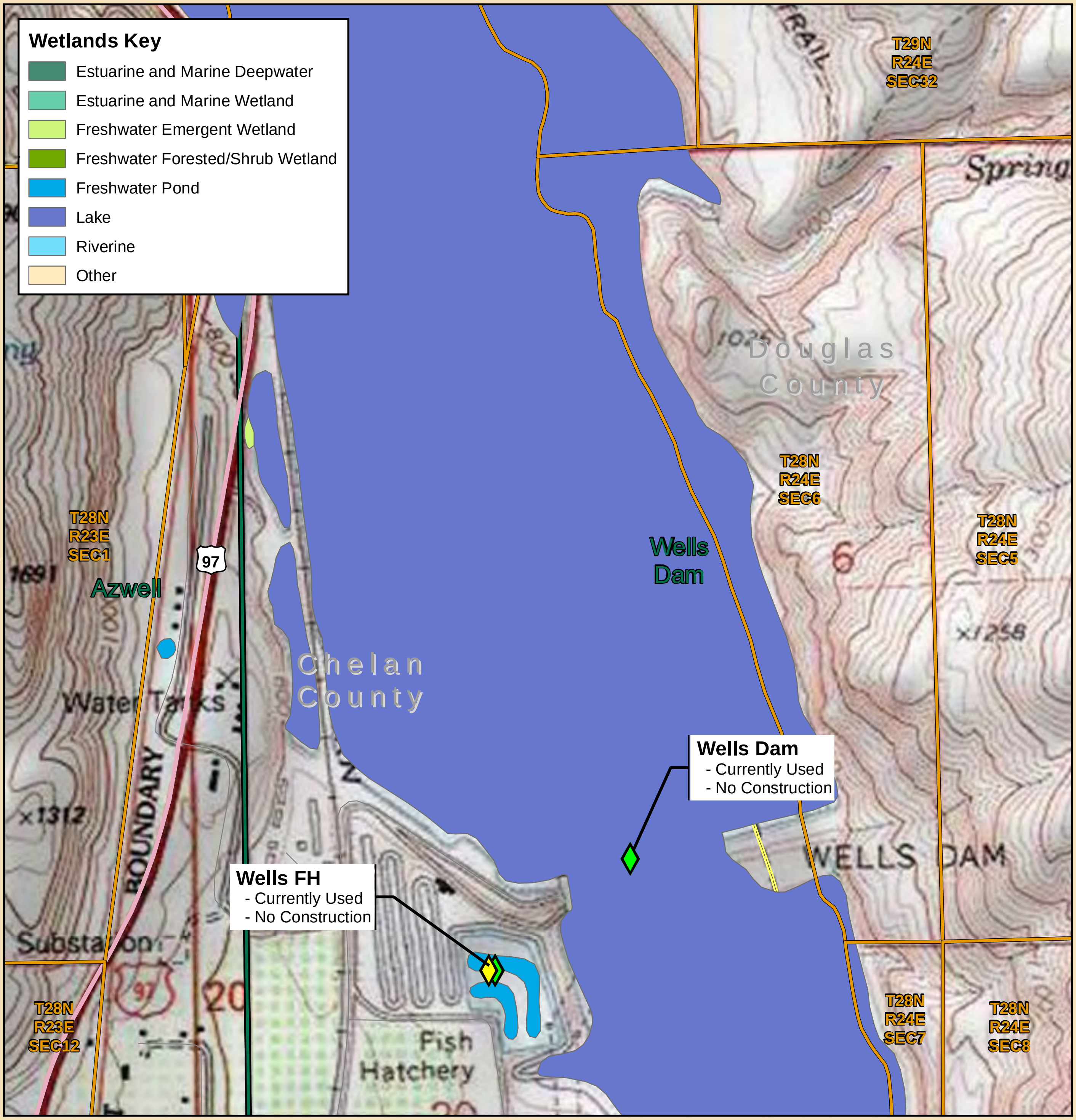


Figure 10aj - Wells Dam and Fish Hatchery

Wells Dam Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet

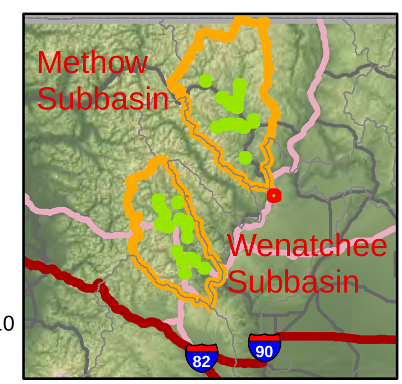
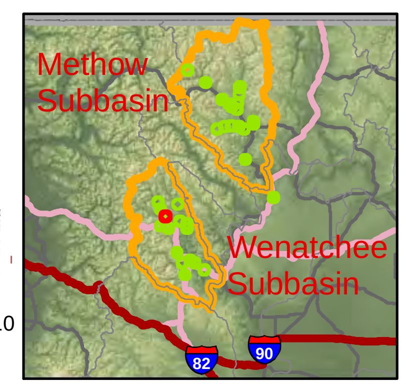


Figure 10ak - Two Rivers

Lake Wenatchee Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action



Appendix 5. Monitoring and Evaluation Program

Note: This section has been adapted from the Mid-Columbia Coho Restoration Master Plan (YN 2010). For further information and for a list of cited references, see the Master Plan.

Summary

Table 7-1 summarizes the M&E plan. References to activities for BDP1 are left in the table to show the monitoring that was done for that phase, which is now completed in both basins, and the continuity of program monitoring.

Table 5-1. Summary of M&E activities

M&E Activity	Indicator Measured	Strategy	Restoration Phases	Coordinated with other programs?
Release-to-McNary survival	Project Performance	PIT tags	BDP1, BDP2, NPIP, NPSP[1]	No
In-pond survival	Project Performance	PIT tags Predation control	BDP1, BDP2, NPIP, NPSP[1]	No
Pre-release fish condition	Project Performance	Physical examination	BDP1, BDP2, NPIP, NPSP	No
Volitional release run-timing and tributary residence	Project Performance / Species Interaction	PIT tags Smolt trapping	BDP1, BDP2, NPIP, NPSP[1]	Yes: Integrated Status & Effectiveness Monitoring Program (ISEMP) (BPA project #2003-017-00); CCPUD/ DCPUD HCP Hatchery Programs; GCPUD Hatchery Programs
Spawning escapement and distribution	Project Performance	Redd counts Carcass recovery Radio-telemetry CWT	BDP1, BDP2, NPIP, NPSP	No
Natural smolt production	Project Performance	Smolt trapping CWT	BDP1, BDP2, NPIP, NPSP[2]	Yes: ISEMP; CCPUD/ DCPUD HCP Hatchery Programs; GCPUD Hatchery Programs
Egg-to-emigrant survival	Project Performance	Smolt trapping Redd counts CWT	BDP1, BDP2, NPIP, NPSP[2]	Yes: ISEMP; CCPUD/ DCPUD HCP Hatchery Programs; GCPUD Hatchery Programs
Adult-to-adult survival	Project Performance	Adult trapping Redd counts Carcass recovery CWT	BDP1, BDP2, NPIP, NPSP	No
Adult-to-adult productivity	Project Performance	Adult trapping Carcass recovery CWT Scale analysis	NPIP, NPS	No

[1] PIT tags will be used during NPSP if smolt-to-adult rates are not meeting program goals and further investigation into survival is warranted.

[2] Natural smolt production and egg-to-emigrant survival estimates will be specific to release tributaries during NPIP and NPSP, and basin-wide during BDP1 and BDP2.

Table 5-1 (continued)

M&E Activity	Indicator Measured	Strategy	Restoration Phases	Coordinated with other programs?
Harvest rates	Project Performance	CWT Scale analysis Database queries	BDP1, BDP2, NPIP, NPSP	Yes: Coordinated with harvest management agencies
NTTOC – Size structure	Species Interactions	Smolt trapping	BDP1, BDP2, NPIP, NPSP[3]	Yes: ISEMP; CCPUD/ DCPUD HCP Hatchery Programs; GCPUD Hatchery Programs
NTTOC – Abundance and survival	Species Interactions / Status of NTTOC	Smolt trapping Underwater observation	BDP1, BDP2, NPIP, NPSP[3]	Yes: ISEMP; CCPUD/ DCPUD HCP Hatchery Programs; GCPUD Hatchery Programs
NTTOC – Distribution	Species Interactions / Status of NTTOC	Redd counts Underwater observation	BDP1, BDP2, NPIP, NPSP[3]	Yes: ISEMP; CCPUD/ DCPUD HCP Hatchery Programs; GCPUD Hatchery Programs
Competition	Species Interactions / Mechanisms of Interaction	Underwater observation Enclosures Size and growth	NPIP	No
Predation by naturally produced coho on spring Chinook fry	Species Interactions / Mechanisms of Interaction	Smolt trapping Emergence and emigration timing	NPIP	Yes: ISEMP; CCPUD/ DCPUD HCP Hatchery Programs; GCPUD Hatchery Programs
Morphometrics and life history traits	Genetic Adaptability	Adult trapping Redd counts Carcass recovery Smolt trapping CWT	BDP1, BDP2, NPIP, NPSP	Yes: ISEMP; CCPUD/ DCPUD HCP Hatchery Programs; GCPUD Hatchery Programs
Genetic monitoring	Genetic Adaptability	Genetic sampling CWT	BDP1, BDP2, NPIP, NPSP	No
Reproductive Success	Genetic Adaptability	Genetic sampling	BDPII, NPIP, NPSP	No

[3] Baseline NTTOC monitoring during BDP1 and BDP2, effects monitoring during NPIP and NPSP.

M & E Plan Details

The goal of the M&E program is to monitor and evaluate the results of reintroduction so that operations can be adaptively managed to optimize hatchery and natural production while minimizing any negative ecological impacts. Pursuing this goal, research data collection and analysis endeavors to: 1) demonstrate when the reintroduction program is meeting the established phased restoration goals; 2) determine whether a change in status of sensitive species is occurring and whether it is a result of coho reintroduction; and 3) provide science-based recommendations for management consideration.

The M&E plan is organized into three distinct categories: Project Performance Indicators, Species Interactions, and Genetic Adaptability. Project performance indicators are intended to evaluate how well reintroduced hatchery fish and the resulting naturally produced fish are surviving and adapting, whether certain reintroduction or hatchery practices can be modified to improve benefits achieved, and whether harvest levels threaten project success. Monitoring of project performance indicators will allow for adaptive management and evaluation of project progress toward successful reintroduction. Species interaction evaluations include monitoring the status of non-target taxa of concern (NTTOC) and investigating mechanisms of interaction (i.e., predation and competition). The species interactions evaluations described in this plan expand on issues examined during the feasibility phase and are integrated with other species monitoring ongoing or proposed in the two basins. Monitoring of genetic adaptability to local conditions is designed to determine whether the project is successfully creating a local broodstock distinct from lower Columbia River stocks in terms of genetic divergence and life history traits; and to determine the biological significance of the changes.

M&E results and plan objectives will be reviewed and revised every six years (two generations) to allow for modification of actions and adaptive management. NTTOC monitoring will continue until program termination, 5 generations (15 years) after starting the natural production phases.

Note: We have left references to Broodstock Development Phase 1 in the text, even though BDP1 has been completed in both subbasins, to show the continuity of the M&E program throughout the project.

5.1 Project Performance Indicators

5.1.1 Release-to-McNary Smolt Survival

Objective: To estimate smolt-smolt survival (release to McNary Dam) for hatchery coho released in mid-Columbia tributaries.

***Metric**:* Smolt-to-smolt survival index (Neeley 2004)

$$\text{Smolt-to-Smolt Survival Index to McNary} = \frac{\sum_{\text{Strata}} \text{Estimated Number of tagged Fish passing McNary during stratum}}{\text{Number of Fish tagged or released}}$$

Rationale: Mullan et al. (1992) and Chapman et al. (1994a; 1994b; 1995a; 1995b) recognize that a central limitation to building self-sustaining populations of anadromous fish in Wenatchee and Methow subbasins is the high smolt and adult mortalities incurred at the numerous hydropower facilities on the mainstem Columbia River. Mortalities related to hydropower facilities can severely reduce the escapement numbers. Salmon abundance is also heavily influenced by ocean conditions. Freshwater conditions reflect variability within a broader spectrum of population abundance that is largely controlled by ocean conditions (Mullan et al. 1992; Nickelson 1986). Therefore, we feel it is important to monitor survival of hatchery juveniles in freshwater to help partition smolt-to-adult survival of hatchery reared program fish into the components of freshwater and marine mortality.

Smolt-to-smolt survival rates will be used to compare the "quality of smolt" produced by different rearing strategies, acclimation sites, acclimation duration, and time of release. Smolt-to-smolt survival indices will be used to evaluate rearing strategies and rearing facilities, to include current and proposed facilities, evaluations of growth rates, acclimation length, and smolt size. Knowing how rearing and environmental conditions affect smolt survival allows researchers to adaptively manage the reintroduction effort to maximize survival. Smolt-to smolt survival indices will be used to parse out that portion of mortality that is occurring during emigration.

Restoration Phases: BDP1, BDP2, NPIP. Smolt-to-smolt survival rates will be measured during the Support Phases if smolt-to-adult rates are not meeting program goals and further investigation into survival is warranted.

Methods: Groups of juvenile coho, ranging from 3,500 to 8,000 individuals, depending upon release location, will be PIT-tagged 3-6 months prior to release. PIT-tagged coho will be released from a minimum of one upper Wenatchee River acclimation site, LNFH, and Methow River site. PIT groups will also be released from ponds which have not previously been used for coho acclimation and from sites where smolt-to-adult survival rates are below expectations. All PIT tagging will follow protocols described in the PIT TAG Marking Procedures Manual (CBFWA 1999). When possible, volitional releases will be monitored for PIT tags. Survival estimates will be calculated based on subsequent PIT detections at McNary, John Day, and Bonneville Dams following methods described in Neeley 2007.

5.1.2 In-Pond Survival

Objective: To estimate in-pond (transport-to-release) survival of hatchery coho.

Metric: In-pond survival estimate based on PIT tag releases (Neeley 2007) or predator and mortality observations (Kamphaus and Murdoch 2008).

Rationale: In-pond survival estimates will increase the accuracy of smolt-to-adult and smolt-smolt survival estimates. In-pond survival estimates will be used to evaluate the success of acclimation ponds and predator control strategies, allowing researchers to maximize survival through adaptive management.

***Restoration Phases*:** All phases.

Method: Groups of approximately 3,500 to 8,000 juvenile coho will be PIT tagged 3-6 months prior to release (see **Section 7.1.1 Release-to McNary Smolt Survival**). In-pond survival estimates based on PIT tags are possible only in ponds with monitored releases. In-pond survival based on PIT tags will be calculated following methods described in Neeley 2007. In-pond survival rates from acclimation sites that do not have PIT tag detection capability will be estimated based on moribund fish, numbers of predators observed, and predator consumption rates (Kamphaus and Murdoch 2008).

5.1.3 Pre-Release Fish Condition

Objective: To provide a comparative measure of fish condition and stage of smoltification prior to release.

Metric: Stage of smoltification will be measured as the proportion of fish which, upon visual examination, appear to be smolts, transitional (in the process of becoming a smolt), or parr. Fish condition will be assessed not only on size and growth accrued during acclimation but also on morphological and physiological measures such as overall condition of fins and eyes; of internal organs (e.g., kidney, liver, spleen, etc.); and of mesenteric fat levels and blood components (% volume of red and white blood cells, plasma protein levels).

Rationale: Pre-release fish condition examinations are intended to assess the normality or overall health of the population. These examinations will allow researchers to compare fish condition between ponds and between years as a measure that may affect survival.

Restoration Phases: All phases.

Methods: A random sample of 100 fish from each acclimation pond will be used to measure stage of smoltification and growth weekly until release. The pre-release fish condition assessment will be done once within 72 hours of release. Detailed methods describing how stage of smoltification is determined and how pre-release fish condition examinations are conducted can be found in Kamphaus and Murdoch 2008.

5.1.4 Volitional Release Run-Timing and Tributary Residency

Objective: To describe volitional release patterns, peak migration from acclimation ponds, duration of time spent in tributaries post-release, and run timing to McNary Dam.

Metric: Run timing, in hours, calculated from PIT tag detections during monitored releases to recapture in tributary traps (i.e., smolt traps), in-stream PIT tag arrays, and Columbia River PIT detection facilities.

Rationale: Knowing tributary residence time will enable researchers to better understand the potential for interaction between hatchery coho and listed and sensitive species (see **Section 7.2 Species Interactions**). We will examine the relationship between volitional exit date and tributary residence time, allowing for programmatic changes to minimize potential negative interactions. The correlation between volitional exit date and smolt-smolt survival may also enable researchers to maximize survival of hatchery fish by releasing hatchery coho at an optimal time.

Run timing is a life history attribute which may change with the development of a local broodstock (see **Section 7.3.1 Morphometrics and Life History Traits**). As natural production increases during the NPIP and Support Phases, run timing will be measured for both naturally produced and hatchery coho based on the distribution of migrating naturally produced coho captured in tributary smolt traps.

Method: Using the same groups of 3,500 to 8,000 PIT-tagged juvenile coho as described in **Section 7.1.1 Release-to-McNary Smolt Survival**, tributary residence time will be calculated from ponds with PIT tag detection capabilities (e.g., Butcher Creek Pond, Rohlfing's Pond, Beaver Creek Pond Coulter Creek Pond, Winthrop NFH back-channel and Lower Twisp Ponds). Dates and times of reported recaptures in tributary traps and Columbia River PIT tag interrogation facilities will be used to calculate residence time and run timing.

5.1.5 Spawning Escapement and Distribution

***Objective*:** To estimate in-basin spawning escapement and distribution for both hatchery origin returns (HORs) and natural-origin returns (NORs).

Metric: Annual redd counts, escapement estimates and spawning ground composition.

***Purpose*:** Redd counts will provide an estimate of spawning escapement and distribution of reintroduced coho salmon. The counts, along with spawning composition (pNOS and pHOS) and distribution, will allow researchers and managers to determine the efficacy of the reintroduction effort, collect empirical productivity data and determine whether spawning ground composition goals for each phase are being met.

Hypotheses:

- Implementation Phase – H_o: pHOS ≤ 90%
- Support Phase (1) – H_o: pHOS ≤ 75%
- Support Phase (2) – H_o: pHOS ≤ 65%

Restoration Phases: All phases.

Method: Spawning escapement and distribution will be evaluated in terms of redd counts and an estimate of fish per redd (based on sex ratio observed at in-basin trapping facilities). Spawning ground surveys will be conducted in all tributaries where juvenile coho have been released and other tributaries that have coho spawning attributes such as low gradient, adequate winter flow and small gravel (about 25 mm) (Quinn 2005). Radio-telemetry or PIT tagging techniques could be used, particularly during the natural production phases, to identify previously unknown coho spawning locations, to ensure that all spawning reaches are surveyed, and to identify spawning locations of straying coho. A description of protocols for both spawning ground surveys and radio telemetry can be found in Murdoch et al. 2005.

5.1.6 Natural Smolt Production

Objective: To provide a population estimate of naturally produced coho smolts emigrating from the Wenatchee and Methow rivers.

Metric: Population estimates of both spring and fall emigrating coho with 95% confidence intervals.

Rationale: Natural smolt production estimates are a measure of productivity. Smolt production estimates will be used to evaluate program progress and success in terms of egg-to-emigrant survival rates and smolt-to-adult survival rates. Natural smolt population estimates during all phases are essential to accurately measure key project performance indicators, such as smolt-to-adult survival rates.

While the broodstock development phases primarily focus on the development of a local broodstock rather than on natural production, some natural production will occur during these early phases, likely in a geographically limited area. Fish trapping facilities at Dryden Dam are not 100% efficient, presumably resulting in some natural production on a limited geographical scale. It is important to collect data regarding natural production during the broodstock development phases because early measures of productivity (e.g., smolts per spawner, egg-to-emigrant survival, etc.) on a basin-wide scale will provide a rough baseline measure of the success of natural spawners prior to the natural production phases.

Restoration Phases: All Phases.

Methods: Operation of rotary smolt traps, protocols for fish handling, and data analysis will proceed as described in Murdoch et al. (2005) and Hillman (2004). Traps will be operated annually between March 1 and November 30.

Broodstock Development Phases: During broodstock development phases we will coordinate with ongoing monitoring activities to reduce duplication of activities.

Currently in the Wenatchee basin, WDFW operates a rotary smolt trap near the town of Monitor. Through a cooperative effort, this trap will be used to provide population estimates for naturally produced coho as it was during the feasibility phase. The YN-operated smolt trap in Nason Creek will provide a tributary-specific population estimate. Similar coordination with WDFW in the Methow basin should provide a basin-wide coho population estimate for the Methow.

Natural Production Phases: All monitoring efforts, including population estimates during the natural production phases, will be coordinated with other co-managers and recovery processes to avoid unnecessary duplication of efforts and cumulative handling effects. In tributaries currently without means of estimating smolt production, the YN proposes to operate either a rotary smolt trap or other sampling equipment during the spring and fall emigration periods to estimate the number of natural coho emigrants.

5.1.7 Egg-to-Emigrant Survival Rates

Objective: To estimate egg-to-emigrant survival rates for naturally produced coho salmon in mid-Columbia tributaries.

Metric: Egg-to-Emigrant Survival (S) will be expressed as the ratio of the estimated number of emigrant coho (C_e) and the estimated number of eggs deposited (E_d).

$$S = C_e/E_d$$

Rationale: The egg-to-emigrant survival rate will provide data to determine which tributaries are most productive for coho production. The relationship between egg-to-emigrant survival and seeding level will assist researchers in developing tributary-specific empirically derived estimates of carrying capacity.

We assume that the freshwater productivity (expressed as an egg-to-emigrant survival rate) will increase as domestication selection is reduced, local adaptation is emphasized and habitat improvement projects are implemented.

Hypothesis:

- H_o: Egg-to-Emigrant Survival $_{\text{Broodstock Development Phases}}$ $\geq$ Egg-to-Emigrant Survival $_{\text{Implementation Phase}}$ $\geq$ Egg-to-Emigrant Survival $_{\text{Support Phase}}$

Restoration Phases: Egg-to-emigrant survival rates will be calculated on a basin-wide scale during the broodstock development phases (i.e., total number of redds vs. total number of emigrants). During the natural production phases we will calculate egg-to-emigrant survival independently in each tributary of reintroduction.

Methods: The number of emigrant coho will be estimated from tributary trap data as described in **Section 7.1.6 Natural Smolt Production**. The number of eggs deposited will be calculated from the number of redds observed (see **Section 7.1.5 Spawning Escapement and Distribution**). Both basin-wide and tributary specific estimates will be calculated.

5.1.8 Smolt-to-Adult Survival (SAR)

Objective: To measure smolt-to-adult survival for hatchery and natural origin coho.

Metric: Smolt-to-adult survival will be calculated as follows:

$$S_{\text{smolt-adult}} = \text{Adults and Jacks}_{\textbf{broodyear X}} / \text{Smolts}_{\textbf{broodyear X}}$$

Where $S_{smolt\text{-}adult}$ is the estimated smolt-to-adult survival rates; Adults and Jacks $_{\mathbf{broodyear}\ X}$ is the number of adult coho to return from broodyear *X* ; Smolts $_{\mathbf{broodyear}\ X}$ is the population of emigrating smolts.

Rationale: For hatchery fish, smolt-to-adult survival will be used to test the premise that SARs will increase with the development of a local broodstock. SARs will also be used to compare the "quality of smolt" produced by different rearing strategies, acclimation sites, acclimation duration, and time of release. Knowing how smolt-to-adult survival indices correlate with rearing and environmental conditions will allow researchers to adaptively manage the reintroduction effort to maximize survival. The SARs will be used to evaluate rearing strategies and rearing facilities to maximize survival. Evaluations will include facility comparisons (currently ongoing), comparisons of growth rates, smolt size, and acclimation length (currently ongoing).

We assume that the survival of Wenatchee and Methow coho will increase as domestication selection is reduced, local adaptation is emphasized and habitat improvement projects are implemented.

Hypothesis:

- H_o: Smolt-to-Adult Survival $_{\text{Broodstock Development Phases}}$ ≥ Smolt-to-Adult Survival $_{\text{Implementation Phase}}$ ≥ Smolt-to-Adult Survival $_{\text{Support Phases}}$

Methods: SARs will be calculated for both naturally and hatchery produced coho. We plan to mark 100% of the hatchery fish released under this program with CWTs. CWTs will be used to calculate SARs from each release group and location, and will be used to distinguish hatchery from natural fish (no CWT). Pre-release CWT retentions will be used to estimate the number of fish with CWTs released. To verify origin, scale samples will be taken from all adult coho that do not have a CWT. During the broodstock development phases, SARs for hatchery and naturally produced coho will be calculated based upon the number of smolts released (hatchery), smolt emigration estimates from WDFW's Methow and Wenatchee river smolt traps, and CWTs recovered from hatchery and naturally produced coho collected at Dryden Dam for broodstock. During the natural production phases, tributary-specific SARs may be based on carcass recovery and tributary population estimates, in addition to the basin-wide metric described above.

5.1.9 Adult-to-Adult Productivity

Metric: Adult productivity will be measured in the Wenatchee and Methow broodstock collection facilities and on the spawning grounds (through carcass recovery) for naturally spawning fish. Adult-to-adult survival will be calculated as follows:

$$P_{adult} = S_2/S_1$$

Where P_{adult} is the estimated adult-to-adult survival; S_2 is the number of returning adults (including jacks); and S_1 is the number of adults from the parent brood year producing the S_2 returning adults. A P_{adult} value that averages greater than 1.0 over several generations indicates that the population is increasing.

Rationale: The adult-to-adult survival rate measures the productivity of reintroduced coho, providing an overall indicator of project success. During the NPIP, P_{adult} may indicate which tributaries are the most productive.

We assume that the productivity of Wenatchee and Methow river coho salmon will increase as domestication selection is reduced, local adaptation is emphasized and habitat improvement projects are implemented.

Hypothesis:

- H_o: $P_{\text{Broodstock Development Phases}} \geq P_{\text{Implementation Phase}} \geq P_{\text{Support Phases}}$

Restoration Phases: Natural Production Phases

Methods: Coho collected for broodstock and naturally spawning coho carcasses will be interrogated for the presence of CWTs. Scales will be taken from coho that are not marked with a CWT to confirm origin. These data will be used in calculations described under ***Metric***.

5.1.10 Harvest Rates

Objective: Estimate out-of-basin harvest rates of program fish in order to determine if harvest rates are likely to limit project success.

Rationale: Harvest may have been a significant factor in the disappearance or reduced number of coho in both the distant and recent past. Currently, the majority of coho in the Columbia River are produced and released below Bonneville Dam. The historical intent of this production was to supply coho for the 80-90% exploitation rate by ocean and lower Columbia River fisheries. However, since the period 1988-1993, harvest rates of coho (commercial ocean troll and recreational) have decreased by approximately 25% (PFMC 1999). Harvest reductions were the result of mixed stock fishery issues related to the Endangered Species Act. Coho released under this project are subject to the following fisheries: ocean commercial troll fisheries, ocean recreation fisheries, Buoy 10 recreational fisheries, lower Columbia River commercial fisheries, lower Columbia River recreational fisheries, Zone 6 (Bonneville to McNary dams) Treaty Indian commercial fisheries, and above-Bonneville Dam recreational fisheries. All recreational fisheries and the ocean commercial troll fisheries are selective for adipose-fin-clipped fish. Harvest mortality for project fish in these fisheries will primarily be limited to incidental mortality, so we have no ability to recover CWTs from these fisheries. The Columbia River commercial coho fisheries (Buoy 10 to Bonneville Dam) do intercept both adipose-clipped and non-clipped fish. All coho captured in this fishery are examined for the presence of a CWT, with an approximate sampling rate of 20%. Presently, harvest monitoring of Treaty Indian fisheries does not include recovery of CWT. Although the total harvest rate on adipose-clipped fish could be as high as 50-60%, the total harvest rate on non-adipose-fin-clipped fish is substantially lower (20-25%) due to the selective fisheries that are likely to remain in place for many years as a result of ESA constraints.

Restoration Phases: All phases.

Methods: We will coordinate with agencies responsible for harvest management (WDFW, ODFW, USFWS, CRITFC, etc.) to estimate the harvest rates of target stocks by querying existing databases that may contain harvest or stray information for program fish.

5.2 Species Interactions

During the feasibility phase, the YN completed several studies to evaluate predation and competition by hatchery coho with listed and sensitive species (Dunnigan 1999; Murdoch and

Dunnigan 2002; Murdoch and LaRue 2002; Murdoch et al. 2004; Murdoch et al. 2005). Results of these studies indicate low predation rates and species-specific habitat segregation (see **Chapter 3**). Stream dwelling salmonids that have evolved in sympatry have developed mechanisms to promote coexistence and to partition the available habitat. Studies with coho salmon and steelhead trout (Hartman 1965; Johnson 1967; Fraser 1969; Allee 1974), Chinook salmon and steelhead trout (Everest and Chapman 1972), Chinook salmon and coho salmon (Lister and Genoe 1970; Stein et al. 1972; Murphy et al. 1989), coho salmon and cutthroat trout (Bjornn 1971; Bustard and Narver 1975; Sabo and Pauley 1997) and coho salmon and dolly varden (Dolloff and Reeves 1990) all support this statement.

Mechanisms to measure negative interactions between hatchery fish and other species have been studied by others (Larkin 1956; Fraser 1969; Stein et al. 1972; Glova 1986; Marnell 1986; Cannamela 1993; Riley et al. 2004), but impacts to non-target species in terms of abundance, distribution and size have not been conclusively measured (Fresh 1997, Pearsons et al. 2004) on a basin-wide scale. Interactions between reintroduced coho and listed and sensitive species will be evaluated through an integrated NTTOC monitoring program. A basin-wide NTTOC monitoring program has been implemented in the Yakima River (Busak et al. 1997, Hubble et al. 2004; Pearsons et al. 2004).

NTTOC status monitoring (**Section 7.2.1**) answers the question “Are there adverse changes in the status of NTTOC in tributaries where coho have been introduced?” NTTOC status monitoring does not answer questions of whether coho caused the changes in NTTOC status or the mechanism of change (e.g., predation, competition, etc.). The studies outlined in **Section 7.2.2** address those causal questions.

Species interaction monitoring will continue for a minimum of six years (two coho generations) during the Support Phases, but may continue longer pending results.

5.2.1 Status of Non-Target Taxa of Concern (NTTOC)

During the feasibility phase of the Mid-Columbia Coho Reintroduction Program, the HGMP (YN et al. 2002) and the mid-Columbia Coho Technical Workgroup (TWG) identified a number of critical uncertainties associated with coho reintroduction and species interactions. Studies implemented during the feasibility phase (see Chapter 3) answer many of those uncertainties, including the rates of predation by hatchery coho on spring Chinook fry and on sockeye fry. One main question remains unanswered, that of the predation rate of naturally produced coho on spring Chinook fry. As stated in Chapter 3, numbers of naturally producing coho were not sufficient to undertake a meaningful study (Murdoch et al. 2005). The study described in **Section 7.2.2.2** proposes to address this remaining question.

With most of the critical uncertainties answered, the proposed NTTOC monitoring plan is designed to integrate the coho reintroduction effort with other ongoing programs to monitor the status of listed and sensitive species. The non-target taxa monitoring program will focus on the status and freshwater residence of spring Chinook and steelhead, but data on all other species encountered, such as bull trout, cutthroat trout, lamprey and sockeye, will also be collected.

We define status as the interaction of abundance, distribution, and size. A change in status is the deviation from baseline conditions. **A change in status does not indicate causation, but if coho reintroduction has a negative impact on listed and sensitive species, decline in status**

would occur. If a decline in status is detected, further investigations into the mechanism of interaction and source of decline are warranted (see **Section 7.2.2**).

To provide baseline data for evaluating effects of coho reintroduction, monitoring will begin during the broodstock development phases when the hatchery coho are released on a geographically limited scale and numbers of naturally spawning coho in tributaries containing spring Chinook and steelhead will be minimal. Baseline monitoring will be done in most tributaries proposed for future coho releases during the natural production phases. Monitoring of changes in tributaries with no previous coho release will occur during the Implementation Phase. The study design will include both a temporal and spatial control. Baseline data collected prior to coho reintroduction will function as a temporal control from which to compare any change in NTTOC status.

The NTTOC monitoring plan builds on, and will be coordinated with, ongoing monitoring efforts in the Wenatchee, Entiat and Methow basins, thus avoiding duplication of efforts and minimizing cumulative handling effects and costs. Existing programs currently collecting data that may be used to help determine a change in status for NTTOC include the Chelan and Douglas County PUD HCP hatchery compensation monitoring and evaluation programs, the developing Grant County PUD hatchery monitoring and evaluation program, and the Integrated Status and Effectiveness monitoring program (ISEMP) (BPA project # 200301700).

This NTTOC monitoring program is designed to provide data to measure the effects of both Type I and Type II interactions. Type I interactions are those that occur between hatchery fish and wild fish, while Type II interaction may occur between NTTOC and the naturally produced offspring of hatchery fish (Pearsons and Hopley 1999).

5.2.1.1 NTTOC Risk Assessment

As one part of the Monitoring and Evaluation Plan for HCP Hatchery Compensation programs (Murdoch and Peven 2005; DCPUD 2005) and the Monitoring and Evaluation Plan for Grant PUD Salmon and Steelhead Supplementation programs (GCPUD 2009), coho salmon will be included in a NTTOC risk assessment. An expert panel will conduct the assessment to evaluate risks associated with potential effects of supplemented Plan Species (including coho salmon) on non-target taxa using an approach similar to that used in the Yakima Basin (Ham and Pearsons 2001). The process is intended to focus on assessing the risks to NTTOC and on identifying interactions, the actions that could be taken to minimize risks, and the level of uncertainty. Both positive and negative species interactions are included in the assessment; a list of interactions and species considered is shown in Table 7-1. The list of species was decided upon by consensus of the Chelan and Douglas County PUD HCP Hatchery Committees.

Table 7-1. List of species and interactions to be considered in the NTTOC risk assessment

NTTOC	Negative Interactions Considered	Positive Interactions Considered
Spring Chinook Steelhead Sockeye	Competition Behavioral anomalies Pathogenic Predation	Prey Nutrient Enhancement

5.2.1.2 Reference Stream Comparisons

For a spatial control, we propose to use the Entiat River as a reference population of Chinook and steelhead from which any observed changes in abundance (as measured through egg-to-emigrant survival rates), distribution, or size can be gauged.

The Entiat River has been proposed by the resource managers (NOAA, WDFW, YN, USFWS, Colville Tribe), Chelan PUD and Douglas PUD as a potential reference stream for both spring Chinook and steelhead, to measure the success of the PUDs' HCP hatchery programs (Murdoch and Peven 2005). As such, analysis to determine the ultimate suitability of the Entiat River as a reference stream for spring Chinook and steelhead, along with the data required to compare changes in size, abundance and distribution would be collected by the HCP monitoring activities funded by CCPUD and DCPUD hatchery compensation programs (Murdoch and Peven 2005). Reference stream suitability criteria have been adapted from the Chelan and Douglas HCP hatchery compensation program M&E plan (Murdoch and Peven 2005) and include the following:

- No recent (within the last 5-10 years) hatchery releases directed at target species
- Similar information of hatchery contribution on the spawning grounds
- Similar fluvial-geomorphologic characteristics
- Similar out-of-subbasin effects
- Similar historic records of productivity
- Appropriate scale for comparison
- Similar in-basin biological components, based upon analysis of empirical information.

The USFWS generates population estimates of juvenile salmonids through rotary trap operation, uses underwater observation techniques to estimate juvenile rearing distribution, and conducts spawning ground surveys for spring Chinook, summer Chinook, and steelhead in the basin. The use of the Entiat River as a potential reference stream for steelhead and spring Chinook precludes the release of these species in the Entiat basin, making the Entiat River similarly a reference stream to gauge potential NTTOC interactions as a result of coho reintroduction in the Wenatchee and Methow.

The continued status of the Entiat River as a reference from which to gauge changes in the status of NTTOC in the Wenatchee and Entiat rivers is currently unknown. Spring Chinook spawning habitat is upstream of the ENFH, and the USFWS rotary smolt trap used to calculate population abundance is located near the facility. A portion of the steelhead production and likely all bull trout production also are upstream of the ENFH.

Use of the Entiat River as a reference stream may also be complicated due to the intensive habitat restoration that is currently ongoing and planned. The ISEMP is testing the effectiveness of habitat restoration actions in the Entiat River. The ISEMP is supporting an accelerated schedule for the implementation of 75-80 in-stream habitat actions defined in Entiat Watershed Plan (CCCD 2004) within a short time frame (goal of 5 years). In relation to the size of the Entiat basin, this is a substantially faster rate of habitat improvement than will take place in the Wenatchee or Methow basins, potentially resulting in a population increase that could preclude the use of the Entiat River as a reference stream.

If it is later determined that the Entiat River is not suitable as a spatial reference, we may need to rely solely on the temporal control to gauge changes in NTTOC status.

5.2.1.3 Status of NTTOC

We define a change in status of NTTOC as a change in size, abundance, or distribution. The following sections describe how we plan to monitoring any change in status of NTTOC as we proceed with coho restoration in the Wenatchee and Methow basins.

The Integrated Status and Effectiveness Monitoring Program (ISEMP), BPA project #2003-017-00, is a statistically robust intensive monitoring framework that builds on current status and trend monitoring infrastructures in the upper Columbia. The intent of the ISEMP project is to efficiently collect data to address multiple management objectives over a broad range of scales, including evaluating the status and trends for anadromous salmonids in their habitat. Since 2004, ISEMP in the Wenatchee and Entiat basins has focused on the design and implementation of a sampling regime and status and trend monitoring program with 67 monitoring indicators (Hillman 2004). This monitoring project targets salmon and steelhead populations and habitat and is implemented in collaboration with the Upper Columbia Regional Technical Team.

Data collected in this intense Status, Trend, and Effectiveness monitoring program will give statistically robust status updates for spring Chinook and steelhead on 5-year intervals. By coordinating with the ISEMP program, we minimize a duplication of sampling effort.

Size Structure

Objective: To monitor size (growth and K-factor) of NTTOC and juvenile coho in all tributaries proposed for coho reintroduction.

***Rationale*:** The size, condition, and growth of NTTOC and juvenile coho, combined with abundance and distribution data, will be used to evaluate the effect, if any, of coho reintroduction. Baseline monitoring during the broodstock development phases will establish trends in size, abundance and distribution of NTTOC prior to the natural production phases. Baseline monitoring in all tributaries with proposed coho releases will provide a temporal control in which to evaluate any changes in NTTOC size.

Hypotheses:

- H_o: NTTOC Size $_{\text{before reintroduction}}$ < NTTOC Size $_{\text{after reintroduction}}$
- H_o: NTTOC Size $_{\text{treatment stream}}$ < NTTOC Size $_{\text{reference stream}}$

***Restoration Phases*:** Baseline monitoring during broodstock development phases; change monitoring during the natural production phases.

Methods: The importance of monitoring size and growth of NTTOC in both the treatment and reference streams prior to reintroduction of coho is emphasized. Because seeding levels and intra-specific competition can influence the size structure of each population, a careful analysis of the relationship between seeding levels, survival, and growth should be established in each tributary (treatment and reference) in order to gauge the change.

We will collect size and condition factor information from the various smolt traps operating within the Wenatchee, Entiat and Methow basins (Nason Creek, Chiwawa River, White River, Upper Wenatchee River, Entiat River, Twisp River and Methow

River). Currently the Nason Creek smolt trap is operated by the YN as a cost-sharing effort between two BPA projects (Project # 1996-040-00 and #2003-017-00) and Grant County PUD. The White River smolt trap is operated by the YN and funded by Grant County PUD. The Chiwawa River trap is operated by WDFW. In the Methow basin, the Twisp and Methow rivers traps are both operated by WDFW. The USFWS operates two rotary smolt traps in the Entiat River (reference populations). Additional baseline and post-reintroduction data will be provided through the ISEMP status and trend monitoring program.

Abundance and Survival

Objective: To measure the abundance and corresponding survival rates for NTTOC in target tributaries.

Rationale: See **Size Structure** above. Abundance of NTTOC, in-terms of population size and survival rates (egg-to-emigrant survival), will be used to evaluate the effect, if any, of coho reintroduction. Baseline monitoring during the broodstock development phases will establish trends in abundance and survival prior to the natural production phases. Abundance and survival monitoring for spring Chinook and steelhead in Nason Creek, Chiwawa River, White River, Wenatchee River, Twisp River, Methow River, and Entiat River are currently on-going or proposed under other programs. We propose to continue this monitoring as baseline and effect monitoring throughout the broodstock development and natural production phases.

Baseline monitoring in all tributaries with proposed coho releases will provide a temporal control. Inclusion of the Entiat River in the monitoring plan will allow for a spatial control or reference stream.

Hypotheses:

- H_o: NTTOC Egg-to-Emigrant Survival $_{\text{before reintroduction}}$ < Egg-to-Emigrant Survival $_{\text{after reintroduction}}$
- H_o: NTTOC Egg-to-Emigrant Survival $_{\text{treatment stream}}$ < NTTOC Egg-to-Emigrant Survival $_{\text{reference stream}}$

Methods: It is important to monitor NTTOC abundance in terms of egg-to-emigrant survival in both the treatment and reference streams before reintroduction of coho. Currently, such monitoring is ongoing in Nason Creek, Chiwawa River, White River, Peshastin Creek, Twisp River, Methow River, and Entiat River. Because seeding levels and intra-specific competition directly influence the egg-to-emigrant survival rate (stock-recruitment curve) of each population, a careful analysis of the relationship between seeding levels, survival, and growth should be established in each tributary (treatment and reference) in order to gauge the change.

Current on-going smolt trapping programs in Nason Creek, Chiwawa River, White River, Wenatchee River, Twisp River, Chewuch River, Methow River and Entiat River will form the basis for the NTTOC abundance and survival estimates. Similar traps on the Little Wenatchee may be proposed for coho natural production monitoring during the natural production phases and will also be used to collect abundance and survival data for the NTTOC monitoring program.

In addition, ISEMP has implemented a PIT tagging program for natural origin juvenile spring Chinook and steelhead in the Wenatchee and Entiat basins. All Chinook and steelhead longer than 60 mm captured at all smolt traps are currently being PIT tagged. Parr rearing in the tributaries captured either by seine nets, electro-fishing, or hook and line are also being PIT tagged. This intensive tagging effort is expected to provide life-stage-specific survival rates for spring Chinook and steelhead rearing in tributary streams over time.

Smolt trap operation for emigrant population analysis will proceed as described in Hillman (2004) and Prevatte and Murdoch (2004). We will follow protocols for underwater observation as described in Thurow (1994) and for electro-fishing in Temple and Pearsons (2004). The same index sites will be monitored annually. Any correlation between egg-seeding level, indexed rearing density, egg-to-emigrant survival, and emigrant population estimates will be analyzed using multiple regression techniques (Zar 1999).

In order to avoid duplication of efforts, NTT abundance and survival monitoring will be closely coordinated with ongoing monitoring and evaluation programs in the Wenatchee and Methow basins, including but not limited to BPA project #2003-017-000 (ISEMP) and M&E activities funded by the mid-Columbia PUDs.

Restoration Phases: Baseline monitoring will proceed as described above during the broodstock development phases in all tributaries proposed for future coho releases. Monitoring of changes will be done during the natural production phases. Any change in NTTOC status during this monitoring will be closely evaluated in subsequent studies such as those described Section 7.2.2, to determine if the coho reintroduction efforts are causing the observed change or if other factors may be involved.

Distribution of NTTOC

Objective: To evaluate the status of NTTOC in terms of their distribution throughout each basin.

Rationale: Data on the distribution of NTTOC and juvenile coho, in combination with abundance and size data, will enable researchers to evaluate changes in NTTOC status during the coho reintroduction process.

Baseline monitoring in all tributaries with proposed coho releases will provide a temporal control. Inclusion of the Entiat River in the monitoring plan will allow for a spatial control or reference stream.

Hypotheses:

- H_o: NTTOC Distribution $_{\text{before reintroduction}}$ < NTTOC Distribution $_{\text{after reintroduction}}$
- H_o: NTTOC Distribution $_{\text{treatment stream}}$ < NTTOC Distribution $_{\text{reference stream}}$

Restoration Phases: Same as for size and abundance monitoring.

Methods: It is important to monitor NTTOC spawning and rearing distribution in both the treatment and reference streams before reintroduction of coho. Currently NTTOC monitoring is ongoing in Nason Creek, Chiwawa River, White River, Peshastin Creek, Twisp River, Methow River, and Entiat River. A careful analysis of the relationship between seeding levels, survival, and distribution should be established in each tributary (treatment and reference) in order to gauge the change.

Distribution will be evaluated in terms of adult spawning distribution (adult spawning distribution data are collected by WDFW and CCPUD) and juvenile rearing distribution, through the annual snorkel and electro-fishing surveys conducted under ISEMP.

5.2.2 Mechanism of Interaction

5.2.2.1 Competition

***Objective*:** To continue to evaluate competition for space and food between naturally produced coho and NTTOC.

Rationale: If the status of NTTOC is determined to have declined, continued investigations into competition between reintroduced coho and NTTOC will help determine the cause of the decline and, if necessary, programmatic changes that can be made to minimize negative interactions between coho (hatchery and/or natural) and NTTOC.

Hypotheses: Possible hypotheses to investigate include the following:

- H_o: NTTOC microhabitat $_{\text{with coho}}$ = NTTOC microhabitat use $_{\text{without coho}}$
- H_o: NTTOC growth $_{\text{with coho}}$ = NTTOC growth $_{\text{without coho}}$
- H_o: Coho microhabitat use = NTTOC microhabitat use

Methods: Competitive interactions between species are often investigated using two general techniques: controlled field studies or laboratory investigations (using aquaria or enclosures). Field studies can lack statistical power but are seldom criticized for lacking relevance to actual conditions. Studies in aquaria or enclosures more easily achieve statistical power through replication, but the natural conditions which closely parallel the stream ecosystem are difficult to duplicate.

To investigate competition, a combination of approaches may be used, including field studies similar to those conducted during the feasibility phase (Murdoch et al. 2004, Murdoch et al. 2005) or direct measures of competition such as growth and condition of NTTOC in small-scale enclosures with varying abundance of competitors under differing habitat and environmental conditions. Together competition studies may help ascertain conditions under which competition may have a negative effect on NTTOC.

5.2.2.2 Predation by Naturally Reared Coho on Spring Chinook Fry

Objective: To quantify predation rates by naturally produced coho on spring Chinook fry.

Rationale: The extent to which naturally produced coho may prey upon NTTOC in the Wenatchee and Methow rivers is largely unknown. Preliminary investigations during the feasibility phase documented that some naturally produced coho smolts will consume fry-sized fish. Due to the low numbers and abundance of naturally produced coho in areas of ESA-listed spring Chinook production during the feasibility phase, it was not possible to accurately measure incidence of predation (Murdoch et al. 2005).

Restoration Phases: Predation evaluations will occur during the NPIP. The tributary(s) chosen for the predation evaluation(s) will be based on the natural production rates and resources for fish capture.

Methods: A study to determine the incidence of predation and an estimate of the total number of spring Chinook fry consumed will follow methods described in Murdoch et al. (2005). The study may be replicated in more than one tributary as deemed necessary to adequately assess the extent that predation may occur.

5.3 Genetic Adaptability

Few opportunities in the Columbia Basin exist to investigate the local adaptation process required for a species reintroduction project to be completely successful. This coho reintroduction plan presents such an opportunity to understand the natural selection intensities on naturalized coho. Success of this coho reintroduction program relies on the use of hatchery fish to develop naturalized spawning populations. Until recently the project has relied entirely upon the transfer of lower Columbia River hatchery coho to produce adult coho returns. If a viable self-sustaining population of coho is to be re-established in the Wenatchee and Methow basins, parent stocks must possess sufficient genetic variability to allow the newly founded population to respond to differing selective pressures between environments of the lower Columbia River and the mid-Columbia region. Some changes in the life history characteristics of the introduced broodstock are likely, due to multiple factors such as longer migration distance, differing environmental conditions of inland rivers, and historical artificial selection on donor stocks. Several of the life history characteristics that might be expected to differ could be endurance, run timing, sexual maturation timing, fecundity, egg size, length at age, juvenile migration timing, sex ratio, and allele frequencies of non-neutral loci. Therefore, a long-term monitoring effort will be continued to track changes over several generations.

Implementation of the proposed study plan would be a valuable contribution to the science of salmon recovery by quantitatively addressing the following questions:

1) Is divergence at neutral and adaptive SNP (Single Nucleotide Polymorphism)[1] loci a useful measure of reproductive isolation and adaptation?

2) Is phenotypic divergence (if observed) a useful proxy for local adaptation, or are observed differences simply the result of phenotypic plasticity?

3) What is the biological significance to perceived local adaptation/naturalization?

4) What is the mechanism leading to local adaptation, and how quickly can stocks react to alternative natural selection regimes?

5.3.1 Morphometrics and Life History Traits

Metric: We will measure traits such as fecundity, body morphometry, run timing, maturation timing, length-at-age and spawn timing.

Rationale: Because conditions in mid-Columbia tributaries are likely to be different from coastal streams and the lower Columbia River where the broodstock used for reintroduction originated, life history characteristics of reintroduced coho are likely to change. For one, the migration distance is much greater between the ocean and the mid-Columbia than, for example, between the ocean and Cascade Fish Hatchery. Optimal maturation rates and spawn timing are likely to be different between these two areas. In order to determine if the

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[1] SNP – Single nucleotide polymorphism: an alteration of one base in the genome of an organism (e.g., A⇔G or C⇔T).

stock used has adequate genetic variance and phenotypic plasticity to adapt to local conditions, the life history characteristics of the coho broodstock should be monitored over the length of the program.

Monitoring life history traits and morphometrics of mid-Columbia coho will contribute to answering broader questions about the rate of genetic drift when a broodstock is established in a subbasin.

Methods: Through sampling efforts in the Wenatchee and Methow basins, we will collect morphometric and life history data from the reintroduced population. From adult coho captured for broodstock (HORs and NORs) we will collect data from phenotypic traits such as fecundity, body morphometry and maturation timing. Similar data will be collected from HORs and NORs recovered on the spawning grounds. Trend monitoring will be used to ascertain changes in life history or morphometry for each generation.

5.3.2 Phenotypic Traits at Tumwater and Dryden Dams

Metric: We will measure traits such as lipid levels, run timing, state of maturation (measured by hormone levels), fish size, fish shape, and gender.

Rationale: In addition to tracking any changes in phenotypic traits over time for the population as a whole, during Broodstock Development Phase 2 (BDP2) we plan to assess whether there is any measurable difference in phenotypic traits between coho salmon that are able to ascend Tumwater Canyon and those that cannot. Knowledge of any potential phenotypic difference between fish that can ascend the canyon and those that cannot, could be used to revise our broodstock collection efforts if we are unsuccessful in completing BDP2 as described in Section 5.2 of this Master Plan. However, because targeting broodstock collection for certain traits would reduce genetic diversity and could also result in the inadvertent selection for deleterious traits, such measures would be a last resort.

Hypotheses: Possible hypotheses to investigate include the following:

- H_o: Lipid Levels $_{\text{successful coho}}$ = Lipid Levels $_{\text{unsuccessful coho}}$
- H_o: State of Maturation $_{\text{successful coho}}$ = State of Maturation $_{\text{unsuccessful coho}}$
- H_o: Run Timing $_{\text{successful coho}}$ = Run Timing $_{\text{unsuccessful coho}}$
- H_o: Morphometrics $_{\text{successful coho}}$ = Morphometrics $_{\text{unsuccessful coho}}$

Methods: Coho smolts released upstream of Tumwater Dam will be marked with a blank wire in the adipose fin. Upon return, adults headed upstream of Tumwater Dam will be identifiable at downstream trapping sites. During broodstock collection efforts at Dryden Dam, all coho destined for the upper Wenatchee basin will be scanned for a PIT tag; if no PIT tag is found, a tag will be applied. Phenotypic data described above will be collected. Fish that successfully ascend Tumwater Canyon to the dam will either be re-collected or detected on the antenna arrays (2) within the fishway. Data from phenotypic data from fish that have arrived at Tumwater Dam will then be compared to the data collected from the fish that did not successfully ascend the canyon.

5.3.3 Genetic Monitoring

Objective: To determine whether the project is successfully creating a local broodstock distinct from lower Columbia River coho salmon stocks; to measure the rate of divergence at neutral markers, and to determine the biological significance of local adaptation.

Metric: We will measure the rate and direction of divergence in neutral and adaptive allele frequencies of coho stocks that are used for reintroduction in mid-Columbia rivers.

Rationale: A sound understanding of the genetic structure of the species is a prerequisite for the assessment of the genetic impacts of human activities such as introductions, transfers, or stock enhancement on natural populations. A measure to assess the impact of human activities on natural populations is the degree to which the population structure responds to applied management action. This can be done by measuring the frequencies of alleles at specific loci through time in a population (Allendorf and Phelps 1981; Utter 1991; Allendorf 1995). Such a database permits the determination of temporal and geographic (degree of isolation) variance components.

Within the body of peer-reviewed literature, scientific views remain mixed regarding the scale and biological significance of perceived local adaptations (Taylor 1991b; Purdom 1994). Utilizing both neutral and adaptive SNP loci provides the opportunity to evaluate the biological significance of genetic differentiation among stocks. The coho reintroduction effort in the mid-Columbia provides an ideal framework for studying rates of genetic and phenotypic divergence.

Restoration Phases: Broodstock development phases will focus on collecting genetic samples from hatchery returns to measure the rate of divergence. Genetic analysis during natural production phases will include naturally spawning coho as described above.

Methods: We propose to measure genetic divergence using 35 SNP markers. To do so, we intend to sample tissue from a minimum of 60 adult coho from each of four study groups: 1) adults destined for natural spawning; 2) adults collected for broodstock; 3) naturally produced smolts; and 4) hatchery origin smolts. Over time the data will allow us to estimate three types of genetic drift:

1) Changes in allele distribution between parent and progeny life history stages (e.g., drift occurring between the adult spawning population and their progeny) relative to the amount of genetic divergence expected to result from genetic sampling error attributed to reproductive events (Weir 1996). In addition, by measuring changes in composite haplotype[2] frequencies we can quantify variation in reproductive success on a very broad scale. These data will be used to scale the relevance of statistical tests of genetic differentiations (e.g., genetic sampling error will be included as a component of variance when assessing differentiation between hatchery and natural-origin adults and progeny).

2) Genetic variation present in the hatchery broodstock compared to the naturally spawning population component. This will allow us to determine whether broodstock collection methods are effectively achieving a representative sample of returning adults. These data will be helpful in optimizing broodstock collection protocols.

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[2] Haplotype: The composite genotype of multiple loci that can provide a "fingerprint" for various lineages, populations, or individuals.

3) Over time, as broodstock development progresses, we will be able to determine the length of time necessary to genetically recognize mid-Columbia coho salmon as a distinct spawning population from the lower river source populations.

5.3.4 Reproductive Success

Objective: To measure changes in reproductive success over generations as an indicator of local adaptation.

Metric: Individual recruits per spawner as assessed through parental assignment.

Rationale: Initially we expect the reproductive success of reintroduced coho salmon do be low because a domesticated hatchery stock was used for the reintroduction. This Master Plan describes a phased approach to first develop a local broodstock and then to focus on natural production and local adaptation to the natural environment (rather than hatchery environment). As we proceed with the phased reintroduction effort, we would expect the reproductive success of the population to improve. Because the program is designed to be an integrated hatchery program, we would not expect the reproductive success to be different between natural and hatchery produced fish; however, as our reliance on hatchery production diminishes in the NPS phases, we would expect an increase in reproductive success for the population.

Hypotheses: Possible hypotheses to investigate include the following:

- H_o: Reproductive Success $_{\text{BDPII (baseline)}}$ = Reproductive Success $_{\text{NPS2 (locally adapted)}}$

Restoration Phases: During the broodstock development phases, we will focus on collecting baseline reproductive success data which would be compared to the reproductive success of reintroduced coho at the conclusion of the Natural Production Phases.

Methods: The reproductive success of reintroduced populations is a CRITFC-sponsored evaluation (Accord Project #200900900). We plan to coordinate with CRITFC researchers for the implementation of this study. A small fin clip will be taken from all coho ascending Tumwater Dam (and possibly Wells Dam). Genetic profiles acquired for each fish will be compared to the profiles for adults in its respective brood year to permit parentage assignment.

Individual productivity (R/S) estimates will be calculated for each adult within brood years as well as average productivity and relative reproductive success among parental types. We will then compare the reproductive success of hatchery and naturally produced coho during the broodstock development phases (baseline) to data collected near the completion of the natural production phases.

References

YN (Yakama Nation Fisheries Resource Management). 2010. Mid-Columbia Coho Restoration Master Plan. Prepared for the Northwest Power and Conservation Council. 199 pages.

APPENDIX 6
Water Quality Data

Table of Contents

List of Figures

LIST OF ACRONYMS AND ABBREVIATIONS

Abbreviation	**Definition**
C	degrees Celsius
cfs	cubic feet per second
cft	cubic feet
DO	Dissolved Oxygen
EIS	Environmental Impact Statement
gpm	gallons per minute
kg/day	kilograms per day
m^3/s	cubic meters per second
mg/l	milligrams per liter
µg/l	micrograms/liter
µS/cm	microSiemens/centimeter
mg/m3	miligrams/cubic meter
NPDES	National Pollutant Discharge Elimination System
pH	$-\log_{10}[H^+]$
river KM	river kilometer (distance from mouth)
RMS	Root Mean Square
SD	Standard Deviation
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
USGS	U.S. Geological Survey
WDOE	Washington Department of Ecology

1. Objectives

Coho salmon are being reintroduced into the Wenatchee and Methow watersheds by the Yakama Nation. Pre-smolts are proposed to be trucked to the upper areas of the watersheds for acclimation and release. Some sites will operate as spring time only facilities, with fish being reared from mid-March through April. Some sites will function as over-winter facilities from early November through April. Rearing will result in the release of some nutrients from these sites and project operation will require environmental evaluations and permits.

The main purpose of the water quality data collection effort is to develop the baseline values and active site impact data necessary to make predictions about how planned salmon acclimation and rearing facilities may affect receiving water quality.

Water quality data was collected in the Wenatchee basin throughout 2009. Nason Creek, a tributary of the Wenatchee was an important sampling target. Several currently active acclimation sites exist on Nason Creek and actual operational impacts were monitored there.

The draft Wenatchee River Watershed Dissolved Oxygen and pH Total Maximum Daily Load (Carroll and Anderson, 2009) produced by WDOE recommends that reductions in Wenatchee phosphorus loading occur to achieve water quality standards. The focus of this water quality data collection effort was, as a result, on pH, dissolved oxygen and phosphorus, with other parameters also being monitored to support various impact evaluation objectives.

1.1. Nason Creek

Phosphorous (P) concentrations and loads entering and leaving the acclimation ponds on Nason Creek were intensively monitored. P measurements were also made in Nason Creek just upstream and just downstream of the mouths of the creeks supplying water to the ponds and at locations farther downstream of the acclimation sites.

Another data collection objective was to measure any possible changes to DO and pH values in Nason Creek while fish were being acclimated. These parameters were measured at the acclimation study sites and at other locations in Nason Creek.

1.2. Wenatchee Basin

Along with the intensive Nason Creek data collection, other locations in the Wenatchee basin were also sampled. The objectives for the Wenatchee basin data included:

- To support the evaluation of impacts in the lower subbasin
- To develop baseline water quality information about receiving waters at proposed acclimation sites
- To check the Total Phosphorous (TP) mass balance in the upper Wenatchee to help better understand the dynamics of nutrients in the watershed
- To support the evaluation of general stream nutrient conditions.

2. Active Study Site Descriptions

2.1. Fish Stocking Details

The Rohlfing and Butcher coho acclimation ponds (see photos below) were in operation the spring of 2009 and 2010. This provided the opportunity to measure changes in water quality at functioning sites and in the Nason Creek receiving waters. A third acclimation site, Coulter, is located between Butcher and Rohlfing, and was also operated during the water quality study. It was not specifically targeted for direct water quality measurement.

2009 stocking details for Rohlfing:

- Fish delivery date: 3/10/09
- Number of fish released: 101,300
- Size at release: 16.2 fish/lb
- Total weight released: 6,250 lbs
- Start of exit migration (date barrier nets pulled): 5/6/09

2009 stocking details for Butcher:

- Fish delivery date: 3/10/09
- Number of fish released: 136,700
- Size at release: 16.7 fish/lb
- Total weight released: 8,190 lbs
- Start of exit migration (date barrier nets pulled): 5/7/09

2009 stocking details for Coulter:

- Fish delivery date: 4/15/09
- Number of fish released: 75,000
- Size at release: 16.7 fish/lb
- Total weight released: 4,490 lbs
- Start of exit migration (date barrier nets pulled): 5/6/09

In February, 2010, prior to acclimation, the Rohlfing pond was excavated and expanded. The pond was divided by a barrier net after the work was completed. Coho were acclimated on one side of the net and a small number of steelhead on the other.

2010 coho stocking details for Rohlfing:

- Fish delivery date: 3/22/10
- Number of fish released: 85,700
- Size at release: 16.7 fish/lb
- Total weight released: 5,130 lbs
- Start of exit migration (date barrier nets pulled): 5/7/10

2010 steelhead stocking details for Rohlfing:

- Fish delivery date: 3/25/10
- Number of fish released: 10,300
- Size at release: 7.4 fish/lb
- Total weight released: 1,390 lbs
- Start of exit migration (date barrier nets pulled): 4/22/10

2010 stocking details for Butcher:

- Fish delivery date: 3/24/10
- Number of fish released: 144,600

- Size at release: 15.7 fish/lb
- Total weight released: 9,190 lbs
- Start of exit migration (date barrier nets pulled): 5/7/10

2010 stocking details for Coulter:

- Fish delivery date: 5/6/10
- Number of fish released: 68,200
- Size at release: 17.3 fish/lb
- Total weight released: 3,930 lbs
- Start of exit migration (date barrier nets pulled): 5/7/10

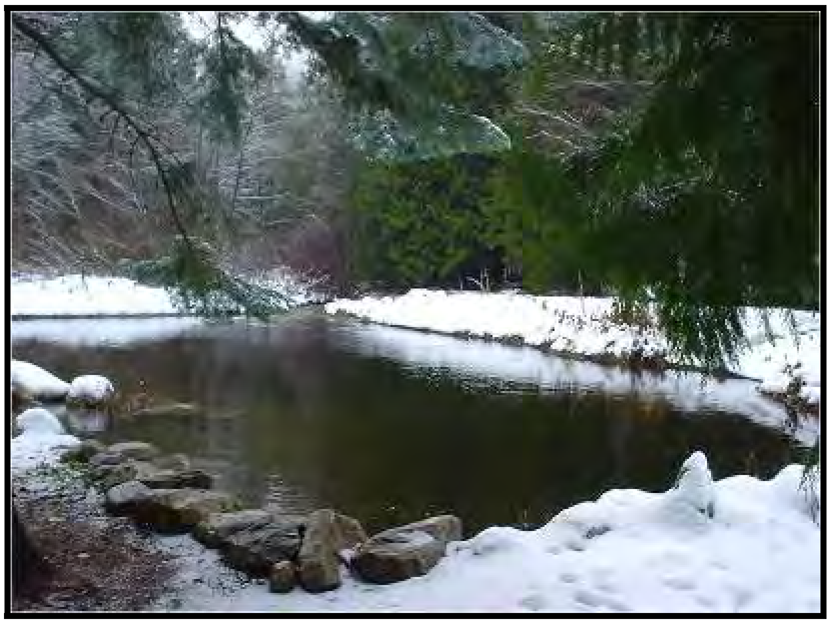


Figure 2-1. Rohlfing Coho Acclimation Pond

Figure 2-2. Butcher Coho Acclimation Pond

2.2. Flow Dependent Parameters

Changes in the concentrations of water quality parameters are impacted by several parameters including fish biomass, the quantity of water flowing through the rearing system and the physical dimensions of the pond. The last two factors control the length of time required for the ponds to flush. A preliminary review of two flow dependent parameters are presented here as a precursor for water quality evaluations. A more detailed evaluation is provided in Appendix 7.

2.2.1. Flow Density

A rough approximation of relative fish biological loading is provided by flow density values, the mass of fish divided by the water flow rate. Flow density is an inexact measure of fish metabolic rates; water temperature and feed rates are other important variables. Nevertheless, it provides a useful relative measure when comparing sites with similar temperatures and feeding regimes. A comparison of fish flow densities for Rohlfing and Butcher in 2009 showed that Butcher had 60% higher flow density on average during the 2009 acclimation season.

	3/14	4/5	4/12	4/19	4/26	5/3	5/7	Average
Rohlfing								
Fish weight (lbs)	4,366	4,626	5,052	5,597	5,890	6,253	6,253	
Density (lbs/gpm)	6.9	7.3	2.7	3.0	3.2	4.0	3.7	4.4
Butcher								
Fish weight (lbs)	5,996	6,510	6,510	7,010	7,552	8,186	8,186	
Density (lbs/gpm)	7.8	8.5	7.6	8.2	6.7	6.5	4.7	7.1

Figure 2-3. Fish Loading – Flow Density

2.2.2. Pond Retention Time

Pond retention time is another parameter that may impact discharge water quality. Retention time is calculated by dividing the pond volume by the volumetric flow rate. It is a measure of the average time taken for water to pass through the pond. High retention time means low relative water velocities and that fish wastes have more opportunity to settle to the pond bottom. Pond nutrient assimilative capacity is presumably greater and discharge loads lower with higher retention times. The retention times for the study sites at the end of 2009 acclimation are shown in the table below.

	Pond volume (cft)	Flow (cfs)	Retention Time (hrs)
Rohlfing	15,000	3.8	1.1
Butcher	73,000	3.9	5.2

Figure 2-4. Pond Retention Time

The full retention time of the pond is not effective for settling wastes if the fish stay at the downstream end of the pond. This was the case at Butcher, fish were fed and the best habitat was near the pond exit.

Settled solids generated by fish are annually covered by material that is carried into the ponds with the inflow. These are deposited on the pond bottoms due to a slowdown in flows through the ponds. The suspended solids loading in the form of gravel, sand, and silt peak during spring snowmelt period, which occurs during and after coho have migrated. Rohlfing has more deposited material than Butcher, with several inches per year being added to the pond bottom. Periodic excavation and land disposal of accumulated silt, sand, and gravel is planned at Rohlfing.

The Rohlfing pond was excavated and expanded in 2010 to increase volume to 20,000 cft.

3. Data Collection Procedures

3.1. Methods

Collections for laboratory analysis were grab samples taken just below the water surface from the main body of flow by using an extension rod from the streambank. Sample bottles were provided by AM Test, the accredited lab that performed the measurements. Each P bottle contained ½ mg of a sulfuric acid solution, giving the sample a 28 day period over which accuracy is maintained.

EPA approved methods were used during the laboratory measurement process, which included:

Chlorophyll a SM	SM1002G
Dissolved Organic Carbon	EPA415.1
Ammonia Nitrogen	EPA350.1
Nitrate/Nitrite	EPA353.2
Nitrogen -Total Persulfate	OSU CCal33A.0
Orthophosphate	EPA365.2
Phosphorus, total low-level	SM4500-P
Total Organic Carbon	EPA415.1

Figure 3-1. Measurement Methods

Phosphorous samples were field replicated. Two collection bottles were filled from the same location at the same time for all P samples.

Temperature, DO, pH, and conductivity field measurements were taken with Hydrolab® Data Sonde multi-meters at the same time and location that laboratory samples were collected. The Hydrolab sondes were maintained and calibrated at the Yakama Nation Peshastin field office. Calibrations were performed before and after each sampling period and used Hydrolab recommended procedures and traceable calibration standards.

Sampling was done with a two person team and was completed over a 1 or 2 day period. All Nason Creek samples were taken on a single day. Most collections occurred between 1PM and 6PM on the first day and 10AM and 1PM on the second day. Samples were delivered to AM Test within 5 days of collection.

Flow measurements were taken at the Butcher and Rohlfing sites. Staff gauges were installed in the creeks supplying water to the ponds and flow volume measurements were taken periodically to develop a stage/discharge relationship. Other flow data in the watershed was taken from USGS and WDOE stream gauging stations.

Periphyton sampling methods and results are discussed in Appendix 7.

3.2. Locations

A total of 22 sites were sampled, with 11 of those being in Nason Creek. The sample site names and general location descriptions are shown in the table below.

Active, Test Sites - Intensive P Study		
Rohlfing 1	RO1	Rohlfing Creek, incoming water to the acclimation pond
Rohlfing 2	RO2	Rohfing Creek, outgoing water from the acclimation pond
Rohlfing 3	RO3	Nason Creek, upstream of the mouth of Rohlfing
Rohlfing 4	RO4	Nason Creek, downstream of the mouth of Rohlfing
Butcher 1	BU1	Butcher Creek, incoming water to the acclimation pond
Butcher 2	BU2	Butcher Creek, outgoing water from the acclimation pond
Butcher 3	BU3	Nason Creek, upstream of the mouth of Butcher
Butcher 4	BU4	Nason Creek, downstream of the mouth of Butcher
Nason Creek - Intensive P Study, DO and pH study		
Boyce	BO3	Nason, upstream of BU3
Nason, Coles Corner	NCC	Nason, between Butcher and the mouth
Mouth of Nason	MNA	Nason, near the mouth
Other Sites - P Baseline Data		
Tall Timber	TA4	Napeequa, near the mouth
McComas 3	MC3	White, at the highway bridge
McComas 4	MC4	White, downstream of the proposed McComas discharge
Chikamin/Minnow	CM4	Chikamin, near the mouth
Clear	CL1	Clear, upstream of the acclimation pond
Chumstick	CH4	Chumstick, at the highway bridge
Dryden	DR4	Wenatchee, upstream of Dryden Dam
Wen. Basin - P mass balance		
Mouth of Little Wenatchee	MLI	Little Wenatchee, at the Two Rivers Gravel mine
Mouth of Chiwawa	MCHI	Chiwawa, at the highway bridge
Mouth of Lake Wen.	MLA	Wenatchee, at the highway bridge
Wen. above Icicle	WIC	Wenatchee, at the highway bridge
General Stream Nutrient Study		
White - McComas	MC4	White, downstream of the proposed McComas discharge
Nason - Butcher	BU4	Nason Creek, downstream of the mouth of Butcher
Dryden - Wenatchee	DR4	Wenatchee, upstream of Dryden Dam
24 Hr Nason DO and pH		
Nason Trap Site		Near mouth of Nason Creek, close to the screw trap

Figure 3-2. Sample Site Names

Sample locations in the Wenatchee basin are shown in the maps below.

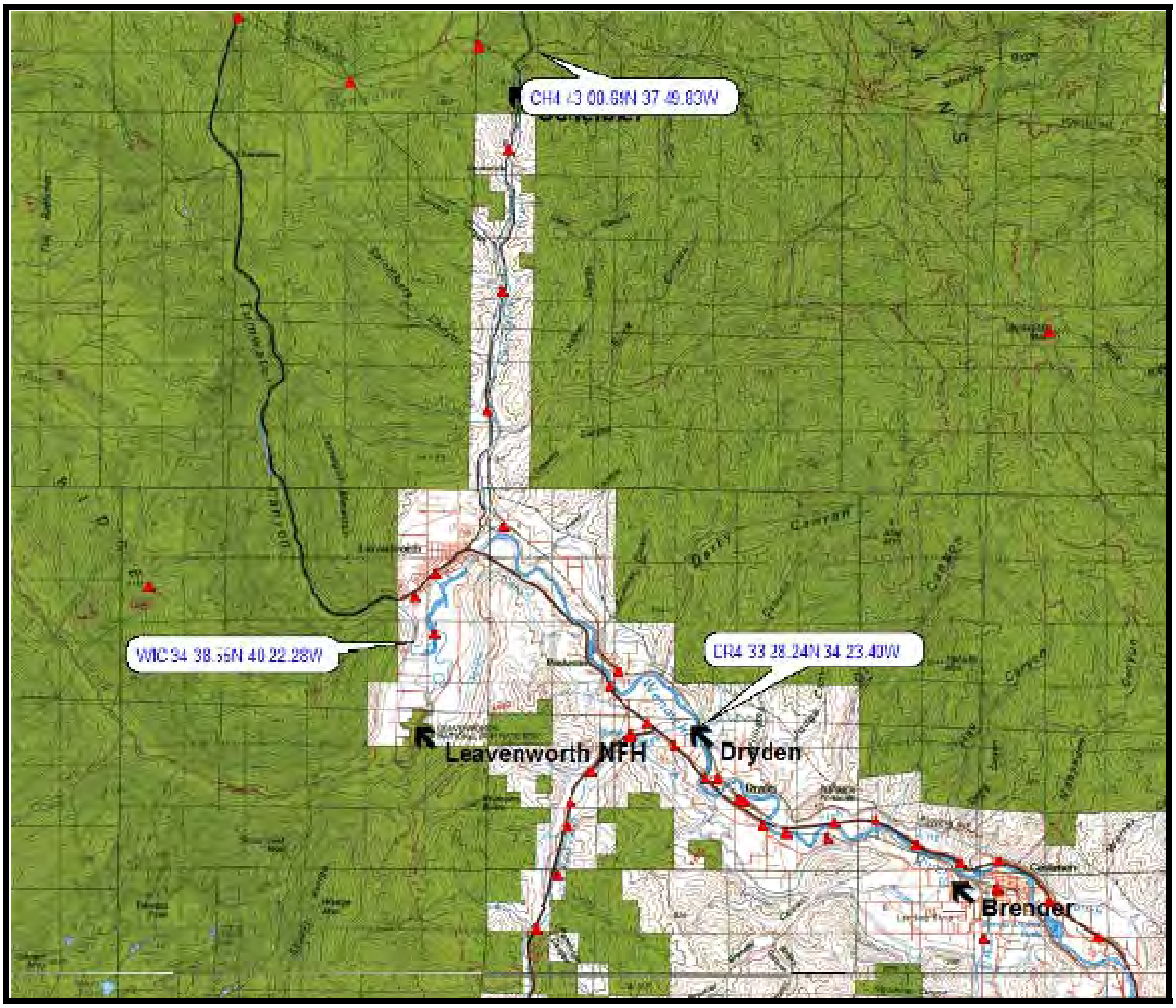


Figure 3-3. Wenatchee Sample Sites 1

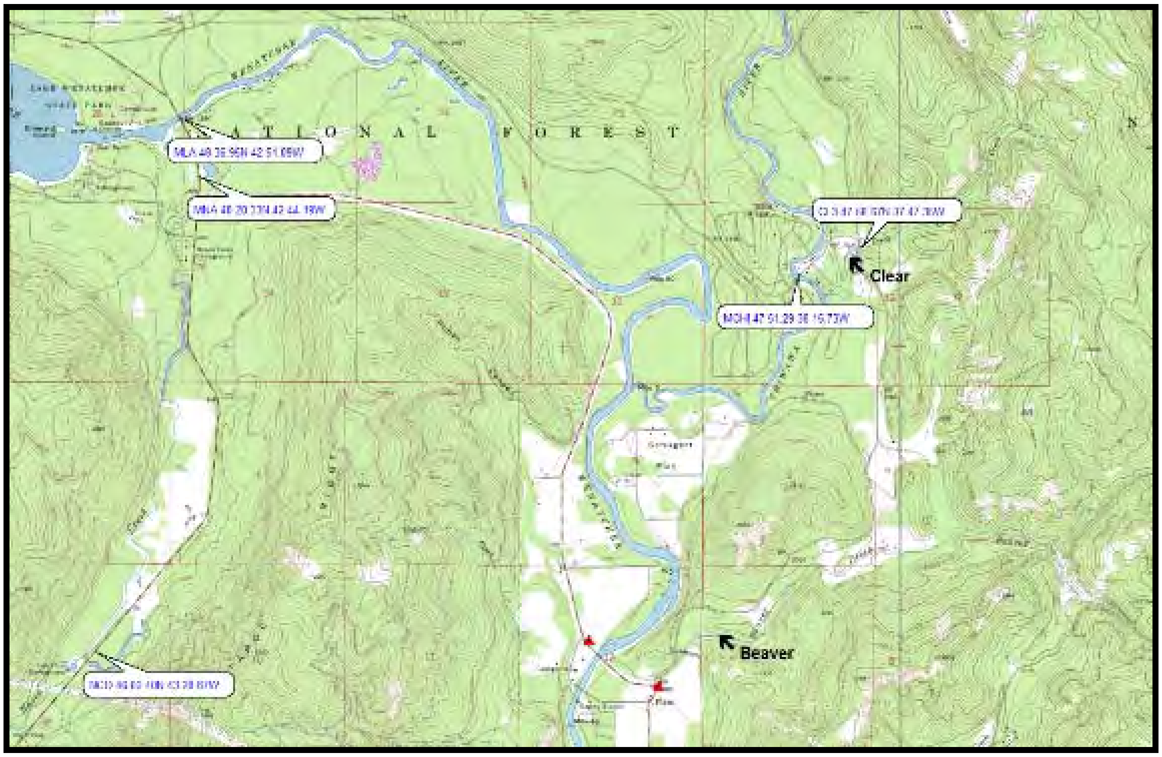


Figure 3-4. Wenatchee Sample Sites 2

Figure 3-5. Wenatchee Sample Sites 3

The Nason Creek active study site locations are shown in the aerials below.

Figure 3-6. Rohlfing Sample Locations

Figure 3-7. Butcher Sample Locations

3.3. Schedule

Water quality data was collected through all of 2009 and through the 2010 acclimation season.

Measurements made at higher frequencies during the spring acclimation periods (March-April). The full sampling schedule for is shown in the table below, with locations and numbers of samples collected.

	1/17/09	2/14/09	3/14/09	4/4/09	4/11/09	4/18/09	4/25/09	5/3/09	5/16/09	6/6/09	7/25/09	9/19/09	10/30/09	11/29/09	12/20/09	2/25/10	3/22/06	4/11/06	4/17/06	4/25/10	5/5/10	5/8/06	
Nason Creek																							
Rohlfing 1,2,3,4	8	8	8	8	8	8	8	8	8	8	8	8	8	8	4	8	8	8	8	8	4	8	168
Butcher 1,2,3,4	8	8	8	8	8	8	8	8	8	8	8	8	8	8	4	8	8	8	8	8	11	8	175
Boyce (upstream)	2	2	2	2	2	2	2	2	2		2	2	2	2	1	2	2	2	2	2		2	39
Mouth of Nason			2		2			2		2	2	2	2	2	1	2	2	2	2	2	1	2	30
Nason, Coles Corner			2		2			2		2	2	2	2	2	1	2	2	2	2	2	1	2	30
Other Acclimation Sites																							
McComas 3,4	4	4	4	4	4	4		4	4	4	4	4	4	4		4	3	2					61
Tall Timber	2	2	2		2			2		2	2	2						2					18
Clear		2	2		2			2		2	2	2						2	2	2		2	22
Chumstick					2			2		2	2	2						2	2	2		2	18
Dryden	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		2	42
Brender																		2	2	2		2	8
Wenatchee Basin																							
Mouth of Little Wenatchee				2			1		2	2	2	2	2	2	1	2		2	2	2		2	26
Mouth of Chiwawa				2				2	2	2		2	2	2				2	2	2		2	22
Mouth of Lake Wen.				2			2		2		2	2	2	2									14
Wen. above Icicle		2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2		2	39
Total TP samples	26	30	34	32	36	26	25	38	32	38	40	42	36	36	15	32	32	32	32	32	32	32	712
General Stream Nutrient Study																							
White - McComas	7	7	8	8				8		8	8	8	8	8		8	8	8	8	8		8	126
Nason - Butcher	7	7	8	8				8		8	8	8	8	8		8	8	8	8	8	8	8	134
Dryden - Wenatchee	7	7	8	8				8		8	8	8	8	8		8	8	8	8	8		8	126
Total water quality samples	21	21	24	24	0	0	0	24	0	24	24	24	24	24	0	24	24	24	24	24	24	24	386

Figure 3-8. Data Collection Schedule

3.4. Quality Control

Quality objectives conform to those listed in the Wenatchee River Basin Dissolved Oxygen, pH, and Phosphorus Total Maximum Daily Load (TMDL) Study (Carroll et al, 2006), Table 5. Objectives for the parameters important to this plan are:

	Accuracy	*Repeatability*	*Bias*	*Reporting limit*
Total Phosphorus	±25%	<10%	5%	3 µg/l
Orthophosphate	±25%	<10%	5%	3 µg/l
Nitrate-Nitrite Nitrogen	±25%	<10%	5%	10 µg/l
Ammonia Nitrogen	±25%	<10%	5%	10 µg/l
Disolved Oxygen			5%	1 mg/l
pH	.2 SU		.1 SU	
Temperature	±0.2^0 C			

Figure 3-9. Data Quality Objectives

Accuracy and bias are expressed as deviations from true values and repeatability as the standard deviation (SD) of the data set. Values above 0.001 mg/l for phosphorous are reported in this study. Values below the 0.001 detection limit are listed at 0.0005 mg/l.

Laboratory data was generated according to QA/QC procedures described in testing lab documents. Quality Control results were provided by the lab for each sampling survey.

Several Hydrolab datasondes were used for measuring DO, pH, temperature, and conductivity. The MS5 minisonde and DS5 sondes employed have the same specifications (see Section 5.4).

4. Wenatchee Basin Water Data

4.1. Flows

4.1.1. Nason Creek

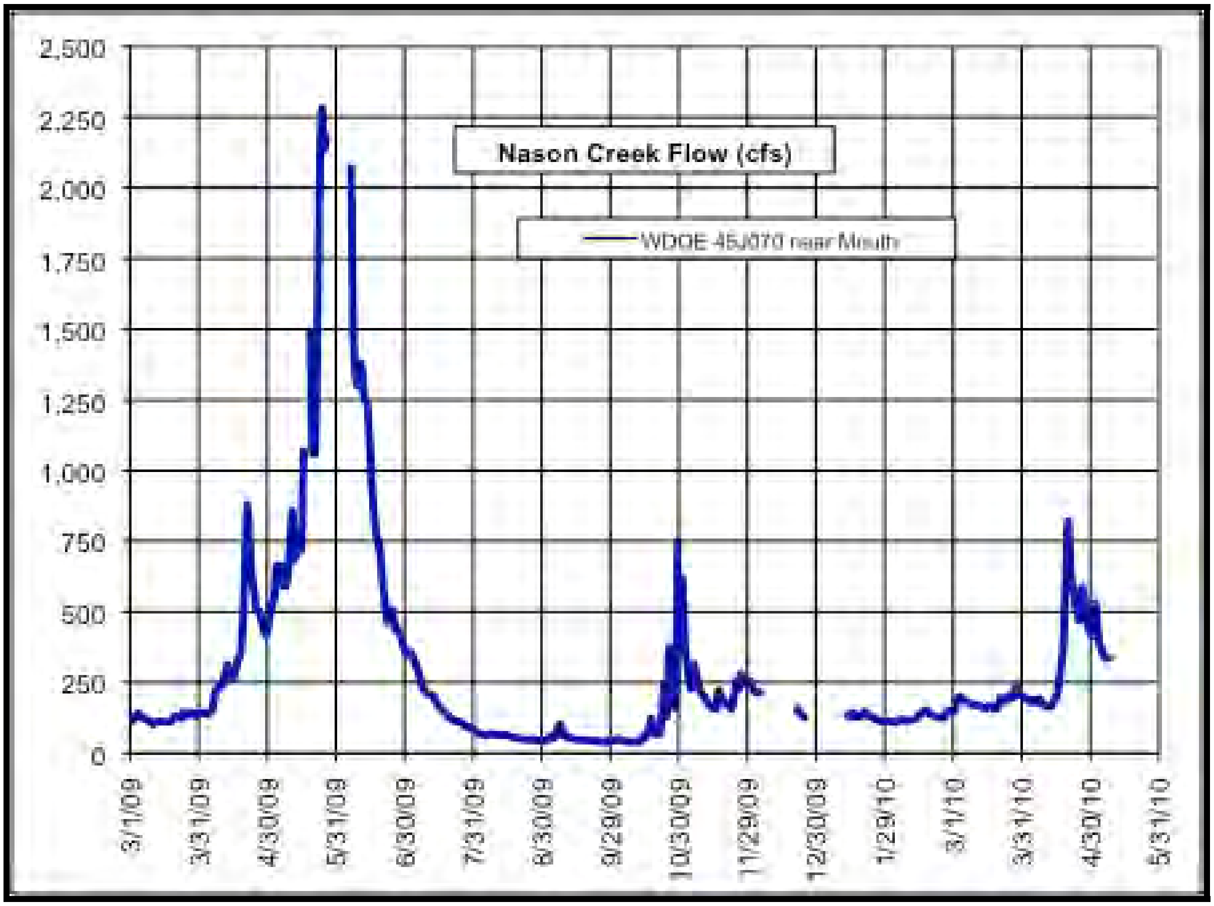
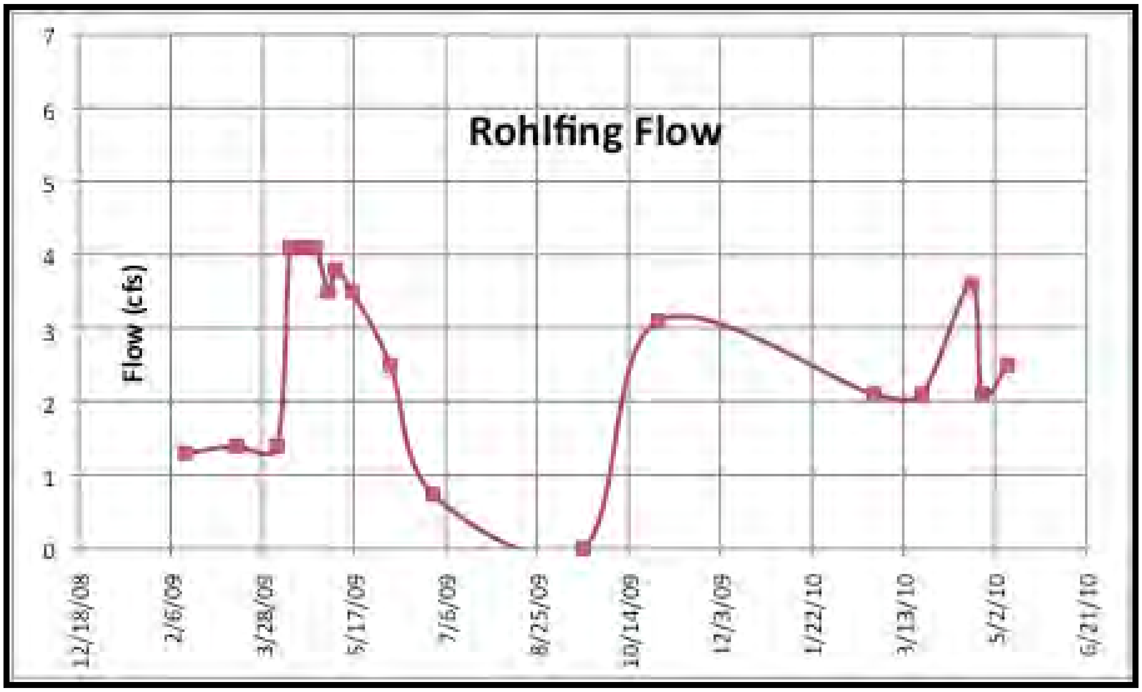


Figure 4-1. Nason Flow

4.1.2. Active Study Sites

Rohlfing and Butcher flows showed the typical snow-melt surge in the spring, while fish were being acclimated. Butcher baseline winter flows were slightly higher and the flow increase happened later than at Rohlfing.



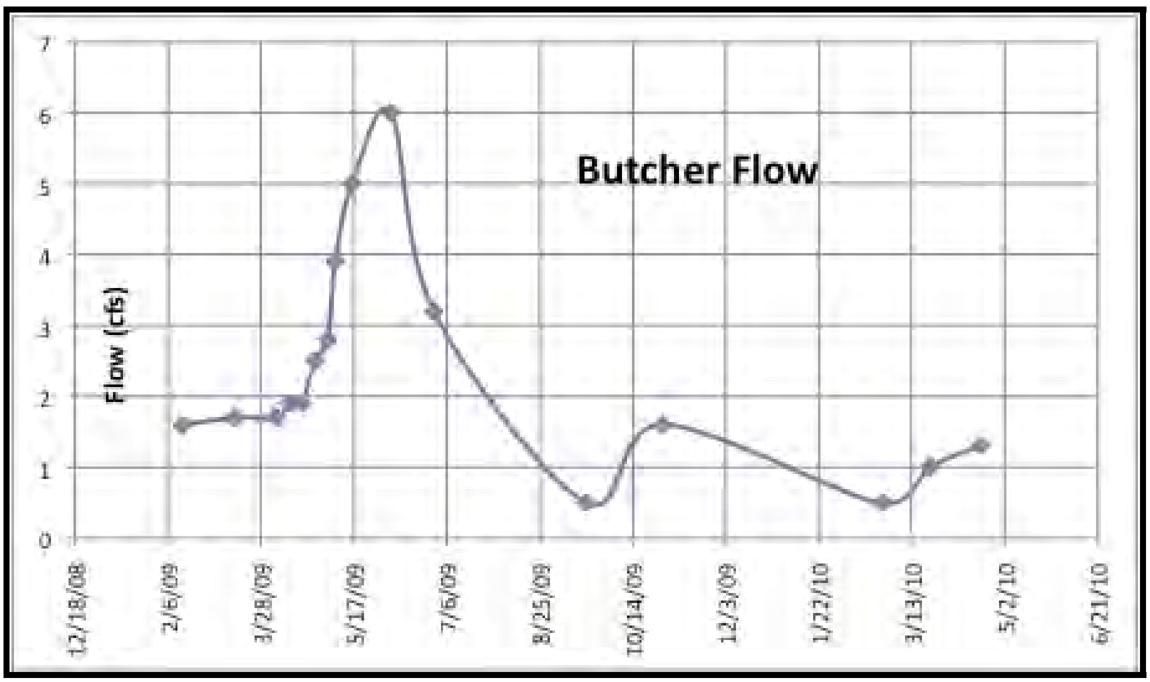


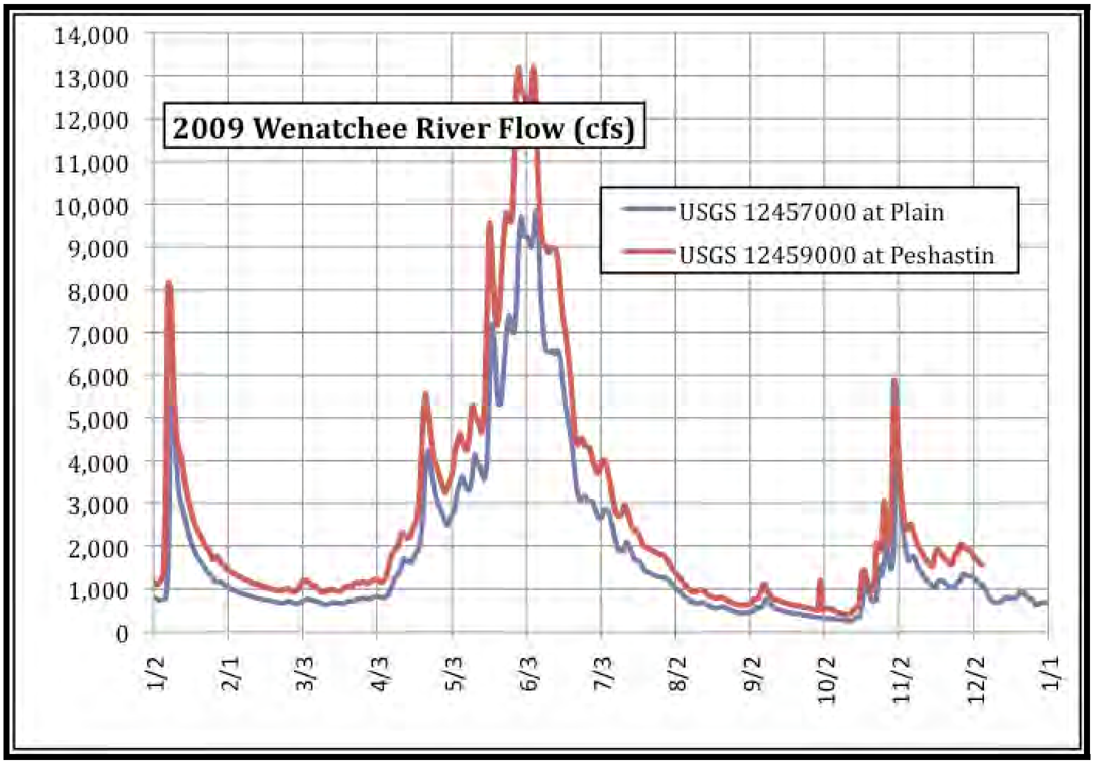
Figure 4-2. Rohlfing and Butcher Flows

The discharge from the ponds was diluted by large amounts after entering Nason Creek. The table below shows the ratio of pond discharge flow to Nason Creek receiving water flow during 2009 acclimation season.

	3/14	4/5	4/12	4/19	4/26	5/3	5/7	**Average**
Rohlfing	0.48%	0.43%	0.77%	0.63%	0.46%	0.39%	0.30%	**0.49%**
Butcher	0.59%	0.52%	0.36%	0.29%	0.28%	0.31%	0.31%	**0.38%**

Figure 4-3. Dilution Ratio

4.1.3. Wenatchee River



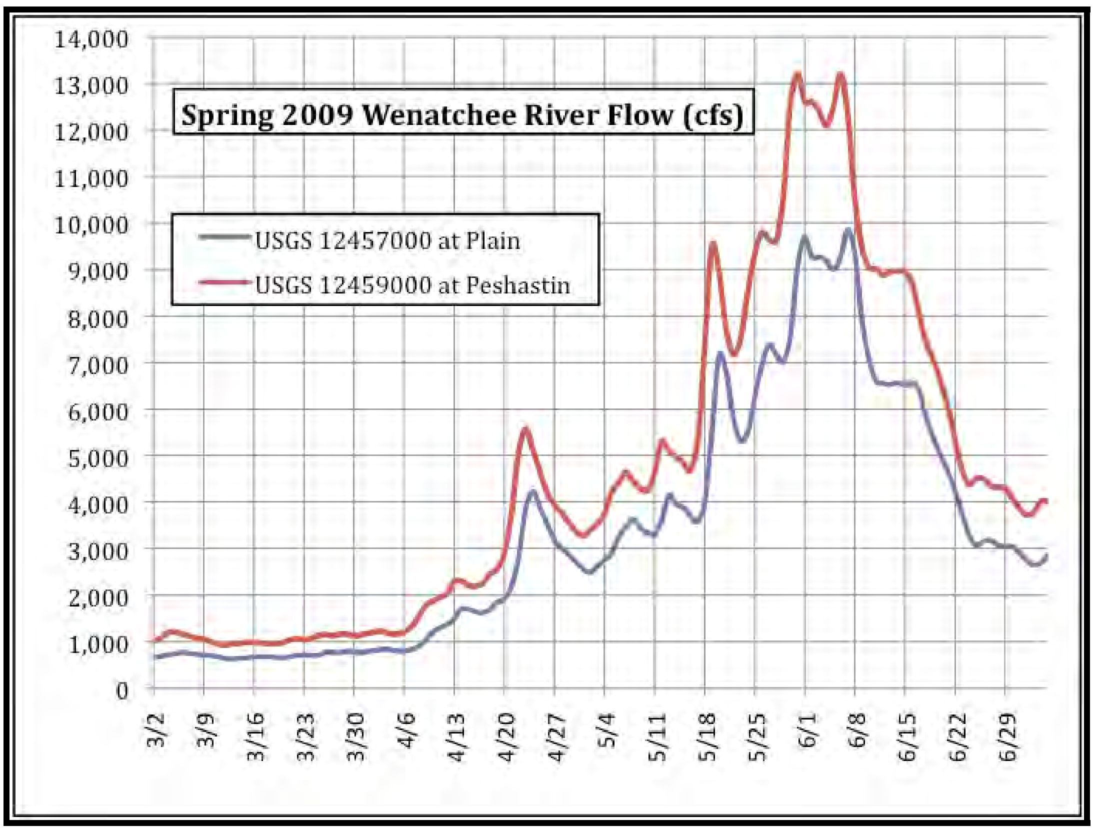


Figure 4-4. 2009 Wenatchee Flow

4.2. Active Study Sites

4.2.1. 2009 Water Quality Data

Anomolous values — TP below detection reported at 0.0005 — Acclimation Period (3/14/09 – 5/3/09)

Site	Parameter	1/17/09	2/14/09	3/14/09	4/5/09	4/12/09	4/19/09	4/26/09	5/3/09	5/16/09	6/7/09	7/25/09	9/19/09	10/30/09	11/29/09	12/20/09	2/25/10	Units
Nason - Rohling																		
RO1 (Rohling - pond in)	Total P	0.001	0.001	0.006	0.002	0.006	0.010	0.006	0.007	0.008	0.005	0.019	0.005	0.008	0.010	0.001	0.001	mg/l
	Total P	0.001	0.001	0.005	0.001	0.008	0.008		0.007	0.011	0.002	0.020	0.005	0.007	0.009	0.001	0.001	mg/l
	AVG	0.001	0.001	0.006	0.002	0.007	0.009	0.006	0.007	0.010	0.004	0.020	0.005	0.008	0.010	0.001	0.001	mg/l
	Ortho P													0.001	0.001	0.001	0.001	
	Ortho P													0.001	0.001	0.001	0.002	
	Total Dis. P													0.005	0.007	0.002	0.001	
	Total Dis. P													0.006	0.007	0.002	0.001	
	Temp	2.9	2.6	2.6	3.5	3.4	4.3	4.5	6.0	7.0	8.9		11.5	6.5	5.4		3.600	°C
	pH	6.5	7.1	6.5	6.5	5.5		6.6	6.6	6.5	6.8		7.0		5.2		5.820	Units
	SpCond	57.0	43.0	68.8	113.0	59.8	62.0	39.0			30.0				101.5		218.000	µS/cm
	Turb																	
	LDO	13.2	12.7	12.4	12.2	12.0	12.1	12.2	12.5	10.6	12.3		10.5	10.4	11.4		13.460	mg/l
	DO, sat	12.4	12.5	12.5	12.2	12.3	11.9	11.9	11.4	11.2	10.6							mg/l
RO2 (Rohling - pond out)	Total P	0.001	0.005	0.003	0.008	0.014	0.008	0.011	0.016	0.002	0.002	0.025	no flow	0.006	0.009	0.001	0.001	mg/l
	Total P	0.001	0.007	0.003	0.004	0.017	0.007		0.017	0.002	0.001	0.025	no flow	0.006	0.002	0.001	0.001	mg/l
	AVG	0.001	0.006	0.003	0.005	0.016	0.008	0.011	0.017	0.002	0.002	0.025	0.000	0.006	0.006	0.001	0.001	mg/l
	Ortho P													0.001	0.001	0.001	0.004	
	Ortho P													0.001	0.001	0.001	0.003	
	Total Dis. P													0.003	0.009	0.001	0.001	
	Total Dis. P													0.005	0.005	0.001	0.001	
	Temp	2.8	2.3	2.3	3.3	3.4	4.3	4.4	6.0	7.0	9.3			5.8	5.4		3.450	°C
	pH	6.5	6.9	6.4	6.4	5.7		6.7	6.4	6.5	6.9				5.2		5.920	Units
	SpCond	58.0	42.7	69.0	112.8	60.0	63.0	39.0			30.0				102.7		215.000	µS/cm
	Turb																	
	LDO	13.3	12.9	11.7	11.6	11.7	11.8	11.7	12.4	10.6	12.3			10.7	11.3		13.430	mg/l
	DO, sat	12.4	12.6	12.6	12.3	12.3	12.0	11.9	11.4	11.2	10.5							mg/l
Delta P		0.000	0.006	-0.003	0.004	0.009	-0.002	0.005	0.010	-0.008	-0.002	0.006	-0.005	-0.002	-0.004	0.000	0.000	
RO3 (Rohling - upstream)	Total P	0.001	0.003	0.004	0.002	0.006	0.007	0.011	0.006	0.002	0.006	0.016	0.003	0.029	0.007	0.002	0.001	mg/l
	Total P	0.001	0.000	0.004	0.001	0.006	0.008		0.014	0.002	0.006	0.016	0.001	0.038	0.005		0.001	mg/l
	AVG	0.001	0.002	0.004	0.001	0.006	0.008	0.011	0.010	0.002	0.006	0.016	0.002	0.034	0.006	0.002	0.001	mg/l
	Ortho P													0.001	0.001	0.001	0.003	
	Ortho P													0.002	0.001		0.002	
	Total Dis. P													0.029	0.003	0.004	0.001	
	Total Dis. P													0.035	0.004		0.001	
	Temp	1.3	1.3	0.8	3.2	2.8	4.2	3.7	5.1	5.2	6.3		10.5	4.3	3.8		2.670	°C
	pH	6.8	7.3	6.7	6.8	6.0		6.5	6.6	6.6	6.7		6.9		5.5		6.280	Units
	SpCond	31.2	33.7	44.0	57.0	39.0	47.0	30.0	224.0		18.0				40.2		79.000	µS/cm
	Turb																	
	LDO	14.0	13.5	13.3	12.5	12.4	12.5	12.6		11.4	13.4		11.0	12.0	12.2		14.140	mg/l
	DO, sat	12.9	12.9	13.1	12.3	12.4	12.0	12.1	11.7	11.7	11.3							mg/l
RO4 (Rohling - downstream)	Total P	0.001	0.001	0.001	0.001	0.007	0.006	0.009	0.004	0.002	0.006	0.010	0.003	0.025	0.009	0.002	0.001	mg/l
	Total P	0.001	0.001	0.001	0.003	0.008	0.006		0.008	0.004	0.005	0.006	0.003	0.026	0.006		0.001	mg/l
	AVG	0.001	0.001	0.001	0.002	0.008	0.006	0.009	0.006	0.003	0.006	0.008	0.003	0.026	0.008	0.002	0.001	mg/l
	Ortho P													0.001	0.001	0.001	0.003	
	Ortho P													0.002	0.001		0.001	
	Total Dis. P													0.020	0.006	0.006	0.004	
	Total Dis. P													0.022	0.006		0.001	
	Temp	1.5	1.5	1.0	3.5	3.0	4.5	4.0	5.2	5.4	6.4		10.6	4.3	3.9		2.840	°C
	pH	6.8	7.3	6.7	6.8	6.0		6.7	6.5	6.6	6.5		6.9		5.5		6.330	Units
	SpCond	34.0	34.0	45.0	61.8	42.0	45.5	31.0			18.3				43.8		90.000	µS/cm
	Turb																	
	LDO	13.9	13.4	13.2	12.4	12.2	12.3	12.4		11.2	13.2		11.0	11.9	12.1		13.990	mg/l
	DO, sat	12.9	12.9	13.1	12.2	12.4	11.9	12.1	11.7	11.6	11.3							mg/l
Delta P		0.000	-0.001	-0.004	0.001	0.002	-0.002	-0.002	-0.004	0.001	-0.001	-0.008	0.001	-0.008	0.002	0.000	0.000	

Anomolous values — TP below detection reported at 0.0005

Acclimation Period: 3/14/09 – 5/3/09

		1/17/09	2/14/09	3/14/09	4/5/09	4/12/09	4/19/09	4/26/09	5/3/09	5/16/09	6/7/09	7/25/09	9/19/09	10/30/09	11/29/09	12/20/09	2/25/10	Units
Nason - Butcher																		
BU1	Total P	0.001	0.003	0.002	0.004	0.007	0.009		0.011	0.012	0.013	0.023	0.014	0.006	0.009	0.008	0.005	mg/l
	Total P	0.001	0.004	0.004	0.004	0.007	0.010		0.008	0.012	0.011	0.019	0.013	0.007	0.007	0.009	0.003	mg/l
	AVG	0.001	0.004	0.003	0.004	0.007	0.010		0.010	0.012	0.012	0.021	0.014	0.008	0.008	0.009	0.005	mg/l
	Ortho P													0.001	0.008	0.001	0.008	
	Ortho P													0.001	0.007	0.001	0.009	
	Total Dis. P													0.006	0.003	0.006	0.004	
	Total Dis. P													0.007	0.005	0.007	0.001	
Butcher - pond in	Temp	2.0	2.2	2.2	3.6	3.7	4.8	4.8	5.9	7.1	8.1		10.6	5.9	4.390		2.790	°C
	pH	7.3	7.9	7.2	7.5	6.8		7.4	7.3	7.1	7.3		7.2		6.1		6.910	Units
	SpCond	59.0	64.0	76.0	75.8	45.0	69.0	49.8			42.0						91.000	µS/cm
	Turb																	
	LDO	13.8	13.0	12.7	12.3	12.0	12.1	12.0	12.8	10.7	12.4		10.4	11.2	11.9		13.950	mg/l
	DO, sat	12.8	12.6	12.7	12.2	12.2	11.8	11.6	11.5	11.2	10.9							mg/l
BU2	Total P	0.003	0.004	0.004	0.017	0.012	0.014	0.017	0.031	0.017	0.005	0.017	0.015		0.008	0.001	0.004	mg/l
	Total P	0.002	0.005	0.002	0.015	0.014	0.014		0.035	0.021	0.002	0.020	0.014		0.009		0.001	mg/l
	AVG	0.003	0.005	0.003	0.016	0.013	0.014	0.017	0.033	0.019	0.004	0.019	0.015		0.009	0.001	0.002	mg/l
	Ortho P													0.001	0.007	0.001	0.004	
	Ortho P													0.001	0.007		0.002	
	Total Dis. P													0.003	0.007	0.007	0.001	
	Total Dis. P													0.002	0.006		0.001	
Butcher - pond out	Temp	1.6	1.7	1.0	4.2	4.1	5.8	5.5	7.6	8.7	9.7		11.6	4.9	4.0		2.410	°C
	pH	7.2	7.7	6.9	7.1	6.4		7.0	6.8	6.9	7.0		6.8		5.9		6.630	Units
	SpCond	59.0	64.0	76.0	77.3	46.8	62.0	47.8			43.9				69.0		89.000	µS/cm
	Turb																	
	LDO	13.4	12.8	11.8	11.2	10.9	11.2	11.2	8.8	10.2	12.3		9.6	10.760	11.6		12.960	mg/l
	DO, sat	12.9	12.8	13.1	12.0	12.1	11.6	11.6	11.0	10.7	10.5							mg/l
Delta P		0.002	0.001	0.000	0.012	0.006	0.005		0.024	0.007	-0.009	-0.003	0.001		0.001	-0.008	-0.002	
BU3	Total P	0.001	0.003	0.004	0.001	0.004	0.003	0.014	0.005	0.012	0.011	0.014	0.002	0.034	0.007	0.001	0.001	mg/l
	Total P	0.001	0.004	0.004	0.003	0.010	0.002		0.008	0.010	0.011	0.014	0.002	0.035	0.008		0.001	mg/l
	AVG	0.001	0.004	0.004	0.002	0.007	0.003	0.014	0.007	0.011	0.011	0.014	0.002	0.035	0.007	0.001	0.001	mg/l
	Ortho P													0.001	0.004	0.001	0.001	
	Ortho P													0.001	0.003		0.001	
	Total Dis. P													0.031	0.004	0.005	0.006	
	Total Dis. P													0.031	0.006		0.006	
Butcher - upstream	Temp	1.6	1.9	1.8	4.9	3.7	5.4	4.9	6.4	6.9	7.4		11.8	4.4	4.1		2.960	°C
	pH	6.6	7.1	6.6	6.7	5.9		6.6	6.4	6.4	6.5		6.4		5.3		6.160	Units
	SpCond	31.8	34.0	45.0	59.3	36.0	45.0	29.0			17.0				40.0		72.000	µS/cm
	Turb																	
	LDO	13.4	12.9	12.5	11.6	11.6	11.9	11.9	11.5	10.8	12.5		10.4	11.7	11.6		13.480	mg/l
	DO, sat	12.9	12.7	12.9	11.5	12.2	11.7	11.8	11.4	11.2	11.1							mg/l
BU4	Total P	0.001	0.007	0.001	0.004	0.005	0.017	0.010	0.008	0.007	0.011	0.014	0.007	0.045	0.007	0.002	0.001	mg/l
	Total P	0.001	0.002	0.001	0.006	0.004	0.014		0.011	0.008	0.012	0.015	0.007	0.040	0.007	0.003	0.007	mg/l
	AVG	0.001	0.005	0.001	0.005	0.005	0.016	0.010	0.010	0.008	0.012	0.015	0.007	0.043	0.007	0.003	0.004	mg/l
	Ortho P			0.001		0.001			0.001	0.001	0.001		0.001	0.012	0.001	0.001	0.001	
	Ortho P													0.012	0.001	0.001	0.001	
	Total Dis. P			0.004		0.003			0.006	0.005	0.003		0.001	0.039	0.003	0.003	0.001	
	Total Dis. P													0.040	0.005	0.002	0.003	
Butcher - downstream	Temp	1.7	1.9	1.6	5.0	3.8	5.4	4.8	6.6	7.1	7.4		11.8	4.4	4.1		2.830	°C
	pH	6.8	7.2	6.6	6.5	6.0		6.7	5.6	6.5	6.7		6.5		5.6		6.340	Units
	SpCond	33.8	36.7	52.0	54.0	38.0	48.0	32.7			21.0				42.7		75.000	µS/cm
	Turb																	
	LDO	13.4	12.9	12.3	11.7	11.5	11.8	11.8	11.1	10.8	12.7		10.1	11.7	11.7		13.430	mg/l
	DO, sat	12.9	12.8	12.9	11.8	12.2	11.7	11.8	11.3		11.1							mg/l
Delta P		0.000	0.001	-0.004	0.003	-0.003	0.013	-0.004	0.003	-0.004	0.001	0.000	0.005	0.008	0.001	0.002	0.003	

Figure 4-5. Active Site Water Quality

4.2.2. 2010 Water Quality Data

Anomalous values   TP below detection reported at 0.0005

		2/25/10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5/8/10	Units
[illegible] – Roething									
101	Total P	0.001	0.001	0.003	0.002	0.005	0.018	0.001	mg/l
	Total P	0.001	0.001	0.002	0.001	0.003		0.001	mg/l
	AVG	0.001	0.001	0.003	0.002	0.004	0.018	0.001	mg/l
	Ortho P	0.001	0.001	0.001	0.001	0.001	0.001	0.001	
	Ortho P	0.002	0.001	0.001	0.001	0.001		0.001	
	Total Dis. P	0.001	0.001	0.005	0.002	0.001	0.016	0.001	
	Total Dis. P	0.001	0.001	0.001	0.002	0.003		0.001	
Roething - pond in	Temp	3.800	4.320	3.870	5.670	0.690	5.110	6.570	°C
	pH	5.820	6.800	6.910	6.560	7.100	6.900	6.740	Units
	SpCond	218.000	129.400	66.500	91.400	72.000	70.300	68.600	µS/cm
	TSS			1.000	0.500	0.500	1.000	2.500	
	LDO	13.480	11.540	12.700	11.300	12.070	11.750	11.610	mg/l
	DO, sat								mg/l
102	Total P	0.001	0.004	0.010	0.007	0.012		0.001	mg/l
	Total P	0.001	0.001	0.010	0.014	0.014	0.027	0.001	mg/l
	AVG	0.001	0.009	0.010	0.011	0.013	0.027	0.001	mg/l
	Ortho P	0.004	0.001	0.002	0.003	0.008		0.001	
	Ortho P	0.003	0.001	0.002	0.003	0.008	0.001	0.001	
	Total Dis. P	0.001	0.001	0.006	0.006	0.005		0.001	
	Total Dis. P	0.001	0.001	0.008	0.009	0.008	0.016	0.001	
Roething - pond out	Temp	3.490	4.200	3.590	5.440	5.570	5.160	6.610	°C
	pH	5.920	6.670	6.460	6.580	7.030	6.900	6.440	Units
	SpCond	215.000	138.400	87.900	92.100	72.400	71.100	69.900	µS/cm
	TSS			1.000	0.500	1.000	0.500	3.500	
	LDO	13.430	11.460	12.010	10.980	11.210	10.910	10.810	mg/l
	DO, sat								mg/l
Delta P		0.000	0.002	0.006	0.007	0.008	0.009	0.000	
103	Total P	0.001	0.001	0.004	0.002	0.004	0.017	0.001	mg/l
	Total P	0.001	0.001	0.002	0.002	0.002		0.001	mg/l
	AVG	0.001	0.001	0.003	0.002	0.003	0.017	0.001	mg/l
	Ortho P	0.003	0.001	0.001	0.001	0.003	0.001	0.001	
	Ortho P	0.002	0.001	0.001	0.001	0.001		0.001	
	Total Dis. P	0.001	0.001	0.001	0.003	0.002	0.019	0.001	
	Total Dis. P	0.001	0.001	0.001	0.003	0.001		0.001	
Roething - upstream	Temp	2.670	4.460	3.180	4.720	4.460	4.470	5.840	°C
	pH	6.280	6.940	6.940	6.650	7.340	7.090	6.560	Units
	SpCond	79.000	72.700	46.000	46.300	37.000	42.500	39.000	µS/cm
	TSS			0.500	0.500	0.500	0.500	3.000	
	LDO	14.140	11.760	13.170	12.380	12.660	12.150	12.020	mg/l
	DO, sat								mg/l
104	Total P	0.001	0.001	0.002	0.003	0.002	0.015	0.001	mg/l
	Total P	0.001	0.001	0.002	0.002	0.002		0.001	mg/l
	AVG	0.001	0.001	0.002	0.003	0.002	0.015	0.001	mg/l
	Ortho P	0.003	0.001	0.001	0.001	0.001	0.001	0.001	
	Ortho P	0.001	0.004	0.001	0.001	0.001		0.001	
	Total Dis. P	0.004	0.001	0.001	0.003	0.001	0.012	0.001	
	Total Dis. P	0.001	0.001	0.001	0.003	0.004		0.001	
Roething - downstream	Temp	2.540	4.580	3.250	4.940	4.620	4.800	5.960	°C
	pH	6.330	6.840	6.860	7.000	7.220	7.090	6.570	Units
	SpCond	80.000	77.400	50.000	48.900	38.700	42.400	40.700	µS/cm
	TSS			0.500	0.500	2.500	0.500	0.500	
	LDO	13.960	11.660	13.030	12.210	12.570	12.100	11.930	mg/l
	DO, sat								mg/l
Delta P		0.000	0.000	-0.001	0.001	-0.001	-0.002	0.000	
[illegible] – Butcher									
201	Total P	0.006	0.004	0.008	0.012	0.012	0.001	0.001	mg/l
	Total P	0.003	0.005	0.011	0.009	0.012		0.001	mg/l
	AVG	0.005	0.005	0.009	0.011	0.012	0.001	0.001	mg/l
	Ortho P	0.008	0.005	0.006	0.002	0.012	0.001	0.001	
	Ortho P	0.009	0.006	0.001	0.002	0.012		0.001	
	Total Dis. P	0.004	0.004	0.006	0.007	0.010	0.001	0.001	
	Total Dis. P	0.001	0.005	0.007	0.007	0.011		0.001	
Butcher - pond in	Temp	2.790	4.430	3.130	6.800	5.450	4.190	6.100	°C
	pH	6.610	7.460	7.550	7.710	7.570	7.640	7.030	Units
	SpCond	91.000	87.200	61.500	66.000	60.600	63.300	63.200	µS/cm
	TSS			1.000	7.500	6.500	3.000	7.000	
	LDO	13.950	11.060	12.990	11.790	9.960	12.060	11.020	mg/l
	DO, sat								mg/l
202	Total P	0.004	0.002	0.022	0.017	0.017	0.016	0.001	mg/l
	Total P	0.001	0.006	0.025	0.018	0.020		0.001	mg/l
	AVG	0.002	0.004	0.024	0.018	0.019	0.016	0.001	mg/l
	Ortho P	0.004	0.006	0.018	0.011	0.027	0.011	0.001	
	Ortho P	0.002	0.001	0.020	0.010	0.026		0.001	
	Total Dis. P	0.001	0.004	0.022	0.014	0.018	0.012	0.001	
	Total Dis. P	0.001	0.004	0.022	0.019	0.017		0.001	
Butcher - pond out	Temp	2.410	5.560	3.210	8.500	8.050	7.400	10.230	°C
	pH	6.630	7.350	6.990	7.280	7.370	7.240	6.760	Units
	SpCond	89.000	81.500	62.400	68.000	67.900	65.300	65.400	µS/cm
	TSS			2.500	3.000	4.500	0.000	5.000	
	LDO	12.960	11.450	10.890	10.550	8.820	9.420	11.320	mg/l
	DO, sat								mg/l
Delta P		-0.002	-0.001	0.015	0.007	0.007	0.016	0.000	
203	Total P	0.001	0.006	0.008	0.004	0.010	0.007	0.004	mg/l
	Total P	0.001	0.006	0.002	0.005	0.009		0.001	mg/l
	AVG	0.001	0.006	0.005	0.005	0.010	0.007	0.002	mg/l
	Ortho P	0.001	0.001	0.002	0.001	0.009	0.001	0.001	
	Ortho P	0.001	0.001	0.001	0.001	0.009		0.001	
	Total Dis. P	0.006	0.008	0.007	0.005	0.010	0.001	0.001	
	Total Dis. P	0.006	0.008	0.003	0.007	0.009		0.001	
Butcher - upstream	Temp	2.650	5.680	3.810	6.060	6.950	5.880	7.110	°C
	pH	6.100	6.650	6.640	6.710	6.910	7.230	6.290	Units
	SpCond	72.000	70.500	46.600	45.300	38.900	38.400	37.700	µS/cm
	TSS			0.500	0.500	3.500	1.000	1.000	
	LDO	13.480	11.230	12.480	11.910	9.940	11.500	11.570	mg/l
	DO, sat								mg/l
204	Total P	0.001	0.008	0.008	0.004	0.005	0.022	0.004	mg/l
	Total P	0.007			0.005	0.004		0.001	mg/l
	AVG	0.004	0.008	0.008	0.005	0.005	0.022	0.002	mg/l
	Ortho P	0.001		0.008	0.007	0.009	0.008	0.001	
	Ortho P	0.001			0.008	0.001		0.001	
	Total Dis. P	0.001	0.008	0.007	0.006	0.008	0.020	0.001	
	Total Dis. P	0.003		0.500	0.005	0.007		0.001	
Butcher - downstream	Temp	2.530	5.650	3.640	8.510	5.970	5.710	7.700	°C
	pH	6.340	6.930	6.800	6.960	7.050	7.080	6.400	Units
	SpCond	75.000	75.400	49.600	37.700	39.500	41.300	40.700	µS/cm
	TSS				0.500	2.500	0.500	0.500	
	LDO	13.430	11.260	12.180	11.750	9.910	11.540	11.390	mg/l
	DO, sat								mg/l
Delta P		0.003	0.000	0.003	-0.002	-0.005	0.015	0.000	

4.2.3. 2009 Total Phosphorous

The figures below show TP data for the Rohlfing and Butcher ponds through the full 2009 year.

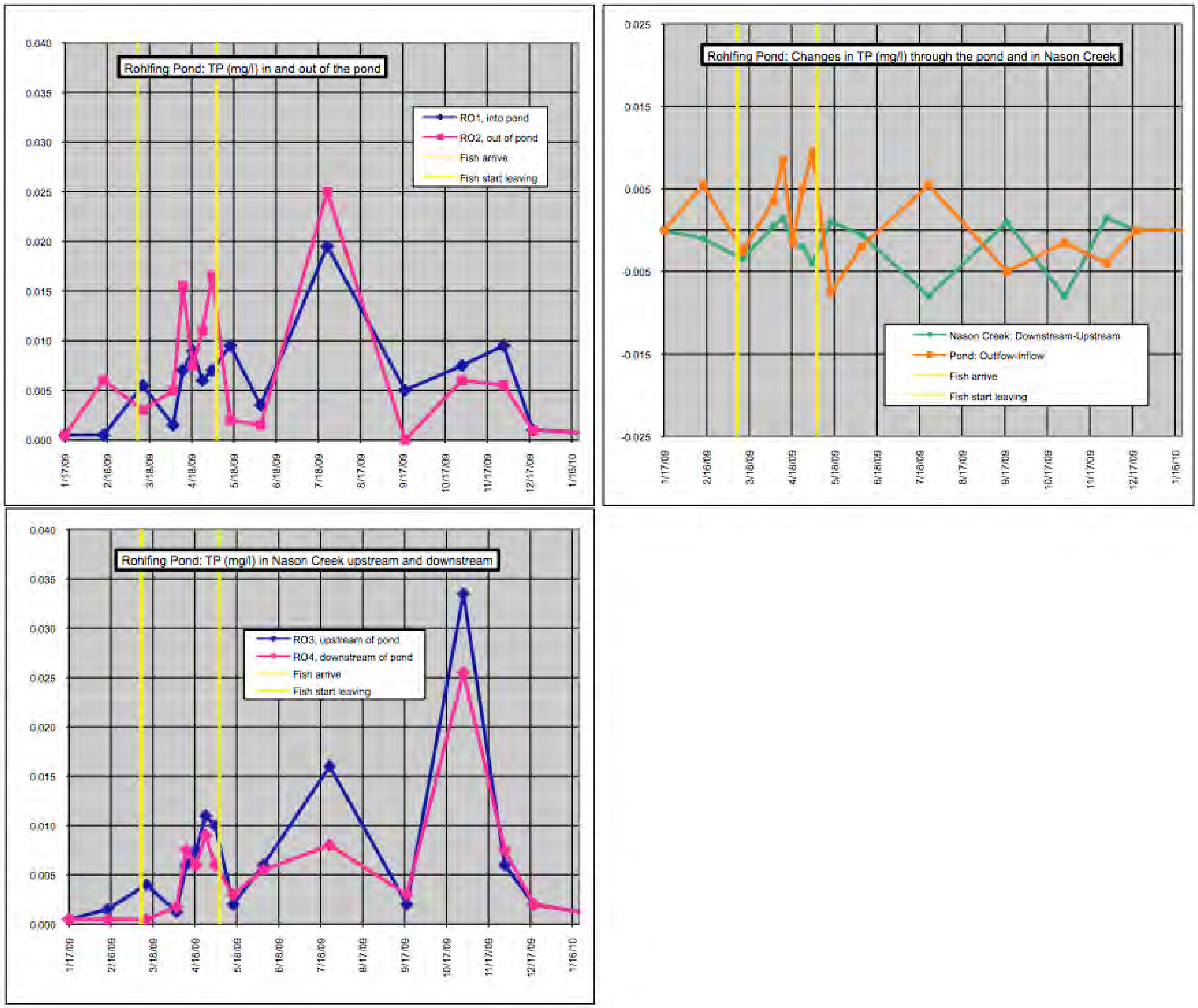


Figure 4-6. 2009 Rohlfing TP

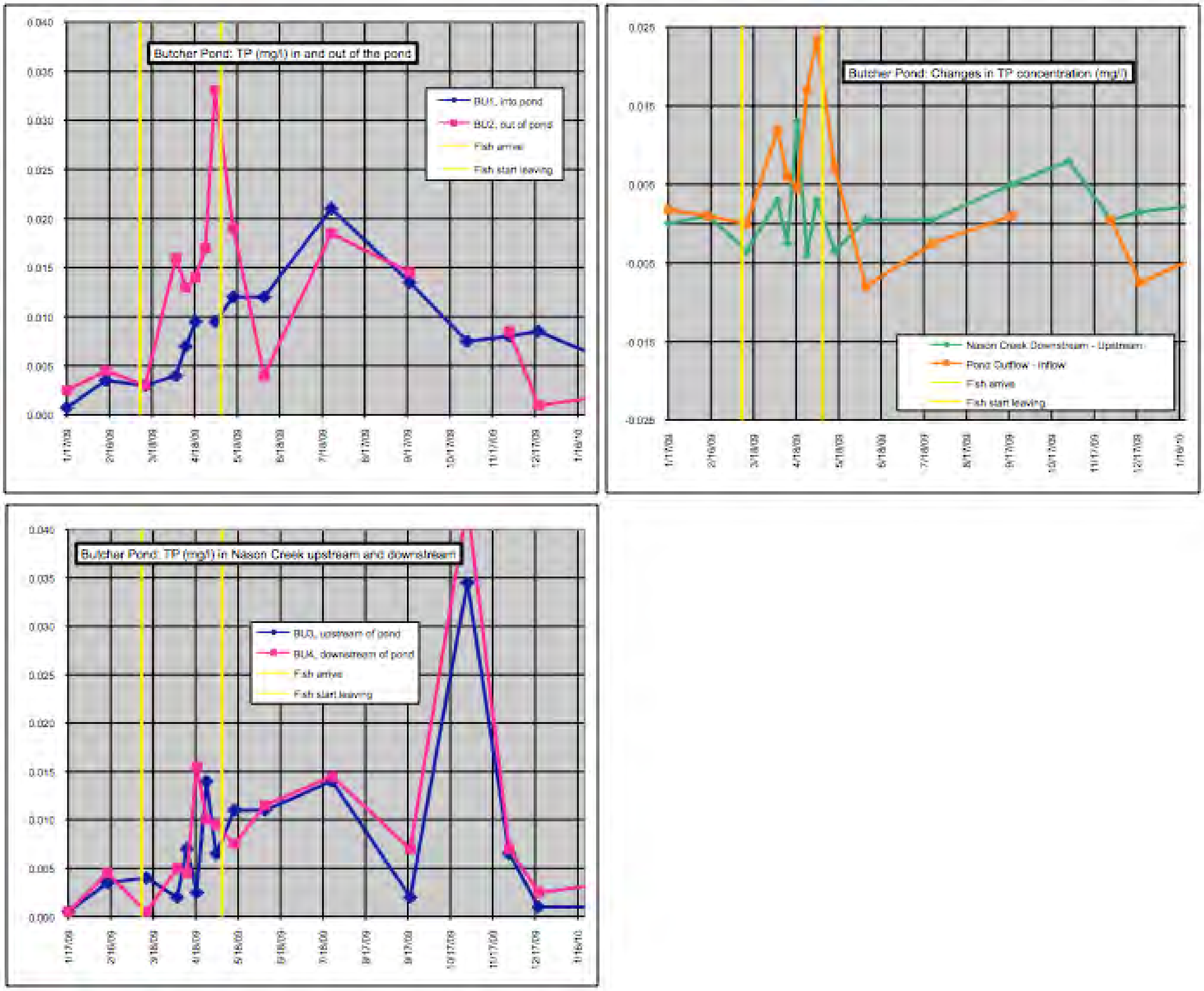


Figure 4-7. 2009 Butcher TP

4.2.4. 2010 Total Phosphorous

The figures below show TP data for the Rohlfing and Butcher ponds during the 2010 acclimation season.

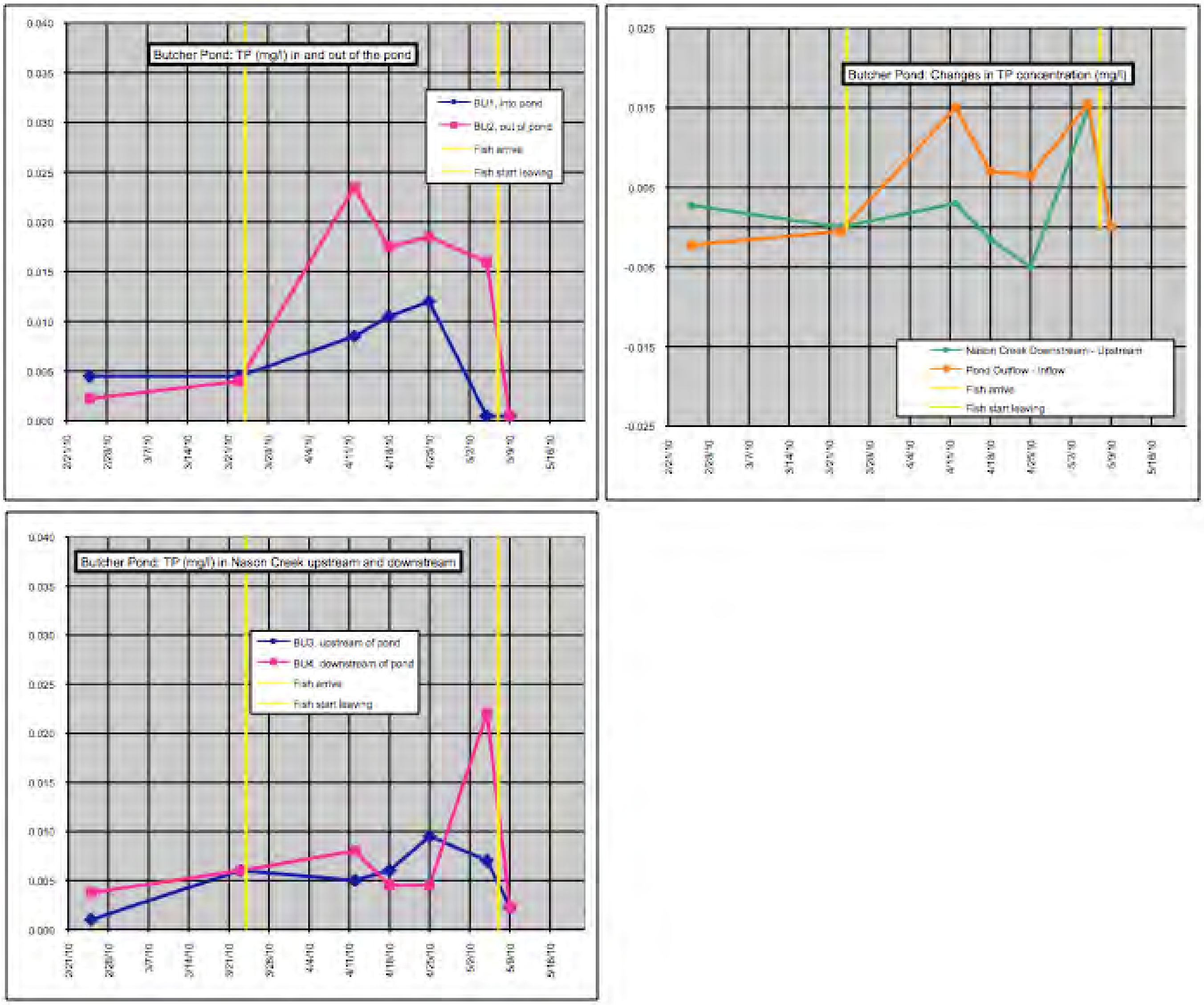


Figure 4-8. 2010 Rohlfing TP

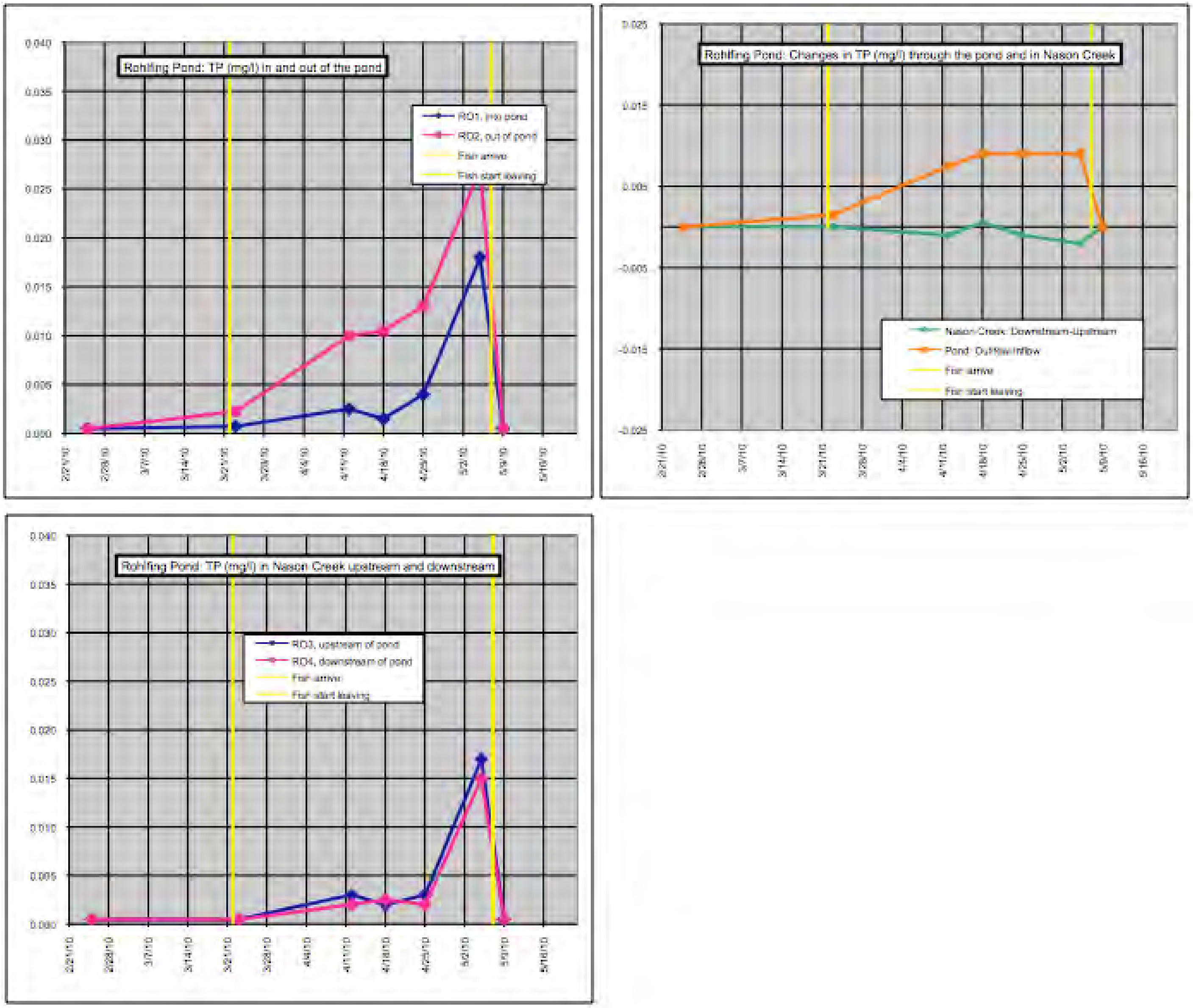


Figure 4-9. 2010 Butcher TP

4.2.5. 2009 DO, pH, and Temperature

Other parameters measured with the Hydrolab sondes are plotted below.

Figure 4-10. Rohlfing DO, pH, and Temperature

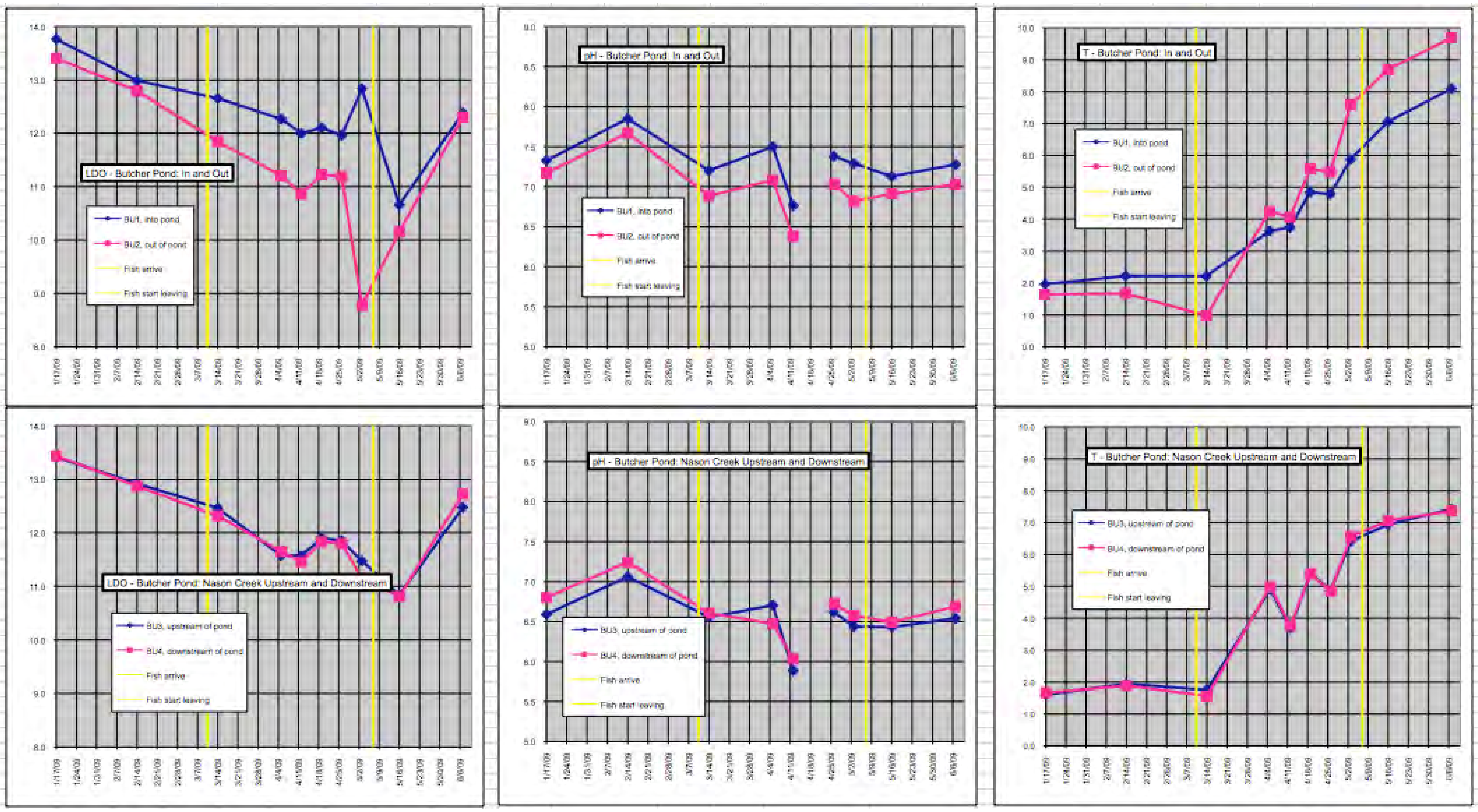


Figure 4-11. 2009 Butcher DO, pH, and Temperature

4.2.6. 2010 DO, pH, and Temperature

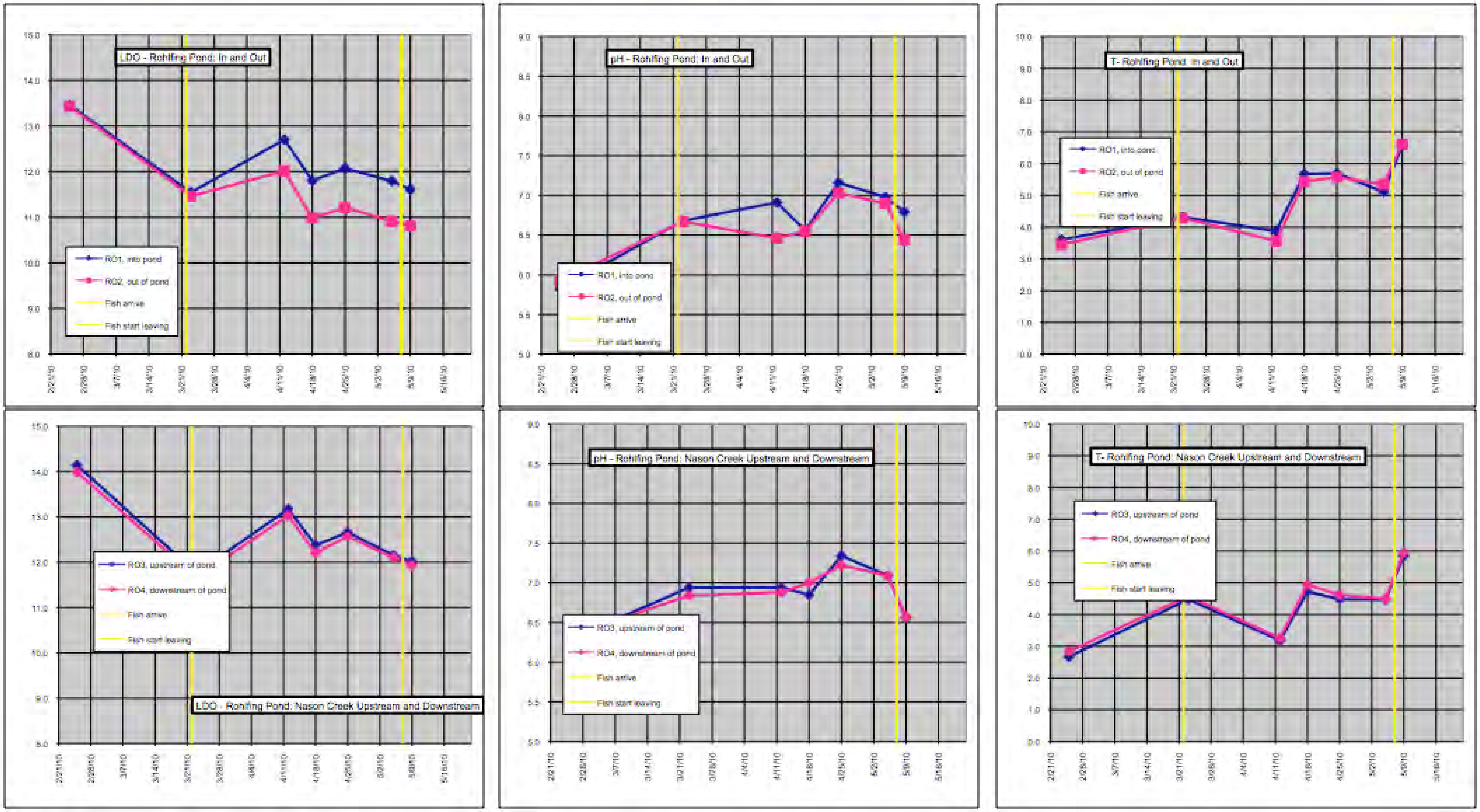


Figure 4-12. 2010 Rohlfing DO, pH, and Temperature

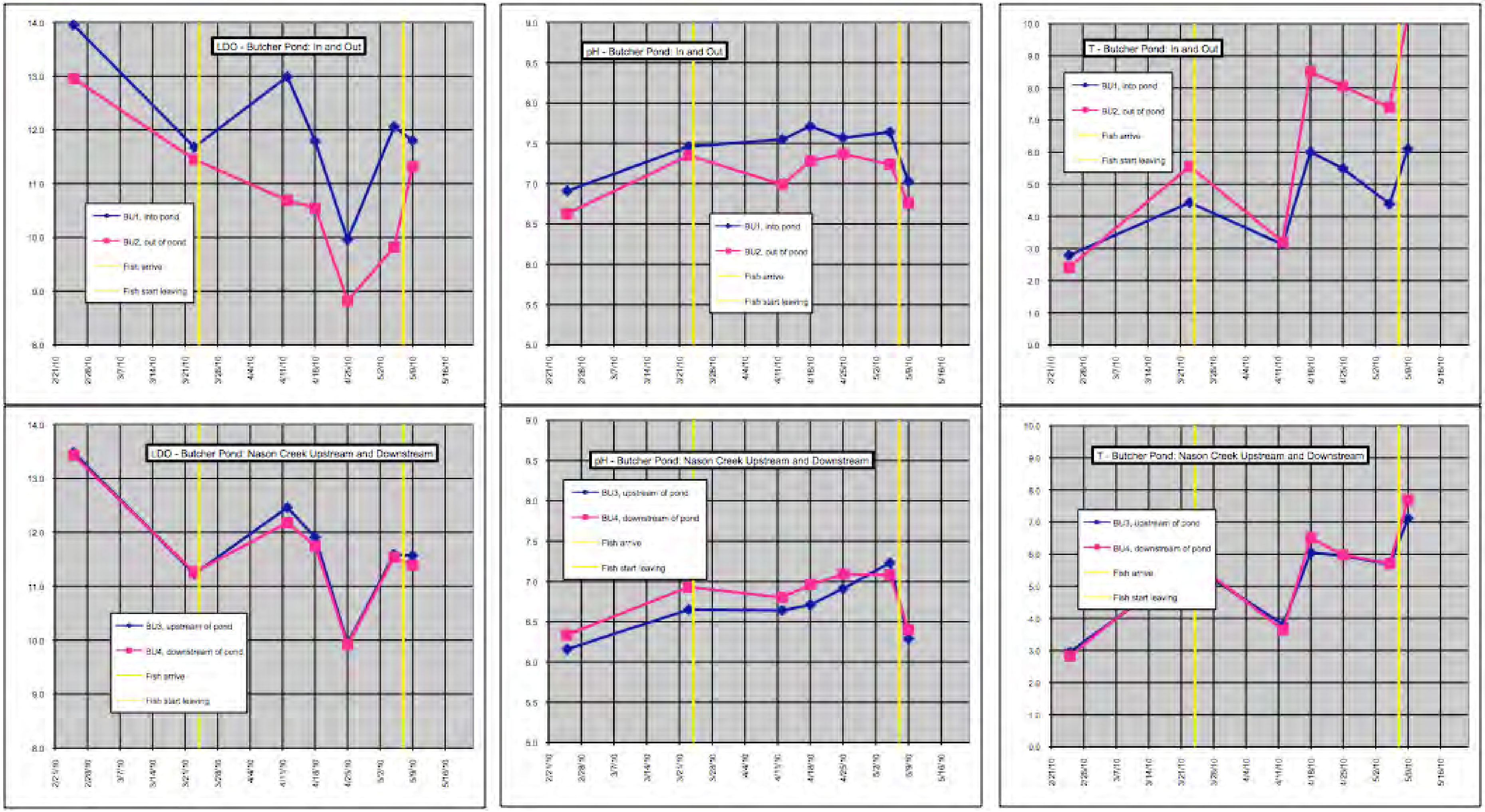


Figure 4-13. 2010 Butcher DO, pH, and Temperature

4.2.7. 24 Hour Test Data

On 5/5/2010 and 5/6/2010 a Hydrolab sonde was moved between the 4 Butcher Creek sites, BU1, BU2, BU3, and BU4. Sample bottles were also filled at the time sonde measurements were recorded. Measurements were made every 2 hours over a 24 hour period, except for a gap between 23:30 and 05:30. Fish were released from the site on 5/7/10.

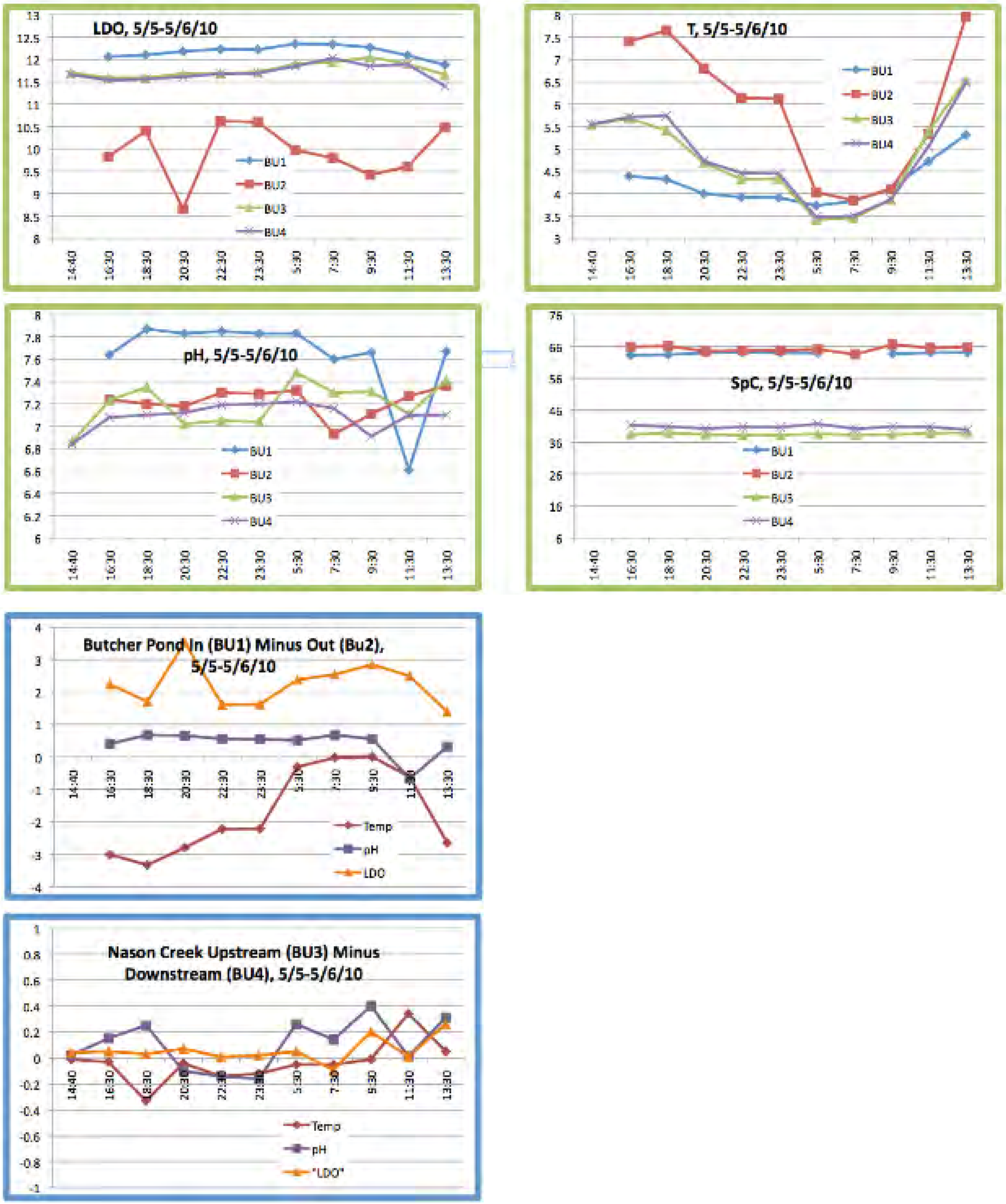


Figure 4-14. 24 Hr. Butcher DO, pH, and Temperature

4.3. Other Basin Sites

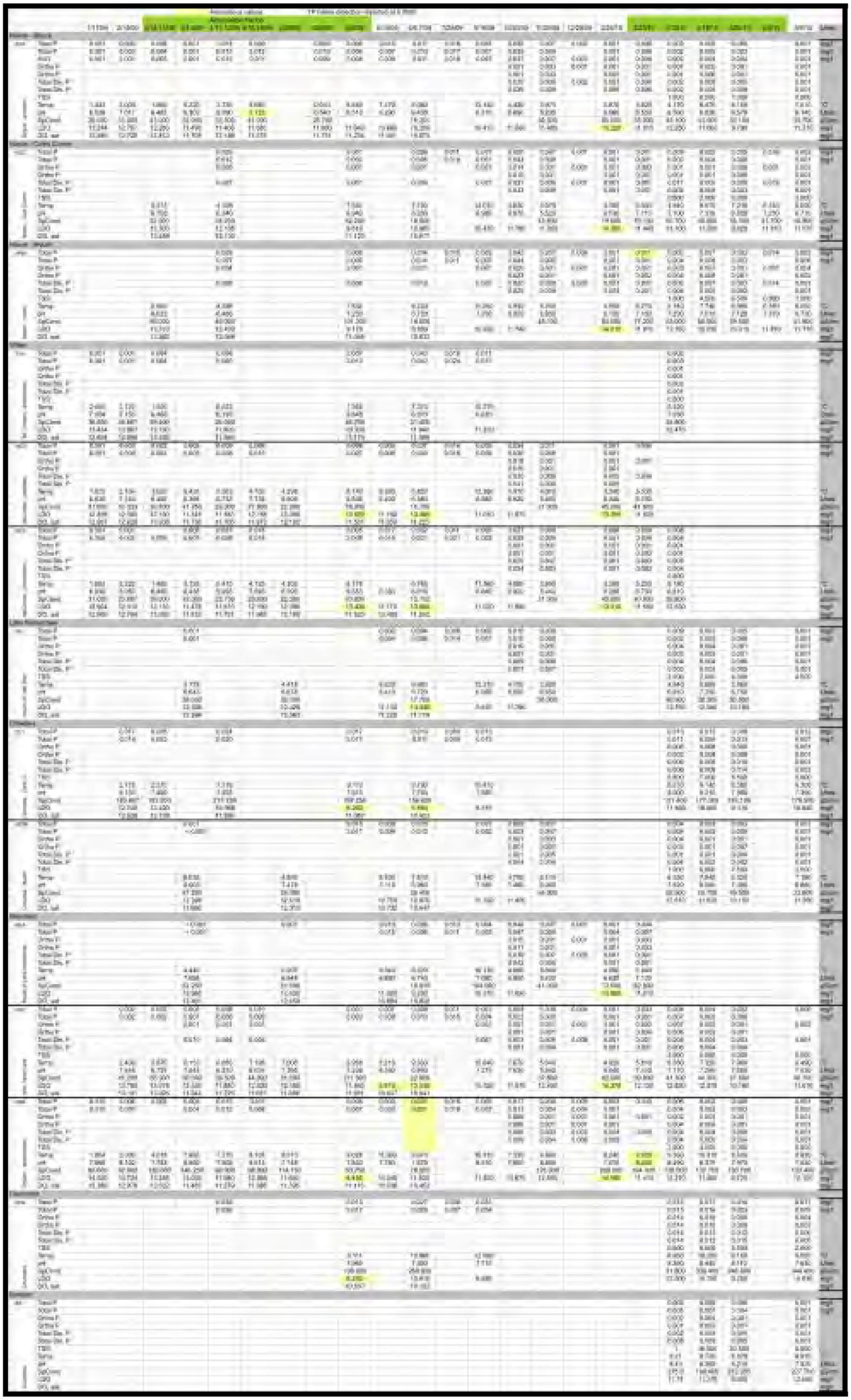


Figure 4-15. Water Quality at Other Sample Locations

4.4. Upper Wenatchee Basin TP Load

The figure below shows the 2009 phosphorous load at the WIC site, just upstream of the mouth of the Icicle and the town of Leavenworth. The TMDL defines "upstream load" as the Wenatchee River load above the confluence with the Icicle. Loads are calculated by multiplying TP concentration times the river flow rate.

The current TP upstream load estimate in the TMDL is 1.24 kg/day and the target load is 0.93 kg/day. The loads measured in this study were much higher than these values with the lowest load measured on 3/15/09 at 4.8 kg/day.

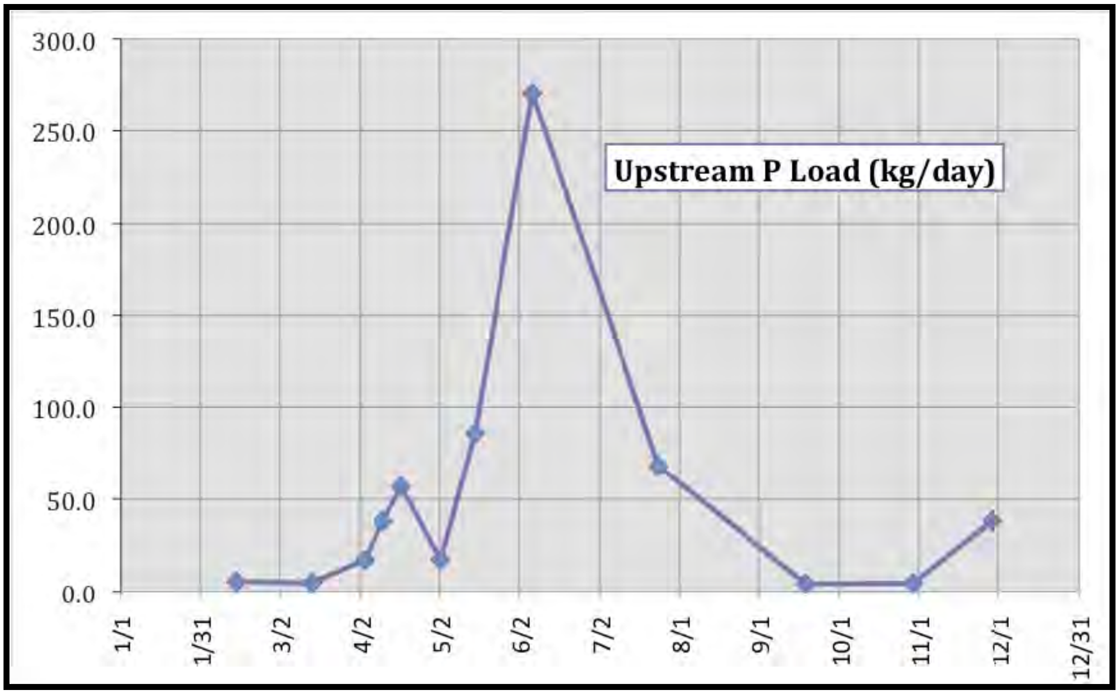


Figure 4-16. Upstream TP Loads

4.5. Detailed Water Quality Sites

A larger suite of water quality parameters were monitored periodically at 3 selected sites, one each on Nason Creek, White River, and the Wenatchee River respectively.

		1/17/09	2/14/09	3/14,15/09	4/4,5/09	4/11.12/09	4/18,19/09	4/25/09	4/26/09	5/3/09	5/18/09	6/6.7/09	7/25/09	9/19/09	10/30/09	11/29/09	12/20/09	2/25/10	3/23/10	4/12/10	4/18/10	4/25/10	5/8/10	5/9/10	Units
Water Quality (minimumums reported at the detection limit)																									
BU4	Total Organic Carbon	4.100	2.900	3.100	9.000					3.500		1.60	1.00	4.40	9.20	6.40		6.500	4.500	1.000	<1	<.5			mg/l
BU4	Dissolved Organic C	0.500	2.200	2.100	3.700					2.700		1.600	0.500	0.830	2.600	1.500		2.600	0.890	0.970	<.5	<1			mg/l
BU4	Chlorophyll a	0.800	0.800	0.300	0.300					0.300		10.000	0.800	0.530	0.800			0.530	7.500	<.3	2.700	1.600	7.500	1.300	mg/m3
BU4	Pheophytin	0.300	1.000	4.200	4.600					1.200		0.300	0.300	1.000	1.500			4.000	<.3	<.3	11.000	0.640	<.3	0.910	mg/m3
BU4	Ammonia Nitrogen	0.020	0.009	0.013	0.022					0.022		0.082	0.210	0.032	<.005	0.030		0.033	<.005	0.040	<.005	<.01	0.010	0.011	mg/l
BU4	Nitrate + Nitrite	0.062	0.031	0.048	0.035					0.060		0.032	0.014	0.005	0.050	0.039		0.035	0.050	0.036	0.110	0.087	0.070	0.071	mg/l
BU4	Total Persulfate N	0.150	0.016	0.070	0.070					0.090		0.040	0.060	0.080	0.150	0.070		0.007	0.100				0.010	0.120	mg/l
BU4	Ortho-Phosphate	0.001	0.001	0.001	0.002					0.001		0.001	0.002	0.001				0.001		0.006	0.007	0.009	<.001	<.001	mg/l
BU4	Suspended Solids			1.000	2.000					3.000		15.000	1.000	9.000	54.000	2.000		1.000	13.000	<1	<1	4.000	<1	<1	
BU4	Nitrite Nitrogen				0.001																				
BU4	BOD-low									2.000		2.000		1.000	<2			1.000		<2	<2	<2	<2	<2	
DR4	Total Organic Carbon	8.100	6.200	5.500	4.200					2.700		7.500	1.500		<1	4.700		10.000	8.400	8.500	6.000	6.900			mg/l
DR4	Dissolved Organic C	7.700	5.500	3.300	3.100					2.100		6.200	0.600	3.500	<.5	4.800		7.000	2.500	2.400	5.600	6.900			mg/l
DR4	Chlorophyll a	1.100	1.100	1.900	3.200					1.600		25.000	1.300	0.530	7.500			0.530	5.300	8.200	4.300	1.600		1.200	mg/m3
DR4	Pheophytin	< 0.3	1.700	0.980	1.500					0.300		0.300	0.300	0.150	4.800			1.500	<.3	<.3	4.500	<.3		<.3	mg/m3
DR4	Ammonia Nitrogen	0.026	0.100	0.012	0.005					0.005		0.074	0.020	0.042	<.005	0.023		0.018	<.005	<.005	<.005	<.01		<.005	mg/l
DR4	Nitrate + Nitrite	0.065	0.040	0.031	0.011					0.024		<.01	0.011	0.036	<.01	0.016		0.028	0.011	<.01	<.01	0.018		0.021	mg/l
DR4	Total Persulfate N	0.150	0.190	0.090	0.070					0.050		0.020	0.080	1.100	0.070	0.050		0.230	0.060	0.080				0.060	mg/l
DR4	Ortho-Phosphate	0.001	0.001	0.001	0.001					0.001		0.001	0.002	0.001				0.001		0.002	0.003	<.001		<.001	mg/l
DR4	Suspended Solids			4.000	1.000					2.000			2.000	2.000	40.000	<1		4.000	9.000	3.000	1.000	5.000		<1	
DR4	Nitrite Nitrogen				0.001																				
DR5	BOD-low									2.000				1.000				1.000		<2	<2	<2		<2	
MC4	Total Organic Carbon	5.200	2.900	1.000	8.300					2.600		1.900	1.000	2.600	<1	3.400		3.600	<1	<1					mg/l
MC4	Dissolved Organic C	4.700	2.700	0.500	4.200					2.300		0.500	0.500	0.025	<.5	1.400		3.500	<.5	<.5					mg/l
MC4	Chlorophyll a	2.700	0.530	0.300	1.600					1.600		27.000	0.530	0.720	0.530			0.900	4.300	<.3					mg/m3
MC4	Pheophytin	0.300	0.300	2.300	0.640					0.300		0.300	0.300	0.015	<.3			1.100	<.3	<.3					mg/m3
MC4	Ammonia Nitrogen	0.031	0.009	0.010	0.073					0.005		0.061	0.044	0.040	0.007	0.021		0.035	<.005	<.005					mg/l
MC4	Nitrate + Nitrite	0.083	0.092	0.044	0.010					0.120		0.068	0.010	0.027	0.042	0.068		0.055	0.046	0.045					mg/l
MC4	Total Persulfate N	0.170	0.030	0.090	0.090					0.160		0.100	0.030	0.080	0.080	0.080		0.130	0.100	0.100					mg/l
MC4	Ortho-Phosphate	0.001	0.001	0.001	0.001					0.001		0.001	0.001	0.001				0.001	0.001	<.001					mg/l
MC4	Suspended Solids			1.000	6.000					2.000			1.000	3.000	23.000	4.000		5.000	8.000	<1					
MC4	Nitrite Nitrogen				0.001																				
MC4	BOD-low									2.000				1.000	<2			1.000		<2					

Figure 4-17. Other Water Quality Data

5. Data Accuracy Analysis

Due to the importance of phosphorous, most of the following error analysis is focused on that parameter. Data is available that would allow detailed analysis of error for the other water quality properties measured as well.

The following error estimates were made using 2009 data only.

5.1. Detection Limits

The following detection limits for the laboratory measured parameters were provided by AM Test. They refer to the Method Detection Limits (MDL) that the EPA defines as “the minimum concentration that can be determined with 99% confidence that the true concentration is greater than zero.”

Chlorophyll a SM	0.03 mg/m3
Pheophytin	0.03 mg/m3
Total Suspended Solids	1.0 mg/l
BOD-low	2.00 mg/l
Dissolved Organic Carbon	0.50 mg/l
Ammonia Nitrogen	0.005 mg/l
Nitrate/Nitrite	0.01 mg/l
Nitrogen -Total Persulfate	0.01 mg/l
Orthophosphate	0.001 mg/l
Total Phosphorous	0.001 mg/l
Total Dissolved Phosphorous	0.001 mg/l
Total Organic Carbon	1.0 mg/l

Figure 5-1. Detection Limits

Phosphorous measurements were made at levels close to the detection limits of the instrumentation, 0.001 mg/l for orthophosphate, total dissolved phosphorous, and total phosphorous. Most of the TP measurement made in January and February were below this limit and the average TP value for all samples was 0.01 mg/l.

5.2. TP Repeatability

Three different repeatability (precision) error estimates were made. One used duplicated measurements of the same samples in the laboratory; another used duplicate field samples collected at the same location, and the third used samples collected in close proximity.

1). For each two day collection period, AM Test pulled every 10th sample and repeated the measurement. This data set consisted of 64 duplicates. The standard deviation of the difference between the two measurements for this data set was 0.001 mg/l or 2.6% of the average measured value.

2). The duplicate TP samples collected in the field provide a large data set for estimating repeatability. The figure below shows the average standard deviation of the differences between the two samples collected at each site.

Site	SD (mg/l)
BO3	0.0021
NCC	0.0029
NMA	0.0018
TA4	0.0026
MC3	0.0022
MC4	0.0034
MLI	0.0036
CL1	0.0044
MCHI	0.0029
MLA	0.0023
W/C	0.0016
DR4	0.0017
CH4	0.0017
RO1	0.0014
RO2	0.0022
RO3	0.0034
RO4	0.0020
BU1	0.0017
BU2	0.0023
BU3	0.0019
BU4	0.0028
Average	0.0024

Figure 5-2. TP Repeatability, Field Samples

The average of all TP measurement taken was 0.011 mg/l for this data set of 480 values. The average standard deviation for all the sites of 0.0024 mg/l is 28% of this value, higher than the accuracy data quality objective for P (see section 3.4). The impact evaluation uses TP values at each site that are the average of the two measurements taken in order to reduce error.

3). Another repeatability estimate can be made by comparing samples taken nearly simultaneously at separate collection sites located in close proximity and where there is no obvious nutrient source or sink between them. A pair of sites on Nason Creek, BO3 and BU4 (separated by 200 meter), and a pair on the White River, MC3 and MC4 (separated by 190 meters), meet these conditions. Neither pair have any incoming tributaries between the sample sites. The standard deviation of the differences between the pairs of TP values (a data set of 100 measurements) at these two locations was 0.0038 mg/l and the average measured value was 0.010 mg/l. The error ratio was then 38%. This large value indicates that there is high instream TP variation within relatively short distances and sampling intervals.

5.3. TP Measurement Accuracy

Estimates of other components of total error were also made. The accuracy of the AM Test laboratory measurements was estimated by comparing them to standard references and to blank samples. References before 4/11/09 had true values of between 0.010 and 0.230 mg/l. After that date, all comparisons were made at 0.100 mg/l. References meet National Environmental Laboratory Accreditation Conference standards and can be traced to National Institute of Standards and Technology reference materials.

The standard reference comparison for TP produced a data set of 68 values. The standard deviation of the difference between the reference and the measured value was 0.0034 mg/l which is 3.5% of the reference value. This accuracy estimate is well below the objective of 25%. However, this estimate was made at TP values that were much higher than the field samples and it is expected that accuracy is lower closer to the resolution limit of the TP measurement method.

Comparisons with blank values (de-ionized water) were also made. The average blank value measured was below the detection limit of the instrumentation, 0.001 mg/l.

5.4. DO and pH Error

The Hydrolab sonde DO and pH parameters were calibrated prior to use on day 1 and after use on day 2. The comparison between these values is shown in the table below. Both DO and pH generally drifted higher. The standard deviation for DO was 3.8% and for pH, 0.21 units. Collected data was not corrected based on the pre and post calibrations. pH data for 4/19/09 and 10/30/09 was not used in the accuracy analysis or in the impact evaluations due to the large shift shown by post-calibration which occurred at some point in the sensor output.

Date	LDO Before	LDO After	Difference		pH Before	pH After	Difference
2/13/09	100.0%	101.5%	1.46%		7.06	7.13	0.07
2/22/09	100.0%	99.5%	-0.50%				
3/21/09	100.0%	98.2%	-1.80%		7.18	7.04	-0.14
4/4/09	100.0%	101.2%	1.20%		6.98	7.04	0.06
4/11/09	100.0%	95.6%	-4.40%		6.98	6.6	-0.38
4/19/09	100.0%	108.5%	8.50%		6.98	8.46	
4/25/26	100.0%	105.2%	5.20%		6.98	7.23	0.25
5/2/09	100.0%	100.2%	0.20%		6.98	7.18	0.2
5/9/09	100.0%	102.2%	2.20%		6.98	7.14	0.16
7/25/09	100.0%	106.9%	6.90%		7.01	7.22	0.21
8/9/09	100.0%	98.0%	-2.00%		7.04	6.89	-0.15
10/30/09	100.0%	102.2%	2.20%		7.01	7.89	
Average			1.6%				0.03
Stnd Dev			3.8%				0.21

Figure 5-3. Hydrolab Sonde Calibrations

All the Hydrolab sondes used had Luminescent Dissolved Oxygen technology (LDO) sensors. The manufacturer specifications are:

Accuracy: +/- 0.2 mg/L

Resolution: 0.01 mg/L

The pH sensors were KCl impregnated glass bulbs with a refillable reference electrode. Manufacturer specifications are:

Accuracy: +/- 0.2 units

Resolution: 0.01 units

5.5. General Error Discussion

Overall measurement accuracy will be a function of error introduced by the field collection methods and by the instrumentation used.

Data collection methods were designed to minimize error but it could have been introduced through several possible mechanisms. A significant error source for phosphorous and possibly other parameters, may be a result of spatial variations in concentrations, flow or other characteristics within the stream and temporal variations in sample collection. This is evidenced by the large differences (38% SD) in TP measurements made at the two sets of collection sites that were close together.

Any estimate of total instrumentation measurement accuracy would need to include several different sources and types of error. Calibration, precision, detection limits, and drift would need to be accounted for. Several of the error terms are interdependent and estimating values for overall accuracy would be complex. Also, some of the error terms are less critical for important parts of the effort to predict impacts due to acclimation. For instance, calibration and precision errors are largely eliminated when differences between measurements made by the same instruments are used in the evaluation.

Total error for LDO was assumed to be the root mean square (RMS) of the manufacturers reported accuracy and the standard deviation of the pre and post calibrated values, +/- 0.56 mg/l. Total pH error used the same assumptions, resulting in an estimated total error value of +/- 0.29 units.

Total phosphorous accuracy was assumed to be +/- 38%, the highest of the errors discussed in the sections above. The RMS of all the error terms was not used because the measurement differences between values collected at sites in proximity include most of the other important sources of error.

APPENDIX 7
WATER QUALITY IMPACTS OF DISCHARGES

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November 2010

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LIST OF ACRONYMS AND ABBREVIATIONS

Abbreviation	Definition
µg/L	micrograms per liter
cfs	cubic feet per second
degrees C	degrees Celsius
DMR	Discharge Monitoring Report
DO	Dissolved Oxygen
EIS	Environmental Impact Statement
g/d	grams per day
kg/d	kilograms per day
L/d	liters per day
LNFH	Leavenworth National Fish Hatchery
MSRF	Methow Salmon Recovery Foundation
MSWA	Methow State Wildlife Area
m^3/s	cubic meters per second
mg	milligrams
mg/L	milligrams per liter
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
pH	$-\log_{10}[H^+]$
POTW	Publicly Owned Treatment Works
PUD	Public Utility District
RKM	River Kilometer
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
USGS	U.S. Geological Survey
WAC	Washington Administrative Code
WDOE	Washington Department of Ecology
WNFH	Winthrop National Fish Hatchery

1 SUMMARY

The proposed coho salmon (coho) restoration activities within the Wenatchee and Methow subbasins pose a negligible impact on surface water quality. In the Wenatchee subbasin, the results of mechanistic modeling indicated that, even under the conservative assumptions applied, the proposed activity is expected to have a negligible impact on the water quality of the Wenatchee River. Indeed, in most instances the measured and predicted impacts were within the range of natural variability or the measurement error of targeted water quality standards. In the Methow subbasin, the assessment of basin-wide impacts of acclimation activity also led to the conclusion that acclimation activity is likely to have a negligible impact on water quality.

The assessment in the Wenatchee subbasin was based on extensive site-specific data analysis and mechanistic water quality modeling of actual and potential discharges and included an evaluation of the cumulative impacts of the proposed acclimation and rearing sites. Impact in the Methow subbasin was assessed by evaluating the total phosphorus (TP) loading estimates for the proposed sites from the context of Methow subbasin characteristics and also by comparison to the impacts estimated for the Wenatchee subbasin.

Water quality data collected through 2009 and 2010 at select locations of proposed and existing acclimation sites within the Wenatchee subbasin formed the basis for the analysis presented herein. Water quality data, collected in the vicinity of active acclimation sites, provided direct measurement of the impacts of ongoing acclimation activity that established acclimation-activity-related nutrient loading rates (total phosphorus load per fish) to the receiving stream. This estimate was then used in the assessment of impacts in the vicinity of the proposed sites in the Wenatchee and Methow subbasins, based on the number of fish proposed for acclimation at each site.

Analysis of dissolved oxygen (DO), pH (negative logarithm of the proton concentration), TP, and temperature data collected upstream and downstream of active acclimation sites in Nason Creek in the Wenatchee subbasin suggested that ongoing acclimation activity has a negligible impact on the receiving stream.

Basin-wide impact of the acclimation and rearing sites was estimated for the Wenatchee subbasin through mechanistic water quality modeling. The QUAL-2K model developed by Washington State Department of Ecology (WDOE) for TP load allocations in the Wenatchee subbasin (Carroll et al. 2006; Carroll and Anderson 2009) was adapted for this basin-wide impact assessment. Several conservative assumptions were made in the mechanistic model application to provide an upper bound estimate of the impact of the site activity on nutrient loading to the Wenatchee River. The results of mechanistic modeling indicated that the proposed activity is expected to have a negligible impact on the water quality of the Wenatchee River. Model predictions indicated that contraventions in DO and pH standards

are unlikely even when the Wenatchee River receives maximum allocated loads (as specified in the WDOE Total Maximum Daily Load [TMDL], Carroll and Anderson 2009) from publicly owned treatment works and other point and distributed sources.

It is concluded that the cumulative impact of the proposed coho restoration activities on the Wenatchee subbasin water quality is expected to be negligible because:

1. The nutrient load is negligible. The maximum total addition of phosphorous due to the project, at peak production levels, is estimated to be 0.38 kilogram per day during the acclimation period, which is about 1% of average Wenatchee River load when acclimation activity is ongoing.
2. Despite the conservative modeling assumptions used, impacts to DO and pH due to upstream acclimation are estimated to be negligible in the TMDL domain (the lower Wenatchee River downstream of the city of Leavenworth).
3. Lower water temperatures during the acclimation period limit in-stream biological activity.
4. An analysis of travel times suggests that the residence times of any nutrients discharged to the system would be small during spring high flows that are prevalent when feed rates are highest. Most of the loads are expected to be removed during spring high flows and impacts are not expected later in the year including the summer low flow period.
5. In-stream data collected from the Wenatchee subbasin showed that most of the phosphorous being discharged is not in a readily bio-available form. Even the travel times calculated under low flow conditions was not expected to provide a sufficiently long residence of the total phosphorus loading in the system thereby keeping it largely unavailable for biological uptake during transport through the subbasin.

Basin-wide impact of acclimation activity within the Methow subbasin was assessed by comparing the TP loading estimates for the proposed sites to the basin-wide TP loads calculated from historical data collected in the basin. The similarity in the characteristics of the two basins, combined with the assessments derived from mechanistic modeling of the basin-wide impacts for the Wenatchee subbasin, led to the conclusion that the basin-wide impacts within the Methow subbasin are also likely to have a negligible impact on water quality.

2 INTRODUCTION AND DISCHARGE EVALUATION OBJECTIVES

Discharges from proposed coho salmon (coho) acclimation sites in the Wenatchee and Methow subbasins may contain nutrients (phosphorus and nitrogen) at levels that promote algal growth. Algal photosynthesis and respiration cycles results in diurnal pH (negative logarithm of the proton concentration) and Dissolved Oxygen (DO) swings and can induce changes in pH and DO beyond the ranges found under natural conditions. Such changes contravene water quality standards and negatively impact the designated uses of these waterbodies, which include swimming; domestic, industrial, and agricultural water supply; aesthetic value; wildlife habitat; harvesting; and spawning, rearing, and migration for Endangered Species Act-listed coho.

The Wenatchee River and portions of Icicle Creek are on the State of Washington's 303(d) list of impaired waterbodies for DO, pH, and temperature excursions. The lower Wenatchee River downstream of the City of Leavenworth, and Icicle Creek below the Leavenworth National Fish Hatchery (LNFH) have a phosphorus Total Maximum Daily Load (TMDL) in effect. The TMDL analysis undertaken by Washington Department of Ecology

(WDOE) advocates the implementation of a phased load reduction from point and non-point sources to prevent water quality excursions during critical low-flow conditions occurring in summer and fall (Carroll et al. 2006; Carroll and Anderson 2009). The Wenatchee River upstream of Leavenworth is presently not included in the State's 303(d) list for DO and pH violations (Carroll and Anderson 2009). However, the WDOE TMDL document has recommended a limit for the total phosphorus (TP) loads entering the lower Wenatchee River from sources upstream of Leavenworth to address water quality degradation in the lower section of the Wenatchee River where the TMDL is in effect.

The Methow River is not listed in the State's 303(d) list of impaired water bodies for pH or dissolved oxygen violations. However, it is currently listed for temperature.

This Appendix presents an analysis of potential water quality impacts (pH and DO) attributable to proposed coho acclimation sites (through nutrient addition) within the Wenatchee and Methow subbasins. The WDOE TMDL analysis of the Wenatchee River focused on phosphorus because it was determined to be the limiting nutrient for algal growth in the lower river and is the primary concern for water quality degradation. Thus, phosphorus was the primary nutrient considered in the analysis presented herein.

The Wenatchee subbasin contains active acclimation sites from which extensive data were collected to form a basis for assessing coho acclimation activity impacts on water quality[1]. Nutrient loading estimates derived from these active acclimation sites were then used as a basis for forecasting nutrient loading from sites proposed in both the Wenatchee and Methow subbasins. Where appropriate, water quality modeling was used to facilitate the evaluation.

2.1 Objectives

The purpose of this evaluation is to provide an assessment of the water quality impact of discharges originating from coho acclimation sites proposed in this project. This evaluation had the following objectives:

- Assess phosphorus loading and the potential impacts on receiving waters from active

[1]Appendix 6 contains details on the data collection effort as well as a preliminary presentation of the data.

acclimation sites in the Wenatchee subbasin

- Use evidence from active sites in the Wenatchee to assess phosphorus loads from sites in the Wenatchee and Methow subbasins
- In each subbasin, assess the combined impact of the project based on the contribution of loading from all acclimation sites relative to the background levels
- Estimate the cumulative impact of the project in each subbasin based on existing subbasin phosphorus loads

2.2 Criteria for Evaluation

2.2.1 Regulatory Guidelines

Washington state law provides protection for surface water quality through an anti-degradation policy (WAC 173-201A-300 of Washington Administrative Code; WAC 2006). Under this law, three levels of protection are provided: Tier I protection extends to all water bodies and maintains the current and designated uses for a given water body and prevents any further pollution; Tier II does not allow degradation of surface waters that are of exceptional quality (exceeding the water quality standards) through new or proposed actions unless such degradation is necessary and in the overriding public interest; and Tier III protection applies to water bodies classified as outstanding resource waters.

Much of the upper Wenatchee subbasin and nearly the entire Methow subbasin exceed the water quality standards for temperature, DO, and pH. Thus, these waters are protected by the Tier II anti-degradation policy. The lower Wenatchee River and portions of Icicle Creek where the TMDL is in effect (to prevent pH and DO excursions) are protected under the Tier I policy.

Most of the existing and proposed acclimation-related sites are located in waters protected by the Tier II anti-degradation policy. A Tier II anti-degradation evaluation will be required if the proposed activity has the potential to cause a measureable change in water quality, where measurable changes relevant to this context as defined in the legislation (WAC 2006) are: temperature increase of 0.3 degree Celsius (C) or greater; DO decrease of 0.2 milligrams per liter (mg/L) or greater; and pH change of 0.1 unit or greater. For Tier I waters, anthropogenic discharges must not affect the existing and designated uses.

Based on the regulatory guidelines presented above, the following criteria were used to evaluate the local and cumulative impacts of the acclimation sites:

- For active discharges in waters protected by the Tier II policy, evaluate the phosphorus levels with reference to the existing background conditions to assess whether acclimation-related discharges produces algal blooms that are sufficient to cause a measurable change in DO and pH beyond the mixing zone of the discharge
- For proposed discharges in waters protected by the Tier II policy, estimate phosphorus load from discharge relative to existing background load to assess the

likelihood of measurable change in DO and pH

- For the lower Wenatchee River (currently protected by Tier I policy), determine whether activities proposed in this project are likely to cause a measurable change in DO and pH, as defined above, that is sufficient to affect the existing and designated uses

2.2.2 Data Quality

Whenever possible, instrument accuracy and precision were used to supplement the interpretations of significance in impacts in addition to the regulatory guidelines discussed in Section 2.2.1. For instance, small changes in DO and/or pH may be undetectable due to equipment limitations.

Field duplicates for TP collected during sampling events were analyzed to obtain an estimate of instrument accuracy and precision. A detailed discussion is available in Chapter 5 of Appendix 6. When evaluating differences in nutrient levels between the acclimation sites and receiving streams, instrument accuracy and precision will be considered.

3 ASSESSMENT OF IMPACTS AT ACTIVE SITES

Nason Creek in the upper Wenatchee subbasin has three coho acclimation sites presently in operation for this project: Rohlfing; Butcher; and Coulter. In all three locations, fish acclimation activity was carried out in spring 2009 and 2010. The construction and operational details of the acclimation sites were presented in Appendix 2, and the associated data collection was presented in Appendix 6.

3.1 Approach

To meet the objectives laid out in Section 2.1, a mass balance approach was adopted where phosphorus loadings entering and leaving the acclimation ponds were evaluated. The inflow phosphorus level provides the background or natural condition existing in the creek feeding the pond, while the outflow concentration reflects any potential impact of acclimation activity.

The relative change in water quality at the upstream and downstream sampling locations compared to the criteria specified for measurable change (see Section 2.2) formed the basis for the evaluation of acclimation pond impacts on the receiving stream (Nason Creek). The applicability of these criteria was based on the following assumptions:

- The concentrations in Nason Creek are unlikely to be affected during non-acclimation periods, given the low flows out of the ponds (typically less than 1 percent (%) of Nason Creek flows). Data collected from Nason Creek in the 2009 post-acclimation period supported this assumption.
- In-stream water quality changes are unlikely due to factors other than the discharge over the reach of the natural waterway between the sampling locations that are

upstream and downstream of the discharge from the acclimation pond because of the proximity of the upstream and downstream locations.

Combined effects of the acclimation ponds were evaluated by comparing relative changes in water quality from upstream to downstream along the length of Nason Creek.

3.2 Analysis of Data Collected at Pond Inflow and Outflow

3.2.1 Rohlfing

3.2.1.1 TP Loads from Acclimation Activity

TP concentrations measured at the pond inflow and outflow measured during 2009 and 2010 are presented in Figure 1. The figure suggests that while there was significant variability in outflow concentrations, the overall pattern indicated that outflow generally tracked inflow concentrations. Outflow concentrations were higher in all but two cases (both in 2009) when acclimation activity was ongoing, suggesting that there was nutrient addition to the receiving stream due to acclimation activity.

Calculations that show the load introduced due to acclimation activity are presented in Table 1. The load calculations showed an average TP load of about 37 grams per day (g/d) being introduced into the outflow. The data also show that the loading occurred during the acclimation period in April and May.

Table 1
TP loads introduced due to acclimation activity at Rohlfing Pond

Date[1]	Flow[2] (cfs)	Flow (L/d)	Average TP Concentration (µg/L)			TP Load Introduced[4] (g/d)
			Inflow	Outflow	Difference[3]	
3/14/2009	1.4	3425206	5.5	3	-2.5	0.0
4/5/2009	1.4	3425206	1.5	5	3.5	12.0
4/12/2009	4.1	10030960	7	15.5	8.5	85.3
4/19/2009	4.1	10030960	9	7.5	-1.5	0.0
5/3/2009	3.5	8563014	7	16.5	9.5	81.3
3/23/2010	2.1	5137809	1	2.5	1.5	7.7
4/18/2010	2.8	6850412	1.5	10.5	9	61.7
4/25/2010	2.1	5137809	4	13	9	46.2
Average						**36.8**

Notes:
1. 4/26/2009, 4/12/2010, and 5/5/2010 TP data were not used due to lack of paired stage measurements
2. Flow was estimated from the stage-discharge relationship developed for the stream feeding into ponds.
3. Difference = total phosphorus concentration between pond inflow and outflow.
4. Volumetric inflows and outflows were assumed to be equal in load calculation. Whenever the difference in loads was negative, load introduced due to acclimation activity was set to 0.
µg/L - micrograms per liter, cfs - cubic feet per second, L/d - liters per day, g/d - grams per day

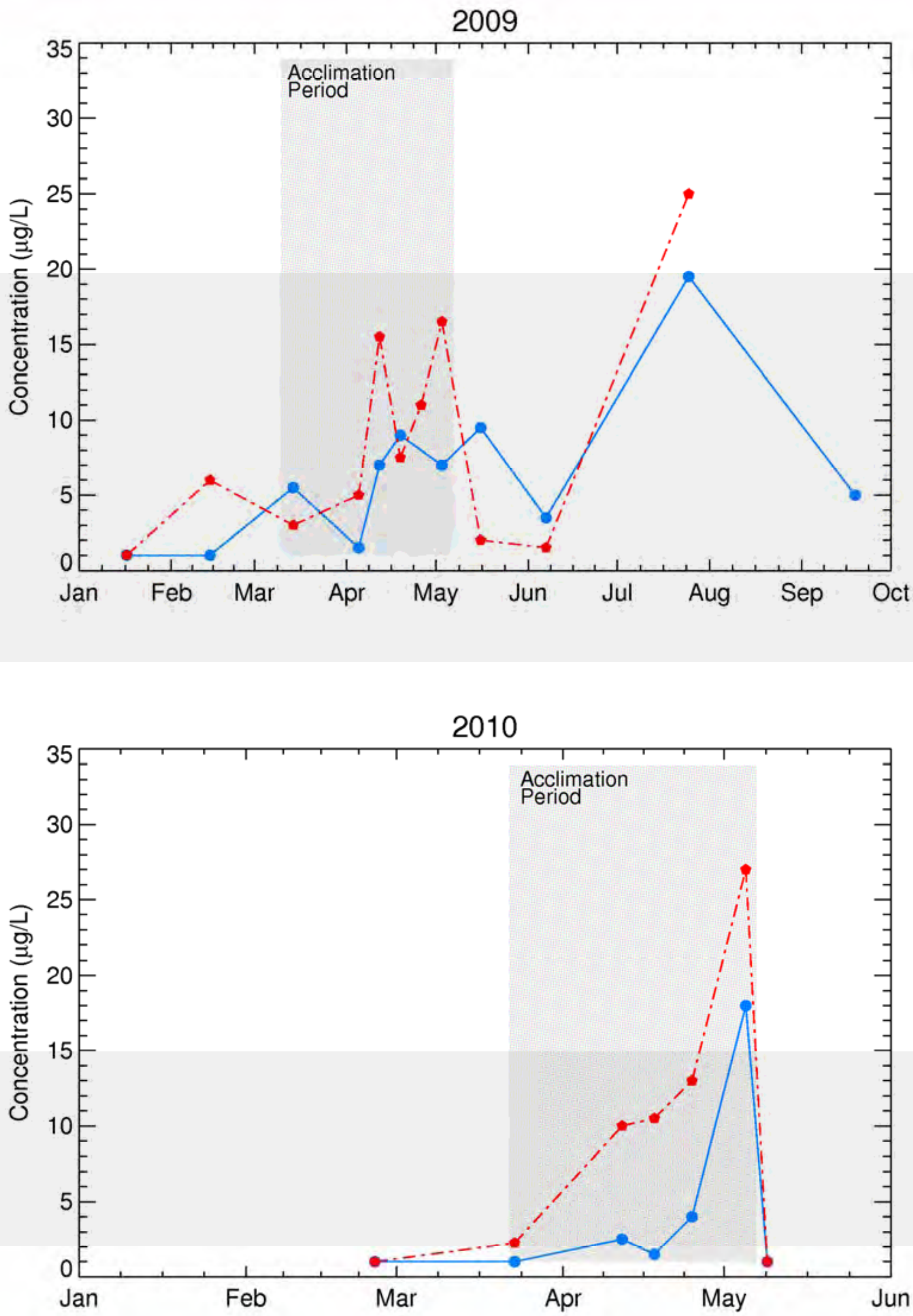

Figure 1

Total phosphorus concentrations measured in Rohlfing Pond

Duplicates averaged. Non-detects plotted at detection limit

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3.2.1.2 Impact on Receiving Stream

Temporal changes in DO, pH, TP, and temperature at two locations in Nason Creek that are upstream and downstream of the Rohlfing discharge are shown in Figures 2a and 2b for 2009 and 2010, respectively. The sampling locations are shown in Figure 3-6 of Appendix 6. The difference between the downstream and upstream values for each component has also been presented (right ordinate in each panel).

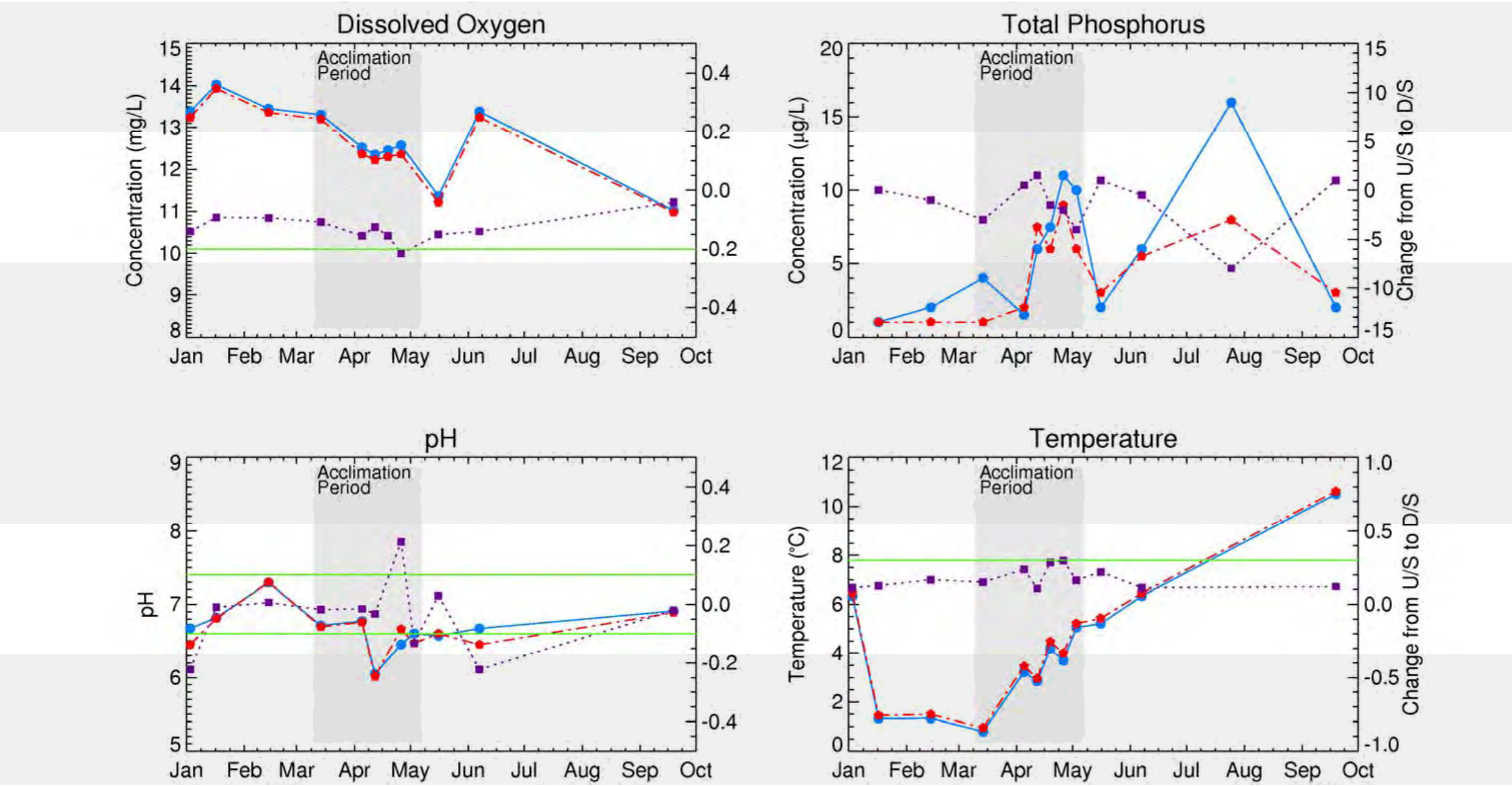
Figure 2 shows that the DO value at the downstream location was consistently lower than the upstream measurements although differences were small. A review of the DO measurement at the pond outflow during the acclimation months (March through May) suggested that DO at the outflow was consistently lower than the corresponding downstream measurements (by about 0.8 mg/L and 1.0 mg/L on average, respectively, for 2009 and 2010; see Figure 4-8 in Appendix 6). Moreover, the DO in the pond inflow was higher than in pond outflow when acclimation activity was ongoing (the average differences between outflow and inflow in 2009 and 2010 were, respectively, 0.4 mg/L and 0.7 mg/L; the average difference during non-acclimation periods in 2009 was 0.07 mg/L—see Figure 4-8 in Appendix 6). These data suggest that DO levels undergo some decline through the ponds when fish acclimation is ongoing. This is likely due to fish respiration. Thus, the somewhat lower DO levels in the downstream location could be a consequence of the discharge. However, it is clear from Figure 2 that even though the values in the downstream location were lower than in the upstream location, the difference is well above the limit for measurable change stipulated for waters protected under the Tier II anti-degradation policy (WAC 2006).

In both years, TP levels downstream of the Rohlfing discharge were typically lower than upstream, suggesting that the loading from the ponds was not significant enough to affect the naturally high background levels that attenuated as the creek flowed past the Rohlfing discharge.

The pH changes from upstream to downstream are negligible and generally fall within the bounds for measurable changes of 0.1 unit (WAC 2006). In 2009, one measurement in late April and one in early May, immediately before release of the acclimated coho, showed changes beyond the limits stipulated for Tier II waters, albeit in opposite directions. The larger of the two changes occurred in late April. Upon comparison with the TP concentrations, it is clear that the upstream TP sample corresponding to the higher pH change in late April showed a significantly larger TP level than the downstream sample suggesting a naturally high background TP level in the stream. This confirms that the departure in pH, if caused by algal activity stimulated by nutrient levels in the stream, did not result from nutrient loading from the Rohlfing discharge.

In 2010, one measurement in mid-April, on the same date when an unusually low DO concentration was measured upstream, showed a pH increase of 0.4 unit at the downstream station. Given that there was no appreciable increase in TP levels from the discharge (see Figure 1) before or during this period, it is unlikely that the discharge caused these water quality changes. On this date, upstream TP was unusually high (about 10 micrograms per liter [µg/L]) and dissolved inorganic phosphorus (used interchangeably with orthophosphate throughout this appendix) was measured to be above the detection limit on this date. This was the only orthophosphate measurement that was above the detection limit among all samples collected in 2010 in the vicinity of Rohlfing discharge. On the same date water temperature was also about 2 degrees C warmer. The elevated orthophosphate levels from upstream and the somewhat warmer water temperature could have contributed to localized algal bloom over the reach spanning the upstream and downstream stations and the resulting photosynthesis and respiration activity may have impacted DO and pH.

The pH excursions occurred during periods when there was no acclimation activity, indicating substantial natural variability in pH. This suggests that the second assumption laid out in Section 3.1 may not be true for all in-stream conditions. Naturally occurring variability in pH could result in localized habitats that are more conducive for algal growth and also result in conditions that promote greater exchange of atmospheric DO and carbon dioxide, all of which could affect pH. Another possible explanation for the detections of pH variability is instrument accuracy—the data sonde (underwater data collection device) accuracy for pH measurement is estimated at 0.29 unit (see Chapter 5 in Appendix 6), which is greater than the differences detected in downstream and upstream measurements in 2009. Temperature changes upstream and downstream of the discharge were within the stipulated increase of 0.3 degree C on all dates when data were collected.



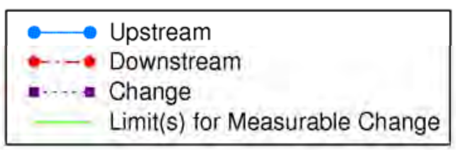


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Figure 2a

Water quality changes in Nason Creek in 2009 in the vicinity of Rohlfing Discharge

Duplicates averaged. Non-detects plotted at detection limit. Horizontal solid green line(s) show the limit(s) for measurable change. Units are same for the right and left axes

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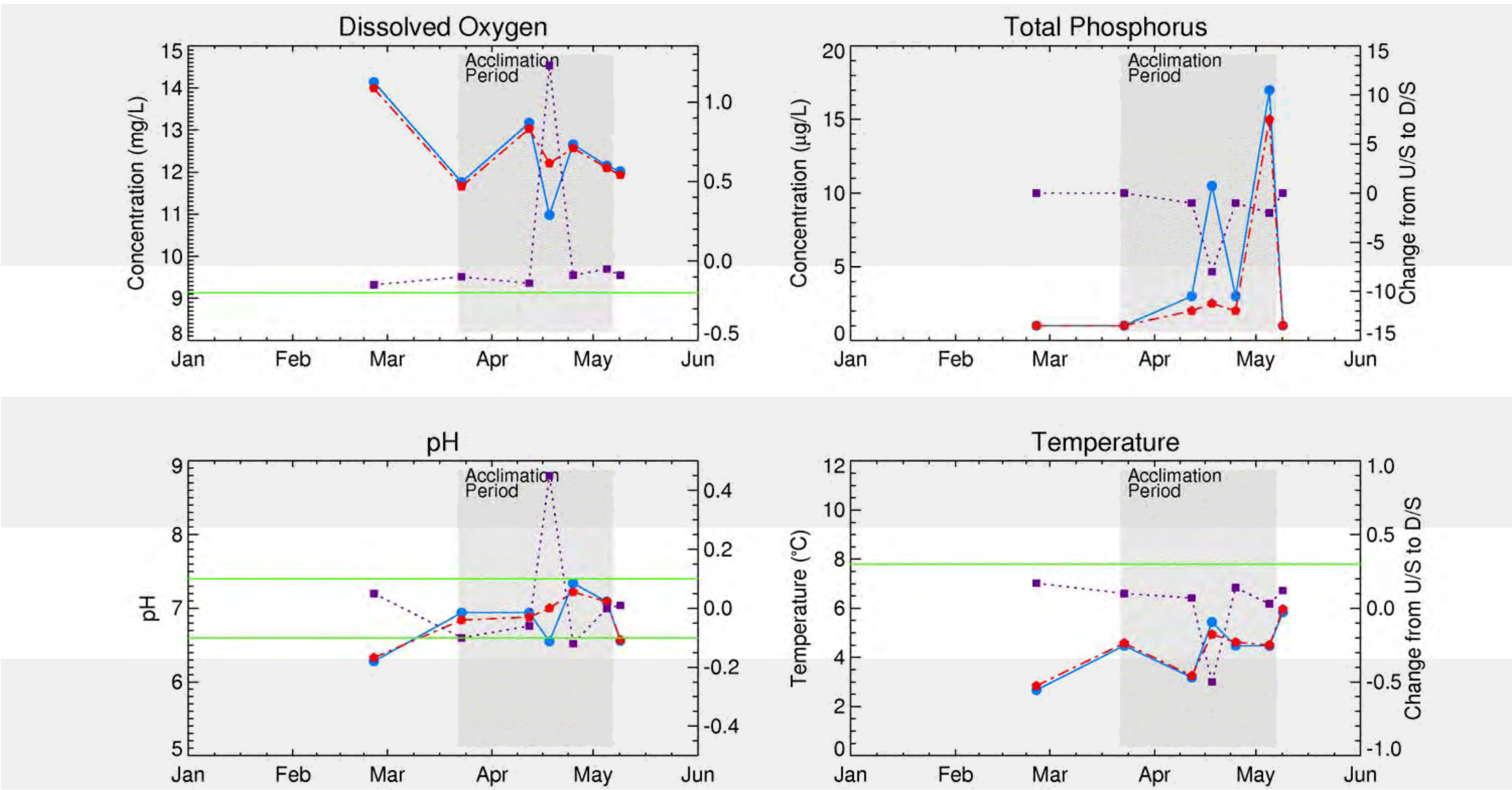

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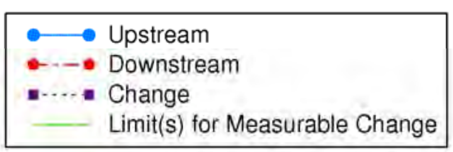

Figure 2b

Water quality changes in Nason Creek in 2010 in the vicinity of Rohlfing Discharge

Duplicates averaged. Non-detects plotted at detection limit. Horizontal solid green line(s) show the limit(s) for measurable change. Units are same for the right and left axes

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3.2.2 Butcher

3.2.2.1 TP Loads from Acclimation Activity

The total phosphorus concentrations measured at the inflow and outflow of Butcher Pond are shown in Figure 3. Based on these measurements and flows estimated from the stage-discharge relationship, the average TP load introduced due to acclimation activity is estimated to be about 39 g/d (see Table 2). As at Rohlfing, in 2009 the dominant portion of the load entered Nason Creek immediately prior to release in early May, which coincided with the highest flow and fish feed rates during the acclimation period.

More fish were acclimated at Butcher than at Rohlfing pond. This difference explains the relatively higher load exiting Butcher compared to Rohlfing.

Table 2
TP loads introduced due to acclimation activity at Butcher Pond

Date[1]	Flow[2] (cfs)	Flow (L/d)	Average TP Concentration (µg/L)			TP Load Introduced[4] (g/d)
			Inflow	Outflow	Difference[3]	
3/14/2009	1.6	3914521	3	3	0	0.0
4/5/2009	1.6	3914521	4	16	12	47.0
4/12/2009	1.9	4648494	7	13	6	27.9
4/19/2009	1.9	4648494	9.5	14	4.5	20.9
5/3/2009	2.8	6850412	9.5	33	23.5	161.0
3/23/2010	1.0	2446576	4.5	4	-0.5	0.0
4/12/2010	1.3	3180548	8.5	23.5	15	47.7
4/18/2010	1.3	3180548	10.5	17.5	7	22.3
4/25/2010	1.3	3180548	12	18.5	6.5	20.7
Average						**38.6**

Notes:

1. 4/26/2009 and 5/5/2010 TP data were not used due to lack of paired stage measurements.
2. Flow was estimated from the stage-discharge relationship developed for the stream feeding into ponds.
3. Difference represents the difference in total phosphorus concentration between the inflow and outflow from the ponds.
4. Volumetric inflows and outflows were assumed to be equal in load calculation. Whenever the difference in loads was negative, load introduced due to acclimation activity was set to 0.

µg/L micrograms per liter g/d grams per day
cfs cubic feet per second L/d liters per day g/d grams per day

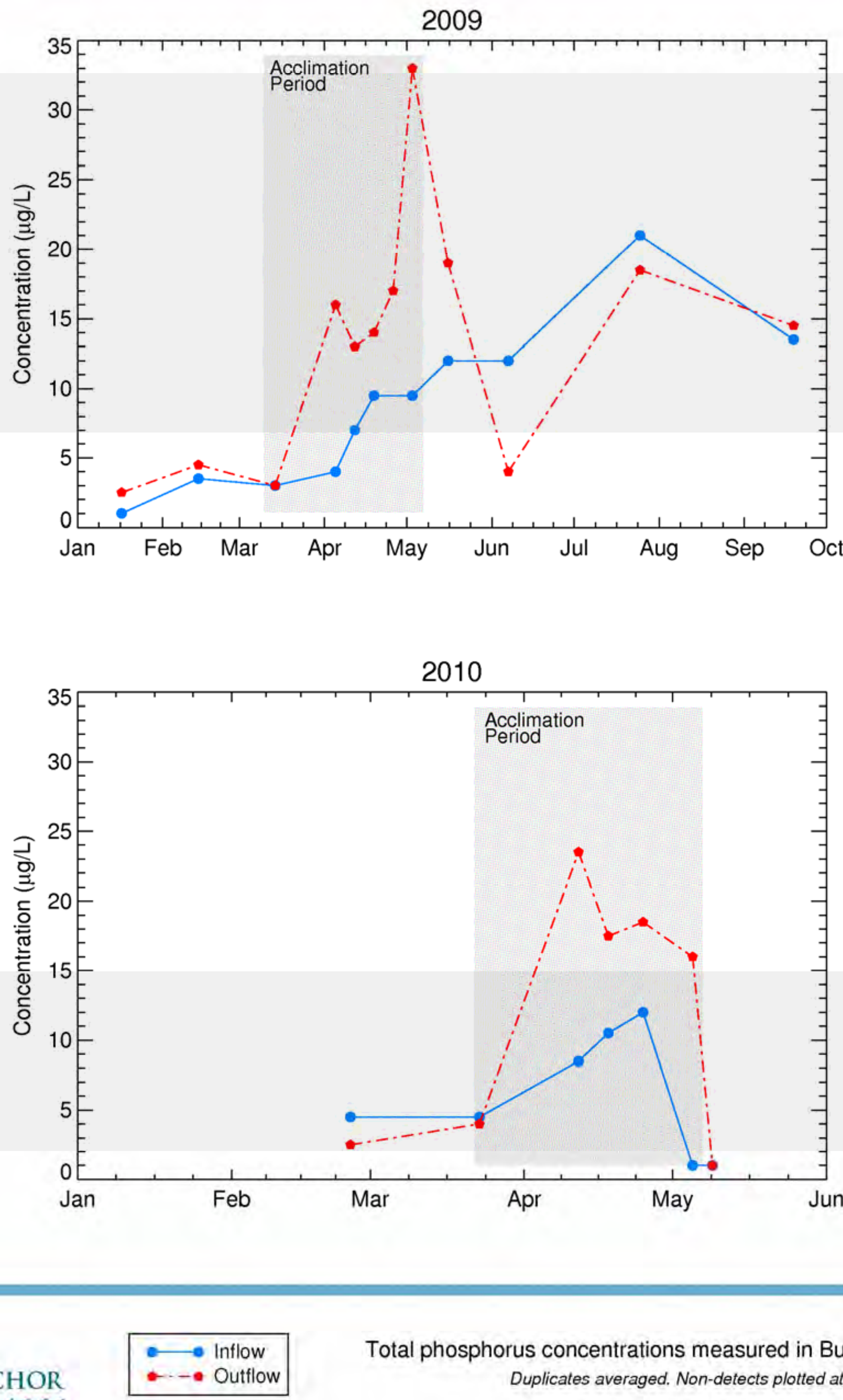

Figure 3

Total phosphorus concentrations measured in Butcher Pond

Duplicates averaged. Non-detects plotted at detection limit

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3.2.2.2 Impact on Receiving Stream

The water quality changes in the vicinity of the Butcher discharge at upstream and downstream sampling locations (see Figure 3-7 in Appendix 6 for sampling locations) are shown in Figures 4a and 4b for 2009 and 2010, respectively. The solid green lines depict the state criteria for measurable change in Tier II waters (WAC 2006).

With the exception of two pairs of measurements, one in May 2009 and one in April 2010, changes in DO concentrations during the acclimation period were below the criterion stipulated for waters protected by Tier II policy (WAC 2006). As with Rohlfing pond, DO at the Butcher Pond outflow was consistently lower than the inflow during acclimation periods (see Figure 4 through 9 in Appendix 6). On May 3, 2009, and April 12, 2010, the dates when these excursions occurred, the differences were particularly large (about 4.0 mg/L and 2.3 mg/L, respectively), which explains the excursion. Notwithstanding these large differences between the pond outflow and inflow, the differences between downstream and upstream DO concentrations are generally small. The larger of the two differences between the upstream and downstream sample is 0.35 mg/L, which is comparable to the accuracy of the data sonde used for measuring DO (see Chapter 5 in Appendix 6). Moreover, this change relative to the upstream DO concentration is less than 3% of the average DO for both cases, and for both cases, the actual DO concentrations are well above the highest surface water aquatic life DO standard of 9.5 mg/L (WAC 2006). Therefore, it is concluded that this decline is sufficiently small and is unlikely to impact the designated uses for the system (whether for recreational contact or as aquatic habitat).

TP levels were quite variable in both years in the upstream and downstream stations. As seen in the Rohlfing measurements, TP levels upstream of the discharge frequently exceeded the value of the downstream measurement, suggesting that TP load from the discharge was insignificant compared to the natural background variability.

Levels of pH measured downstream in 2009 were higher than upstream, frequently exceeding the upper 0.1 unit threshold for measurable change. The pH of discharge from Butcher pond was consistently about .5 units higher than Nason despite being reduced in the pond itself (see Figures 4-11 and 4-12 in Appendix 6). This trend in pH is likely natural to the system because pH measured in the creek feeding Butcher pond were consistently higher at the inflow compared to the outflow, during and after the acclimation period. It is possible that the small increase in pH downstream of the Butcher discharge is a result of the discharge. Moreover, most of the excursions over the upper limit of measurable change were within the instrument accuracy range of 0.29 unit (see Chapter 5 in Section 6). Therefore, it is unclear whether these excursions are real or an artifact of the limitation in instrumentation. In any case, these excursions are small and do not appear to be correlated to acclimation activity.

A similar pattern in pH changes was observed in 2010 though the increases downstream were beyond the limits for measurable change in all cases. The pH measurements in the Butcher pond inflow in 2010 were similarly lower than the pond outflow. As in 2009, the changes in Nason Creek downstream of the pond discharge were generally small, with a largest difference of 0.28 unit, which is comparable to the instrument accuracy range. The same trend in two successive years, under different flow conditions (Spring of 2010 was significantly drier than 2009), suggest that the pH variations in the vicinity of the Butcher pond are natural to the system and are unlikely to be a result of acclimation activity. The pH measurements on May 5, 2010, were the only exception to this pattern observed on all other dates in 2010, with the upstream value exceeding the downstream value by a small amount (0.15 unit).

In order to better understand the pH and TP patterns, correlation coefficients (R^2) were calculated to assess the relationship of pH and TP downstream of the discharge with the corresponding values measured at the discharge point as well as at the location upstream of the discharge. Table 3 shows the R^2 relationships for pH and TP. Correlation does not indicate a direct cause and effect relationship. Nonetheless, R^2 was interpreted simply as the percentage of variance in the second variable that may be explained by the first. Thus, these tables present an estimate of the variability in samples collected downstream of the Butcher discharge that may be explained by the corresponding samples collected at the point of discharge (i.e., pond outflow) and upstream of the discharge.

Table 3 shows that the downstream pH is highly correlated with both the pond outflow data and the upstream data, regardless of status of acclimation activity. In contrast, the variability in downstream TP data is aligned more closely with the upstream data during the non-acclimation periods and only weakly correlated to the discharge data under all conditions. Acclimation-period TP correlations with pH were generally poor for the discharge as well as the upstream locations.

The relationship between TP and pH was also studied to assess whether variations in downstream pH can be explained by variations in upstream, downstream, and discharge TP. The correlations are presented in Table 4. In general, there are no significant correlations between downstream pH and upstream or discharge TP concentrations. The correlations are weak between the downstream TP concentration and pH.

The analysis above indicates that it is difficult to explain the variability in pH through in-stream TP levels. This adds weight to the hypothesis posited above that factors other than TP and its affect on algal metabolism contribute to variability in pH. Another confounding factor is the lack of relationships between downstream TP with either the upstream TP or the discharge TP. This suggests that TP variability is large both spatially and temporally.

The small magnitude of the loads from the ponds (see Table 1 and Table 2) is within the levels of natural variability in the system and is unlikely to be a significant contributor to water quality degradation.

Table 3
Relationships of downstream pH and TP measurements with Butcher discharge and upstream measurements

Period	No. of Samples	R^2 for pH		No. of Samples	R^2 for TP	
		Discharge	Upstream		Discharge	Upstream
All Data	16	0.88	0.82	20	0.07	0.14
Acclimation Period	10	0.84	0.77	11	0.00	0.00
Non-Acclimation Period	6	0.98	0.98	9	0.42	0.79

Table 4
Relationship between pH measurements downstream of Butcher discharge with TP

Period	No. of Samples	R^2 for Downstream pH vs.		
		Discharge TP	Upstream TP	Downstream TP
All Data	17	0.02	0.01	0.09
Acclimation Period	10	0.00	0.05	0.21
Non-Acclimation Period	6	0.03	0.01	0.00

Temperature changes between the upstream and downstream locations were generally small and did not exceed the measurable change criterion in 2009 (see Figure 4). Two measurements in 2010 exceeded the criterion. In both instances, the temperature from the discharge was higher than the upstream temperature (see Figure 4-9 in Appendix 6). Therefore, it is likely that the discharge had an impact on the downstream temperature. The Butcher Pond is an existing, natural system. Acclimation activity does not affect the temperature in the pond in any way because an artificial temperature control system for the pond water has not been installed. Thus, the changes in downstream temperature are a consequence of the natural heat exchanges within the system, which includes the discharge from the Butcher Pond.

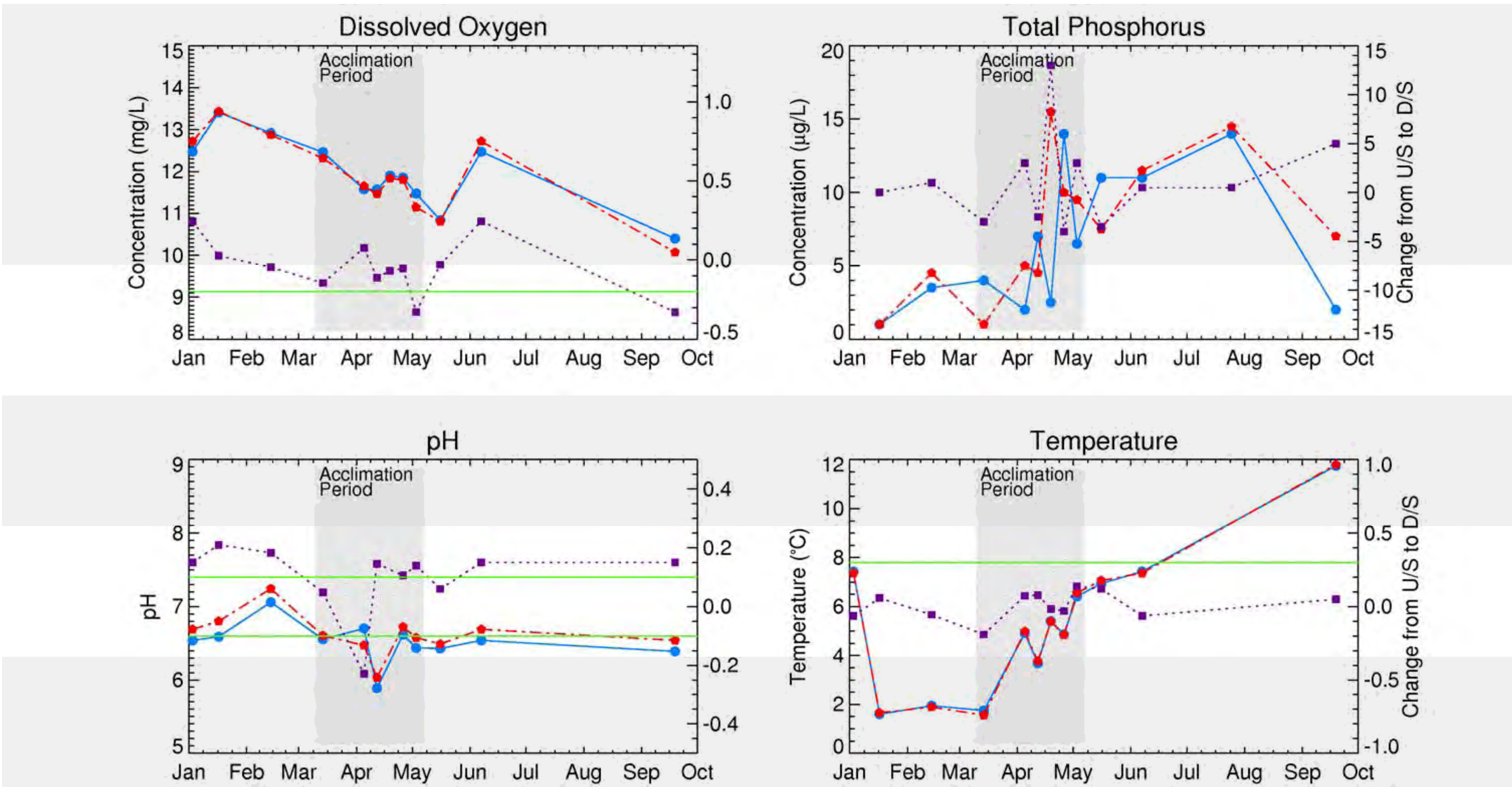

Figure 4a

Water quality changes in Nason Creek in 2009 in the vicinity of Butcher Discharge

Duplicates averaged. Non-detects plotted at detection limit. Horizontal solid green line(s) show the limit(s) for measurable change. Units are same for the right and left axes

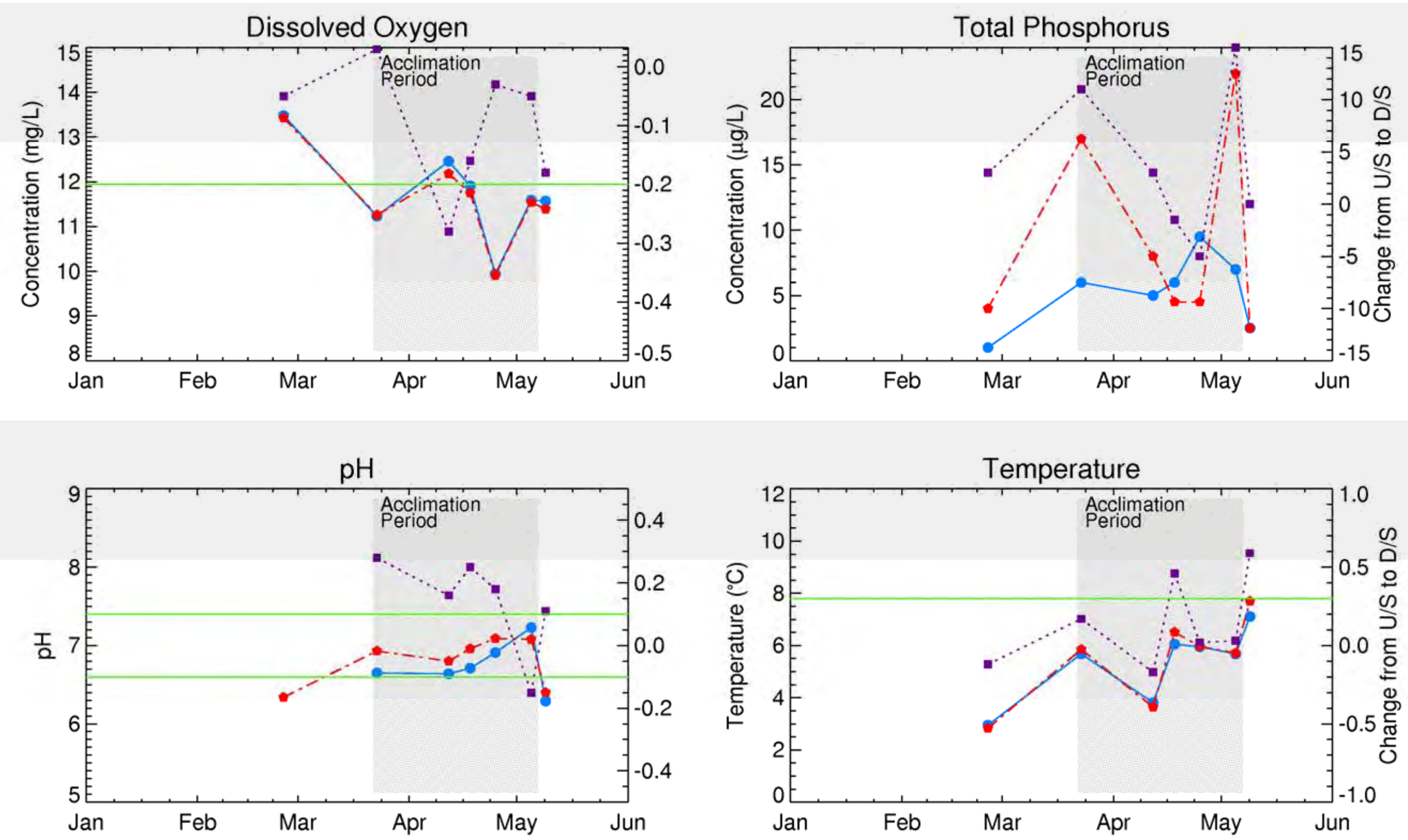

Figure 4b

Water quality changes in Nason Creek in 2010 in the vicinity of Butcher Discharge

Duplicates averaged. Non-detects plotted at detection limit. Horizontal solid green line(s) show the limit(s) for measurable change. Units are same for the right and left axes

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3.2.3 Estimation of Net Phosphorus Loading to Nason Creek

Based on flows estimated through the ponds and the number of fish acclimated at each site, an estimate of the average daily phosphorus load was developed. The calculation of aggregate load is presented in Table 5. The average daily load estimated here provided a basis for evaluating the acclimation-induced loading to receiving streams for the proposed sites.

3.3 Assessment of Combined Impacts on Receiving Stream

To evaluate the combined impact of acclimation activity on Nason Creek and ultimately on the Wenatchee River, an evaluation of the variability in water quality and bioavailability of phosphorus forms along the length of Nason Creek downstream of all discharges was conducted.

3.3.1 Spatial Variability in Water Quality

The spatial variation in water quality along the length of Nason Creek from upstream of the Rohlfing discharge to the mouth of Nason Creek in 2009 and 2010 are presented in Figures 5a and 5b, respectively. The Rohlfing and Butcher discharges enter Nason Creek at approximately River Kilometers (RKM) 23.4 and 19.3, respectively.

The 2009 data consistently showed a drop in DO from the Rohlfing to Butcher discharges, regardless of whether it was during or after the acclimation period, and either rose slightly or fell significantly downstream of the Butcher discharge. Over the same reach, temperature showed a consistent increase of up to 2 degrees C, which likely explains the decline in DO.

The spatial trends in DO in the 2010 acclimation season were consistent with the trends observed in 2009, with the exception of one unusual decline from the Boyce Station (RKM 20.3) to station upstream of Butcher discharge (RKM 19.4). On this same date, pH also showed a sharp decline while the changes in TP and temperature were not unusual. Because the DO and pH levels and the temperature from the Rohlfing discharge were within the observed ranges, this decline could not have been caused by the Rohlfing discharge. It is unclear whether the declines in DO and pH were a consequence of discharge from the wetland complex near Boyce, groundwater influx, or instrument error.

Table 5
Combined TP loads introduced due to acclimation activity in Nason Creek

	Rohlfing			Butcher			Total		
	2009	2010	Overall	2009	2010	Overall	2009	2010	Overall
Total number of fish acclimated	101000	85656	186656	136000	144632	280632	237000	230288	467288
Average TP load (g/d)	35.72	38.53	74.25	51.35	22.66	74.02	87.07	61.19	148.27
TP load per fish acclimated (mg/d/fish)	0.35	0.45	0.40	0.38	0.16	0.26	0.37	0.27	**0.32**

Notes:
g/d grams per day
mg/d/fish milligrams per day per fish

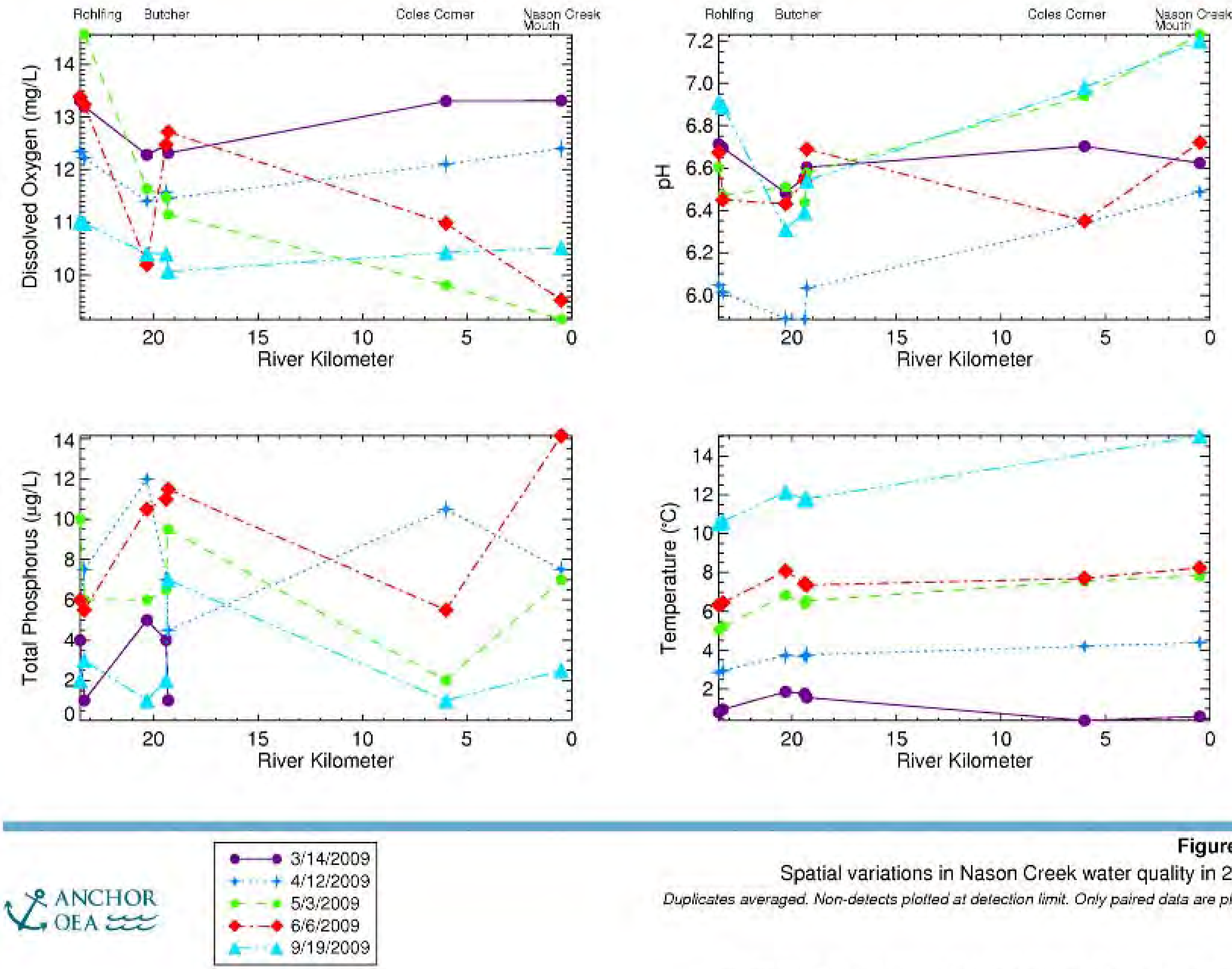

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Figure 5a

Spatial variations in Nason Creek water quality in 2009

Duplicates averaged. Non-detects plotted at detection limit. Only paired data are plotted

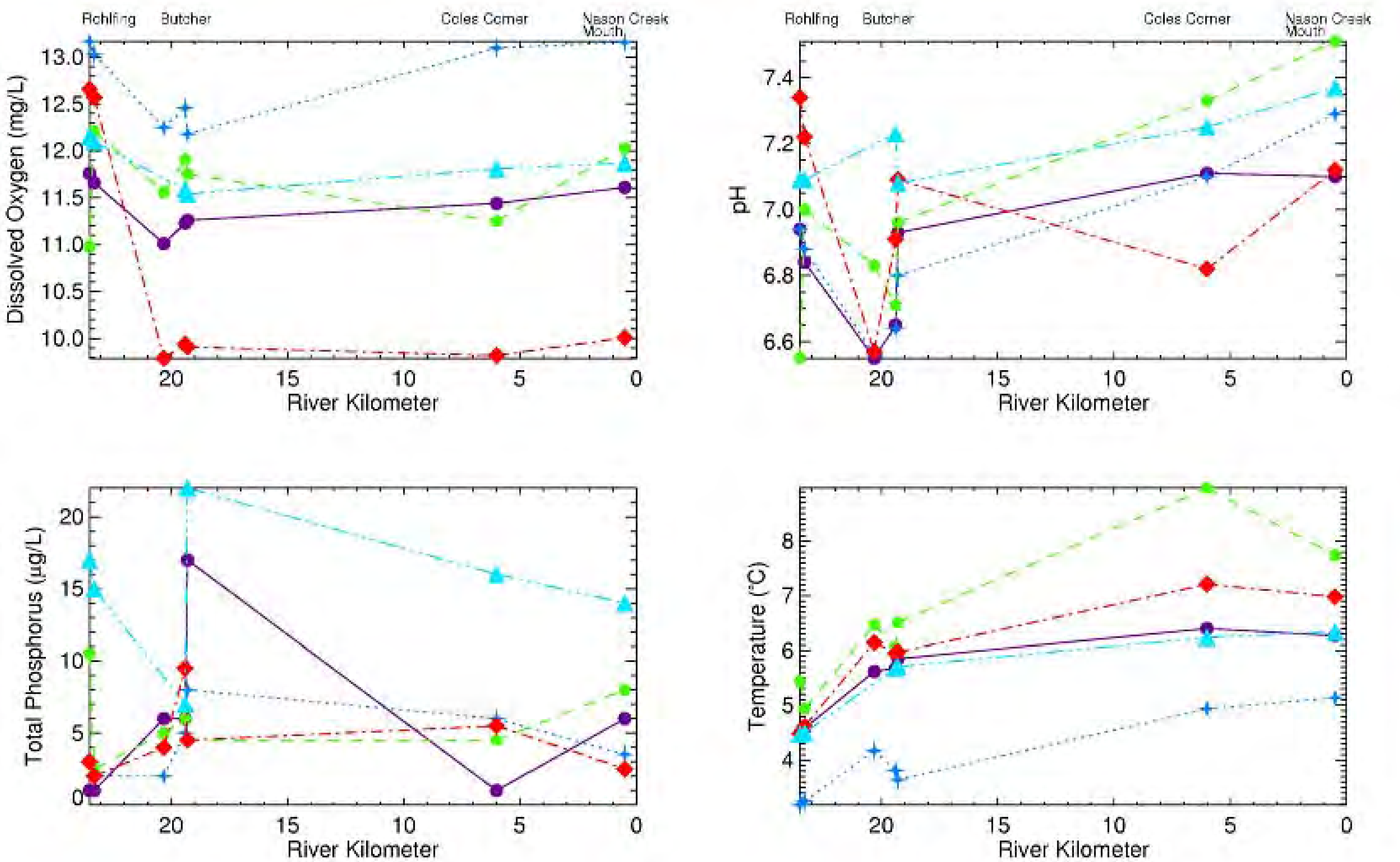

Figure 5b

Spatial variations in Nason Creek water quality in 2010

Duplicates averaged. Non-detects plotted at detection limit. Only paired data are plotted

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Downstream of the Butcher discharge, DO rose slightly on three of the five sampling dates in both 2009 and 2010. DO measurements on April 25, 2010, remained low in-stream, from Boyce station downstream to the confluence with the Wenatchee River. Flows in April 2010 were lower than 2009 but the temporal patterns were comparable. Therefore, the cause for the lack of recovery in DO (pH recovered along this reach) on this date is unclear. The lower values in 2009 occurred during spring high flows. This may be a consequence of the widening and subsequent reductions in creek flow turbulence, and the corresponding reduction in aeration potential in this section of the creek. During lower flows (March, April, and September samples), the DO patterns were similar during and after the acclimation period. The significant drop in DO downstream of the Butcher discharge in May and June samples may have resulted from a reduction in velocity as the creek widens in these reaches, but this could not be established definitively due to lack of stream flow information within this reach.

The data showed an increase in TP for both years from downstream of the Rohlfing discharge to upstream of the Butcher discharge. TP data consistently showed a decline downstream of the Butcher discharge to Coles Corner (at RKM 6), and then an increase to the mouth of Nason Creek, with the exception of one out of four measurements in 2009 and two out of five in 2010. Discharge from the wetland complex upstream of the Route 2 bridge (see Figure 3-7 in Appendix 6) may contribute to the observed increase in TP between the location downstream of the Rohlfing discharge and the location upstream of the Butcher discharge. The decline from Butcher to Coles Corner suggests some in-stream assimilation, while an increase from Coles Corner to the creek mouth is indicative of a potential TP source. As there are no known point sources downstream of Coles Corner, the increase in TP observed at the mouth may result from non-point source inputs, such as groundwater inflow.

The pH data from both years showed a decline downstream of Rohlfing to Boyce station (RKM 20.3), and an increase from downstream of the Butcher discharge to the mouth of Nason Creek. These patterns are consistent with the observations for DO and TP. Data collected during and after acclimation activity were similar (with the exception of the June sample), suggesting that pH changes are minimally affected by discharges from the acclimation ponds.

Temperature patterns suggested negligible impact from acclimation pond discharges. Small changes in the mixing zone of the discharges could result from the natural variability within the system (see Section 3.2.2.2). With the exception of March 2010, changes in temperature were consistent with the season and showed little impact from the discharges. Air temperatures in March were unusually warm in 2010, which was reflected in the recorded water temperatures. In general, a small decline from Boyce Station to upstream of Butcher discharge (RKM 19.3) was observed and is likely a consequence of inherent variability in stream flow, cooler discharge from the nearby wetlands complex, or groundwater influx. Temperatures increased slightly from downstream of Butcher to the creek mouth, reflecting the change in elevation and the associated changes in air temperature.

3.3.2 Phosphorus Bioavailability

Another important metric that determines the amount of available phosphorus for algal uptake is the orthophosphate concentration. Phosphorus in natural aquatic ecosystems consists of particulate and dissolved forms. Both forms can be organic, inorganic, or a combination of organic and inorganic. Particulate organic phosphorus can undergo dissolution to form dissolved organic phosphorus, which in turn can hydrolyze to form dissolved inorganic phosphorus (in this appendix used interchangeably with orthophosphate, the simplest form to which all forms of dissolved inorganic phosphorus are converted prior to measurement in the laboratory).

Phosphorus is an essential nutrient for algal growth. However, not all forms of phosphorus can be taken up by algae. Any form of phosphorus that is readily available for biological uptake is said to be bioavailable (i.e., available for ready assimilation by algae). Orthophosphate is readily utilized by algae during photosynthesis and is therefore considered bioavailable. Because dissolution and hydrolysis are slow processes, other forms such as dissolved organic phosphorus or particulate phosphorus cannot be incorporated into an algal cell. These forms are therefore not considered to be readily bioavailable.

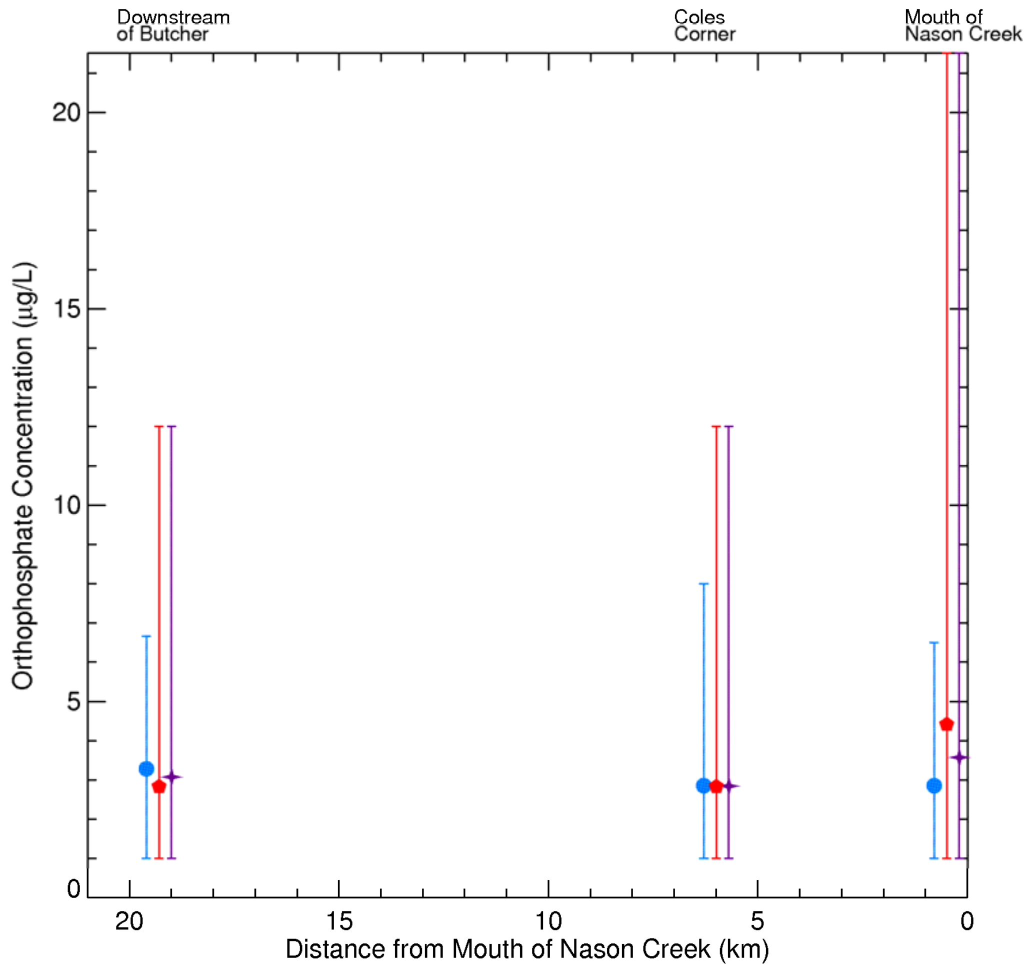
Figure 6 shows the range in orthophosphate concentrations from downstream of the Butcher discharge to the mouth of Nason Creek for periods with and without ongoing acclimation activity. The patterns suggest that there is little difference in the average orthophosphate levels throughout the year regardless of whether acclimation activity was ongoing or not. The variability in the orthophosphate levels is higher during non-acclimation periods in 2009, which is reasonable given that the acclimation period spans only 3 months (March through May). There were occasional spikes during non-acclimation periods, particularly near the mouth of Nason Creek, suggesting that there could be a source of orthophosphate farther downstream of the acclimation sites in Nason Creek that is not related to discharges from the acclimation ponds.

Figure 7 shows the forms of phosphorus entering the Wenatchee River at the Nason Creek mouth. On most dates sampled, the major component of the TP load entering the Wenatchee River was not readily bioavailable. During the 2009 acclimation period (March through May), the bioavailable fraction remained low (a maximum of 50%). In 2010, the bioavailable fractions were calculated to be greater than 50% on several occasions. On most dates when the bioavailable fraction exceeded 50%, the TP concentration was less than 10 μg/L. This phenomenon suggests that even though the bioavailable fractions were higher, the loadings remained low.

It is possible that even though the phosphorus entering the upper Wenatchee River is in a non-bioavailable form (such as dissolved organic phosphorus), it could convert to orthophosphate as the water moves downstream. Assuming an upper bound (i.e., fastest) decay rate of 0.11 per day for conversion of dissolved organic phosphorus to orthophosphate (based on the range reported in Cole and Wells 2003), it would take roughly 6 days for 50% of the organic phosphorus at the headwater to be converted to orthophosphate.

WDOE's TMDL analysis indicated that during September 2002 low-flow conditions (comparable to the 7Q10 low-flow), the travel time from the headwater at Lake Wenatchee to the confluence with the Columbia River is less than 2.5 days (Carroll et al. 2006). This travel time is well below the 6-day estimate for conversion of 50% of the TP to bioavailable forms. Flows encountered during the higher feeding periods in April and May are typically higher, and so travel times would be even shorter. Thus, the fraction of acclimation pond-related phosphorus that enters the upper Wenatchee River will likely be negligible when feeding rates are the highest.

This analysis suggests that the phosphorus released due to acclimation pond activity generally contributes a small proportion of bioavailable load to the Wenatchee River. Moreover, the non-bioavailable form released to the upper subbasin is likely to remain largely non-bioavailable as it is carried through the critical regions of the lower Wenatchee River.



Acclimation Period
Non-acclimation Period
Overall

Figure 6

Spatial variations in orthophosphate concentrations measured downstream of all active acclimation discharges in Nason Creek

Duplicates averaged. Non-detects plotted at detection limit. This analysis used only data from dates when samples were collectedat all locations Error bars show range of data

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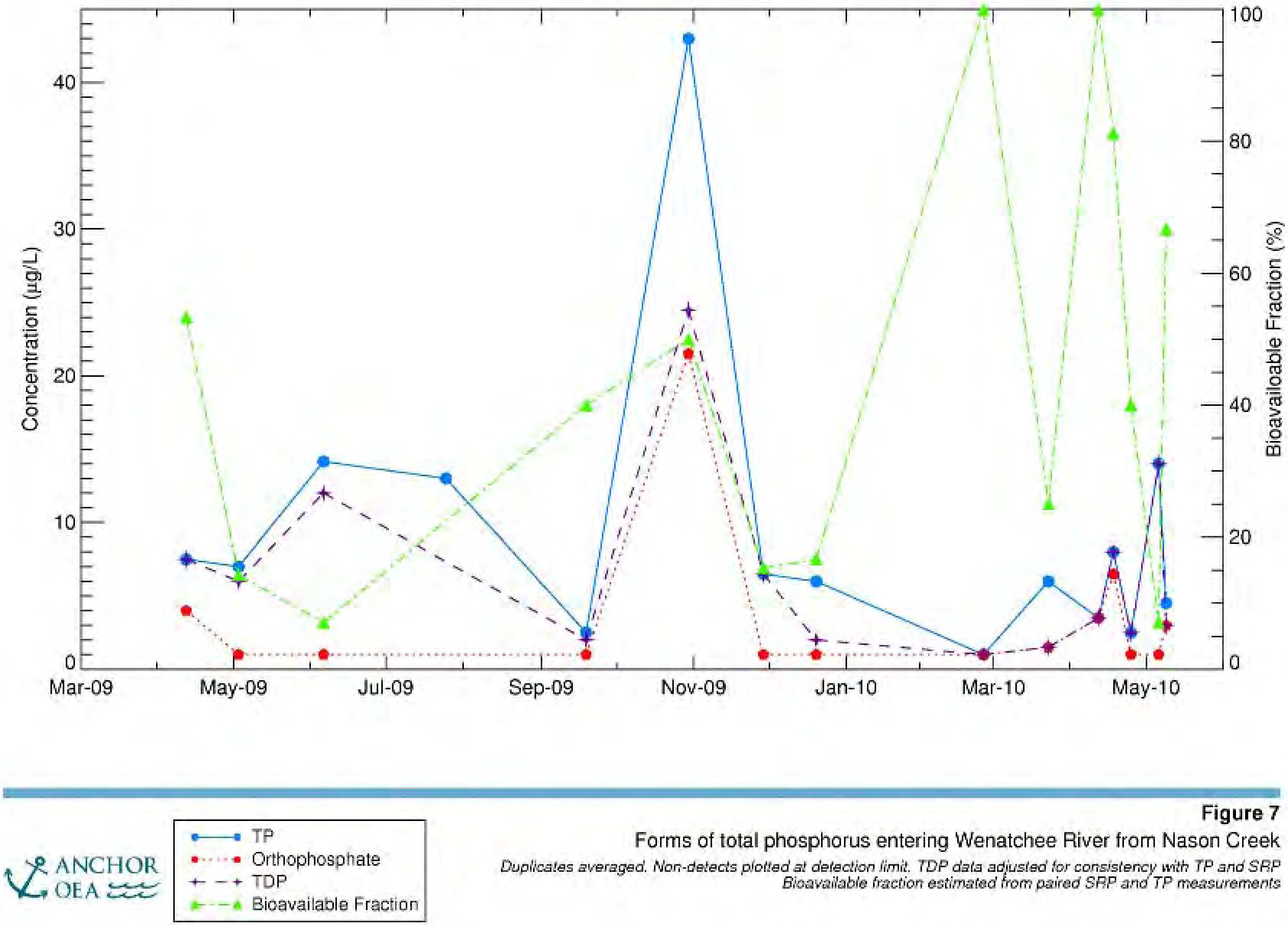

Figure 7

Forms of total phosphorus entering Wenatchee River from Nason Creek

Duplicates averaged. Non-detects plotted at detection limit. TDP data adjusted for consistency with TP and SRP
Bioavailable fraction estimated from paired SRP and TP measurements

4 ASSESSMENT OF IMPACTS AT PROPOSED SITES

4.1 Approach

The main challenge in the evaluation of impacts for proposed acclimation sites is to assign the phosphorus loads that would result from the proposed acclimation activity. A data-based approach was adopted for this project to estimate nutrient loads at proposed acclimation sites[2]. Water quality data collected at Nason Creek in the spring of 2009 and 2010, when active acclimation was ongoing, provided a basis for estimating acclimation activity-related nutrient loads from the proposed sites. Based on these data, the TP load contributed to the receiving stream was estimated to be 0.32 milligrams (mg) per day per fish (see Table 5). This estimate was scaled up or down by multiplying by the number of fish to be acclimated at each proposed site. This contribution was evaluated against the phosphorus loads calculated at the mouth of the major creeks that carried these loads into the Wenatchee and the Methow rivers. The objective behind this approach was to assess the significance of the loads relative to the background loads in the system.

A different approach was adopted for the Dryden Hatchery because it is planned for proposed use as a year-round rearing facility. The Dryden Hatchery will discharge into a critical area of the Wenatchee River that is currently exhibiting water quality excursions. For this site, the mass balance modeling approach used in the WDOE TMDL analyses (Carroll et al 2006; Carroll and Anderson 2009) was adopted, with minor modifications as described in the following sections.

4.1.1 Applicability of Active Site Data to Proposed Sites

Applying the active site data as a means of assessing the impacts of the proposed sites on water quality is reasonable for the proposed sites, aside from Dryden, because: 1) the sites will be used to acclimate the same species; 2) feeds are expected to be similar or identical to those used in the Nason Creek sites; 3) climatic conditions will be similar, which will result in similar metabolism; and 4) the majority of the acclimation sites are small, natural ponds that are fed by small tributary streams.

As discussed above, the Dryden facility is proposed to operate as a year-round rearing facility. It will be a constructed site with discharges being treated to some level before being

[2] An approach that was considered and then abandoned in favor of the direct measurement approach included the estimation of potential acclimation pond loads using the anticipated feed rates, in conjunction with literature-reported rates of fish metabolism and growth, to estimate the amount of phosphorus excreted and egested into the water column, and to predict rates at which nutrients are assimilated in the acclimation ponds. While this approach is technically rigorous, there is considerable uncertainty in applying metabolic estimates from different sources that are potentially derived under different conditions. Moreover, fish rearing pond assimilation rates have not been extensively studied. Therefore, this approach was abandoned in favor of the more empirical approach described herein.

released into the Wenatchee River. Therefore, nutrient loading estimated from active acclimation sites operated over a specific time period (March through May) were not representative of the operations proposed at the Dryden facility.

4.2 Impacts at Wenatchee Subbasin Sites

The estimated TP loads at the proposed sites in the Wenatchee subbasin are shown in Table 6. The details of estimation for each site are discussed in the following subsections.

4.2.1 White River

Three acclimation ponds are proposed in the White River watershed. Flows in the White River were estimated based on the WDOE gauge near Plain (Gauge ID: 45K090). Water quality data were derived from multiple sources: data collected by the Yakama Nation as part of this project at the McComas Site (presented in Appendix 6) were supplemented with monitoring data collected to support ongoing acclimation programs in Lake Wenatchee by Grant County Public Utility District (PUD) No. 2 (Grant PUD 2009) and Chelan PUD (2009 – unpublished data).

4.2.1.1 Tall Timber

Tall Timber is the most upstream of the three proposed acclimation ponds and does not directly flow into the White River, but it is located close to the confluence of the Napeequa and White rivers (see Appendix 2 for details). The estimated TP load from this acclimation site is 19.1 g/d, which is less than one fifth of a percent of the average TP loads delivered by the White River to Lake Wenatchee during the acclimation periods in 2009 and 2010. This level is well within the natural variability of the TP loads in the White River. Moreover, loads released at this site would have to travel a substantial distance prior to entering Lake Wenatchee. In-stream processes such as settling and uptake by biota would mitigate any impact farther downstream from the discharge.

4.2.1.2 Gray

This is one of the smallest proposed ponds, with acclimation of 50,000 coho. Loads from this site are expected to be quite small, at less than one-tenth of a percent of the average White River loads.

4.2.1.3 Dirty Face

Data from Nason Creek are not applicable to the Dirty Face site because adult fish acclimation is proposed at this site. Adult fish are not fed, so water quality impacts associated with the acclimation and feeding of juvenile fish are not relevant to the Dirty Face site.

4.2.2 Little Wenatchee River – Two Rivers

The Two Rivers site is located above the confluence of the Little Wenatchee River with Lake Wenatchee (see Appendix 2). This is one of the larger sites, with an estimated 120,000 coho being proposed for acclimation.

WDOE's gauge at Little Wenatchee River below Rainy Creek (Gauge ID: 45L110) was used to estimate flows. As with White River, water quality data for estimation of loads came from the program described herein, as well as from the Grant and Chelan PUD monitoring programs (Grant PUD 2009; Chelan PUD 2009 – unpublished data).

The estimated loads contributed by this proposed site are higher than for the White River sites because of the greater number of fish proposed for acclimation. Nevertheless, the TP loads from acclimation activity are estimated to be about one-third of a percent of the average TP loads carried by Little Wenatchee River during the acclimation period.

Table 6
TP loads estimated for proposed acclimation activity within the Wenatchee Subbasin

Proposed Site	No. of Fish (thousands)	TP Load[1] (kg/d)	Receiving Stream[2]	No. of Days[3]	No. of Sampling Events[4]	Record Start Date	Record End Date	Receiving Stream Load[5] (kg/d)	Relative Contribution (%)
Tall Timber	110	0.035	White River	84	14	3/15/2009	4/12/2010	19.1	0.18
Gray	50	0.016	White River	84	14	3/15/2009	4/12/2010	19.1	0.08
Two Rivers	120	0.038	Little Wenatchee	83	12	3/23/2009	5/9/2010	11.8	0.33
Chikamin	100	0.032	Chiwawa	71	7	4/4/2009	5/9/2010	7.3	0.44
Minnow	100	0.032	Chiwawa	71	7	4/4/2009	5/9/2010	7.3	0.44
Clear	150	0.048	Chiwawa	71	7	4/4/2009	5/9/2010	7.3	0.66
Beaver	100	0.032	Beaver	N/A	N/A	N/A	N/A	N/A	N/A
Scheibler	65	0.021	Chumstick	23	2	4/11/2009	5/3/2009	2.7	0.77
Leavenworth NFH[6]	100	0.032	Icicle	N/A	N/A	N/A	N/A	1.5	2.21
Brender[7]	50	0.016	Brender	N/A	11	3/10/1997	5/3/2004	1.2	1.39

Notes:

1. Estimated from average load of 0.32 mg per fish per day calculated from measured data at active discharges in Nason Creek.
2. Nearest stream for which estimation of TP load at the downstream end of the receiving stream was possible.
3. Number of days in the acclimation period over which interpolation of loads was possible with available flow and concentration data.
4. Number of events during the acclimation period (3/10/2009 through 5/10/2009 and 3/23/2010 through 5/9/2010). To maximize data coverage, this period was extended to include additional samples. Some events included collection of duplicates.
5. TP load estimated at the mouth of the receiving stream was based on nutrient data collected during the acclimation period.
6. Loads for the receiving stream (Icicle Creek) represent the total load at the mouth of Icicle Creek for 2002 as determined in WDOE TMDL.
7. Average TP load for receiving stream (Brender) was calculated over the acclimation months (March through May) based on historical flow and TP data reported by WDOE for Brender Creek near Cashmere Station (45D070).

kg/d kilograms per day

4.2.3 Chiwawa

Three sites are proposed in the Chiwawa River watershed. This river joins the Wenatchee River near Plain, Washington. Flow data for this site were obtained from the U.S. Geological Survey (USGS) Chiwawa River gauge near Plain (Station ID: 12456500). Water quality data were collected by the Yakama Nation near the mouth of the Chiwawa River.

4.2.3.1 Minnow

This is the most upstream of the three proposed acclimation ponds and enters the Chiwawa River through Chikamin Creek. TP contributions from this site are expected to be less than one half of a percent of the load carried by the Chiwawa River during the acclimation period. Also, given its distance from the mouth of the Chiwawa River, loads from this site are likely to be mitigated by in-stream processes and are unlikely to impact the Wenatchee River.

4.2.3.2 Chikamin

The Chikamin site is close to the Minnow site and similarly enters the Chiwawa River through Chikamin Creek. Because the number of fish acclimated at this site is the same as at the Minnow site, the TP contributions from this site are expected to be similarly less than one half of a percent of the load carried by the Chiwawa River during the acclimation period. As with the Minnow site, loads from this site are also likely to be assimilated in-stream due to the distance from the confluence with the Wenatchee River, and therefore, they are unlikely to impact its water quality.

4.2.3.3 Clear

Discharge from the Clear Creek site would enter the Chiwawa River through Clear Creek close to the confluence with the Wenatchee River. This is the largest site that is being proposed in the Wenatchee subbasin, with 150,000 coho planned for acclimation. Therefore, this site has the highest estimated TP load among all sites. However, in terms of relative magnitude, this load is about two-thirds of a percent of the average TP loads carried by the Chiwawa River. Therefore, this site, on its own, is not expected to significantly alter loads to the Wenatchee system.

4.2.4 Beaver

Water quality data for this site is limited. Given the relatively small phosphorus loads, impacts from this site are expected to be similar to the other sites.

4.2.5 Chumstick Creek - Scheibler

Scheibler Creek is located 13 kilometers upstream of the confluence of Chumstick Creek with the Wenatchee River. Water quality data collected by the Yakama Nation at the mouth of Chumstick Creek (CH4—see Appendix 6) and flow estimated by WDOE near the river mouth (Station ID: 45C060) were used to calculate background loads. Even though nutrient data were collected in 2010, the loading calculations used data from 2009 only, due to lack of paired flow measurements in 2010 (WDOE has suspended the gage operation). The loads from acclimation pond activity are estimated to be less than 1% of the average background load carried by Chumstick Creek. Given the small proportion of the background load, the water quality impacts are expected to be negligible.

4.2.6 Icicle Creek – Leavenworth National Fish Hatchery (LNFH)

Facilities at the LNFH are being used for acclimation as part of this project. Discharges from this facility flow through the main hatchery outfall that dominates the Icicle Creek flow during low-flow season. Data at Icicle Creek were not collected as part of this project. The LNFH is required to provide a discharge report as part of the National Pollution Discharge Elimination System (NPDES). However, a review of recent discharge reports did not yield any nutrient data. Thus, TP load specified at the Icicle Creek mouth in the WDOE TMDL (Carroll et al. 2006) was used as a basis for comparison.

The proposed coho acclimation project was estimated to contribute about 2% of the TP loads used in the WDOE TMDL for summer 7Q10 conditions. Recognizing that acclimation activity is proposed overwinter and during spring, the load comparison here is illustrative. Nonetheless, because a large portion of the load enters during spring high flow, it will likely be rapidly flushed from the system and is unlikely to have a direct impact on the water quality of the lower Wenatchee River and Icicle Creek.

4.2.7 Brender Creek

Brender Creek site discharge would reach the Wenatchee River through Mission Creek. Water quality data were not collected for this site as part of this project. However, historical water quality and flow data were available for this site from WDOE (Brender Creek at Cashmere). A comparison to historical data shows that TP loads discharged from the acclimation site could contribute up to 2% of the loads carried by the creek. This comparison suggests that the loads from this site may have localized impacts, but the estimated average contribution of 16 g/d is unlikely to directly impact Wenatchee River water quality because much of this load will enter during the spring high flow season when loads from the site would be rapidly flushed from the system.

4.2.8 Back-up Acclimation Sites

4.2.8.1 McComas

The McComas site is located in White River and it may be used to acclimate up to 50,000 juvenile fish. The corresponding phosphorus loads are expected to be less than one-tenth of a percent of the loads carried by White River (see Table 7). Therefore, the impacts are not expected to adversely affect water quality.

4.2.8.2 Squadroni

The Squadroni site is located on Nason Creek and is planned as a back-up site should the other Nason Creek sites not be used. If used, 105,000 fish are expected to be acclimated at this site. Based on the active Nason Creek sites, the TP load due to acclimation activity is expected to be 34 g/d (see Table 7). This is about half a percent of the TP loading from Nason Creek to the Wenatchee River. Moreover, it was demonstrated earlier that the active acclimation occurring simultaneously at Rohlfing and Butcher with more than twice the number of fish (237,000 in 2009 and about 230,000 in 2010) did not adversely affect water quality in Nason Creek. Thus, the Squadroni site, if developed, is not likely to adversely affect water quality.

4.2.8.3 Coulter/Roaring

The Coulter/Roaring site is part of a wetland complex owned by the Yakama Nation. As with Squadroni, if used, up to 105,000 fishes could be acclimated here and the impacts are likely to be similar to those at the Squadroni site. However, because this site is in a wetlands complex, the TP loads from ponds are likely to be assimilated within the marsh environs. Thus, impacts from acclimation activity are likely to be minimal.

4.2.8.4 Allen

The Allen site, if used, is expected to acclimate up to 50,000 fishes, which could result in phosphorus loading of up to 16 g/d to Peshastin Creek. There were no nutrient or flow data available for Peshastin Creek for the month of March. In order to obtain a general sense of the relative contribution, the loading estimate for this site was compared to the loads specified in the WDOE TMDL summer natural conditions model (Carroll and Anderson 2009). It is estimated that acclimation activity at this site could contribute about 10% of the loads carried by the stream during the summer season. Given that 7Q10 flows used in the WDOE TMDL are substantially lower than typical spring flows, the upstream loads calculated for 7Q10 conditions are substantially lower than what would be carried by the creek during spring high-flow season. Therefore, the contribution from acclimation activity is likely to be a much smaller fraction of the creek TP loads than that estimated using the 7Q10 conditions. Regardless of the seasonal differences, 10% is still a small fraction of the total loads carried by the creek and is not likely to affect the water quality dynamics in the creek substantially.

Table 7
TP loads estimated for proposed acclimation activity at back-up sites in Wenatchee Subbasin

Proposed Site	No. of Fish (thousands)	TP Load[1] (kg/d)	Receiving Stream[2]	No. of Days[3]	No. of Sampling Events[4]	Record Start Date	Record End Date	Receiving Stream Load[5] (kg/d)	Relative Contribution (%)
McComas	50	0.016	White River	84	14	3/15/2009	4/12/2010	19.1	0.08
Squadroni	105	0.034	Nason Creek	112	22	3/14/2009	5/9/2010	6.3	0.53
Coulter/Roaring	105	0.034	Nason Creek	112	22	3/14/2009	5/9/2010	6.3	0.53
Allen[6]	50	0.016	Peshastin Creek	N/A	N/A	N/A	N/A	0.2	10.46

Notes:

1. Estimated from average load of 0.32 mg per fish per day calculated from measured data at active discharges in Nason Creek.
2. Nearest stream for which estimation of TP load at the downstream end of the receiving stream was possible.
3. Number of days in the acclimation period over which interpolation of loads was possible with available flow and concentration data
4. Number of events during the acclimation period (3/10/2009 through 5/10/2009 and 3/23/2010 through 5/9/2010). To maximize data coverage, this period was extended to include nearby samples. Some events included collection of duplicates.
5. TP load estimated at the mouth of the receiving stream was based on nutrient data collected during the acclimation period.
6. There were no data available for the receiving stream. Loads from the WDOE TMDL model for the 7Q10 natural conditions simulation are used here for comparison.

kg/d kilograms per day

4.2.9 Dryden Hatchery

4.2.9.1 Mass Balance Modeling Setup

As mentioned in Section 4.1, the Dryden Hatchery site is proposed for use as a year-round rearing operation. Therefore, it was necessary to evaluate impacts during low-flow conditions when water quality is most vulnerable to increases in nutrient loading.

The QUAL-2K model was used in the WDOE TMDL (Carroll et al. 2006; Carroll and Anderson 2009) to allocate nutrient loading to point and non-point sources to bring DO and pH into compliance with existing state regulations. A phased implementation of load reductions has been recommended in the TMDL. Based on discussion with WDOE (November 12, 2009, meeting with Ryan Anderson, Yakima Regional office, Yakima), it is assumed for this evaluation that the load reduction measures will be implemented as recommended in the TMDL.

The QUAL-2K model was set up for 7Q10 low-flow conditions with publicly owned treatment works (POTW) discharging at design flow and a phosphorus concentration of 90 μg/L, and other sources were set to the estimated maximum natural condition values as determined in the WDOE TMDL (Carroll and Anderson 2009).

Nutrient loading for the proposed hatchery was estimated based on the anticipated rearing of approximately 220,000 smolts at the hatchery, such that about 110,000 smolts will be removed in November and 110,000 will be removed the following March. Table 8 presents the details on the nutrient loading that is expected to result from hatchery operation. The average flow for the month of September, estimated at about 0.06 cubic meter per second (m^3/s) (about 1,000 gallons per minute), was specified for the QUAL-2K model. Discharge from Dryden Hatchery was assumed to occur immediately upstream of Dryden Dam (at RKM 56.5).

The Skretting Nutra Fry feed that is proposed for use at the hatchery contains about 1.42% phosphorus by weight. Tipping and Shearer (2007) have reported a phosphorus retention range of 29% to 36% for coho salmon fed commercial diets with similar phosphorus content (range 1.1% to 1.3%). Similar research on rainbow trout estimated phosphorus retention at 50% (Flimlin et al. 2003). The average of these values, 39% phosphorous retention, was assumed for the analysis presented herein. The effluent from the hatchery is expected to undergo treatment prior to discharge to the Wenatchee River. For our purposes, we have assumed a treatment efficiency of 50%, which is the minimal requirement for any treatment system that will be designed for the system.

The phosphorus loads estimated for the month of September (see Table 8) were specified as a point source in the QUAL-2K model. Other water quality parameters were set to the same values as those used for LNFH in the Icicle Creek water quality model used in the WDOE

TMDL analysis (Carroll et al 2006). This is appropriate because the level of treatment at Dryden Hatchery is expected to be similar or better than what is being implemented at LNFH. All other settings remained unchanged from the 7Q10 simulations in the WDOE TMDL analysis (Carroll and Anderson 2009).

4.2.9.2 Model Predictions and Impact Analysis

Steady-state predictions for flow, TP, DO, pH, and temperature over the length of the Wenatchee River are shown in Figures 8 through 12. Given the relatively small flows out of the proposed Dryden Hatchery, mass balance modeling has shown that effluent from the hatchery is unlikely to change flows and water quality significantly in the lower Wenatchee River. Indeed, DO remains in compliance downstream of the hatchery discharge (Figure 10) and the change in minimum DO meets the measurable change criterion laid out in state standards (Figure 13; WAC 2006).

The model predicts that pH could exceed the upper limit of 8.5 units downstream of Cashmere POTW discharge (Figure 11). After about RKM 60, there is little difference in the model predictions with and without the proposed hatchery discharge. This suggests that the pH excursion does not result from the hatchery loads, but is rather a consequence of the Cashmere POTW loads. This interpretation is reinforced by the WDOE TMDL, which acknowledges that Cashmere POTW discharge should release phosphorus at less than 90 µg/L to prevent pH excursion downstream of the city of Cashmere.

Table 8
Estimation of effluent phosphorus loads for proposed hatchery at Dryden

Month	Number of Fish[1]	Flow (m^3/s)	Total Weight of Fish (kg)	Feed Rate (g feed/ g fish/d)	Phosphorus Feed Rate[2] (g/d)	Phosphorus Concentration (mg/L)			Effluent Phosphorus Load (g/d)
						Feed	Untreated Effluent[3]	After Treatment[4]	
Mar	236703	0.010	106.5	2.9%	43.86	0.051	0.016	0.008	6.69
Apr	235135	0.015	190.5	2.8%	75.73	0.060	0.018	0.009	11.55
May	233578	0.020	315.3	2.7%	120.90	0.069	0.021	0.010	18.44
Jun	232031	0.028	511.6	2.6%	188.89	0.078	0.024	0.012	28.81
Jul	230495	0.033	663.8	2.6%	245.08	0.085	0.026	0.013	37.38
Aug	228968	0.041	906.7	2.5%	321.88	0.091	0.028	0.014	49.09
Sep	227452	0.060	1627.4	2.4%	554.62	0.106	0.032	0.016	84.58
Oct	225946	0.079	2420.8	2.2%	756.27	0.111	0.034	0.017	115.33
Nov	224449	0.089	2929.1	2.0%	831.85	0.108	0.033	0.016	126.86
Dec	112963	0.048	1626.7	1.9%	438.87	0.106	0.032	0.016	66.93
Jan	112215	0.049	1666.4	1.9%	449.59	0.107	0.033	0.016	68.56
Feb	111472	0.049	1705.5	1.9%	460.15	0.108	0.033	0.017	70.17
Mar	110733	0.052	1843.7	1.9%	497.43	0.111	0.034	0.017	75.86

Notes:

1 Numbers back-calculated to produce 220,000 smolts, and assuming mortality of 0.7 percent per month, with 110,000 fish removed in November and the remaining 110,000 removed in March.
2 Skretting Nutra Fry diet contains 1.42 percent phosphorus by weight.
3 Assumes assimilation of 39 percent based on a highly digestible diet.
4 Assumes treatment efficiency of 50 percent.

mg/L milligrams per liter
m^3/s cubic meters per second
kg kilograms
g feed/g fish/d grams of feed per gram of fish per day
g/d grams per day

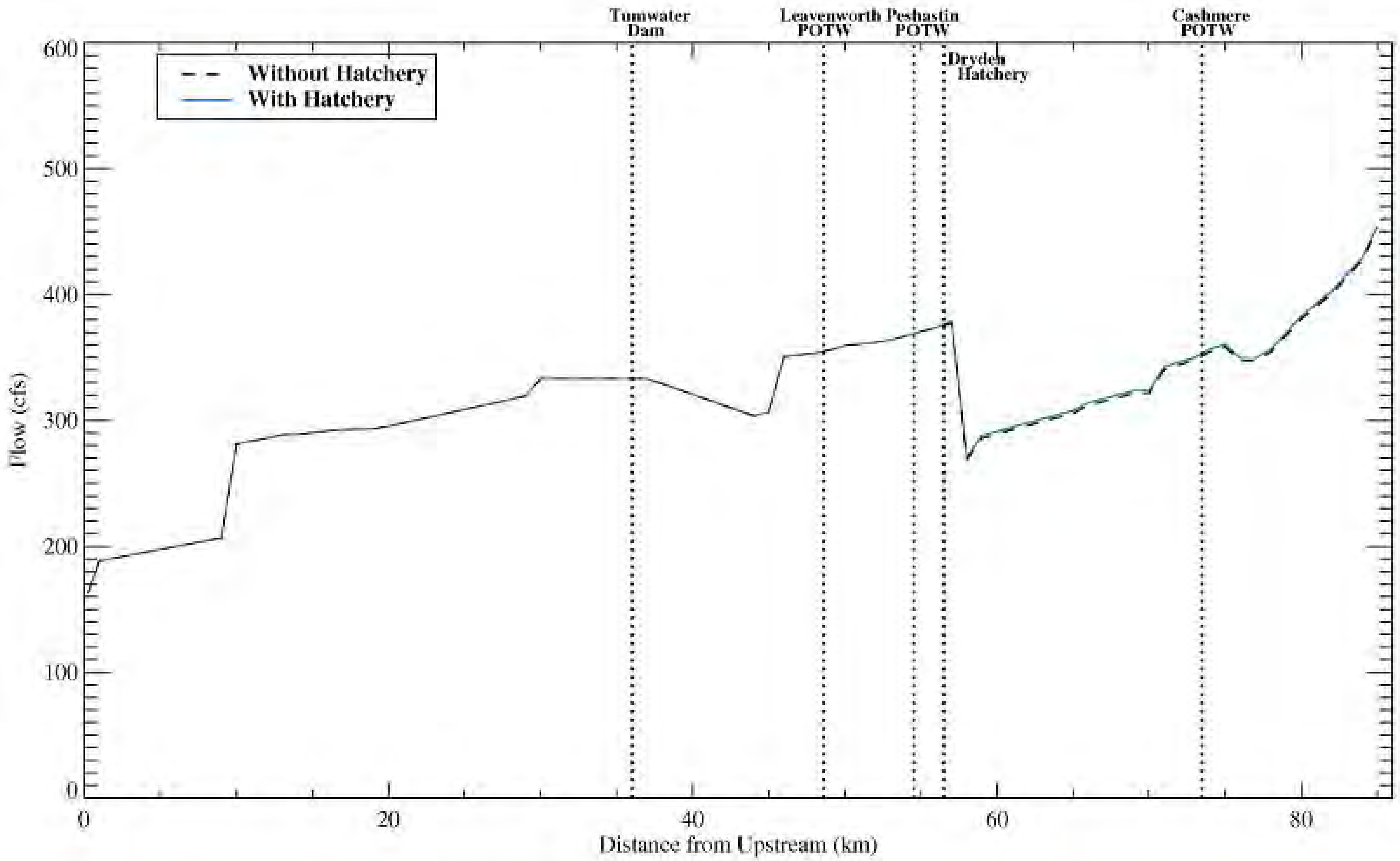

Figure 8

Flows simulated by QUAL-2K model shown compared for cases with and without proposed hatchery at Dryden

Dryden Hatchery discharge was assumed to occur at river km 56.5 just upstream of Dryden Dam with an estimated inorganic phosphorus load of 42.5 g/d
Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
"Natural conditions" in all figures from here onwards refer to background conditions as defined in WDOE TMDL (Carroll and Anderson 2009)

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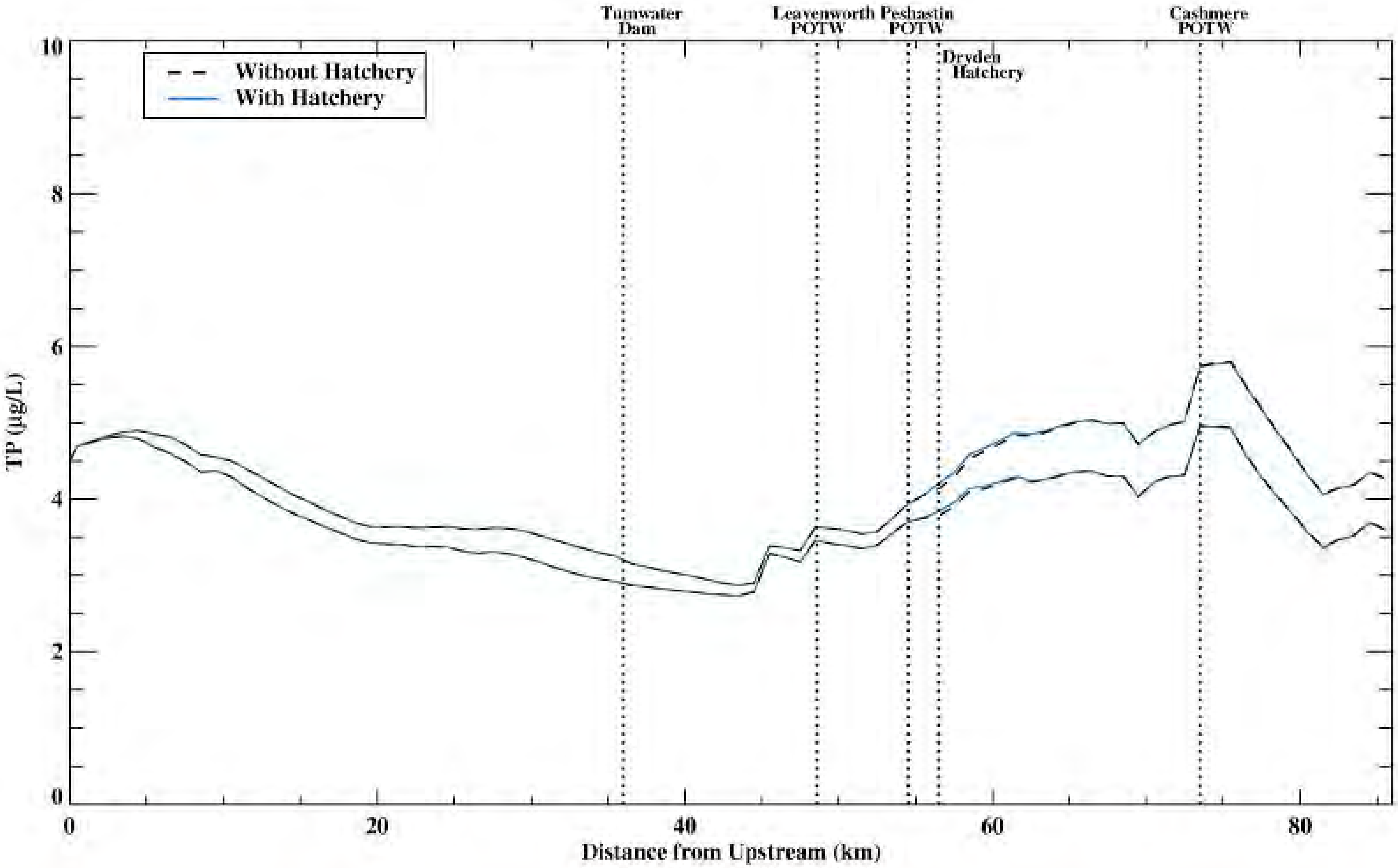

Figure 9

Total phosphorus concentrations simulated by QUAL-2K model shown compared for cases with and without proposed hatchery at Dryden

Dryden Hatchery discharge was assumed to occur at river km 56.5 just upstream of Dryden Dam with an estimated inorganic phosphorus load of 42.5 g/d
Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
Minimum and maximum values simulated by the model are shown

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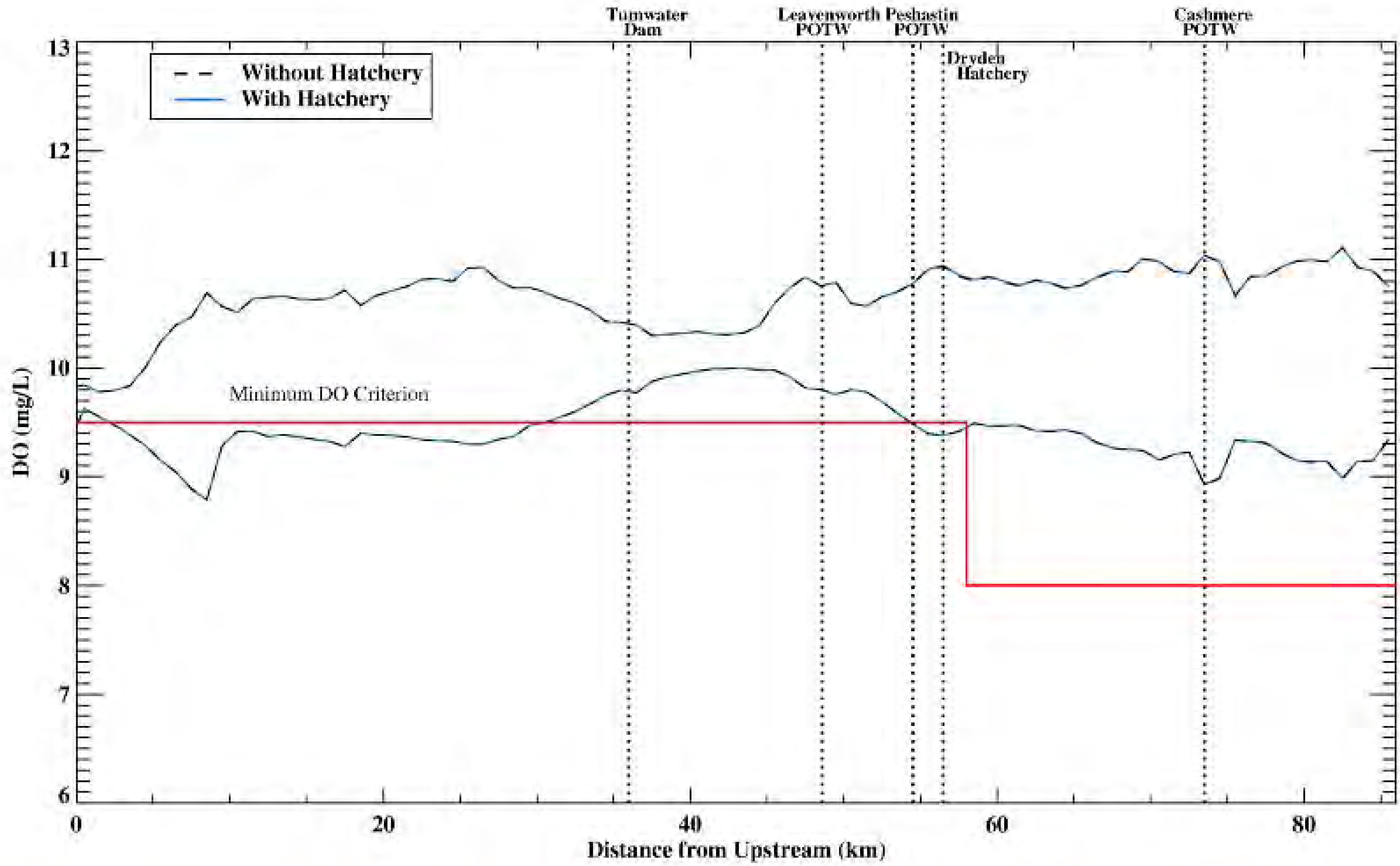

ANCHOR OEA

Figure 10

Dissolved oxygen concentrations simulated by QUAL-2K model shown compared for cases with and without proposed hatchery at Dryden

Dryden Hatchery discharge was assumed to occur at river km 56.5 just upstream of Dryden Dam with an estimated inorganic phosphorus load of 42.5 g/d
Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
Minimum and maximum values simulated by the model are shown

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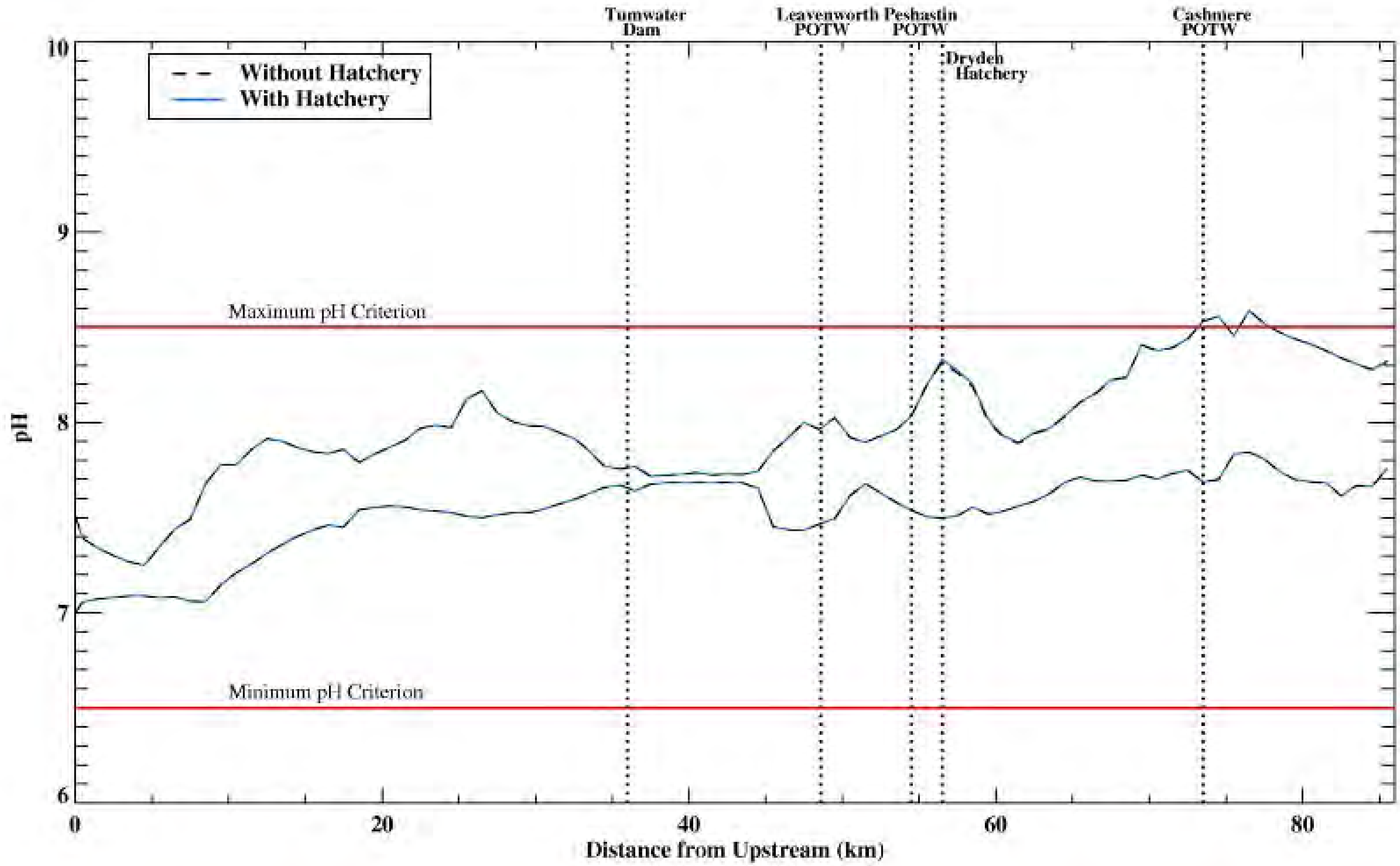

Figure 11

pHs simulated by QUAL-2K model shown compared for cases with and without proposed hatchery at Dryden

Dryden Hatchery discharge was assumed to occur at river km 56.5 just upstream of Dryden Dam with an estimated inorganic phosphorus load of 42.5 g/d
Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
Minimum and maximum values simulated by the model are shown

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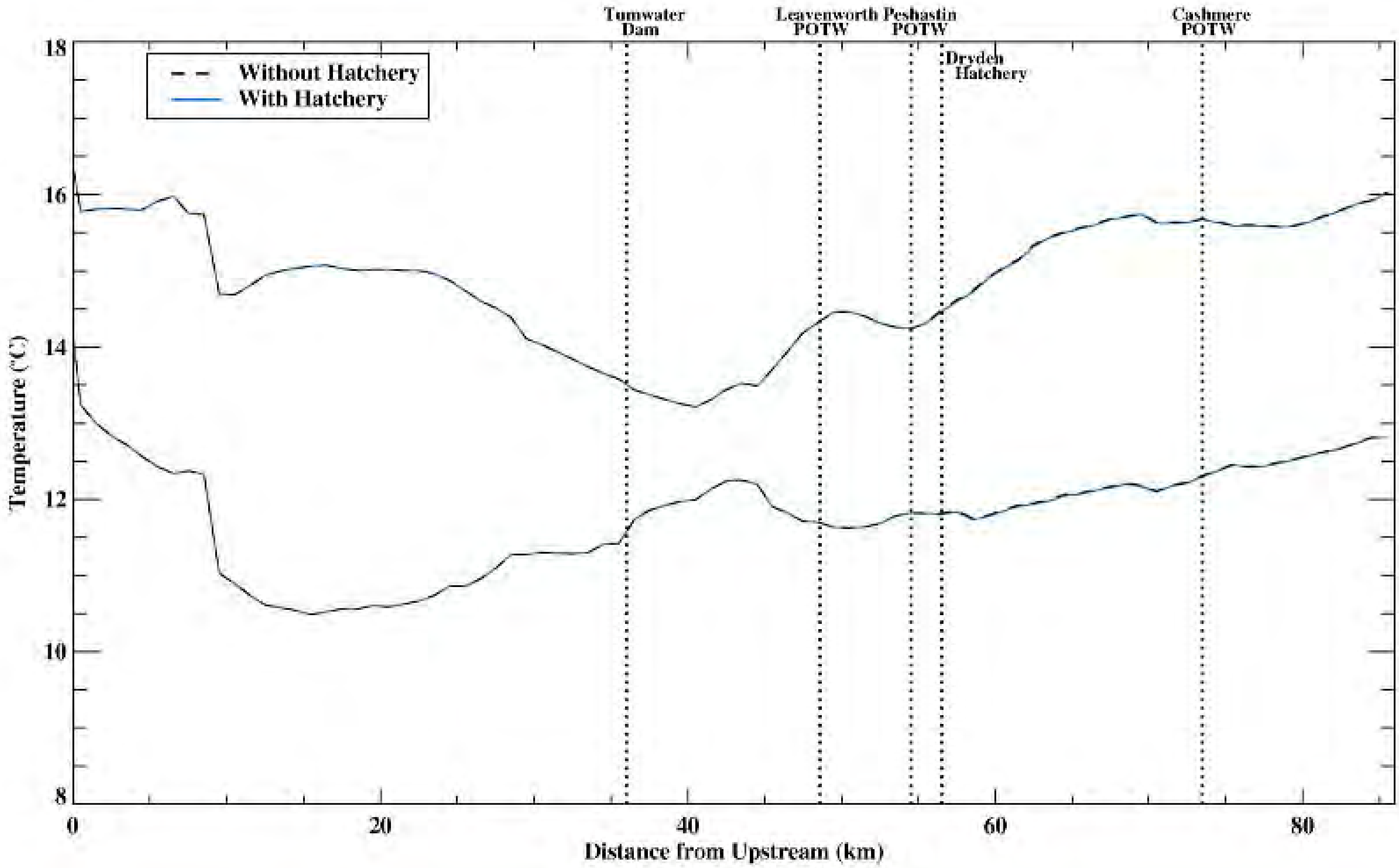

Figure 12

Temperatures simulated by QUAL-2K model shown compared for cases with and without proposed hatchery at Dryden

Dryden Hatchery discharge was assumed to occur at river km 56.5 just upstream of Dryden Dam with an estimated inorganic phosphorus load of 42.5 g/d
Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
Minimum and maximum values simulated by the model are shown

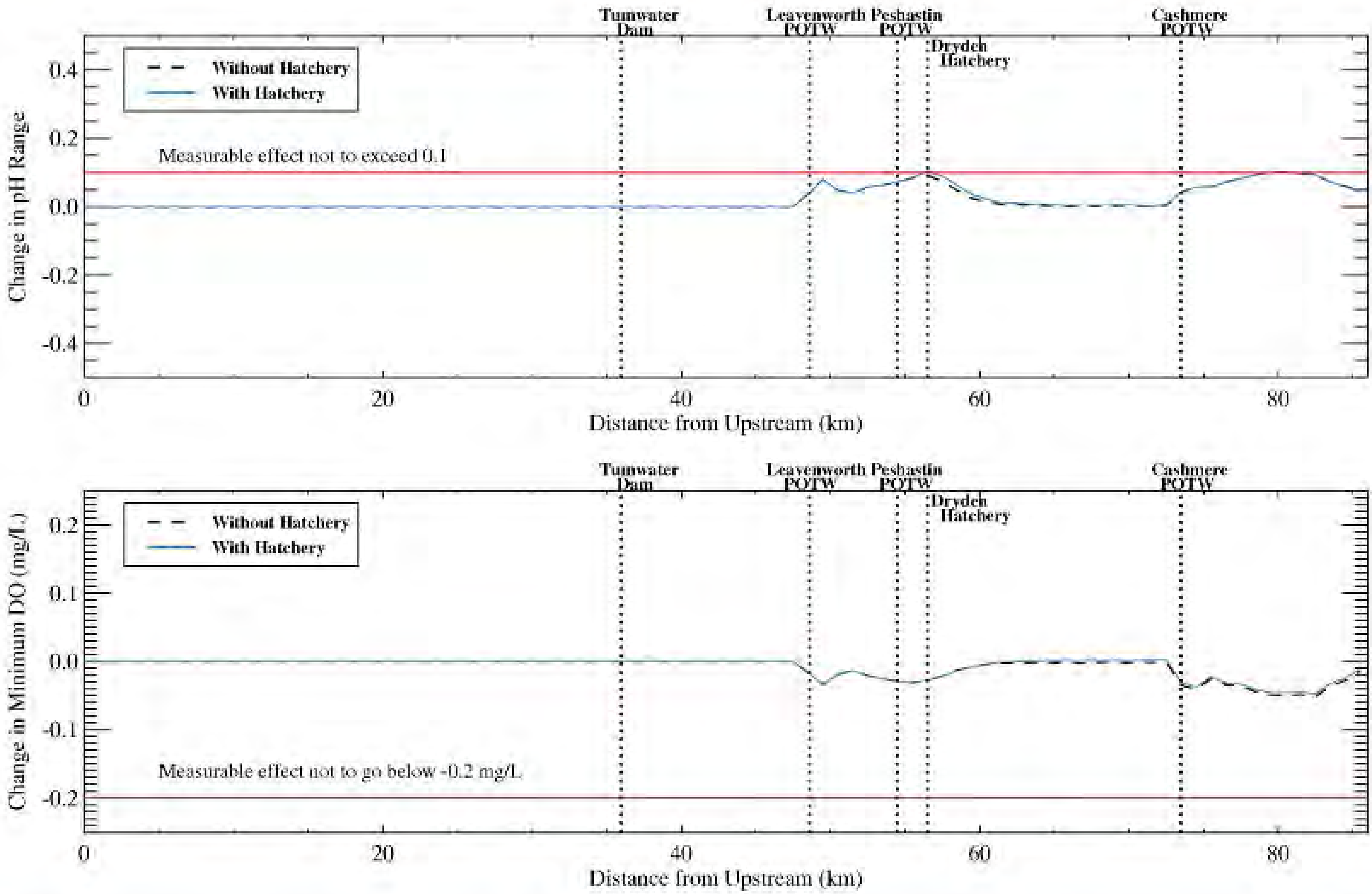

Figure 13

Difference from natural conditions in range of pH and minimum dissolved oxygen at permissible POTW loading with and without the proposed hatchery at Dryden

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Dryden Hatchery discharge was assumed to occur at river km 56.5 just upstream of Dryden Dam with an estimated inorganic phosphorus load of 42.5 g/d
Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration

In the vicinity of the hatchery as well as downstream of the Cashmere POTW, the difference in the pH range marginally exceeds the measurable change criterion (by much less than 0.1 unit which is well below the limits of instrument accuracy—see Chapter 5 in Appendix 6) and is well within the typical ranges encountered within a day (Figure 13).

Based on the analysis provided here, it is expected that the discharges from the Dryden Hatchery will have minimal impacts on the water quality of the lower Wenatchee River even under critical low-flow conditions.

4.2.10 George Hatchery

George Hatchery is being considered as an alternative to the Dryden Hatchery if the operation of the latter is determined to be infeasible. Discharge from the hatchery will enter the Wenatchee River 3 km downstream of the Lake Wenatchee outlet. Discharges from this hatchery, if operated, will flow through a disconnected side channel for about a mile before entering the Wenatchee River.

The hatchery is expected to be operated under the same conditions as Dryden. Therefore, the QUAL-2K modeling approach taken to evaluate the discharge impacts was adopted here. The impact of hatchery operation was evaluated for 7Q10 summer low flow conditions. The only difference between this model setup and the one employed for Dryden is the location of the discharge. The reader is referred to the previous section for details on the assumptions, and phosphorus loading calculations.

The channel into which the discharge from the proposed hatchery will enter is vegetated significantly and flows only during flood events. Therefore, it is unlikely that the hatchery discharge will enter the Wenatchee River in its entirety during critical summer conditions due to infiltration losses to the underlying aquifer. Also, significant amounts of nutrients will be assimilated in the 20 acres of side channel habitat that exists between the hatchery discharge and the river. However, for the purposes of this evaluation it is assumed that the discharge will reach the Wenatchee River in its entirety without any assimilation of phosphorus, and without any loss in flow. This is likely a substantial over estimate of the loading to the Wenatchee River, but in the absence of additional information further refinement was not possible and this conservative approach was adopted.

4.2.10.1 Model Predictions and Impact Analysis

Figures 14 through 18 show the simulated steady state flow, TP, DO, pH and temperature respectively for the cases with and without the proposed hatchery. Changes to flow (Figure 14) are minimal given the small quantity of flow expected from the discharge. Phosphorus concentration (Figure 15) was predicted to increase downstream of the discharge but the differences over natural conditions are imperceptible past Tumwater Dam. In the same section of the river both dissolved oxygen (Figure 16) and pH (Figure 17) show significantly wider ranges compared to the natural condition predictions. Predicted temperature range (Figure 18) showed negligible change over natural conditions simulation.

Figure 19 shows the difference over the maximum natural conditions simulation for the case with the hatchery discharge. The differences in section of the river upstream of Tumwater Dam are relatively higher, particularly between river kilometer 5 through 15 where the changes are predicted to exceed the threshold for measurable change.

These differences can be explained from the context of the hatchery loading relative to the background phosphorus load. The hatchery loading contribute to about 9% of the background load in the upstream section. The relative contribution for the Dryden Hatchery was calculated to be about 3% of the predicted background load immediately upstream of the discharge. Thus, the higher background concentration downstream of the George Hatchery discharge could produce a measurable change in DO and pH on a localized scale.

When viewed in light of the fact that a very conservative estimate was used for specifying the load, the negligible impacts in the downstream reaches particularly in the TMDL domain (i.e., downstream of the city of Leavenworth) where the water quality changes resulting from the hatchery loads are imperceptible from the background condition simulation. Thus, it is concluded that while localized impacts are possible due the proposed hatchery, impacts farther downstream is unlikely.

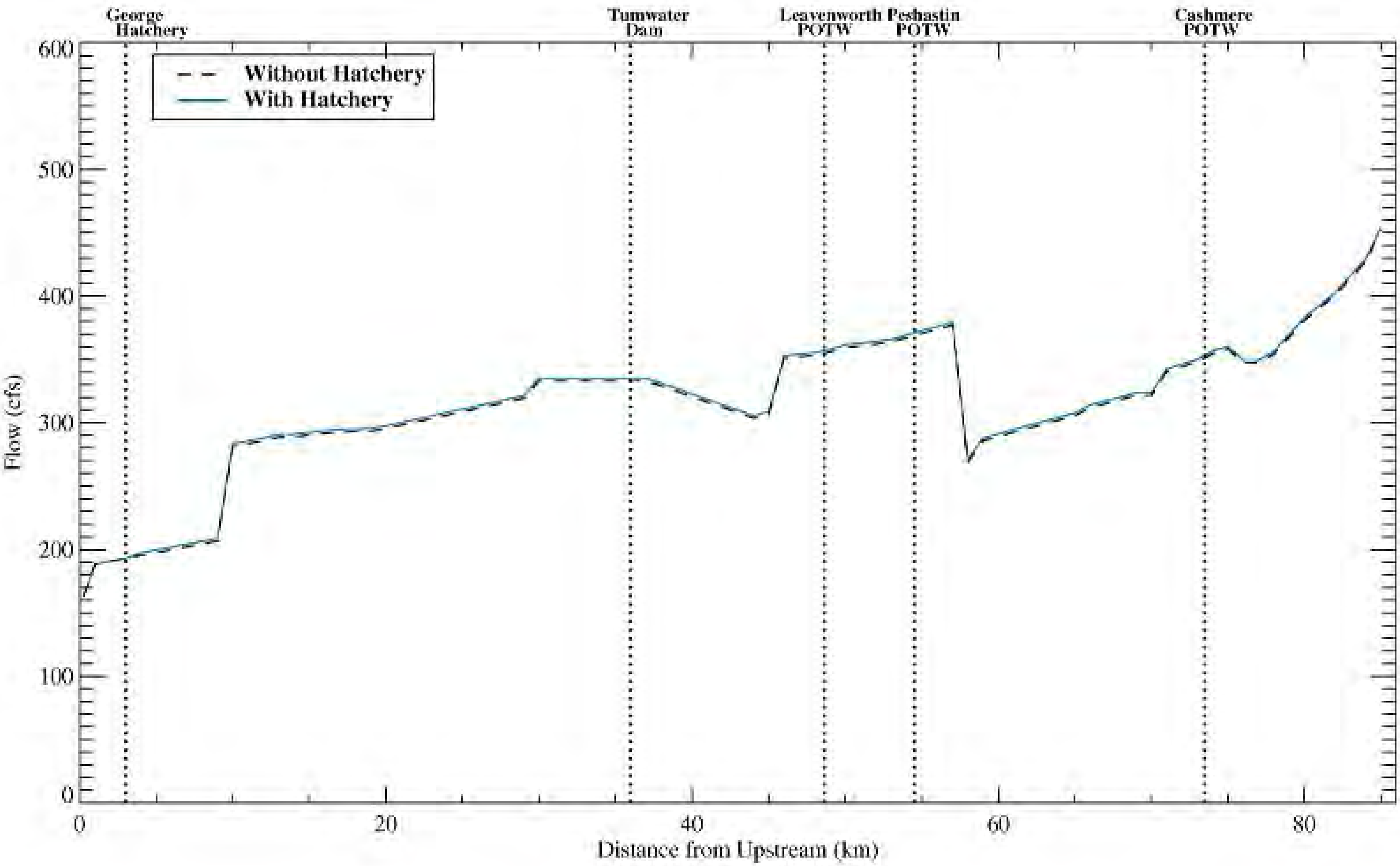

Figure 14

Flows simulated by QUAL-2K model shown compared for cases with and without discharge from George Hatchery

George Hatchery discharge was assumed to occur at river km 3 with an estimated inorganic phosphorus load of 42.5 g/d
Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
Minimum and maximum values simulated by the model are shown

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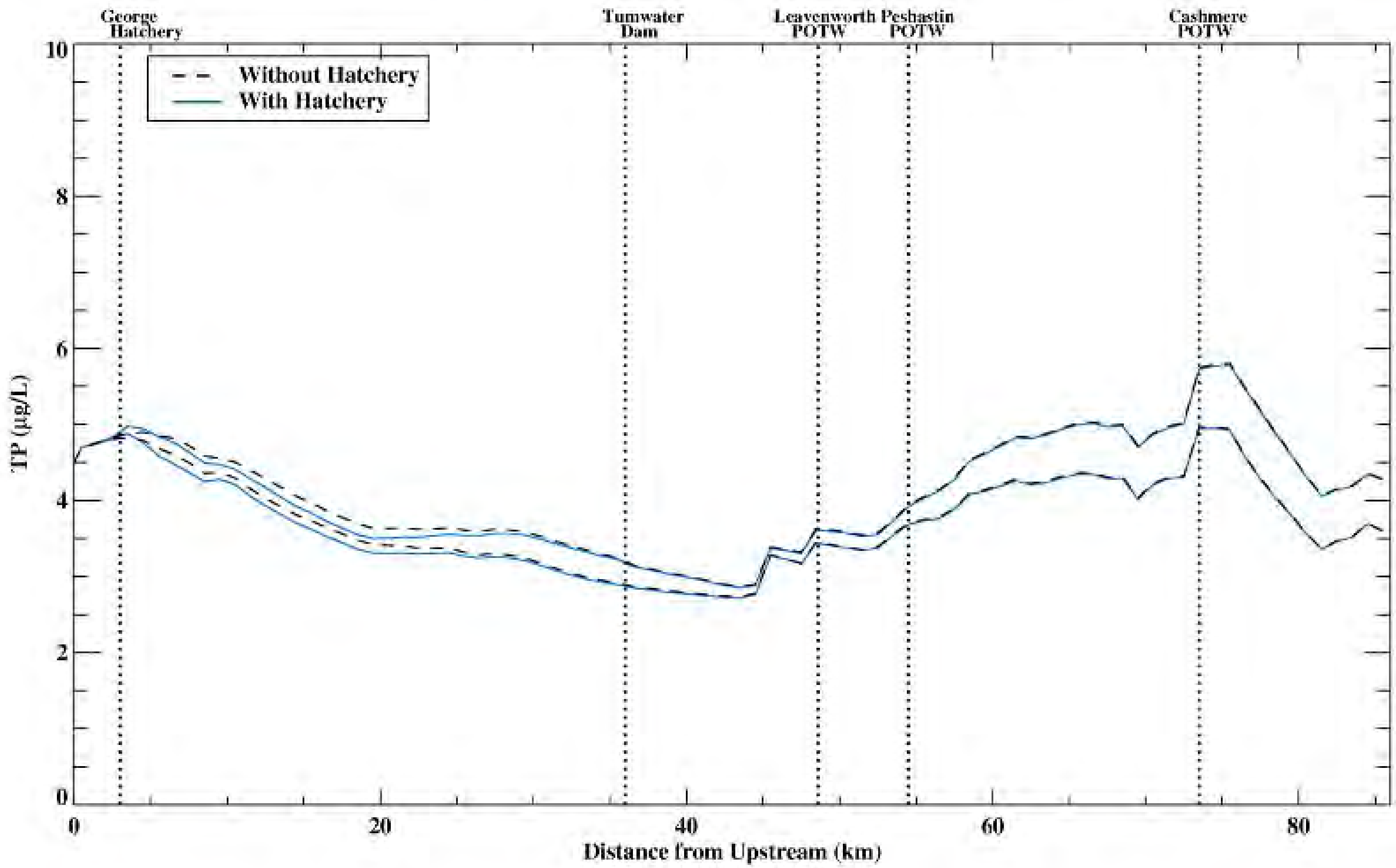

Figure 15

Total phosphorus concentrations simulated by QUAL-2K model shown compared for cases with and without discharge from George Hatchery

George Hatchery discharge was assumed to occur at river km 3 with an estimated inorganic phosphorus load of 42.5 g/d
Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
Minimum and maximum values simulated by the model are shown

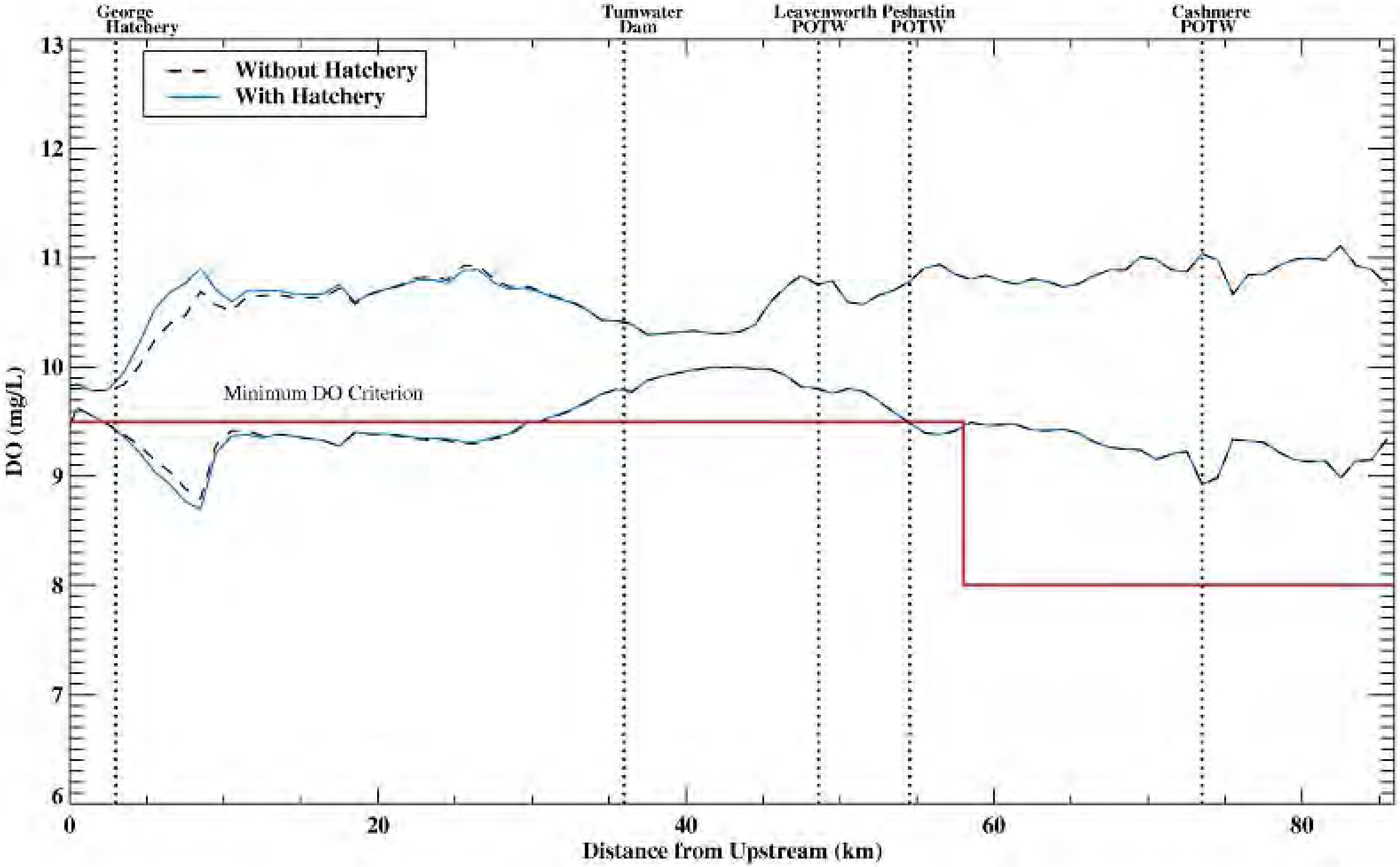

Figure 16

Dissolved oxygen concentrations simulated by QUAL-2K model shown compared for cases with and without discharge from George Hatchery

George Hatchery discharge was assumed to occur at river km 3 with an estimated inorganic phosphorus load of 42.5 g/d
Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
Minimum and maximum values simulated by the model are shown

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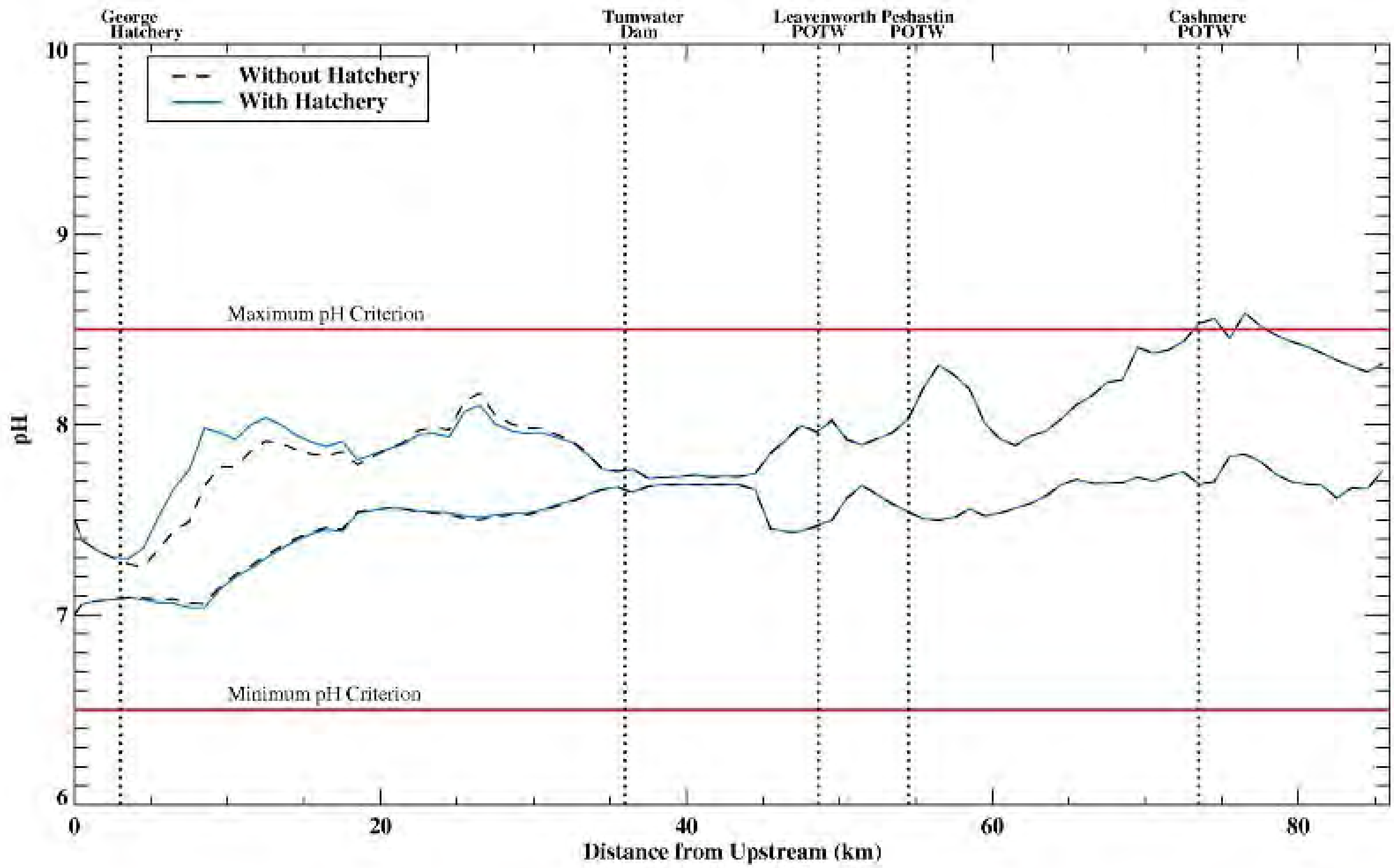

Figure 17

pHs simulated by QUAL-2K model shown compared for cases with and without discharge from George Hatchery

George Hatchery discharge was assumed to occur at river km 3 with an estimated inorganic phosphorus load of 42.5 g/d
Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
Minimum and maximum values simulated by the model are shown

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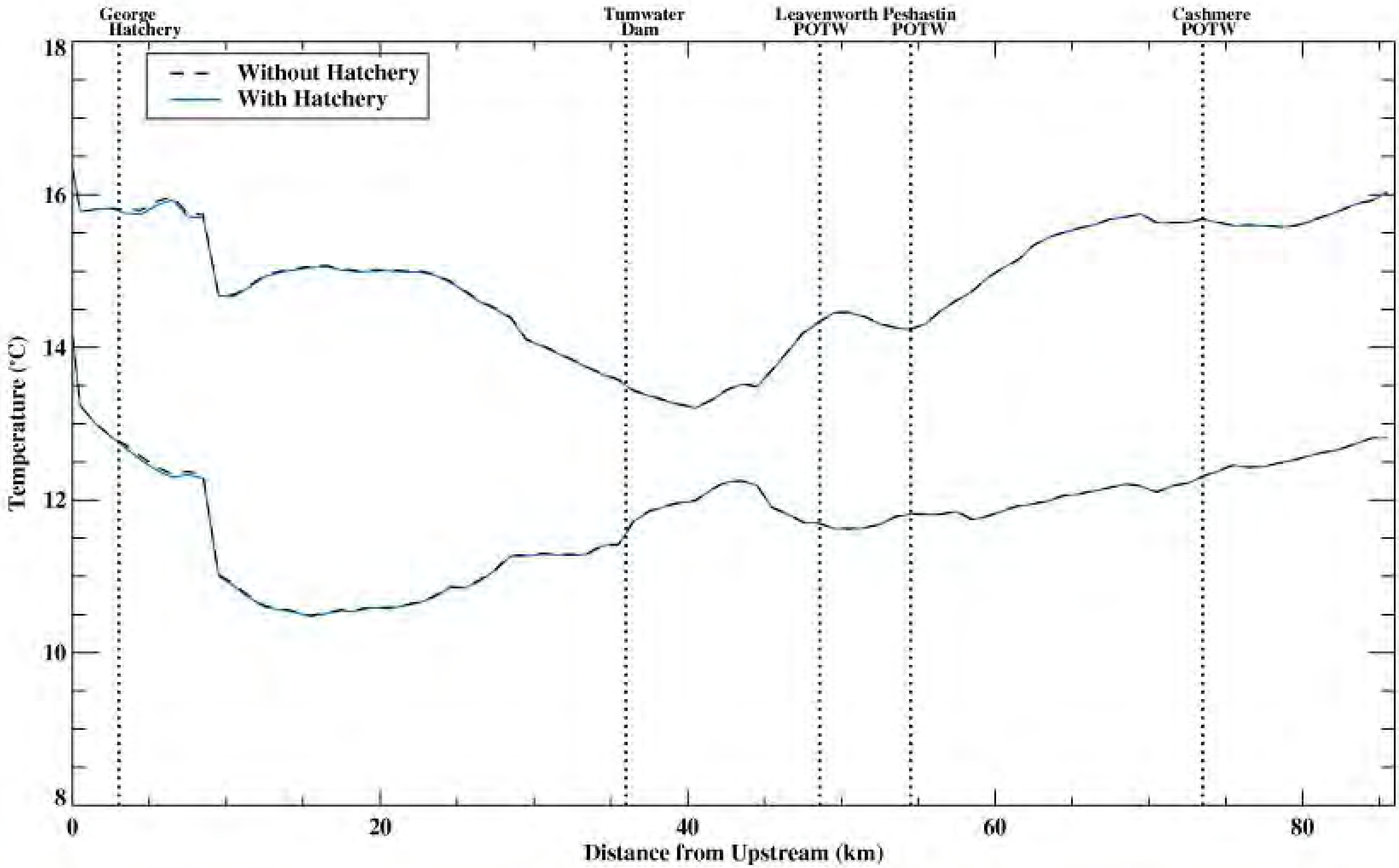

Figure 18

Temperatures simulated by QUAL-2K model shown compared for cases with and without discharge from George Hatchery

George Hatchery discharge was assumed to occur at river km 3 with an estimated inorganic phosphorus load of 42.5 g/d
Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
Minimum and maximum values simulated by the model are shown

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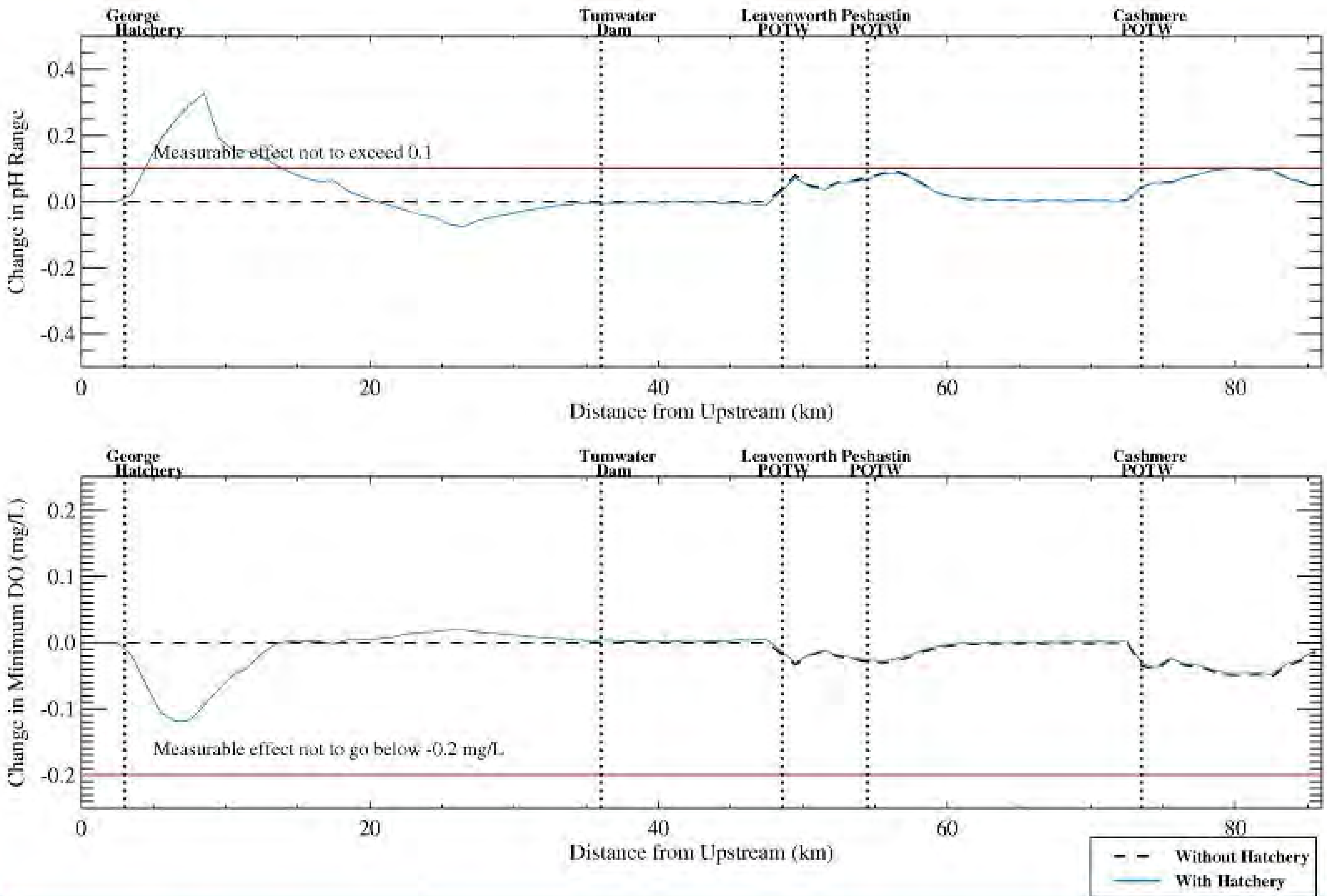

Figure 19

Difference from natural conditions in range of pH and minimum dissolved oxygen at permissible POTW loading with and without George Hatchery discharge

Discharge was assumed to occur at river km 3 with an estimated inorganic phosphorus load of 42.5 g/d
Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration

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4.3 Methow Subbasin Sites

The site-specific acclimation-related nutrient loads for the Methow sites were calculated using an approach similar to that of the Wenatchee sites. Loads estimated from measured data at active acclimation sites in Nason Creek (see Table 5) were used for this analysis. The TP loads estimated for the proposed sites in the Methow subbasin are shown in Table 9.

The Methow subbasin was not sampled at the same spatial and temporal resolutions as the Wenatchee subbasin. Historical information on phosphorus concentrations for the acclimation months was limited. Therefore, the evaluations performed here are based on the potential for the acclimation-related TP loads dominating the background conditions as determined by a comparison to the impacts assessed for the Wenatchee subbasin. This method is possible because the characteristics of the Wenatchee and Methow subbasins are comparable (see Section 5.1.2 for a detailed discussion of the similarities).

4.3.1 Methow River Mainstem

4.3.1.1 Goatwall

This is the most upstream site proposed that would discharge directly into the Methow River. For the relatively small number of smolts (50,000) acclimated, the TP loading to the Methow River is expected to be about 16 g/d. The average flow from 1990 through 2010 for the months of March through May in this section of the Methow River (USGSG Gage 12447383, Methow River near Goat Creek) is about 900 cfs, which is comparable to the flow at the mouth of the White River in the Wenatchee subbasin (WDOE Station 45K090, March through May average from 2003 through 2010 is about 1,000 cfs). Given the predominantly forested nature of the upper portions of the Wenatchee and Methow subbasins, the background phosphorus concentrations are likely to be similar. It was shown that a TP load of up to 35 g/d (see Table 6) from individual acclimation-related discharges in the White River will only comprise a very small fraction (less than a fifth of a percent) of the background load. Given the similarity in the flows and land type between the two watersheds, the impacts are expected to be similarly negligible in this reach of the Methow River due to discharges from this site.

4.3.1.2 Heath

About 200,000 smolts are expected to be acclimated in a large pond at the proposed Heath acclimation site. The TP loads from this site are estimated to be four times that of Goatwall at about 64 g/d. This site is located upstream of the city of Winthrop in the same section of the river as Goatwall (although farther downstream). Therefore, the assessment applied for Goatwall can be extended here. Even though the load is higher, this is comparable in magnitude to the largest load expected for the White River sites. By extending the reasoning from Goatwall, the impacts are expected to be similarly negligible.

4.3.1.3 Winthrop National Fish Hatchery (WNFH)

This is a public hatchery and discharges from this site are covered by a discharge permit. The loads from acclimation activity are expected to be about 32 g/d. Some level of treatment of the discharge that is associated with hatchery operations is expected. Thus, the loads from this site will be even smaller. Therefore, potential impacts related to acclimation activity are expected to be negligible.

4.3.2 Chewuch River

4.3.2.1 Methow State Wildlife Area (MSWA)

The MSWA site is the most upstream proposed site on the Chewuch River, located in a side channel above the confluence with Eight Mile Creek. About 87,500 smolts are proposed to be acclimated, for which the estimated TP load to the system is 28 g/d. The watershed for the Chewuch is similar to the upper portions of the Methow River (predominantly forested with very little anthropogenic influence). Thus, a similar approach as that used for the upper Methow sites (Goatwall and Heath) was used here. The long-term (1991 through 2010) average flow for March through May reported at the USGS Gage in Winthrop (Chewuch at Winthrop, USGS Gage 12448000) is about 700 cfs, which is lower than but comparable to the upper Methow River flows. Given the similarity in the subbasin characteristics, background loads, and acclimation-related nutrient loads, water quality impacts from acclimation activity are expected to negligible.

4.3.2.2 Mason

Discharges from this proposed site enter the Chewuch River through Eight Mile Creek. The number of smolts proposed to be acclimated at this site is identical to MSWA. Given its proximity to MSWA and the similarity in in-stream conditions, impacts are expected to be similar to MSWA.

4.3.2.3 Pete Creek Pond

Approximately 125,000 smolts are expected to be acclimated at this site, corresponding to a TP load of 40 g/d. This site is proposed on the lower Chewuch River where the watershed and background loads will be comparable to the other two Chewuch River sites. While the acclimation-related loads are expected to be higher (by 40% compared to MSWA) due to the greater number of fish acclimated, the background loads in the Chewuch River will be much higher. Moreover, this site is located closer to the confluence with the Methow River, thereby providing greater dilution of any phosphorus loading that is transported farther downstream. Given these factors, acclimation activity-related impacts on the receiving stream are expected to be negligible.

Table 9
TP loads estimated for proposed acclimation activity in the Methow Subbasin

Proposed Site	# of Fish (thousands)	TP Load[1] (kg/d)	Receiving Stream
Goat Wall	50	0.016	Methow
Heath	200	0.064	Methow
Winthrop NFH	100	0.032	Methow
MSWA	87.5	0.028	Chewuch
Mason	87.5	0.028	Chewuch
Pete Creek Pond	125	0.040	Chewuch
Lincoln	110	0.035	Twisp
Twisp Weir	110	0.035	Twisp
Lower Twisp	30	0.01	Twisp
Parmley	50	0.016	Beaver
Gold	50	0.016	Gold

Notes:

1. Estimated from average load of 0.32 mg per fish per day calculated from measured data at active discharges in Nason Creek.

kg/d kilograms per day

4.3.3 Twisp River

4.3.3.1 Lincoln

This site is the most upstream among the proposed sites on the Twisp River. The TP load in the discharge associated with the proposed acclimation of 110,000 smolts is expected to be about 35 g/d.

The primary anthropogenic influence in the Twisp River occurs near the city of Twisp, which is at the confluence of the Twisp and Methow rivers. Thus, much of the Twisp River watershed is forested, which is similar to the upper section of the Methow River and the Chewuch River. Therefore, background phosphorus concentrations in the Twisp River will likely be similar. The Twisp River flows are smaller than those in the upper Methow River and Chewuch River (average flow at the USGS Gage 12448998 on the Twisp River near the city of Twisp for March through May in 1990 through 2010 is about 440 cfs). Therefore, background loads in the Twisp River will be smaller, and the acclimation-related loads can be a larger proportion of the background loads than what will be encountered in the Chewuch River and upper Methow River sites. Even if the proportion is double what is expected at the upper Methow River and Chewuch River sites, it is still expected be a small fraction of the background conditions (see proportions calculated for the upper Wenatchee River sites in Table 6 for an order of magnitude estimate). Impacts on the receiving stream are therefore expected to be negligible.

4.3.3.2 Twisp Weir

This site is the located approximately midway between the Lincoln site and the confluence of the Twisp River with the Methow. As with Lincoln, the TP load in the discharge associated with the proposed acclimation of 110,000 smolts is expected to be about 35 g/d. Given the similar in-stream conditions to the Lincoln site and the same number of fish being proposed, impacts resulting from the Twisp Weir site are expected to be negligible.

4.3.3.3 Lower Twisp

The Lower Twisp proposed acclimation site is located close to the Twisp River confluence with the Methow River. For the 30,000 fish proposed at this site the acclimation-related TP loads are expected to be less than 10 g/d. Given the Lower Twisp River site's proximity to the Methow River, greater dilution of the TP load can be expected downstream of the confluence. Therefore, impacts for this site will likely be lower than for the Lincoln site.

4.3.4 Beaver Creek – Parmley

The Parmley site is expected to be used for acclimating 50,000 smolts. The TP load associated with this site is an estimated 16 g/d. Beaver Creek is smaller than the other streams considered thus far; however, the number of fish proposed for acclimation at this site is proportionally smaller. Consequently, the nutrient loading that could occur as a result of acclimation at this site is also expected to be smaller than the other sites discussed thus far. Impacts are therefore likely to be negligible. A more definitive evaluation was not possible due to the lack of sufficient data for calculating background loads in the creek.

4.3.5 Gold Creek – Gold

This proposed site is located in the lower Methow subbasin. About 50,000 smolts are expected to be acclimated here, with a corresponding TP load of about 16 g/d to Gold Creek. Gold Creek is similar in size to Beaver Creek. Also, because this is the only acclimation site proposed on Gold Creek with the same number of fish as proposed for the Parmley site on Beaver Creek, localized impacts are expected to be similarly negligible.

4.3.6 Back-up Acclimation Sites

Five backup sites are proposed for the Methow subbasin. The TP loads estimated for these sites are presented in Table 10 and discussed in the following sections.

4.3.6.1 Chewuch Acclimation Facility

This is an existing acclimation facility proposed for expansion under this project in case other sites on the Chewuch River are not developed. About 125,000 smolts will be acclimated in the proposed site. The TP loads associated with this activity are expected to be about 40 g/d. The assessments from the other Chewuch River sites can be extended here due to the similarity in location and number of fish. Impacts are expected to be negligible.

4.3.6.2 Methow Salmon Recovery Foundation (MSRF)

The number of fish proposed for acclimation at the MSRF site is the same as proposed for the Chewuch Acclimation Facility (about 125,000). Given the site's proximity to the confluence with the Methow River and the similarity in the magnitude of the estimated TP loads to the other Chewuch sites for which localized impacts were expected to be negligible, localized impacts on the Chewuch River due to TP loading from this site are expected to be negligible.

4.3.6.3 Biddle

This acclimation site is located on Wolf Creek. About 16 g/d of TP is expected to be discharged due to the proposed acclimation of about 50,000 smolts. Given that this is the only site on a relatively small creek, the impacts are likely to be similar to those estimated for the Parmley and Gold Creek sites. A detailed evaluation of localized impacts associated with this proposed site was precluded by a paucity of data.

4.3.6.4 Canyon

This is the most upstream of the proposed back-up acclimation sites on the Twisp River. For the 83,000 smolts proposed to be acclimated here, the TP loads are expected to be about 27 g/d. The number of fish proposed is less than Lincoln and Twisp Weir (the two primary sites) on the Twisp River. Following the discussion for the larger primary sites (Section 4.3.3) the arguments for negligible impact from those sites can be extended here.

4.3.6.5 Utley

The Utley site is proposed with the same number of smolts downstream of the Canyon site. The TP loads and the impacts are expected to be similar.

Table 10
TP loads estimated for backup sites in the Methow Subbasin

Proposed Site	No. of Fish (thousands)	TP Load[1] (kg/d)	Receiving Stream
Chewuch A.F.	125	0.040	Chewuch
MSRF	125	0.040	Chewuch
Biddle	50	0.016	Wolf
Canyon	83	0.027	Twisp
Utley	83	0.027	Twisp
Newby	83	0.027	Twisp
Poorman	83	0.027	Twisp
Balky Hill	50	0.016	Beaver

Notes:
1. Estimated from average load of 0.32 mg per fish per day calculated from measured data at active discharges in Nason Creek.

kg/d kilograms per day

4.3.6.6 Newby

The Newby site is proposed with the same number of smolts downstream of the Canyon and Utley sites. The TP loads and the impacts are expected to be similar to the other two sites.

4.3.6.7 Poorman

This proposed acclimation site is located farthest downstream of all back-up sites on the Twisp River. Given its proposed location on the Twisp River and the identical number of fish to the other Twisp sites, the arguments for negligible impact from those sites can be extended here.

4.3.6.8 Balky Hill

This site is located in Beaver Creek, and impacts are expected to be similar to those at the Biddle and Parmley sites. As with the Biddle site, due to lack of sufficient data, a detailed evaluation of localized impacts was not possible.

5 EVALUATION OF COMBINED AND CUMULATIVE IMPACTS

The assessments provided in the previous sections have indicated that water quality impacts from the individual sites are likely to be negligible because they would not result in a measurable change in the DO and pH levels in the receiving water. In addition to the assessment of the impacts from the individual sites, the combined and cumulative impacts on the water quality of the Wenatchee and Methow rivers required assessment. For the purposes of this assessment, combined and cumulative impacts were defined as follows:

- *Combined impacts* are the water quality impacts, specifically pH, DO, and temperature excursions, that lead to measurable change, as defined in Section 2.2, in the Wenatchee and Methow subbasins based on all the discharges proposed in this project at each subbasin without the influence of any other anthropogenic sources. Back-up sites are not included as they will be used only as replacements for the primary proposed sites.
- *Cumulative impacts* are the combined water quality impacts under the condition that all anthropogenic and natural influences are simultaneously considered while evaluating the discharges proposed in this project.

5.1 Approach

The approach for evaluation of combined and cumulative impacts differed between the two subbasins because a calibrated water quality model was readily available for the Wenatchee River, but such a model was not available for the Methow River. Development of such a model for the Methow would require a great deal of focused data collection, which was beyond the scope of this assessment. Thus, a more simplistic approach, as discussed in the following sections, was adopted for the Methow.

5.1.1 Wenatchee Subbasin

The mass balance model developed by WDOE for the purpose of establishing load allocations (Carroll et al. 2006; Carroll and Anderson 2009) was applied to assess both the combined and cumulative impact evaluations for the Wenatchee River (hereafter referred to as the lower Wenatchee subbasin). The portion of the Wenatchee subbasin composed of Lake Wenatchee and its tributaries, the White River and the Little Wenatchee River (hereafter referred to as the upper Wenatchee subbasin) was evaluated based on mass balance analyses using existing water quality and flow data as discussed below.

5.1.2 Methow Subbasin

A rigorous mass balance model, such as the one developed by WDOE for the Wenatchee subbasin, was not undertaken for the Methow subbasin due to the paucity of data for model development and calibration. The evaluation for the Methow subbasin applied existing data. Loads estimated for the Methow were compared to the trends simulated using the QUAL-2K model for the Wenatchee subbasin and results and conclusions from the Wenatchee subbasin were used to inform the assessment of impacts in the Methow subbasin.

Important subbasin characteristics that affect in-stream conditions including water quality and quantity are shown compared for the two subbasins in Table 11. Both watersheds are predominantly forested. Both have the high peaks of the Cascade Mountains that contribute the majority of flows through snowmelt in spring. In both subbasins, much of the precipitation occurs during the months of October through March, and this precipitation is predominantly in the form of snow (Andonaegui 2001; Konrad et al. 2003).

Table 11
Comparison of Methow and Wenatchee subbasins

Attribute	Methow	Wenatchee
Area (sq.mi.)	1,825	1,333
Elevation Range (ft)	800 (near Pateros) to 8,500 (Cascade Crest)	610 (near Wenatchee) to 5,000 (Cascade Crest)
Annual Precipitation (inches)	10 (Pateros) to 80 (Cascade Crest)	8.5 (Wenatchee) to 150 (Cascade Crest)
Predominant Form of Precipitation	Snow	Snow
Predominant Land Type	Forest (about 87%)	Forest (about 70%)

Data Sources: KWA Ecological Sciences Inc. et al. 2004; Andonaegui 2000; Andonaegui 2001

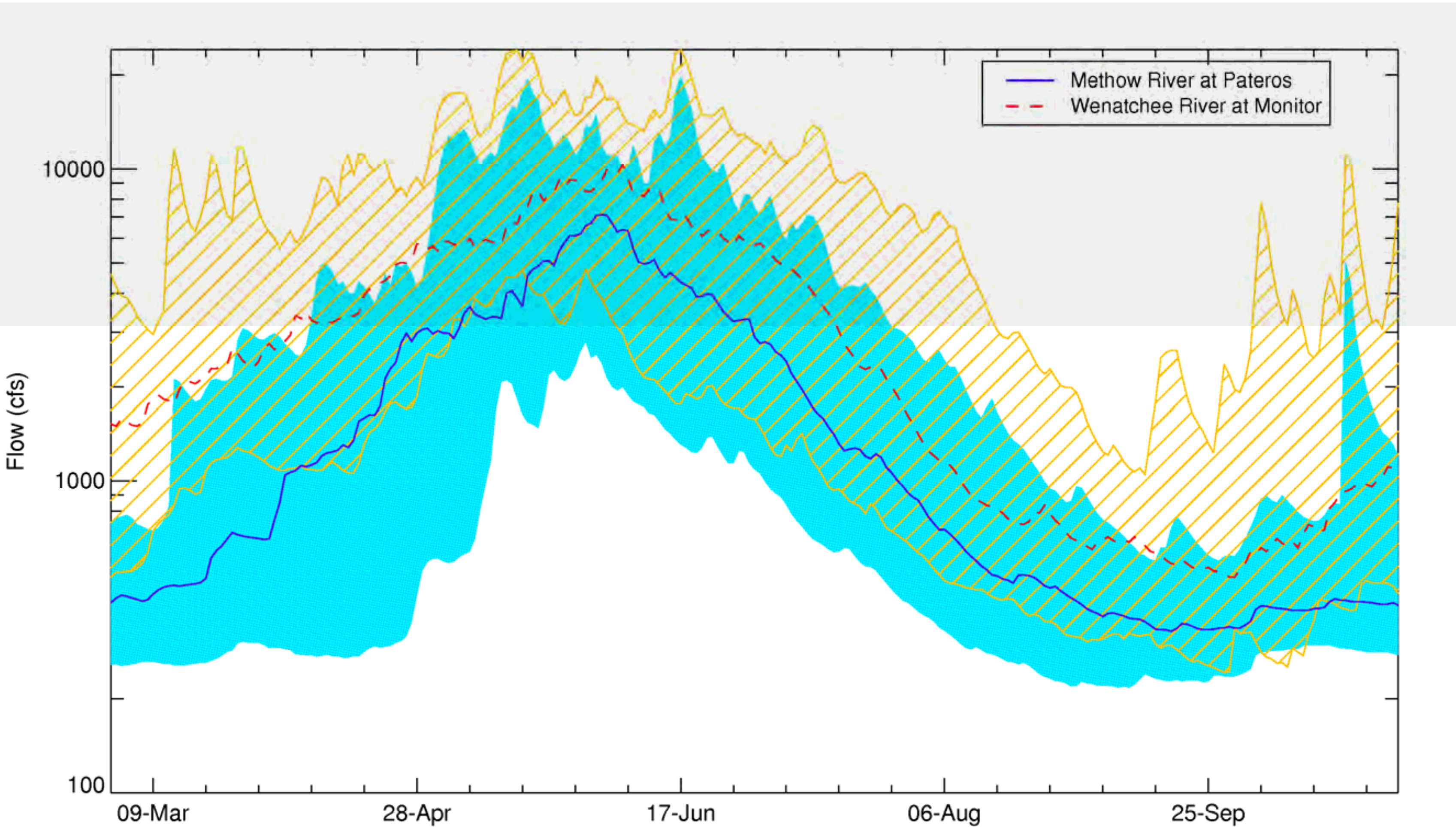

Figure 20

Comparison of flows in Methow and Wenatchee Rivers

Medians and ranges over 1990 to 2009 are plotted. Shaded regions show the respective ranges and central lines show the medians

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Table 11 shows that the Methow subbasin is somewhat drier (even though it is larger in terms of area) than the Wenatchee subbasin. This is evident in the long-term flows shown in Figure 20 where the Wenatchee River flows are higher. Notwithstanding these differences, the flow patterns in Figure 20 are consistent between the two subbasins with coincident peak and dry flow periods. This indicates that flow-driven processes such as mobilization of particulates, dilution of nutrients, in-stream re-aeration, and habitat conditions for attached algae are likely to be similar between the two subbasins. Moreover, a majority of the watershed is forested for both subbasins, with minimal anthropogenic influence. The populations within the Methow and Wenatchee subbasins, excluding the city of Wenatchee, are similar, at around 5,000 based on the census from the year 2000. The city of Wenatchee is at the confluence of the Wenatchee and Columbia rivers. Nutrient loads from the city's sources do not pose any water quality concerns for the Wenatchee River.

Based on this discussion, it is evident that the similarities between the two subbasins provide some justification for using the evaluation for the Wenatchee subbasin to inform the assessment performed for the Methow subbasin.

5.2 Conservative Assumptions to Determine Reasonably Maximum Impacts

As described in Section 4, local impacts in the vicinity of the discharges are not expected to adversely impact water quality. The objective of the mass balance modeling was to assess potential combined and cumulative water quality impacts imposed by the proposed project in the most critical areas of the Wenatchee River (i.e., below the City of Leavenworth).

To achieve this objective, several assumptions were made to determine the reasonable maximum impact in the lower Wenatchee River:

1. March was chosen as the critical period for evaluation. All the proposed acclimation sites would be operational at this time. Flows later in the spring increase significantly, diluting nutrient loads and scour attached algae from the system. Approximately half the sites may be operated through the winter but due to the smaller number of fish being acclimated, low water temperatures, and low feed rates, water quality impacts in winter are expected to be lower than during March.
2. Flows in March were specified as the 7Q10 summer low flow calculated by WDOE for the TMDL evaluation (typically, March flows are somewhat higher).
3. Phosphorus discharged due to acclimation activity was considered to be 100% bioavailable (i.e., phosphorus discharges are all in the orthophosphate form such that they can be readily taken up by algae during photosynthesis).
4. Phosphorus released from the acclimation ponds enters the Wenatchee River without undergoing any change while being transported through the receiving stream (i.e., there is no assimilation of phosphorus prior to reaching the Wenatchee River).

This bounding assumption ensures that the entire phosphorus load discharged from the ponds reaches the Wenatchee River.

5. Average phosphorus loads from the proposed acclimation ponds that were developed based on the data collected from the active ponds in Nason Creek from late March through early May are applicable in March. The implication of this assumption is that fish feed rates in March reflect the overall average feed rate. However, feed rates are typically highest immediately before release, which occurs in the beginning of May, and lowest in March when the smolts are smaller.

The assumption that the loadings occur under extreme low-flow conditions maximizes any potential impacts the discharges may have on water quality because the effect of dilution in the receiving water is minimal under these conditions (i.e., this will manifest the highest possible concentration in the receiving water). The other assumptions provide an upper bound estimate of bioavailable phosphorus loads from the discharge location to the lower Wenatchee River. Combined, these assumptions provide an upper bound on the potential impacts that acclimation activity may have in the lower Wenatchee River. If river water quality is protected under these extreme conditions, then it provides a level of confidence that the water quality of the Wenatchee River will be fully protected under the proposed project.

5.3 Assessment of Combined Impacts

5.3.1 Upper Wenatchee Subbasin – Lake Wenatchee

Lake Wenatchee is a deep water lake (maximum depth of nearly 100 feet) that is fed by the Little Wenatchee River and the White River and discharges to the Wenatchee River. Four of the proposed acclimation sites discharge to this receiving water system. These include the Two Rivers site in the Little Wenatchee River and the Tall Timber, Gray, and Dirty Face sites in the White River.

Given the relatively large size of the lake and its associated long hydraulic retention period, it is unlikely that loads entering the lake will reach the Wenatchee River directly; instead, they are likely to be cycled within the lake. Therefore, the water quality impact of concern within the upper Wenatchee subbasin is Lake Wenatchee proper. The approach adopted here was to perform a mass balance analysis for phosphorus for the lake based on tributary flows and measured TP concentrations.

Flows estimated for the upper Wenatchee subbasin are shown in Figure 21. Flows for the outlet were estimated based on simple flow balance of gauged flows at the mouth of Nason Creek, the Wenatchee River at Plain, and the mouth of the Chiwawa River. TP data for Lake Wenatchee, the White River, and the Little Wenatchee River were based on Grant and Chelan PUD monitoring programs (Grant PUD 2009; Chelan PUD 2009 – unpublished data).

In addition, for the White and Little Wenatchee rivers, data collected under the project described herein were applied to construct the mass balance.

Figure 22 shows the estimated TP loads for the upper Wenatchee subbasin including the loads at the mouth of Lake Wenatchee. A comparison of flows in conjunction with the TP data shows a clear correlation—higher flows mobilize more phosphorus in the system. The data suggest that TP concentrations in the White River can be high (up to 50 µg/L), while background levels in the Little Wenatchee River did not reach such levels in 2009.

Figure 23 shows the estimated cumulative monthly TP loads that entered and exited the lake in 2009. The differences between the loads brought in by the inflows and the loads leaving the lake are shown in the bottom panel. As expected, the data suggest that the lake acts as a net sink of phosphorus loading from the tributaries. The lake is known to be oligotrophic and the tributaries that contribute to the lake are in forested watersheds with little to no anthropogenic influence. The TP loads brought in are typically associated with high flows (see Figures 21 and 22); much of it is from watershed and snowmelt runoff from forested lands (Chelan County and Yakama Nation 2004), which typically do not have readily bioavailable forms of phosphorus. The TP load entering the lake is therefore most likely dominated by non-reactive particulate forms. These likely settle upon reaching the lake. The lake thus buffers the upstream phosphorus loads and transmits only a fraction of the upstream loads to the Wenatchee River.

To estimate the combined impact of the four proposed locations, the total phosphorus loads anticipated from acclimation activity were calculated based on the proposed number of coho to be acclimated. Table 12 shows the relative contribution of the loads from combined acclimation activity in the White River and the Little Wenatchee River. In 2009, these loads were estimated to contribute less than 0.25% of the total background loads that entered the lake over the acclimation period (March through May) from these two tributaries. This calculation does not account for in-stream assimilation, which, if considered, would further reduce the relative contribution from acclimation activity.

Table 12
Estimated relative contribution of TP loads from 50 days of acclimation activity in upper Wenatchee sites

Location	No. of Fish	TP Loading from Acclimation[1] (kg)	TP Load In System[2] (kg)	Contribution to Total
Little Wenatchee River	120,000	1.92	604.50	0.32%
White River	160,000	2.56	1242.86	0.21%

Notes:

1. Uses an estimate of 0.32 mg/d/fish derived from active sites in Nason Creek, see Table 5
2. Loads calculated using 2009 flows and TP measurements from 3/23/2009 to 5/10/2009

kg kilograms

Based on this analysis, the proposed acclimation activity in the upper Wenatchee subbasin will produce TP loads that are sufficiently low as to not produce a measurable impact on the water quality of the tributaries and Lake Wenatchee.

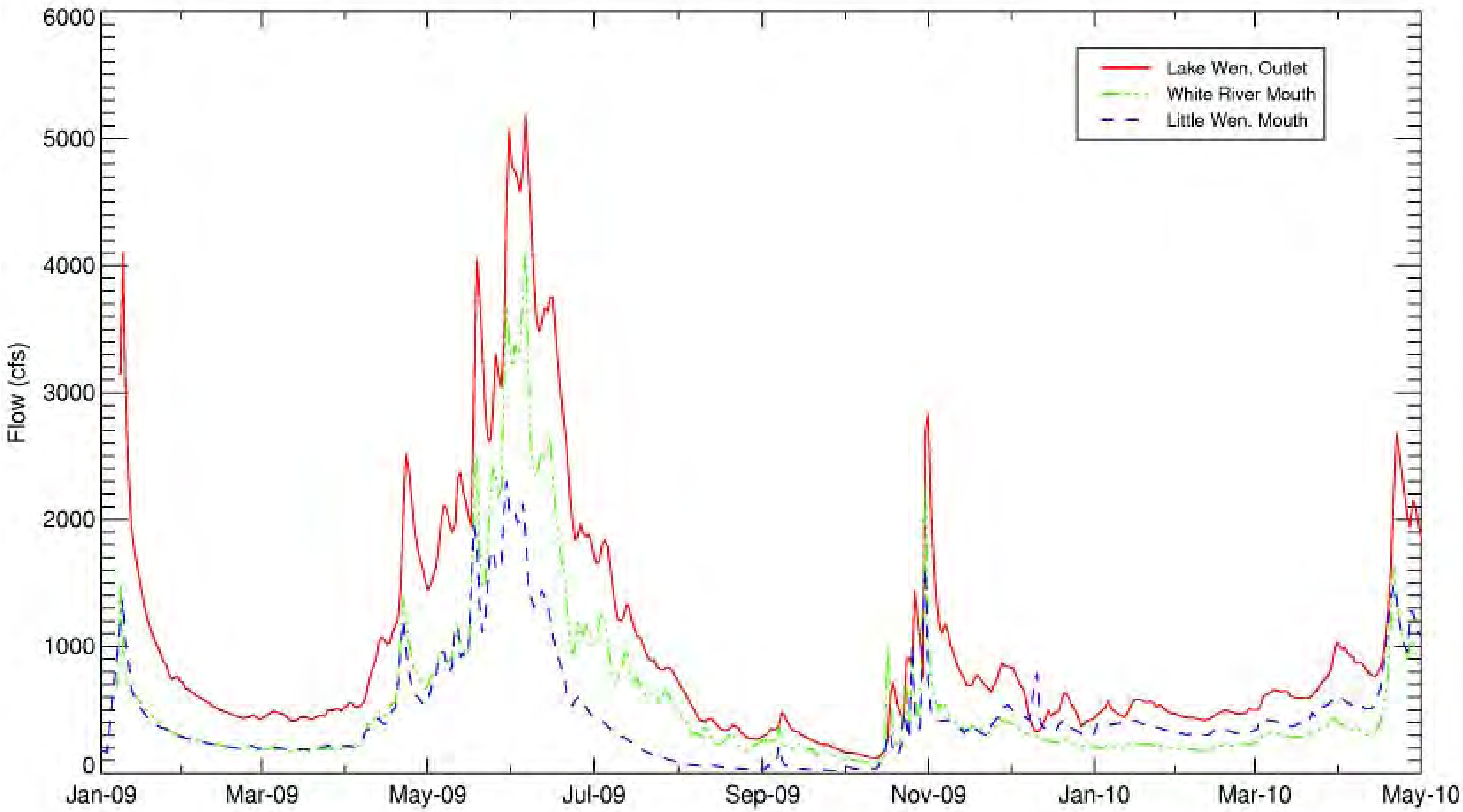

Figure 21

Streamflows in the upper Wenatchee subbasin in 2009 and 2010

Flows at lake outlet estimated from WDOE gage at Nason Creek mouth, and USGS gauges at Wenatchee River at Plain and Chiwawa at Plain

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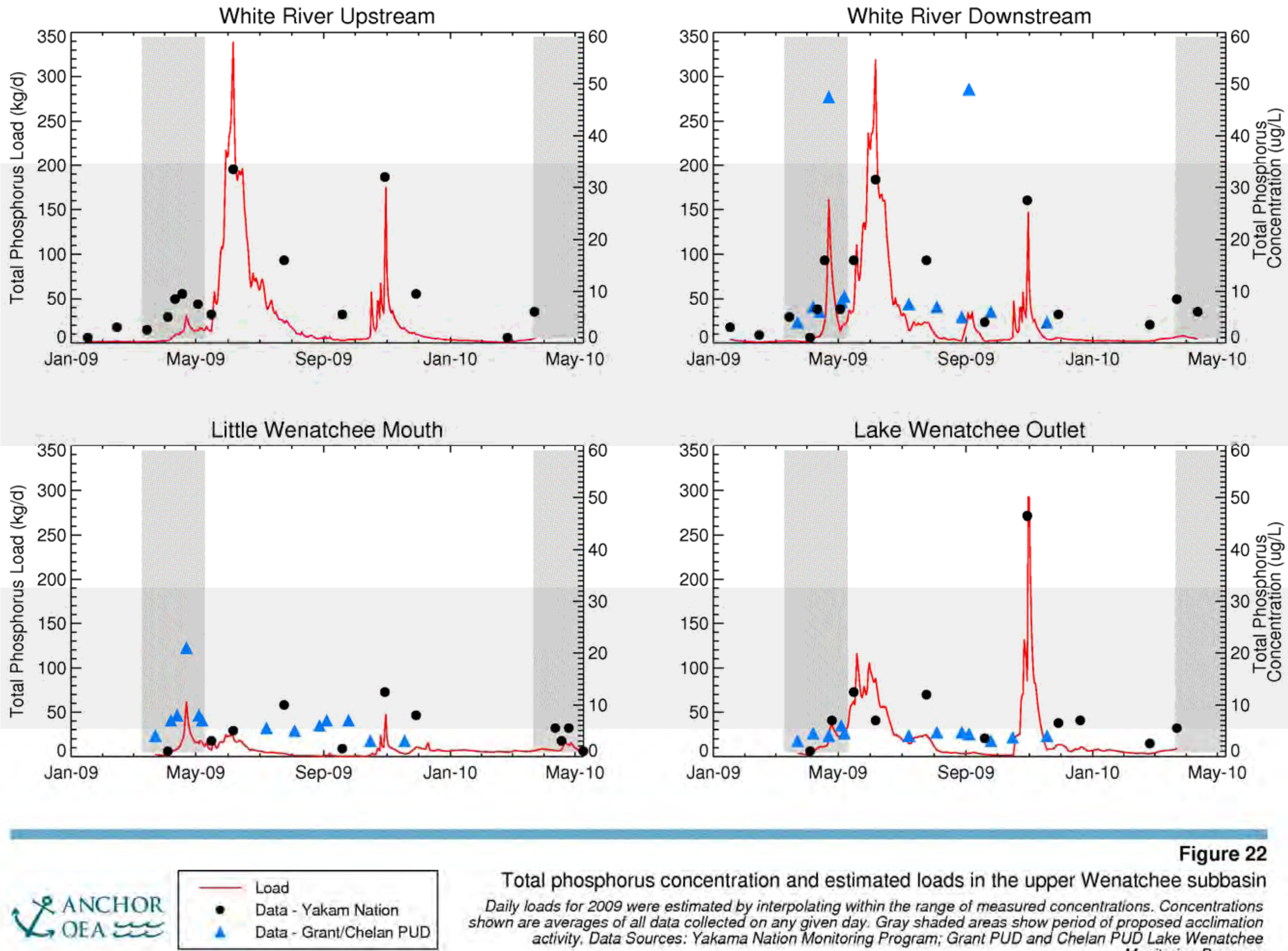

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Figure 22

Total phosphorus concentration and estimated loads in the upper Wenatchee subbasin

Daily loads for 2009 were estimated by interpolating within the range of measured concentrations. Concentrations shown are averages of all data collected on any given day. Gray shaded areas show period of proposed acclimation activity. Data Sources: Yakama Nation Monitoring Program; Grant PUD and Chelan PUD Lake Wenatchee Monitoring Programs

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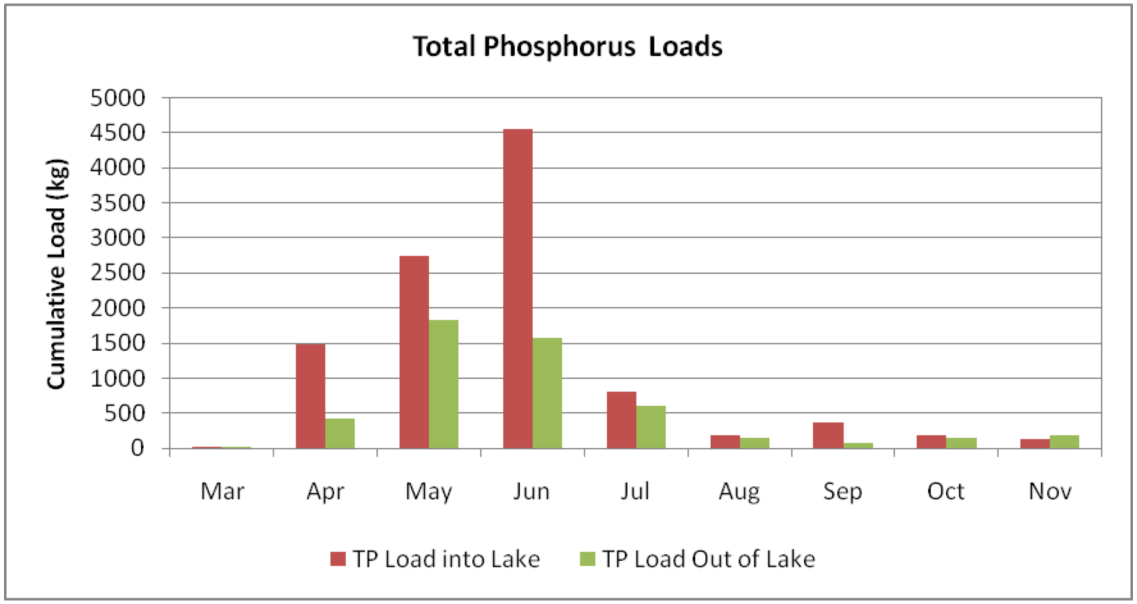

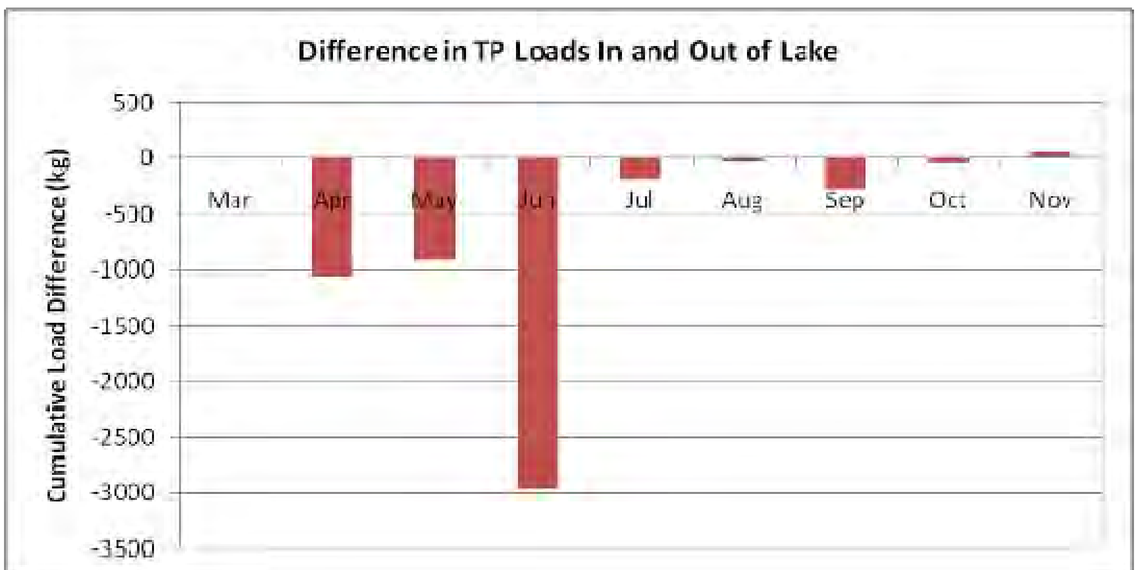

Figure 23
Monthly TP loads entering and leaving Lake Wenatchee in 2009
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5.3.2 Lower Wenatchee Subbasin – Wenatchee River

5.3.2.1 Approach for Adopting WDOE's Model

The WDOE TMDL model that was used to determine the Wenatchee River and Icicle Creek phosphorus load allocations (Carroll and Anderson 2009) was applied with minimal changes to assess the potential impacts of the proposed acclimation sites on water quality within the lower Wenatchee subbasin. Changes to the model focused on representing boundary conditions for the month of March. As discussed in Section 5.1, 7Q10 low-flow conditions were used for headwater and all tributaries without modification from the WDOE TMDL model. The simulation was setup to represent March 23 (near the spring equinox), so that photoperiod was approximately equal to that used by WDOE for development of the TMDL which simulated the autumnal equinox period (September 23). Model parameters (e.g., reaction rates, stoichiometric coefficients, etc.) remained unchanged from those applied by the WDOE for the TMDL. Finally, nutrient loads, with the exception of those pointed out in the subsequent sections, were applied unchanged.

Forcing functions applied to the model reflected climatic conditions for the month of March. Long-term March air temperature readings were obtained from National Ocean and Atmospheric Agency's (NOAA's) meteorological station in Leavenworth, Washington. Based on the daily minimum and maximum temperatures recorded for the month of March, a sinusoidal function was developed to capture the diurnal variations (see Figure 24). This function was assumed to be representative of the entire domain from the mouth of Lake Wenatchee to the confluence with the Columbia River. A similar approach was adopted in the WDOE TMDL model. Dew point temperature was estimated from the temperature function in Figure 24, and the relative humidity values were estimated from the WDOE TMDL model. This approach was adopted due to a lack of dew point temperature data for the month of March.

Water temperature is also significantly colder in March compared to summer conditions. A temperature function was developed for the headwater to encompass the range of temperatures measured at the mouth of Lake Wenatchee and in the Wenatchee River in the month of March (see Figure 25).

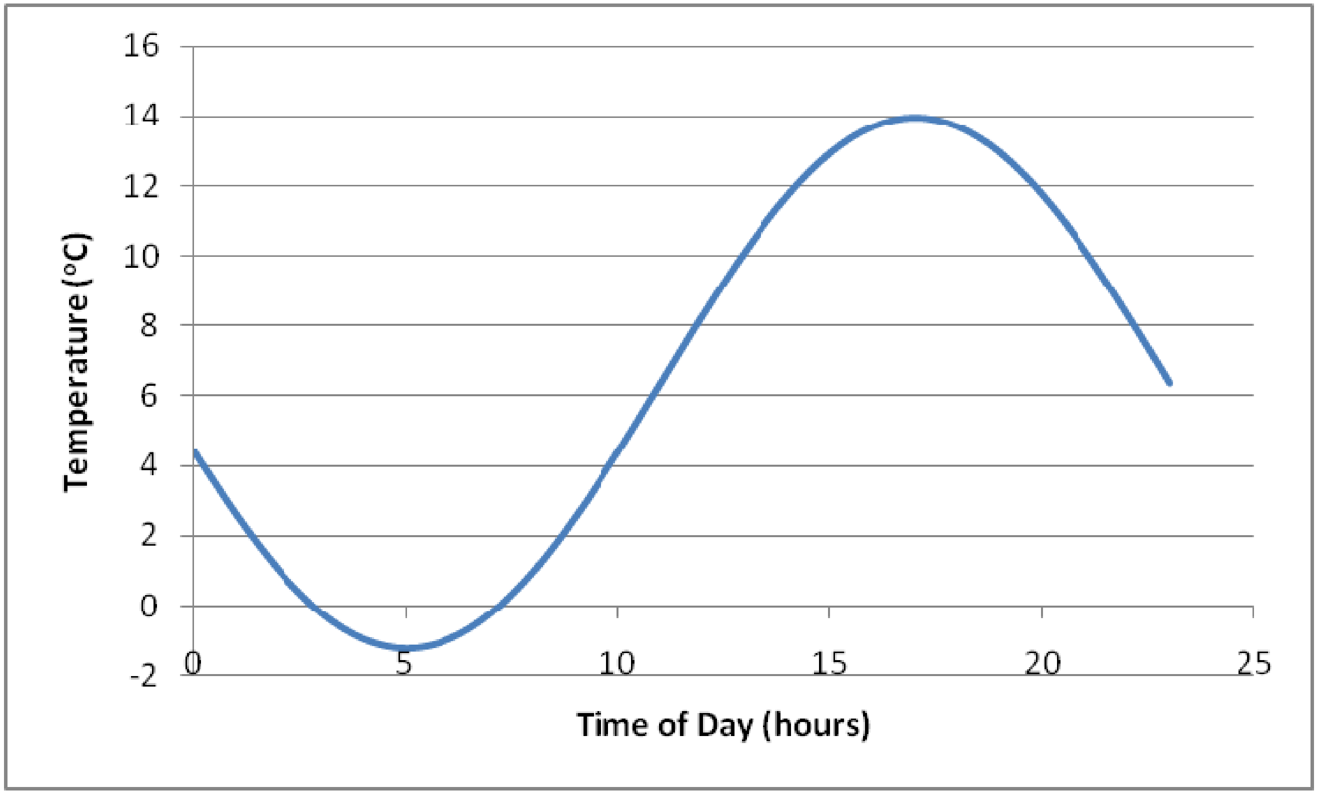

Figure 24
Air temperature function for QUAL-2K model
Discharge Evaluation Appendix
Mid-Columbia Coho Restoration Project

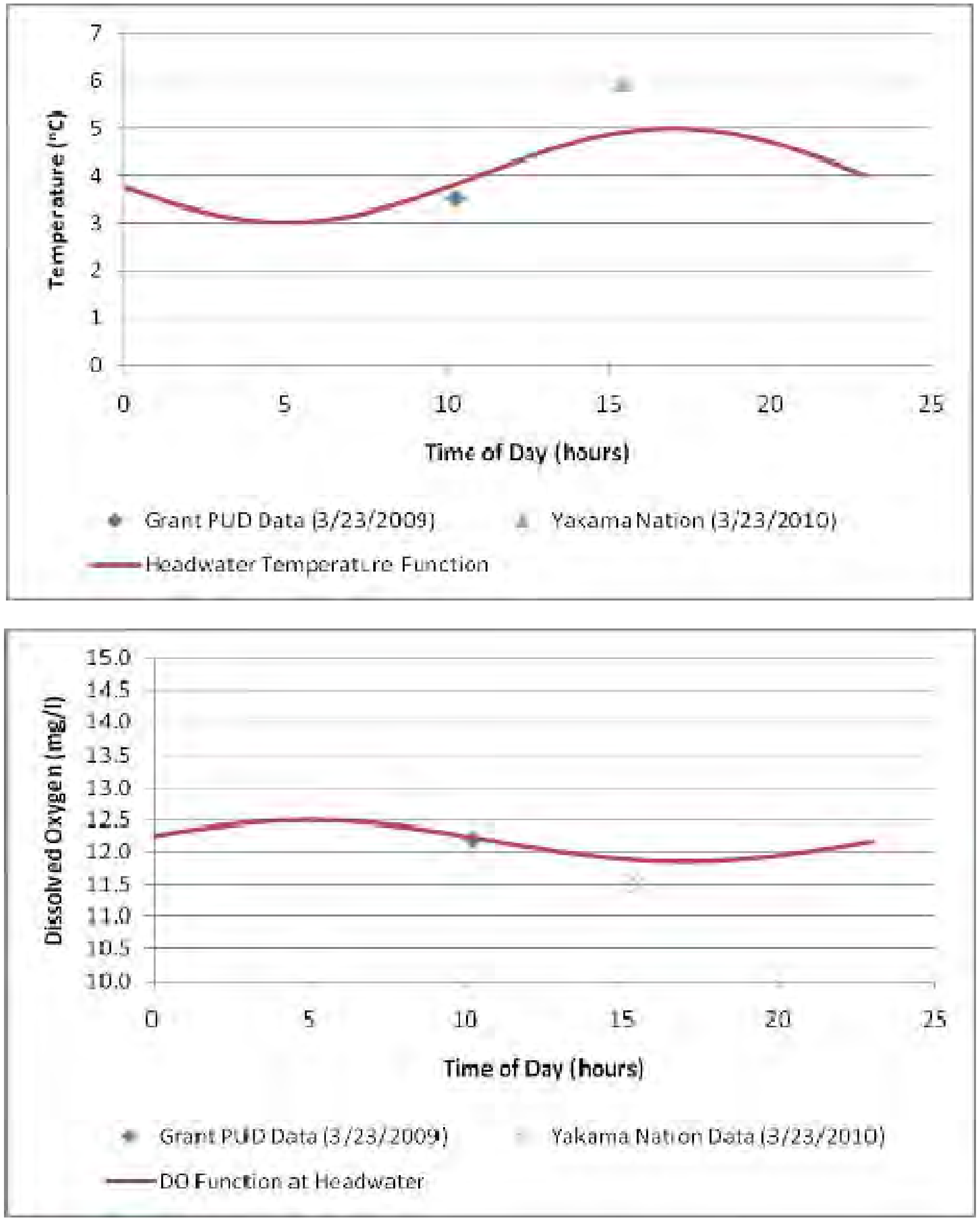

Figure 25
Water temperature and dissolved oxygen functions specified at the mouth of Lake Wenatchee
for the QUAL-2K model for March conditions
Discharge Evaluation Appendix
Mid-Columbia Coho Restoration Project

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Temperatures for tributaries and groundwater inflows for the month of March were estimated using the headwater temperature and the ratio of respective tributary/groundwater source temperature to the headwater temperature available in the WDOE TMDL model.

DO was assumed to be at saturation for the headwater and all other inflows. It was estimated from the water temperature and river elevation. Figure 25 shows the DO function specified in the QUAL-2K model at the mouth of Lake Wenatchee along with observations from March 2009 and 2010.

5.3.2.2 Determination of Background Conditions in March

Due to the differences in some of the boundary conditions as described previously, the upper bound in natural conditions developed for the summer period as represented in the WDOE TMDL model cannot be used as the basis for evaluation of potential impacts of the acclimation sites. Hence, new background water quality conditions were established by simulating the model with the changes described above, but without introducing any loads from the proposed acclimation sites. The term "background conditions" is used to describe this simulation, rather than WDOE's terminology of "maximum natural conditions," to emphasize that the conditions simulated here are representative of critical conditions expected to occur in March during operation of the acclimation ponds and not the summer critical period in the TMDL evaluation.

Figure 26 compares the differences in summer (WDOE TMDL) and March background simulations. Model results indicated that temperature is the primary driver of water quality in March. DO levels generally reflected saturation conditions for the range of water temperatures simulated in March. Diurnal pH variations were generally smaller in March, likely a result of depressed biological activity and temperature (higher water temperature stimulates biological activity and reduces the solubility of carbon dioxide and oxygen). TP variations were similar between the two periods, with the summer model showing slightly lower TP in the lower reaches which correlated well with bottom algae levels (not shown) and suggests stimulated biological activity in summer (and hence higher use of phosphorus).

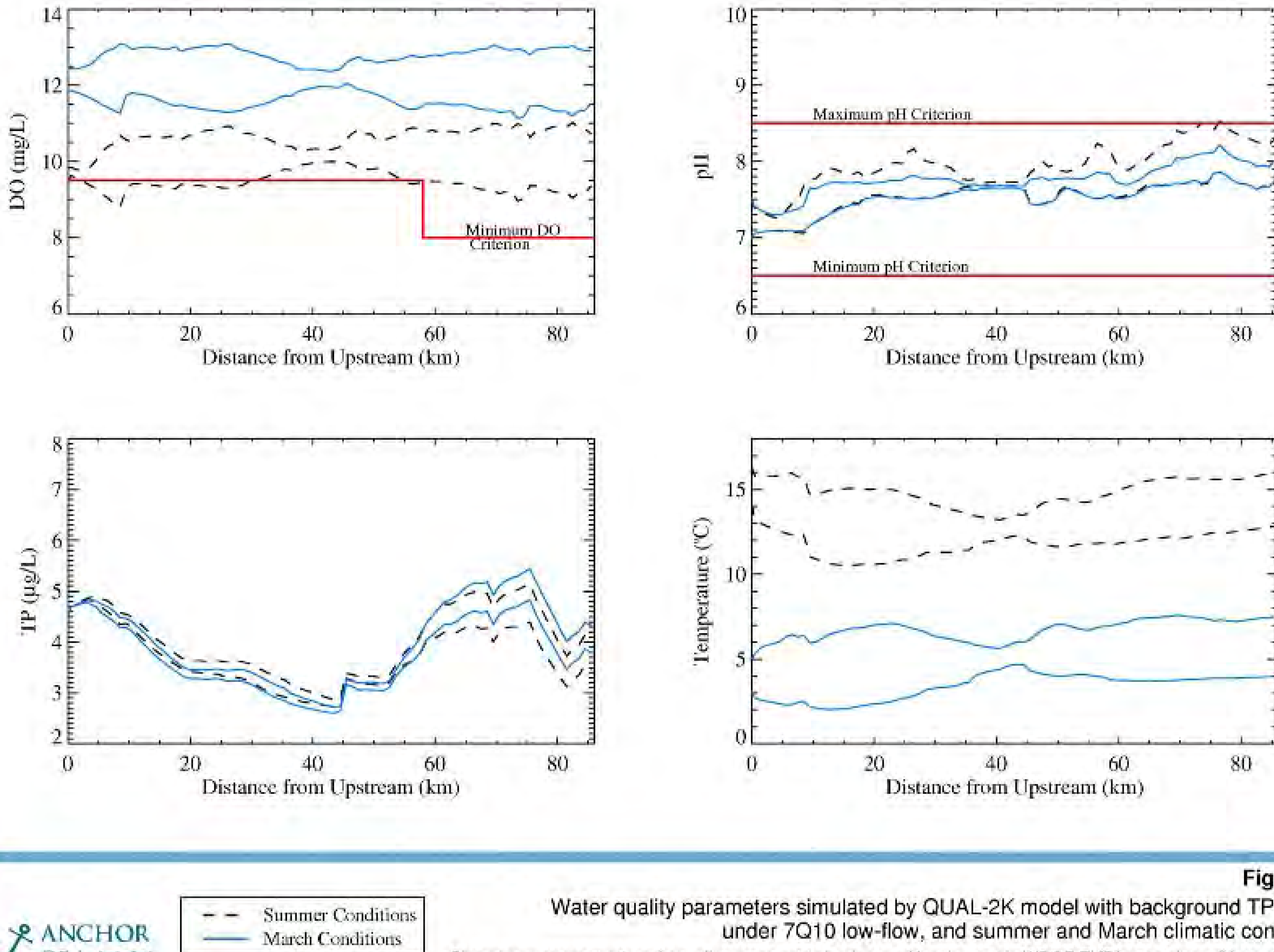

Figure 26

Water quality parameters simulated by QUAL-2K model with background TP loads under 7Q10 low-flow, and summer and March climatic conditions

Phosphorus concentrations from all sources set to background levels used in WDOE TMDL natural conditions simulation
Minimum and maximum values simulated by the model are shown

5.3.2.3 Estimation of Nutrient Loads for Assessing Combined Impacts

To assess the combined impacts, TP loads were estimated for the active sites (Table 5) and proposed sites (Table 6). Dryden Hatchery inputs determined for the month of March (see Table 8) were also used. The estimated TP loads from the discharges were included with the background orthophosphate load in the model. The final orthophosphate concentrations were calculated using the flows used in the model and the combined load estimate. The calculations are summarized in Table 13.

Even though a separate analysis was presented in Section 5.2.1 for upper Wenatchee subbasin sites in White River and Little Wenatchee River, and given that Lake Wenatchee will buffer TP loads originating from the upper subbasin sites, discharges from these sites were represented in the model as being 100% available at the outlet of Lake Wenatchee. Hence, these assumptions provide an upper bound estimate of the potential impacts in the Wenatchee River. As with the background conditions simulation, nutrient inputs from POTWs were not considered (see the introduction in Section 5 for definition of combined impacts). Other model inputs remained unchanged from the March background conditions simulation. As pointed out in Section 5.1, phosphorus loads were represented in the model as being available for biological uptake and were assumed to discharge to the Wenatchee River proper without any assimilation in the receiving tributary.

5.3.2.4 Model Predictions

Figure 27 presents model-predicted flows as compared to March background conditions. Differences in flow between the two simulations were imperceptible because acclimation-related inflows were predominantly derived from natural inputs that contribute to the Wenatchee system under background conditions. Moreover, Dryden Hatchery inflows were relatively too minor to substantially alter flows in the system.

Table 13
Estimation of inorganic phosphorus concentration for acclimation impacted point sources in the Wenatchee subbasin

Source[1]	Station ID	River Kilometer	Flow (m^3/s)	Natural Conditions Orthophosphate[2]		TP Load due to Acclimation Activity (g/d)	Combined Orthophosphate	
				Concentration (µg/L)	Load (g/d)		Load (g/d)	Concentration (µg/L)
Upper Wenatchee Subbasin Loads[3]	--	0	4.616	1.50	598.2	89.6	687.8	1.72
Nason Creek Sites[4]	45NC00.7	0.5	0.655	4.55	257.4	67.2	324.6	5.74
Chiwawa Sites	45CW00.5	9.1	2.039	3.90	687.0	112.0	799.0	4.54
Beaver	45BC00.1	12.2	0.051	4.70	20.8	32.0	52.8	11.92
LNFH - Icicle Creek	45IC00.1	45.9	1.214	4.70	492.9	32.0	524.9	5.01
Chumstick	45CS00.1	49.4	0.066	4.70	26.9	20.8	47.7	8.33
Dryden[5]	--	59.0	0.010	--	--	6.7	6.7	7.74
Brender	45BR00.1	70.8	0.187	4.70	75.9	16.0	91.9	5.69

Notes:
1. See Table 6 for a list of proposed sites in the Wenatchee subbasin and the estimated TP loads from these sites.
2. Loads estimated from flows and concentrations specified for natural conditions QUAL-2K model simulation in WDOE TMDL (Carroll and Anderson 2009).
3. Loads from the White and Little Wenatchee River sites were assumed to enter the Wenatchee River at the mouth of Lake Wenatchee.
4. Includes loads from the Coulter site in addition to Rohlfing and Butcher ponds (see Table 2 in Appendix 2 for number of fish at each site).
5. Estimated TP loads from proposed Dryden Hatchery for the month of March (see Table 8).

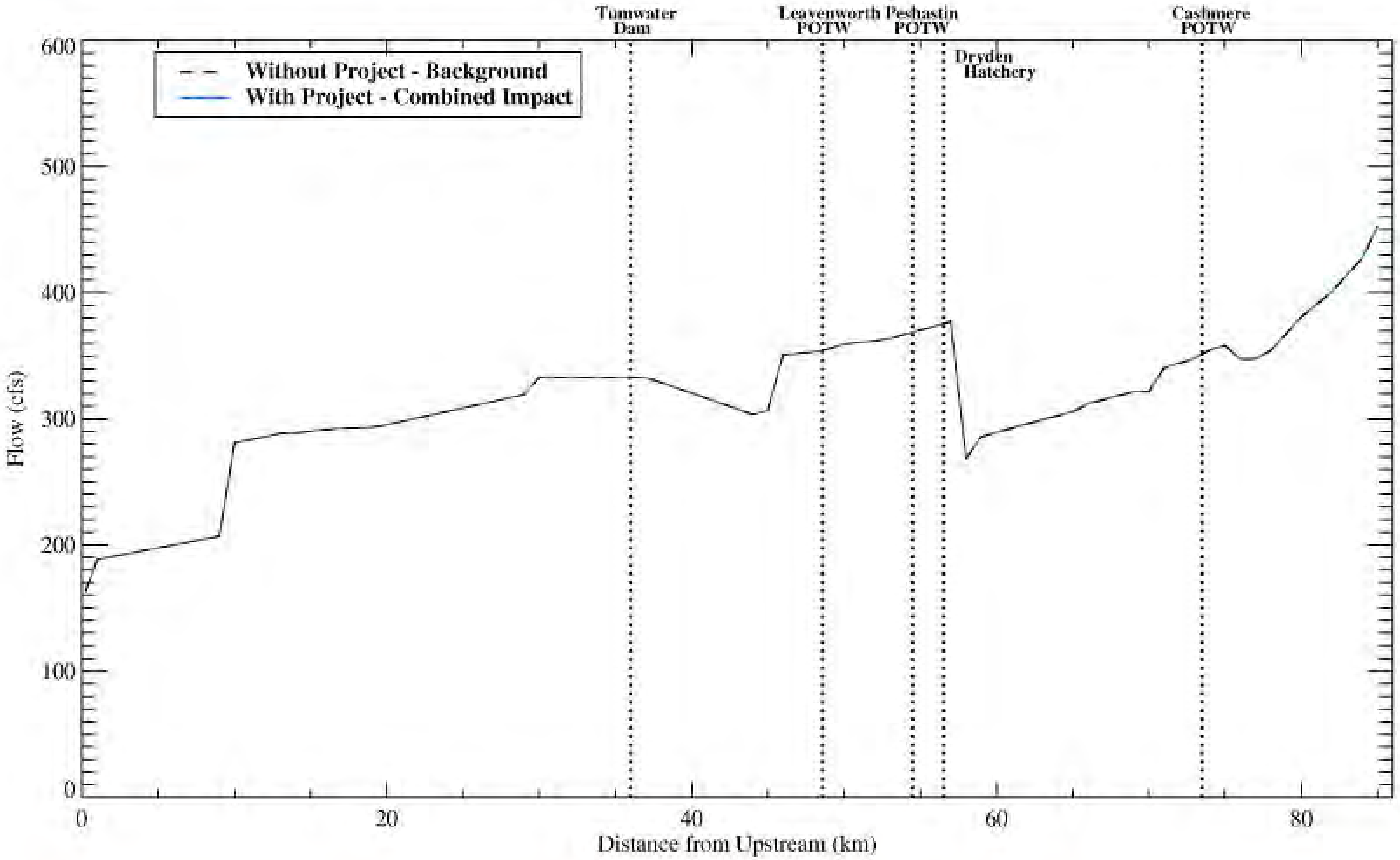

Figure 27

Flows simulated by QUAL-2K model shown compared for cases with and without the proposed project for 7Q10 low-flow and March climatic condition with maximum background loadings determined in WDOE TMDL

Phosphorus concentrations from all sources set to background levels used in WDOE TMDL natural conditions simulation

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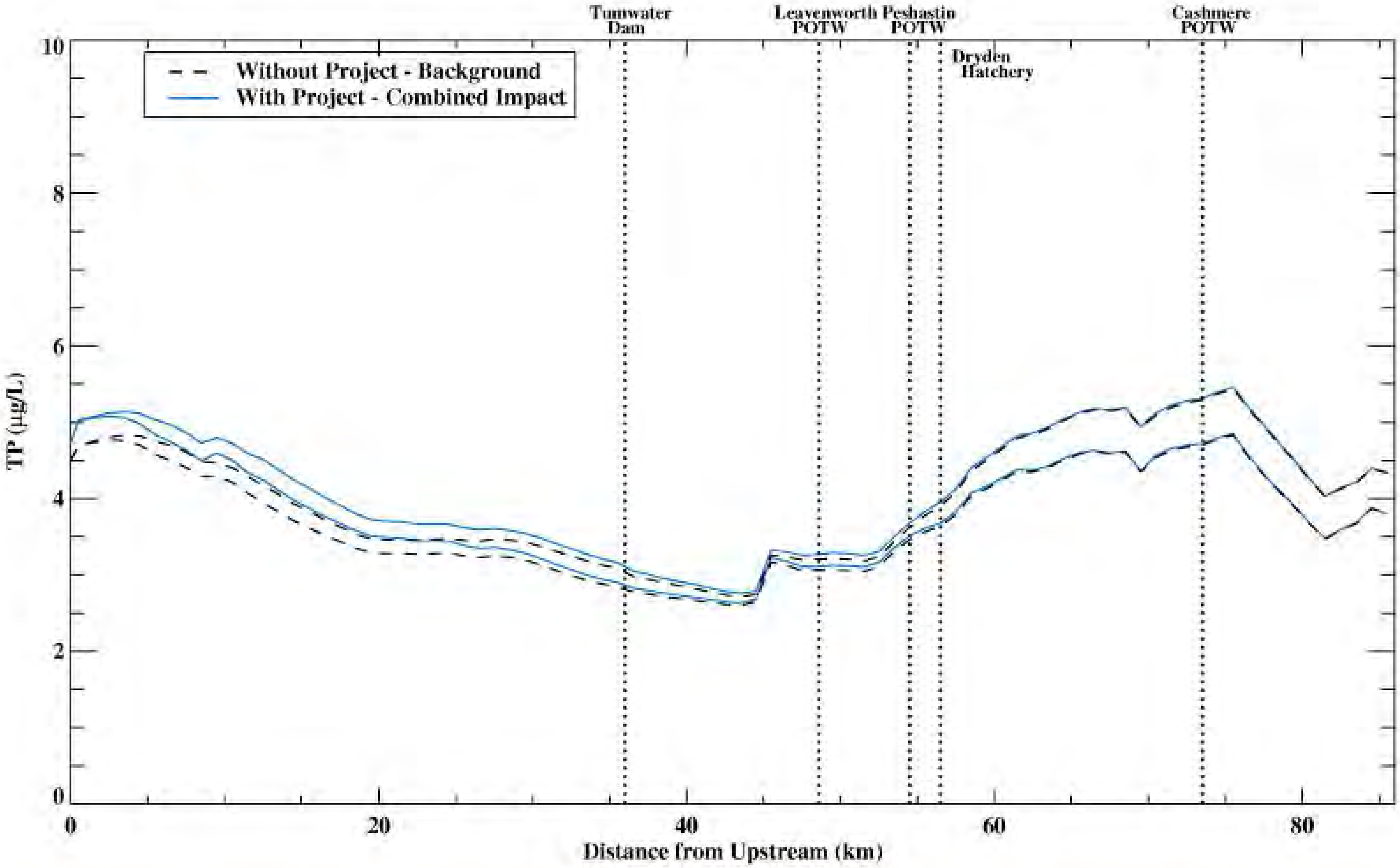

Figure 28

Total phosphorus concentrations simulated by QUAL-2K model shown compared for cases with and without the proposed project for 7Q10 low-flow and March climatic condition with maximum background loadings determined in WDOE TMDL

Phosphorus concentrations from all sources set to background levels used in WDOE TMDL natural conditions simulation
Minimum and maximum values simulated by the model are shown

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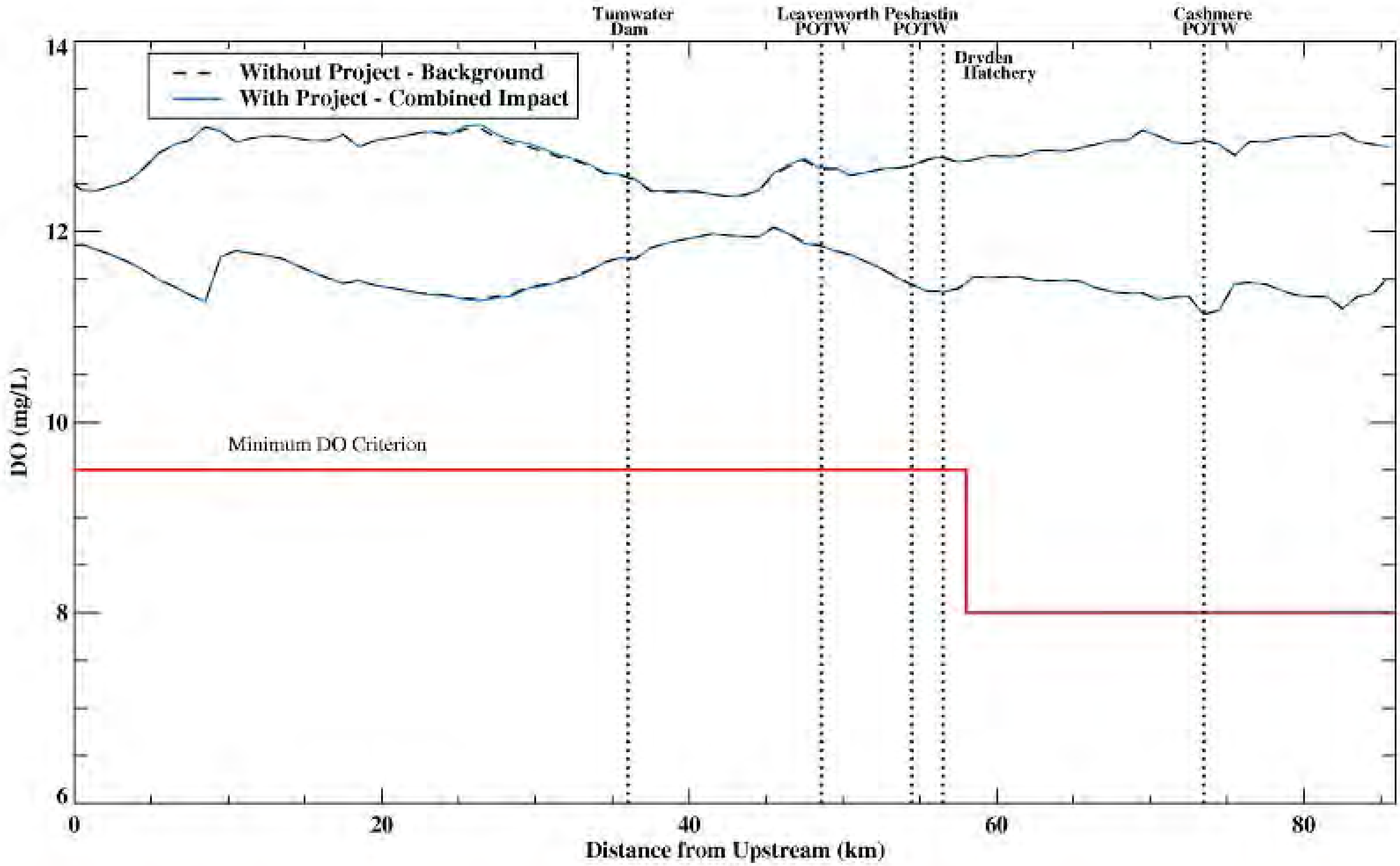

Figure 29

Dissolved oxygen concentrations simulated by QUAL-2K model shown compared for cases with and without the proposed project for 7Q10 low-flow and March climatic condition with maximum background loadings determined in WDOE TMDL

Phosphorus concentrations from all sources set to background levels used in WDOE TMDL natural conditions simulation
Minimum and maximum values simulated by the model are shown

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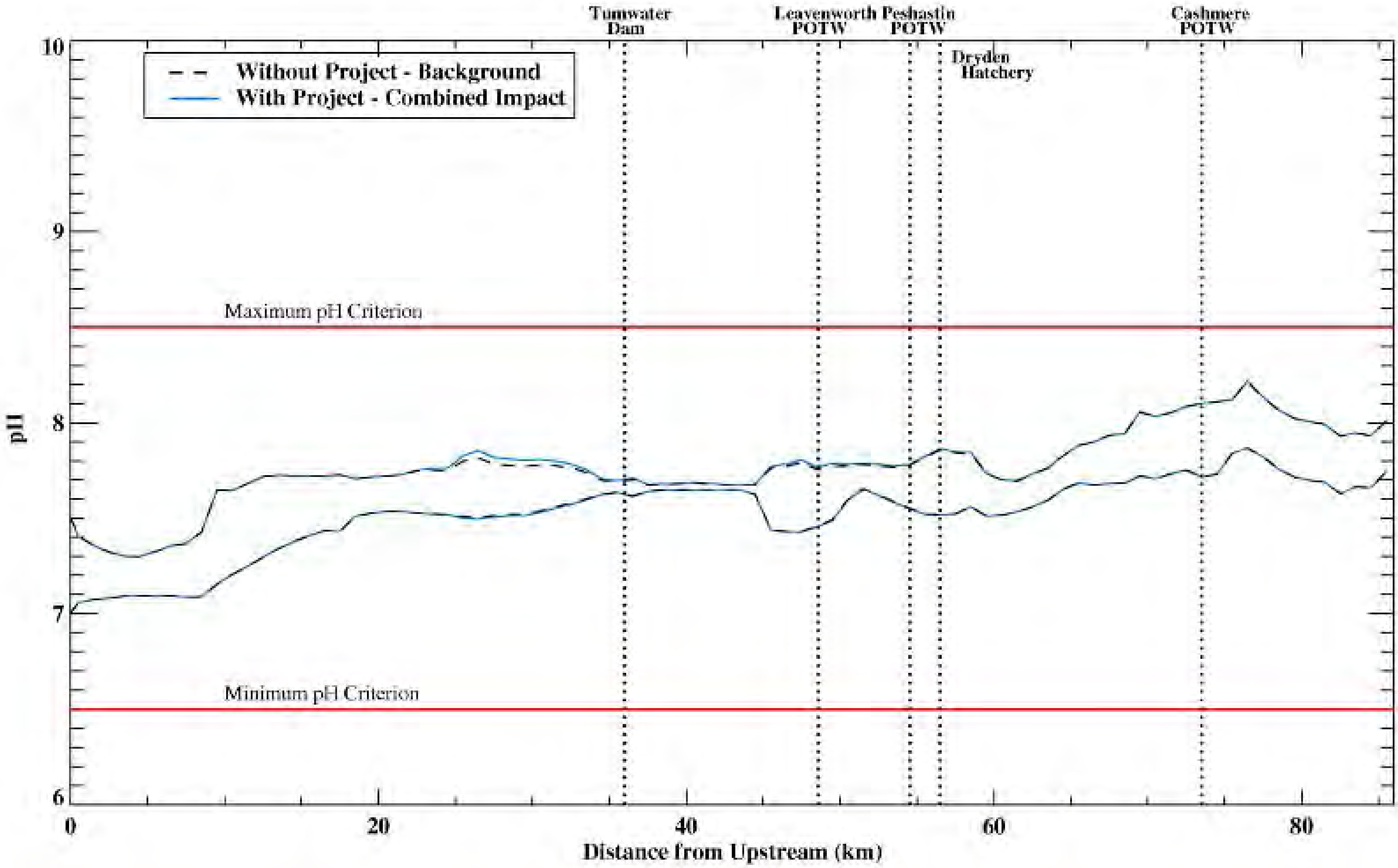

Figure 30

pHs simulated by QUAL-2K model shown compared for cases with and without the proposed project for 7Q10 low-flow and March climatic condition with maximum background loadings determined in WDOE TMDL

Phosphorus concentrations from all sources set to background levels used in WDOE TMDL natural conditions simulation
Minimum and maximum values simulated by the model are shown

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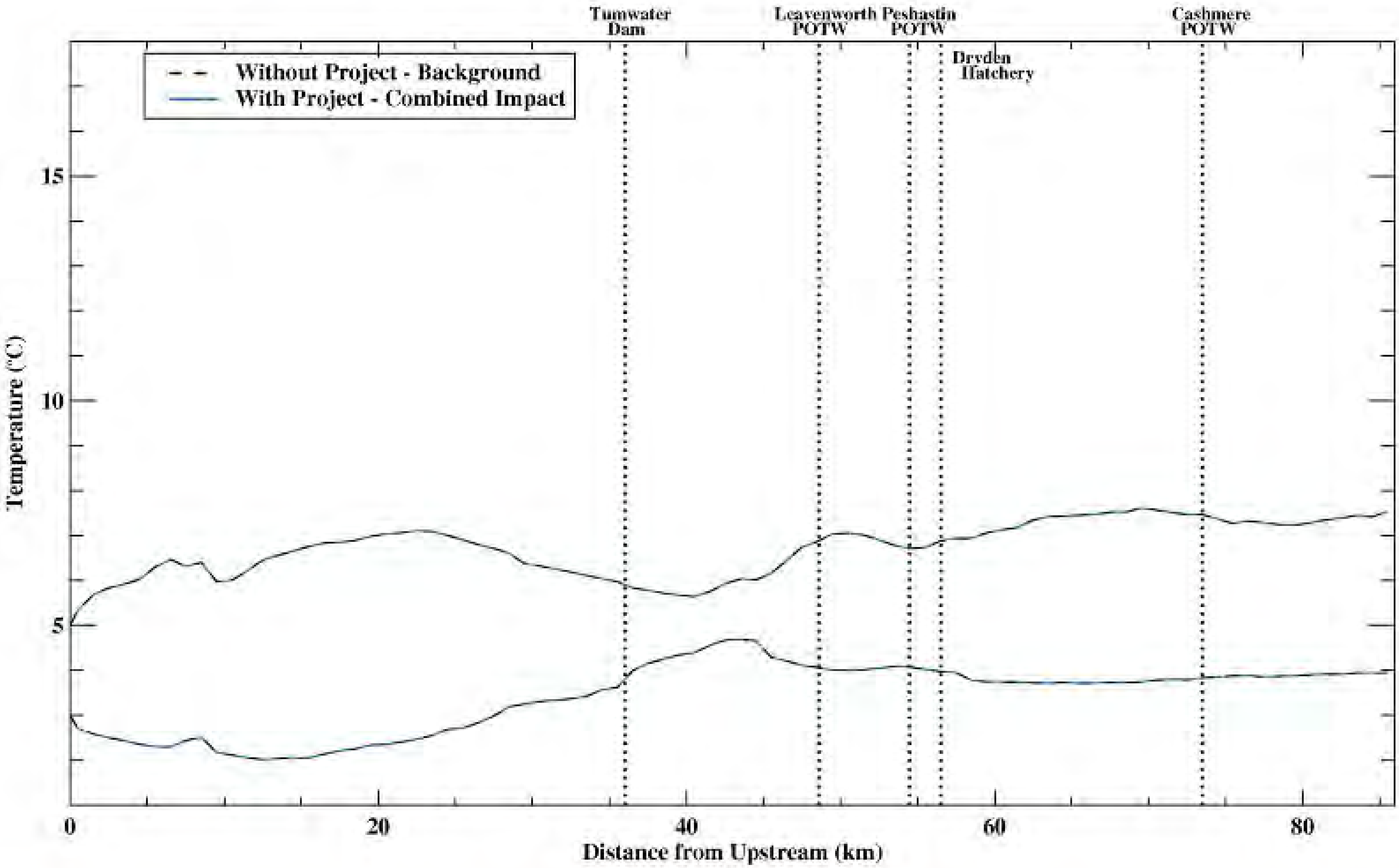

Figure 31

Temperatures simulated by QUAL-2K model shown compared for cases with and without the proposed project for 7Q10 low-flow and March climatic condition with maximum background loadings determined in WDOE TMDL

Phosphorus concentrations from all sources set to background levels used in WDOE TMDL natural conditions simulation
Minimum and maximum values simulated by the model are shown

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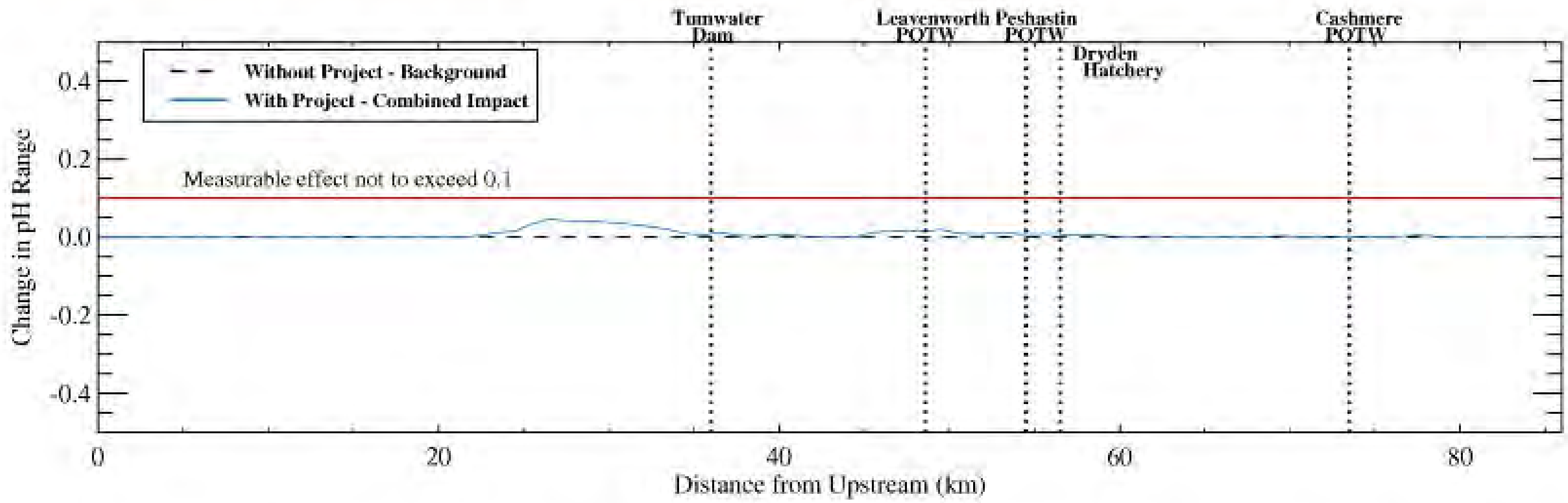
TP predictions for combined impacts are presented and compared to background conditions in Figure 28. TP is higher in the upper reaches (upstream of Leavenworth) and declines steadily after an initial increase. The increase in the first 10 kilometers of the river reflects inputs from the Nason Creek, the upper Wenatchee subbasin, and the Chiwawa River sites. Much of the phosphorus appears to be assimilated around RKM 27, which is upstream of Tumwater Canyon. In this stream reach, lower simulated flows provide habitat for bottom algae whose growth was elevated relative to the simulated values for background conditions in this reach.

Differences in the range of DO simulated with and without the project-related loads are negligible (see Figures 29 and 32; the maximum difference is less than 0.1 mg/L). The daily minimum DO is well above the water quality threshold for DO. These results indicate that in the absence of other nutrient sources, the project alone is not expected to adversely impact DO resources within the Wenatchee River.

The range of pH with the project is generally equal to the range simulated for the natural conditions (Figure 30). At approximately RKM 27, the upper bound of the pH appears to be somewhat higher than the pH simulated for background conditions. This is a consequence of the higher algal levels simulated in this reach over background conditions, as discussed above.

Finally, there is no appreciable difference in the range of the temperature simulated with and without the project loads (Figure 31).



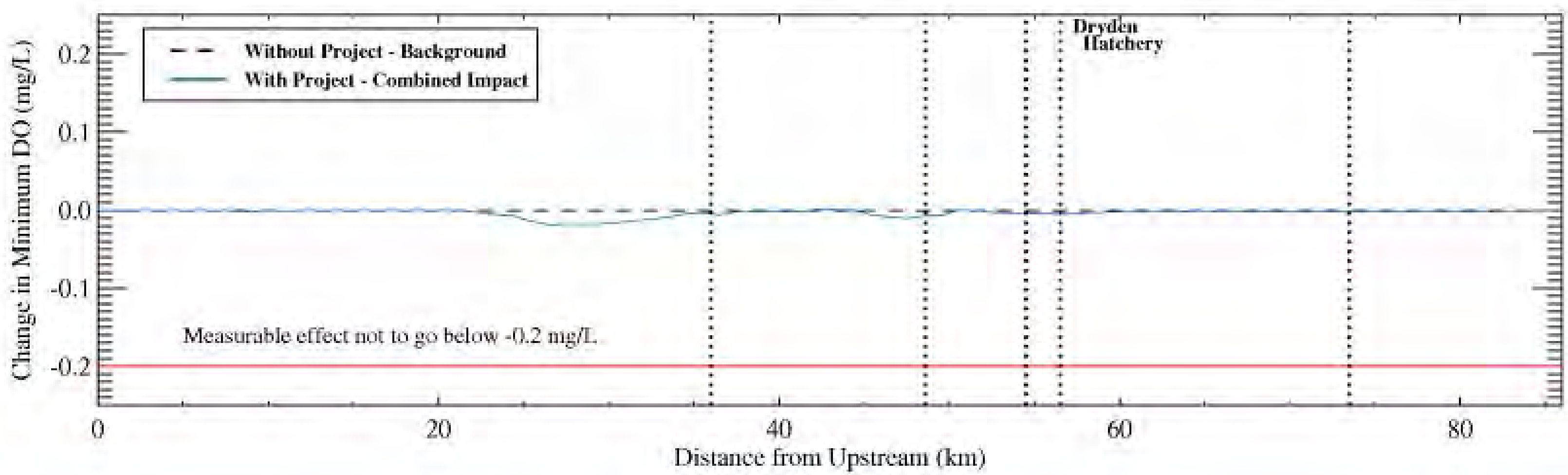


Figure 32

Difference from March background conditions in the range of pH and minimum dissolved oxygen with and without the proposed project in the Wenatchee subbasin

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5.3.2.5 Determination of Significance of Impacts

The measurable change criterion defined in Section 2.2 was applied as the basis for assessing the QUAL-2K model outputs and determining potential water quality impacts of the proposed project. The difference in the range of pH evaluated against the measurable change criterion of 0.1 unit is presented in Figure 32. The model simulations are generally well below the criterion. The minor increase in the difference in range near RKM 27 can be attributed to induced biological activity associated with project loads. Nonetheless, these increases were well below the criterion. Moreover, Figure 32 also shows that the DO concentrations simulated by the model do not produce any deficit that exceeds 0.2 mg/L. The only deviation from the background conditions appears to be at RKM 27 and is associated with algal activity.

The spatial differences in TP, DO, and pH simulated by the model with and without the loads from the proposed project show that the majority of the phosphorus load from the project enters in the upstream reaches and much of it is assimilated in the Wenatchee River prior to entry into the lower reaches (below the city of Leavenworth). Collectively, these results indicate that even under the extreme flow and extreme project-related loading conditions simulated here, the proposed project will not adversely impact water quality. The model simulations presented herein have demonstrated that the maximum predicted impact from the proposed project, including discharges from the proposed hatchery at Dryden, is so small as to be undetectable.

5.3.3 Methow Subbasin

The sparsely populated Methow subbasin[3] has very little anthropogenic impacts upstream of the city of Winthrop (Ely 2003). Even between Winthrop and Pateros, the subbasin is sparsely populated[3]. Konrad et al. (2003) concluded, based on an analysis of water quality data collected throughout the subbasin, that anthropogenic impact is generally low. The major anthropogenic sources within the subbasin are the Twisp and Winthrop POTWs and WNFH.

Figure 33 shows TP loads calculated at the city of Pateros for the months of March, April, and May, and the overall average loads for this period based on data collected by WDOE from 2005 to 2009. These TP loads represent the cumulative loads from the entire subbasin. As with the Wenatchee subbasin, the loads generally followed the flow (compare to Figure 20) with peaks in May that were much larger than March and April. The average TP load over the 3-month period was estimated at approximately 36 kg/d.

[3] Population of less than 5000, based on 2000 census.

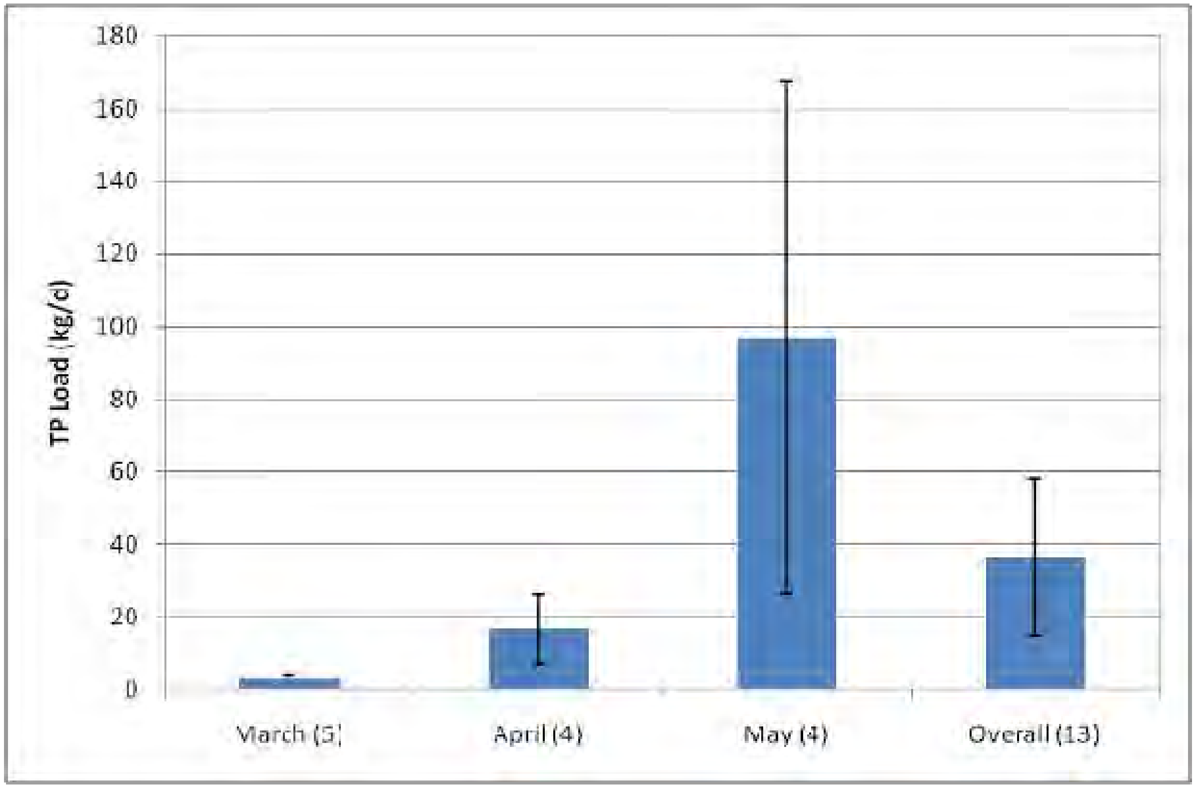

Figure 33
TP loads in the Methow River calculated at the city of Pateros
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In order to estimate the combined impact of the proposed project, the TP loads from POTWs were separated out of the overall loads to provide an estimate of background conditions. Based on discharge monitoring reports (DMR), the average daily loads from the POTWs were estimated and subtracted out of the average loads calculated for the Methow River at Pateros. A DMR was not available for WNFH. Thus, the loads from this facility could not be differentiated.

Acclimation activity may contribute about 0.9% of the average background loads (Table 14). Noting that loads from WNFH and other minor point sources were not included, this is likely an underestimate of the relative contribution of the acclimation activity loads.

There is some incongruence in the overall analysis because DMR data from fall were used for estimation of the loads due to lack of data for spring periods. Loads from municipal POTWs generally do not show strong seasonal variability. Moreover, subbasin flows in October through February are generally comparable to flows in early spring (see Figure 20). Thus, loads estimated for POTW presented herein, while seemingly inexact, are meaningful for the analysis performed.

In order to determine the veracity of the calculations for Methow subbasin, a similar loading calculation was performed for the Wenatchee subbasin (see Table 15), where point source discharge data were available for spring, and a comparison between the two subbasins was performed. Major point source loads were estimated for April 2003 based on point source measurements reported in WDOE TMDL appendices (Carroll et al. 2006). TP loads were estimated for the Wenatchee subbasin based on paired flow and TP measurements for the WDOE station at Wenatchee for the month of April 2003. An estimate of the background loads for the Wenatchee subbasin was obtained by subtracting the major point source loads from the subbasin loads (Table 15). Once the anthropogenic influences were subtracted from the loads, the background load at the downstream reaches of either subbasin is comparable (about 35 kg/d for Wenatchee and 39 kg/d for Methow).

The relative contribution for the Wenatchee subbasin sites relative to the background load is approximately 1.5%. This is higher than the Methow subbasin estimate of 0.9%. This difference is expected because a larger number of fish are proposed for acclimation in the Wenatchee subbasin (about 1.155 million versus 1 million in Methow) and because of the contribution of TP loads from the proposed year-round rearing activities at the Dryden Hatchery in the Wenatchee subbasin.

Table 14
TP loads estimated for the Methow subbasin with and without POTW loads

Source	TP Load (kg/d)
Methow River at Pateros[1]	39.20
Twisp POTW[2]	1.30
Winthrop POTW[3]	0.58
Estimated Background Load	37.31
Acclimation Activity Loads[4]	0.32

Notes:
1. Average over March - May calculated from paired TP and flow data collected respectively by WDOE (48A070) and USGS (12449950) in the Methow River at Pateros in 2005 through 2009.
2. Based on NPDES discharge monitoring report information from October 2009 through February 2010.
3. Based on NPDES discharge monitoring report information from November 2009.
4. Sum of the loads estimated for the individual sites in Table 9.

Table 15
TP loads estimated for Wenatchee subbasin with and without point source contributions

Source	TP Concentration (mg/L)	Average Flow (cfs)	Load (kg/d)
Lake Wenatchee POTW[1]	2.850	0.020	0.139
Leavenworth POTW[1]	2.260	0.440	2.433
LNFH - Main Outfall[2,3]	0.015	34.534	1.225
Peshastin POTW[1]	7.050	0.050	0.862
Dryden POTW[2,5]	4.170	0.030	0.306
Cashmere POTW[1]	2.330	0.680	3.876
Non-contact Cooling Water[6]	--	--	0.020
Total Point Source Loads	--	--	8.862
TP Loads from Acclimation Activity[7]	--	--	0.376
TP loads for Wenatchee River at Wenatchee[8]	0.0043	3280	34.507
Background Loads[9]	--	--	25.644

Notes:
1. TP concentration reported for composite samples from April 2003 were used.
2. Composite values were not reported. Values reported for grab samples from April 2003 were used.
3. Paired flow for April 2003 not available. Flows represent average of monthly average flows for April reported in DMR from 2006 to 2010.
4. TP measurement was not reported in WDOE TMDL study. Orthophoshpate values from April 2003 were used.
5. Paired flow not available. Design flow used in WDOE TMDL study is used here.
6. Critical period loads used in WDOE TMDL used here.
7. Sum of acclimation loads estimated in Table 13 and estimated April TP load for proposed hatchery in Dryden (see Table 8).
8. April 2003 data reported for Wenatchee River at Wenatchee WDOE station (45A070).
9. Background loads estimated as difference between TP load at Wenatchee and total point source loads.

This analysis suggests that the background conditions in the two subbasins are comparable. Furthermore, loads from the proposed project contribute to a smaller proportion of the background phosphorus loads in the Methow subbasin.

Mechanistic modeling for the Wenatchee subbasin suggests that even for critical conditions, acclimation-related nutrient loads are not expected to produce a measurable change in DO and pH (see Section 5.3.2.5). Based on the analysis in this section and considering the similarities between the two subbasins (see Section 5.1.2), it is concluded that, in the absence of anthropogenic sources, the TP loads introduced to the Methow subbasin from this project are unlikely to produce a measurable change (as defined in Section 2.2.1) in DO and pH.

5.3.4 The Effect of Seasonal Flow Patterns on Combined Impacts

The timing of acclimation nutrient discharges, in relation to annual subbasin flow patterns, is important to the evaluation of combined project impacts on water quality. The Wenatchee and Methow rivers have peak average flows in early June (see Figure 20). Acclimation ends in early May just as spring runoff begins. Data collected from the subbasins (see Figure 4-16 in Appendix 6) demonstrated that river phosphorous concentrations and loads peak along with river flows, as accumulated nutrients and attached algae that have been suspended are flushed from the subbasins. The majority of the phosphorous introduced by acclimation is included in this mechanical removal process thereby limiting the impact of project nutrients on water quality in the critical late summer through winter period.

5.4 Assessment of Cumulative Impacts

5.4.1 Wenatchee Subbasin

The cumulative impacts of the proposed project were assessed by applying the WDOE TMDL model and including discharges from POTWs in addition to the project-related loads. For this purpose, POTWs were assumed to be discharging at the load allocations specified in the WDOE TMDL (at a TP concentration of 90 µg/L) and at their design flows. The WDOE load allocation included allowance for future growth. Hence, it is assumed for the purpose of cumulative impact assessment that this represents a reasonable estimate of future loading conditions from municipal sources.

5.4.1.1 Background Conditions

For the purpose of comparing the cumulative impacts, background conditions were determined by including loads from POTWs (as specified above) to the base case simulation presented in Section 5.2.2. Figure 34 presents simulated water column TP concentration for the cases with and without the POTW loads.

DO changes with and without the POTW loads are generally small and limited to the vicinity and immediately downstream of the discharges (Figure 35). The simulated DO levels were well above minimum DO criterion. In the lower reaches of the Wenatchee River where the POTW loads enter, the upper bound of the simulated pH levels appears to be affected more than the lower bound (Figure 36). POTW loading does not affect the temperature as there was no change in the specified temperature function (Figure 37).

The change in the range of pH and DO for the simulation that included loads from POTWs is presented in Figure 38. As expected, the highest changes were predicted in the vicinity of and downstream from the POTW discharges. In all cases, the changes were less than the measurable effect criteria for both pH and DO.

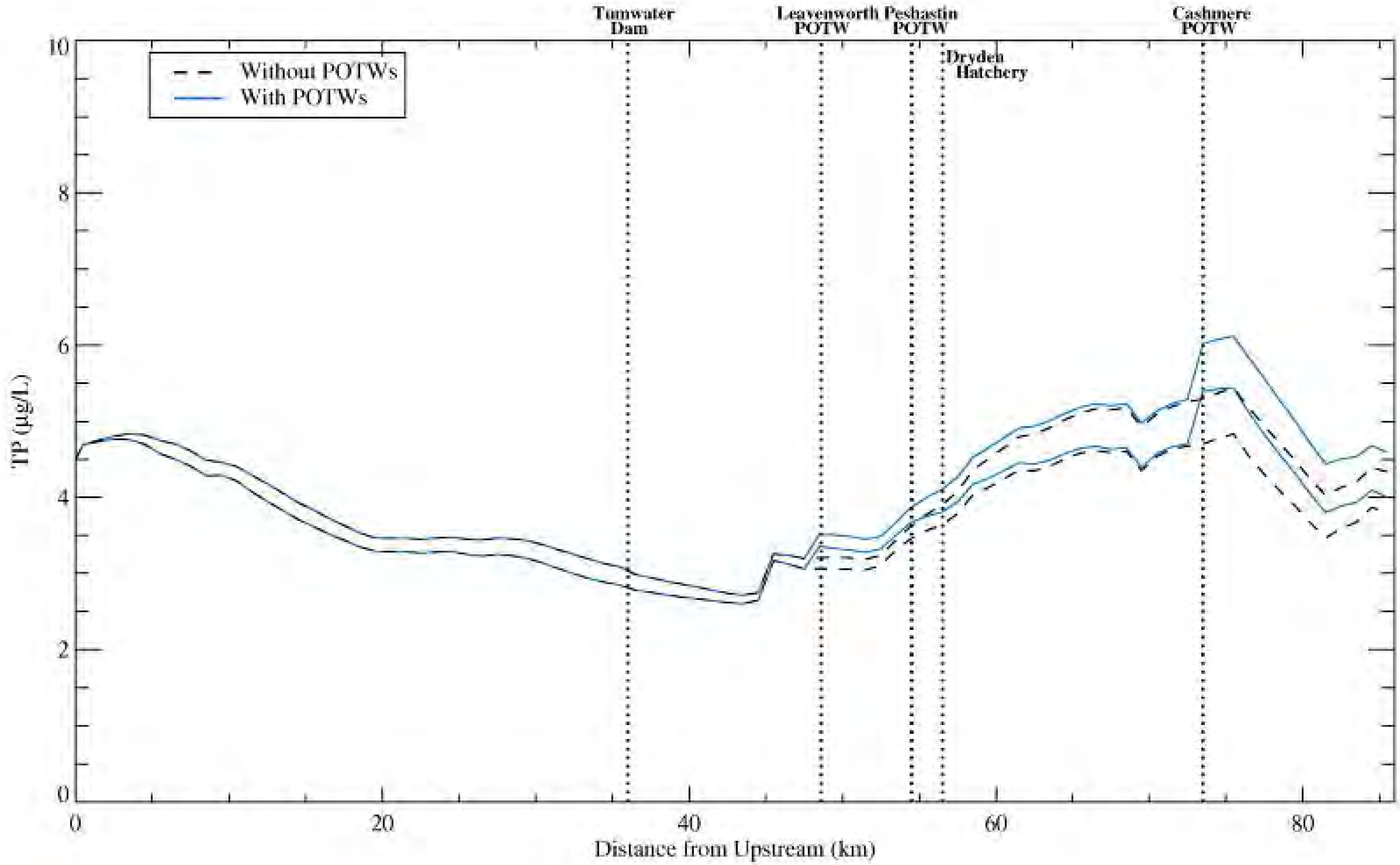

Figure 34

Total phosphorus concentrations simulated by QUAL-2K model shown compared for cases with and without POTW discharges for 7Q10 low-flow and March climatic condition

Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
Phosphorus concentrations from all other sources set to background levels used in WDOE TMDL natural conditions simulation

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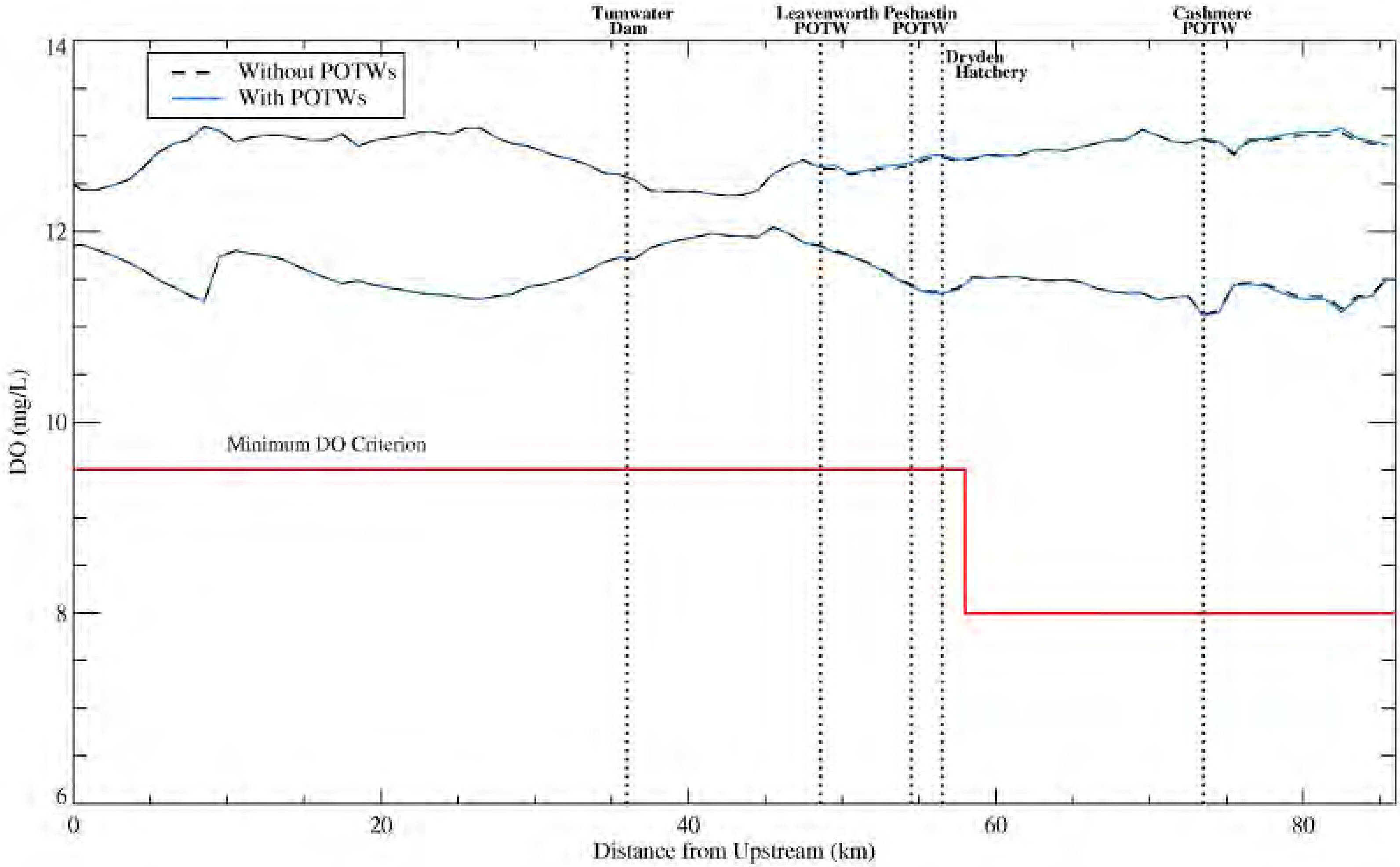

Figure 35

Dissolved oxygen concentrations simulated by QUAL-2K model shown compared for cases with and without POTW discharges for 7Q10 low-flow and March climatic condition

Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
Phosphorus concentrations from all other sources set to background levels used in WDOE TMDL natural conditions simulation
Minimum and maximum values simulated by the model are shown

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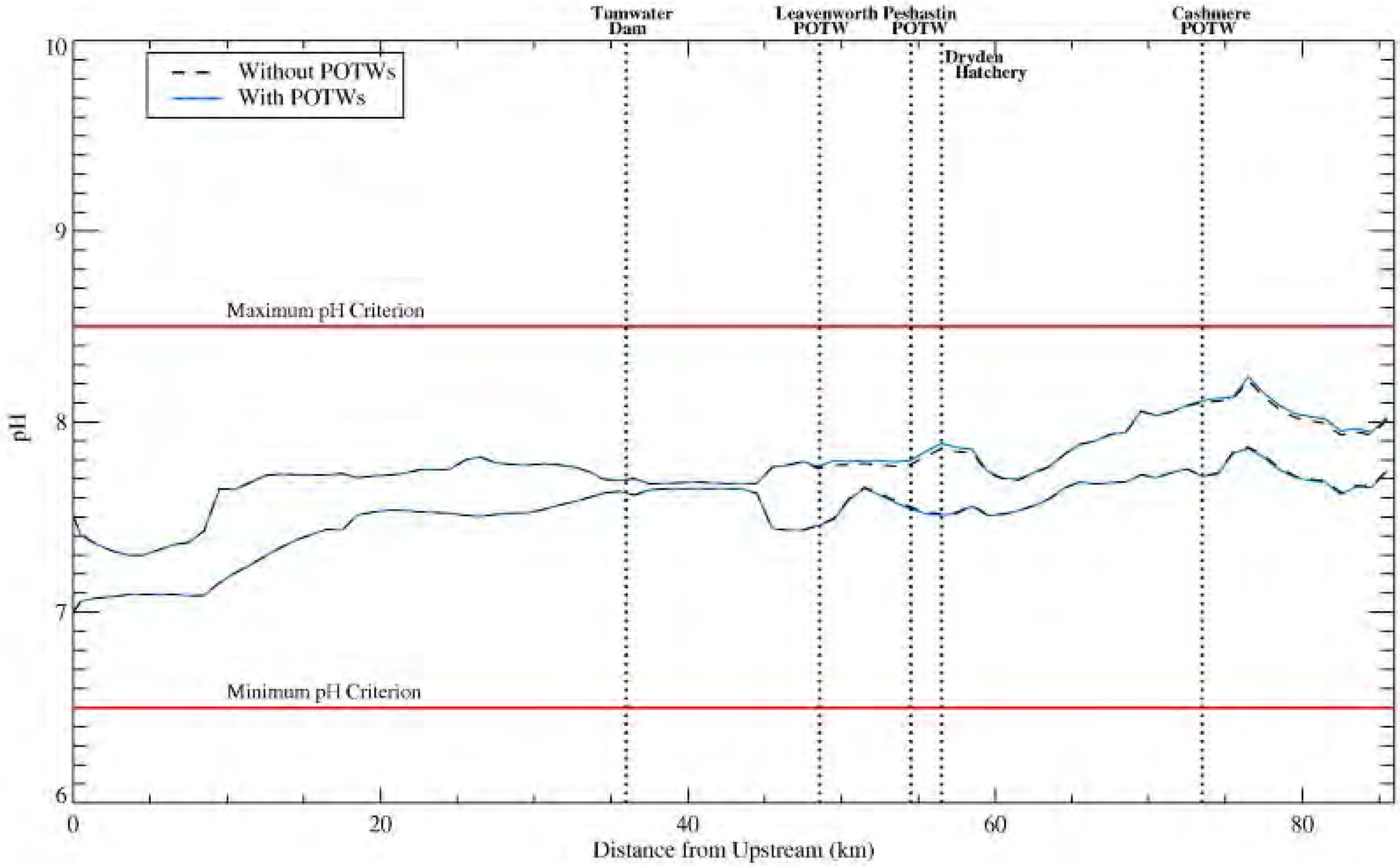

Figure 36

pHs simulated by QUAL-2K model shown compared for cases with and without POTW discharges for 7Q10 low-flow and March climatic condition

Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
Phosphorus concentrations from all other sources set to background levels used in WDOE TMDL natural conditions simulation
Minimum and maximum values simulated by the model are shown

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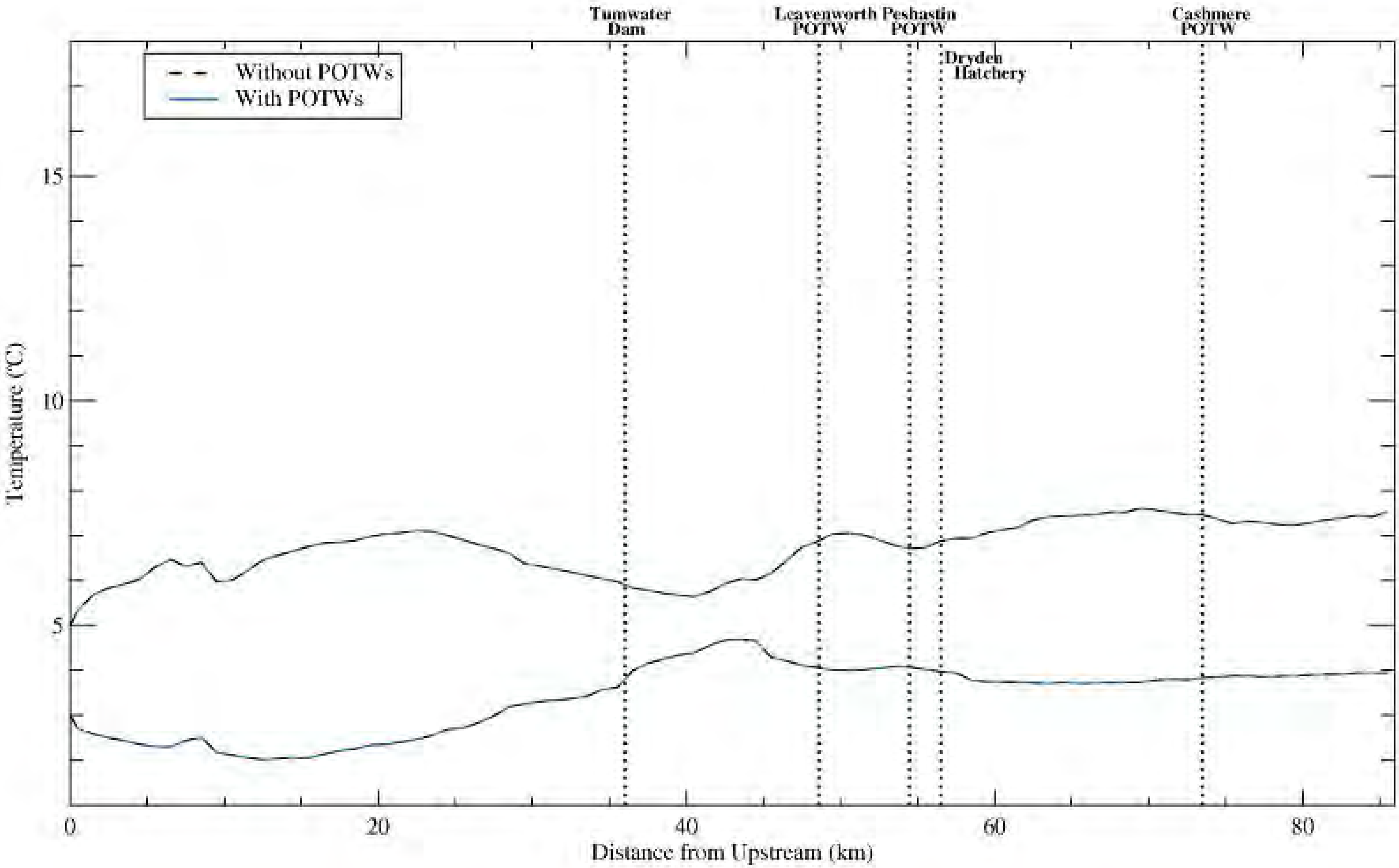

Figure 37

Temperatures simulated by QUAL-2K model shown compared for cases with and without POTW discharges for 7Q10 low-flow and March climatic condition

Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
Phosphorus concentrations from all other sources set to background levels used in WDOE TMDL natural conditions simulation
Minimum and maximum values simulated by the model are shown

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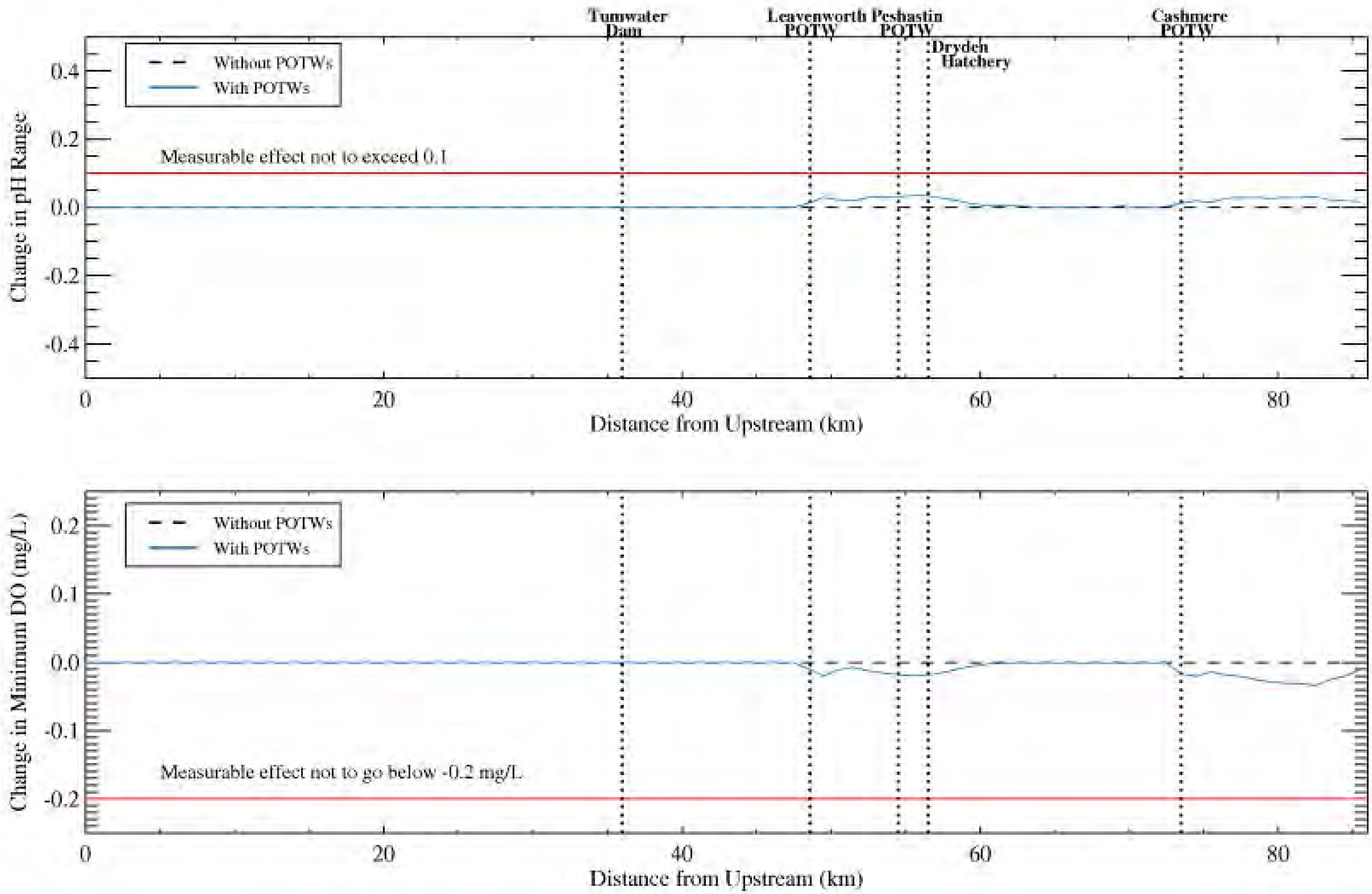

Figure 38

Difference from March background conditions in the range of pH and minimum dissolved oxygen with and without the POTW discharges in the Wenatchee subbasin

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The model simulations with and without the POTW loading have indicated only minor changes in water quality. The principal difference between these sets of simulations performed for March conditions and those performed for load allocations in the WDOE TMDL are the climatic conditions and water temperature. In the WDOE TMDL analysis, these same POTW loads when introduced in summer resulted in significantly elevated effects in water quality deterioration. These results suggest that temperature plays an important role in determining water quality of the Wenatchee River.

5.4.1.2 Assessment of Cumulative Impacts

The loads estimated for the proposed project (Section 5.2.2.3) were added to the background conditions and POTW model presented in the previous sub-section. This setup provided a reasonable conservative estimate of the cumulative nutrient loads to the Wenatchee River.

Figure 39 depicts the TP concentrations simulated by the QUAL-2K model both with and without the loads estimated from the proposed project. As observed in the analysis of the combined impacts, TP levels are slightly elevated in the upper section of the river (up to RKM 60) from the project loads. The downstream reaches do not show an appreciable increase in TP. This phenomenon is due to the proposed locations for the acclimation ponds, which are in the upper subbasin. This also suggests that TP loads introduced in the upper subbasin are largely assimilated prior to entering the TMDL domain, which is downstream of the city of Leavenworth.

The DO (Figure 40) and pH (Figure 41) ranges follow a very similar trend compared to those estimated under the combined impacts scenario (i.e., higher upper bound values in the vicinity of RKM 27 and minor changes elsewhere). As explained in the combined impacts analysis, this area likely provides habitat conducive to the establishment of bottom algae due to slower flows. Nonetheless, the model does not predict any water quality criteria excursions for DO and pH in the river. Finally, temperature changes under the cumulative impacts scenario are negligible (Figure 42).

5.4.1.3 Determination of Significance of Impacts

The change in the range of pH and DO for the cumulative impact simulation compared to the case without the project loads (note that the latter includes POTW discharges over background conditions simulations) is presented in Figure 43. The differences between simulations represent changes from the March background conditions established in Section 5.2.2.2. As expected, the largest differences occur in the vicinity of RKM 27 due to enhanced algal activity.

In all cases, the model simulations suggest that potential impacts of the proposed project, as defined by the criteria for DO and pH, will be negligible under foreseeable future conditions.

When viewed in light of the conservative assumptions employed in establishing the translation of loads and flow conditions within the model framework (see Section 5.1), the actual impacts under average flow conditions will be much smaller than what was determined by the QUAL-2K modeling exercise. The fact that the model results indicated that much of the loads are likely to be assimilated upstream of Leavenworth suggests that existing POTWs are not likely to be further burdened to exceed their treatment requirements to buffer activity from the proposed project in the upper reaches.

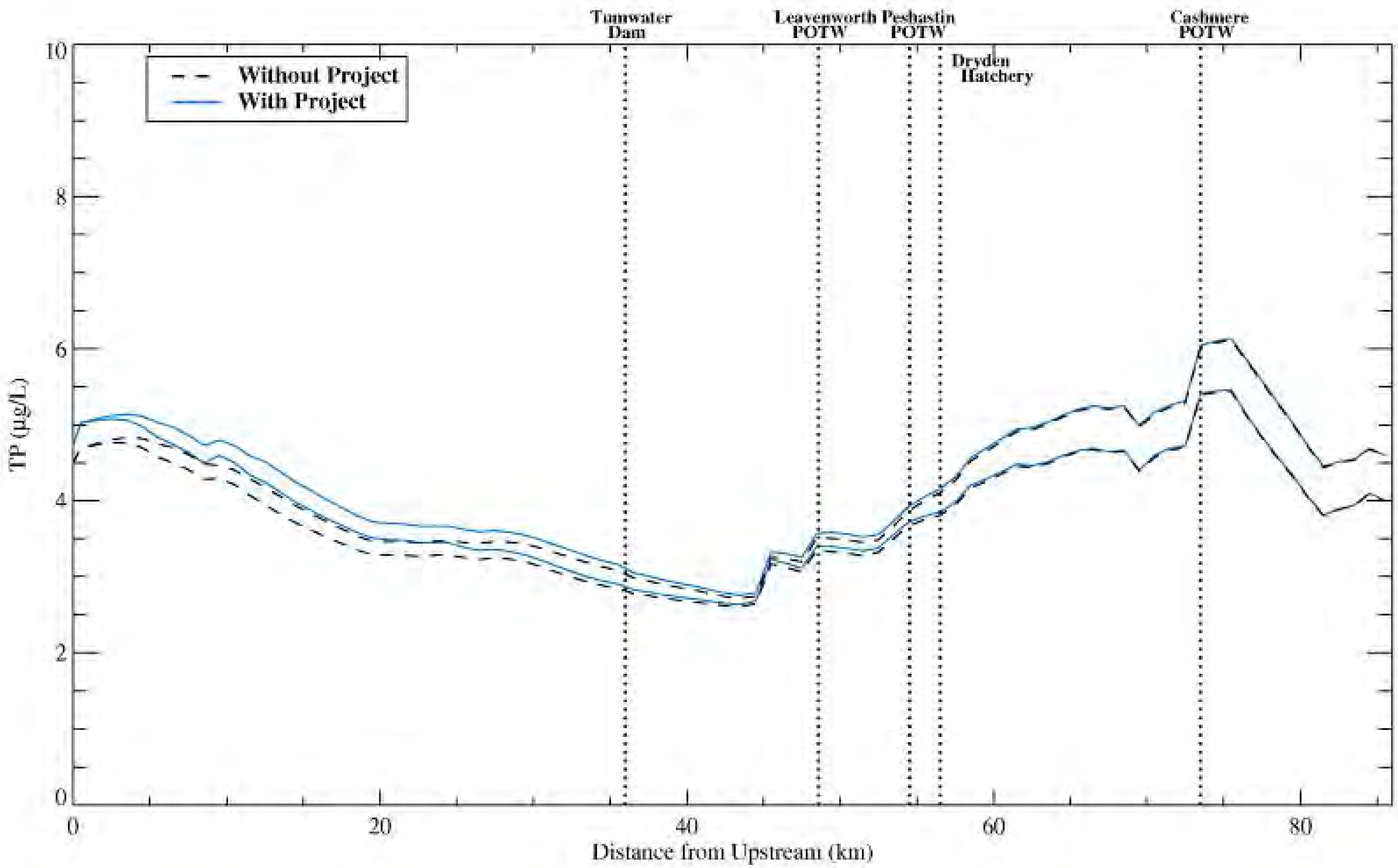

Figure 39

Total phosphorus concentrations simulated by QUAL-2K model shown compared for cases with and without the proposed project for 7Q10 low-flow and March climatic condition with maximum POTW loading

Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
Phosphorus concentrations from all other sources set to background levels used in WDOE TMDL natural conditions simulation

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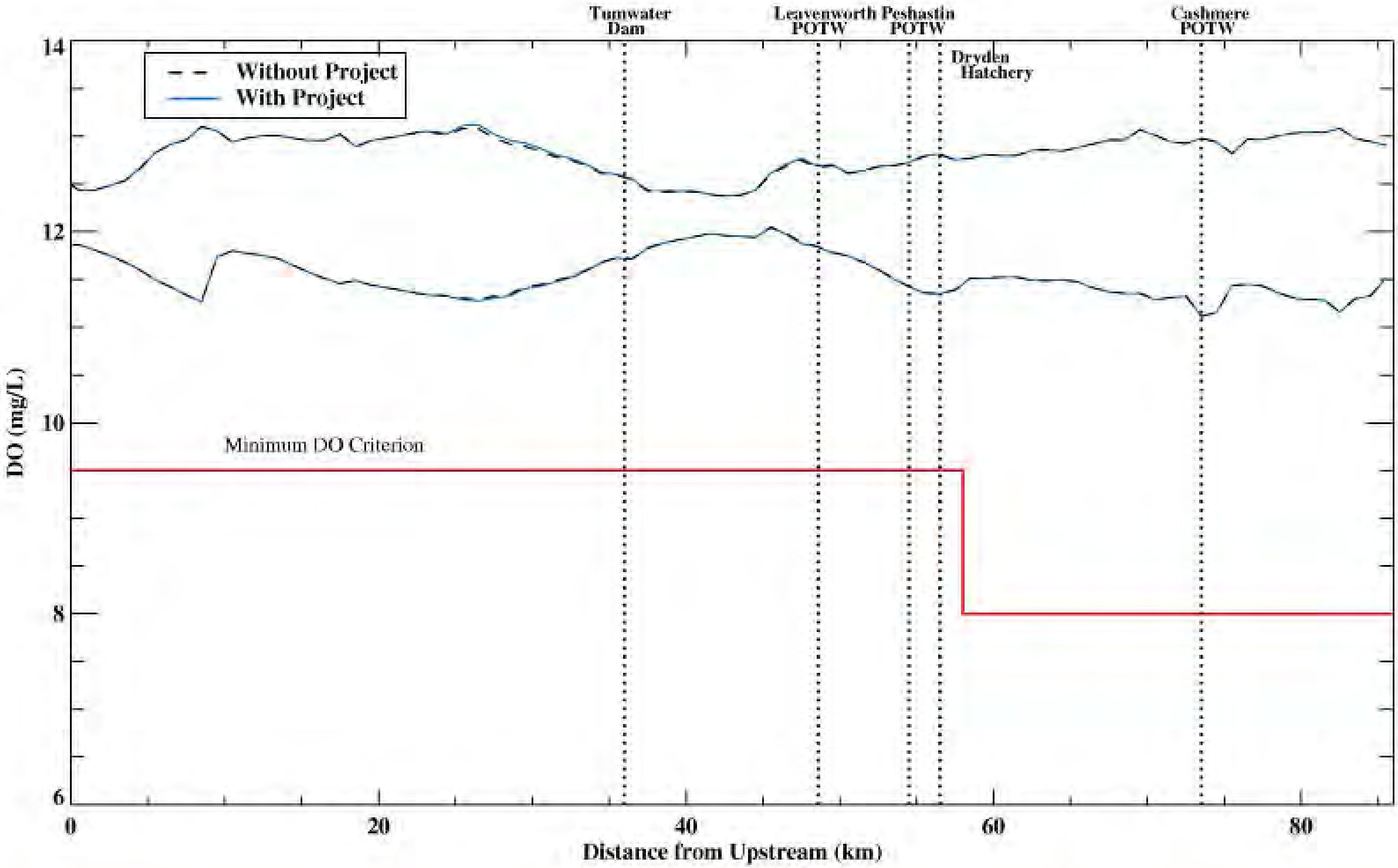

Figure 40

Dissolved oxygen concentrations simulated by QUAL-2K model shown compared for cases with and without the proposed project for 7Q10 low-flow and March climatic condition with maximum POTW loading

Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
Phosphorus concentrations from all other sources set to background levels used in WDOE TMDL natural conditions simulation
Minimum and maximum values simulated by the model are shown

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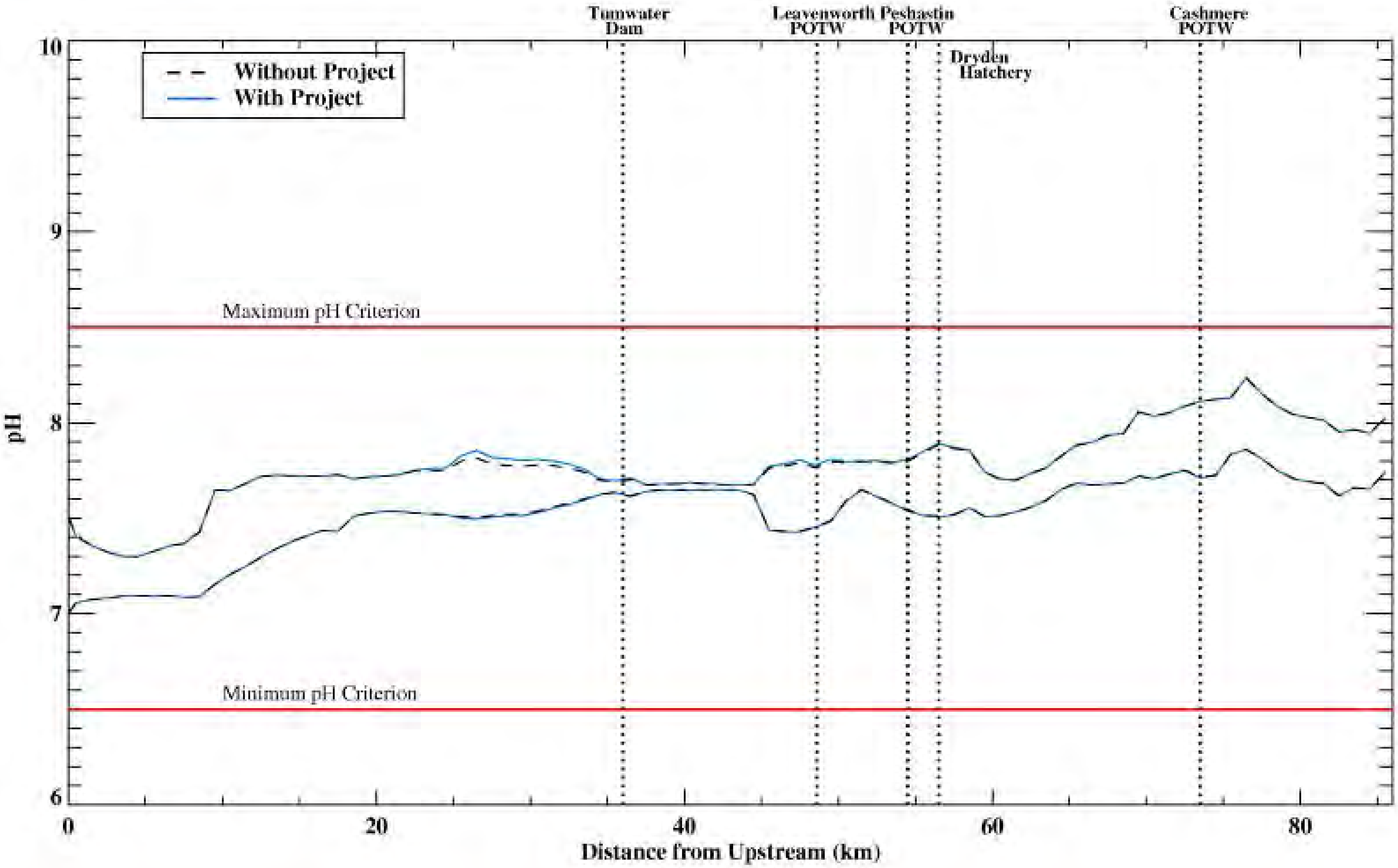

Figure 41

pHs simulated by QUAL-2K model shown compared for cases with and without the proposed project for 7Q10 low-flow and March climatic condition with maximum POTW loading

Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
Phosphorus concentrations from all other sources set to background levels used in WDOE TMDL natural conditions simulation
Minimum and maximum values simulated by the model are shown

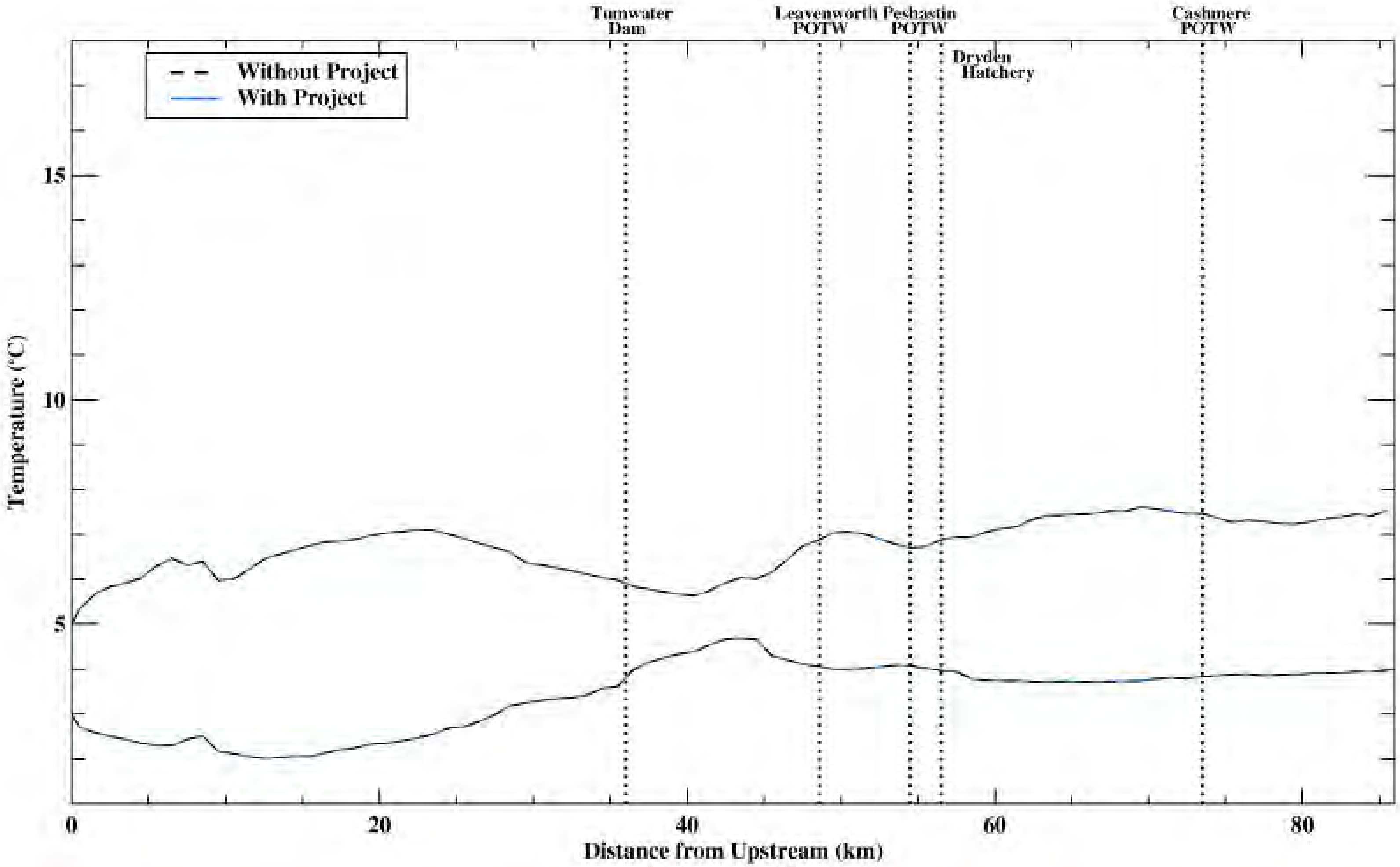

Figure 42

Temperatures simulated by QUAL-2K model shown compared for cases with and without the proposed project for 7Q10 low-flow and March climatic condition with maximum POTW loading

Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
Phosphorus concentrations from all other sources set to background levels used in WDOE TMDL natural conditions simulation
Minimum and maximum values simulated by the model are shown

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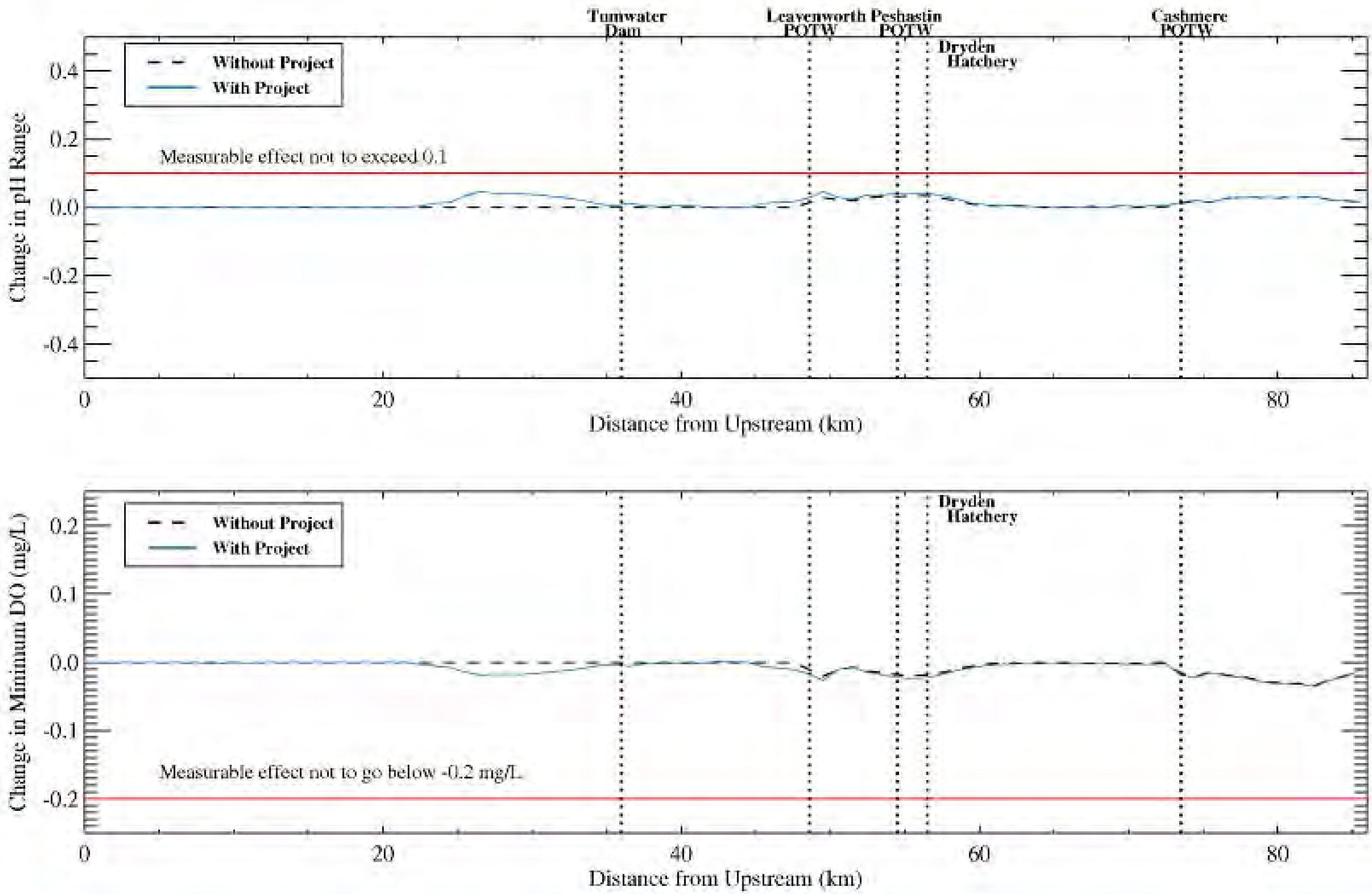

Figure 43

Difference from March background conditions in the range of pH and minimum dissolved oxygen with and without the proposed project in the Wenatchee subbasin with maximum POTW loading

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5.4.2 Methow Subbasin

An estimate of the cumulative project impact was assessed from the calculations performed for the combined project impacts presented in Section 5.3.3. The contribution of the project related loads relative to the cumulative subbasin load (Methow River at Pateros in Table 14) was estimated to be about 0.8%.

The equivalent calculation for the Wenatchee sites resulted in a relative project contribution of 1.1% of the subbasin TP loading (Table 15). Mechanistic modeling in the previous section indicated that acclimation-related loads in the Wenatchee subbasin caused a negligible change in DO and pH even in the presence of anthropogenic sources. Given the lower estimate of nutrient loading from acclimation activity in the Methow subbasin (see Table 14) and the similarity in the basin characteristics (see Section 5.1.2), the TP loads from acclimation activity are unlikely to cause a measurable change in DO and pH in the Methow River.

6 NO ACTION ALTERNATIVE

The No Action alternative is described in the Environmental Impact Statement (EIS). The sites included in the No Action alternative for the Wenatchee and the Methow subbasins are shown respectively in Table 16 and Table 17. This section presents the combined and cumulative impacts expected from the No Action alternative.

6.1 Assessment of Impacts for the Wenatchee Subbasin

The mechanistic modeling approach used for estimating the combined and cumulative impacts for the preferred alternative (see Sections 5.3 and 5.4.1) was extended for the No Action alternative sites. The estimated phosphorus loads for the sites in the No Action alternative (see Table 16) were used to calculate the phosphorus concentrations of the respective tributaries receiving the discharge in the QUAL-2K model. Loading from any other site in the preferred alternative that is not listed in Table 16 was excluded. All other simulation conditions and modeling assumptions remained unchanged from the preferred alternative simulations.

6.1.1 Combined Impacts

Figures 44 through 47 show the water quality parameters for the combined impact simulation. These figures show that the impacts to water quality are negligible if the project were to continue without the changes proposed in the preferred alternative. This is not surprising given that the results discussed in previous sections demonstrated that even with the greater number of sites proposed in the preferred alternative, impacts were determined to be negligible.

Figure 48 shows that the DO and pH changes over the background conditions are expected to be milder than the preferred alternative. Because two-thirds of the loads in the No Action alternative are released into Nason Creek, impacts in the upper section of the river (particularly near RKM 27) are comparable to, albeit smaller than, those resulting from the preferred alternative. In the lower Wenatchee River, there is almost no change in DO and pH over the background conditions for both alternatives.

Table 16
No Action alternative sites in Wenatchee subbasin

No Action Site	No. of Fish ('000s)	TP Load[1] (kg/d)	Receiving Stream
Rohlfing	100	0.032	White River
Coulter	100	0.032	White River
Butcher	100	0.032	Little Wenatchee
Beaver	100	0.032	Beaver
Leavenworth NFH	100	0.032	Icicle
Total	**500**	**0.16**	

Notes:
1. Uses an estimate of 0.32 mg/d/fish derived from active sites in Nason Creek; see Table 5.

Table 17
No Action alternative sites in Methow subbasin

No Action Site	No. of Fish ('000s)	TP Load[1] (kg/d)	Receiving Stream
Heath	20	0.006	Twisp River
Lincoln	60	0.019	Twisp River
Lower Twisp	20	0.006	Methow River
WNFH	100	0.032	Methow River
Total	**200**	**0.064**	

Notes:
1. Uses an estimate of 0.32 mg/d/fish derived from active sites in Nason Creek; see Table 5.

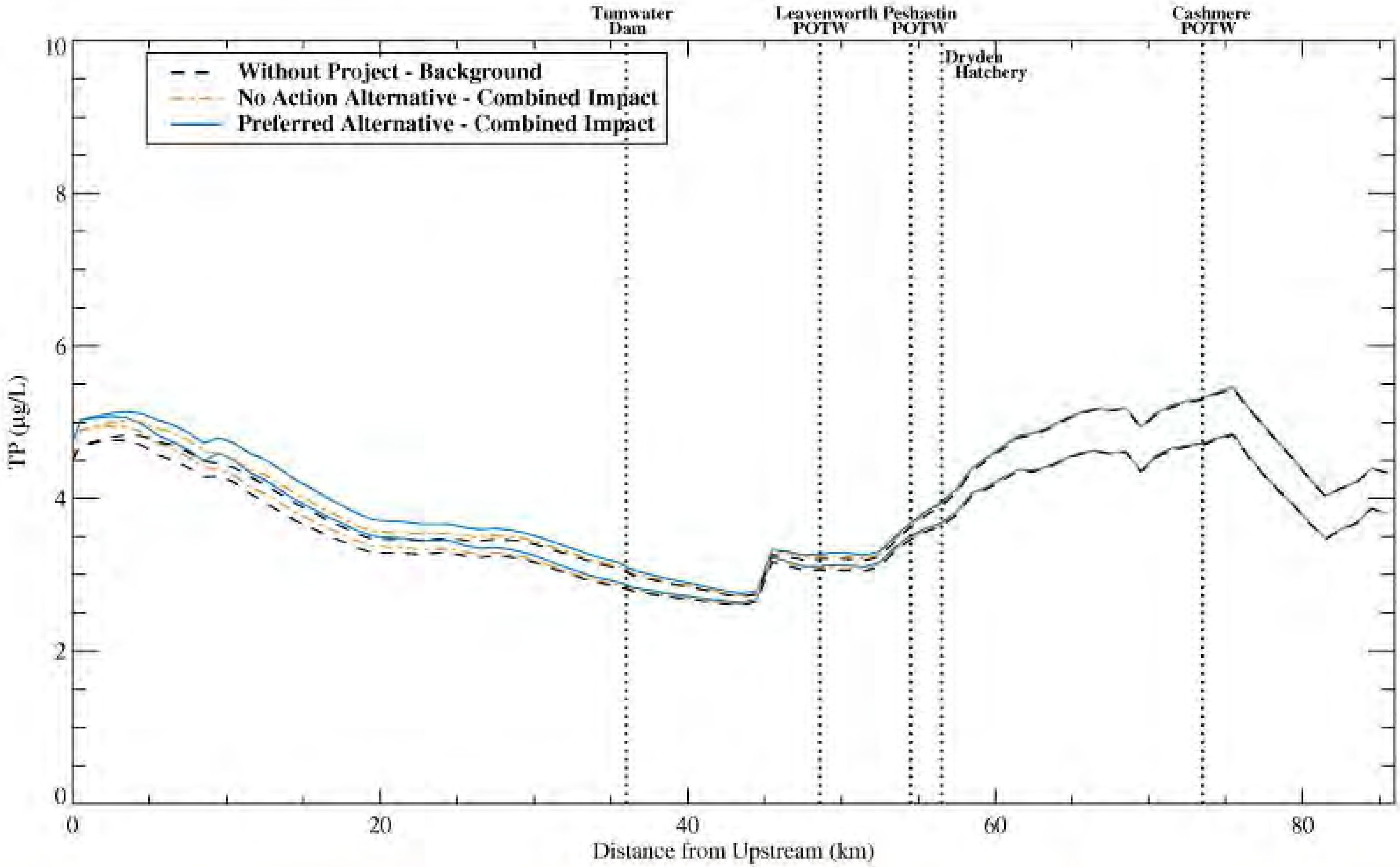

Figure 44

Total phosphorus concentrations simulated by QUAL-2K model shown compared for the No Action and Preferred alternatives for 7Q10 low-flow and March climatic condition with maximum background loadings determined in WDOE TMDL

Phosphorus concentrations from all sources set to background levels used in WDOE TMDL natural conditions simulation
Minimum and maximum values simulated by the model are shown

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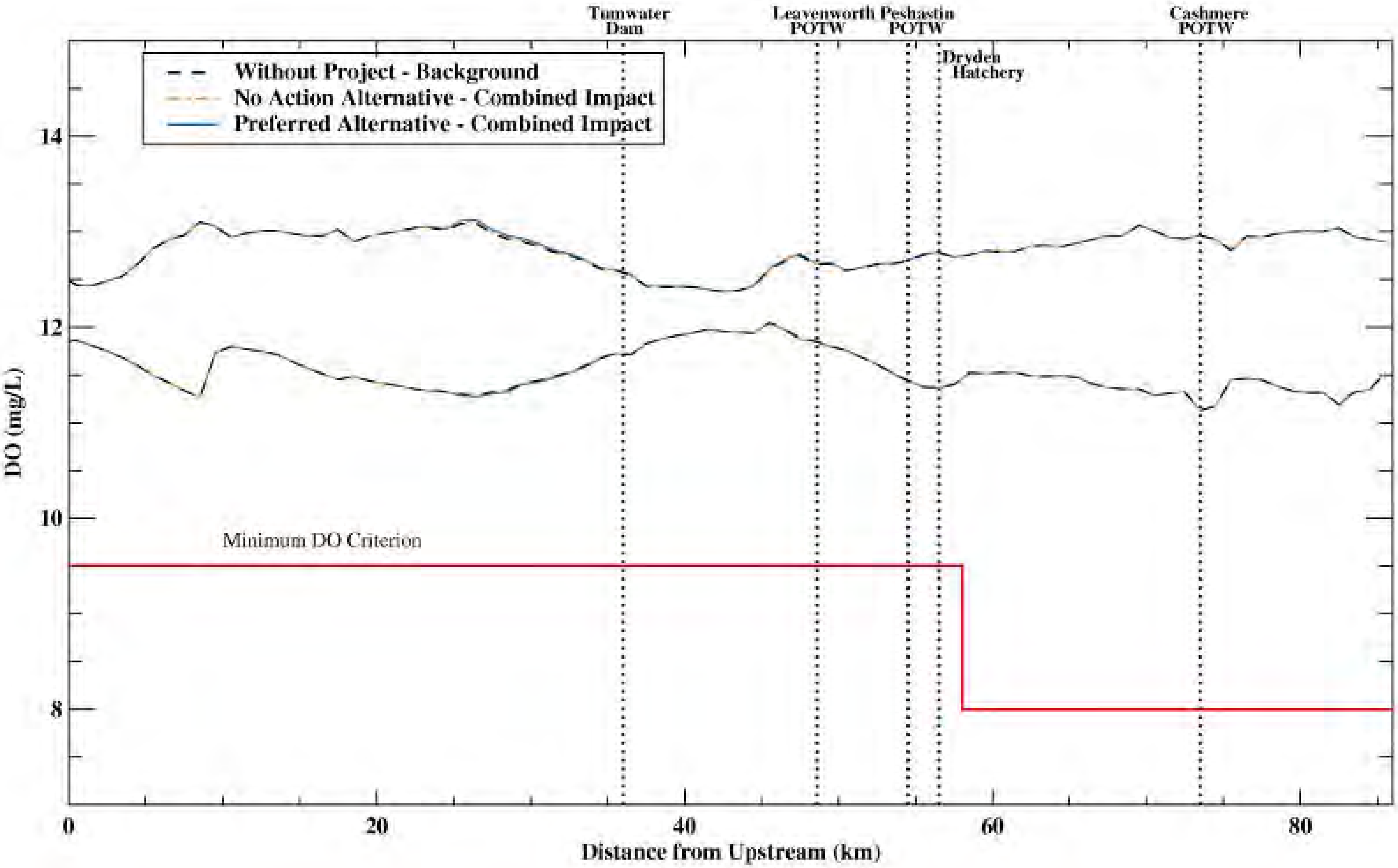

Figure 45

Dissolved oxygen concentrations simulated by QUAL-2K model shown compared for the No Action and Preferred alternatives for 7Q10 low-flow and March climatic condition with maximum background loadings determined in WDOE TMDL

Phosphorus concentrations from all sources set to background levels used in WDOE TMDL natural conditions simulation
Minimum and maximum values simulated by the model are shown

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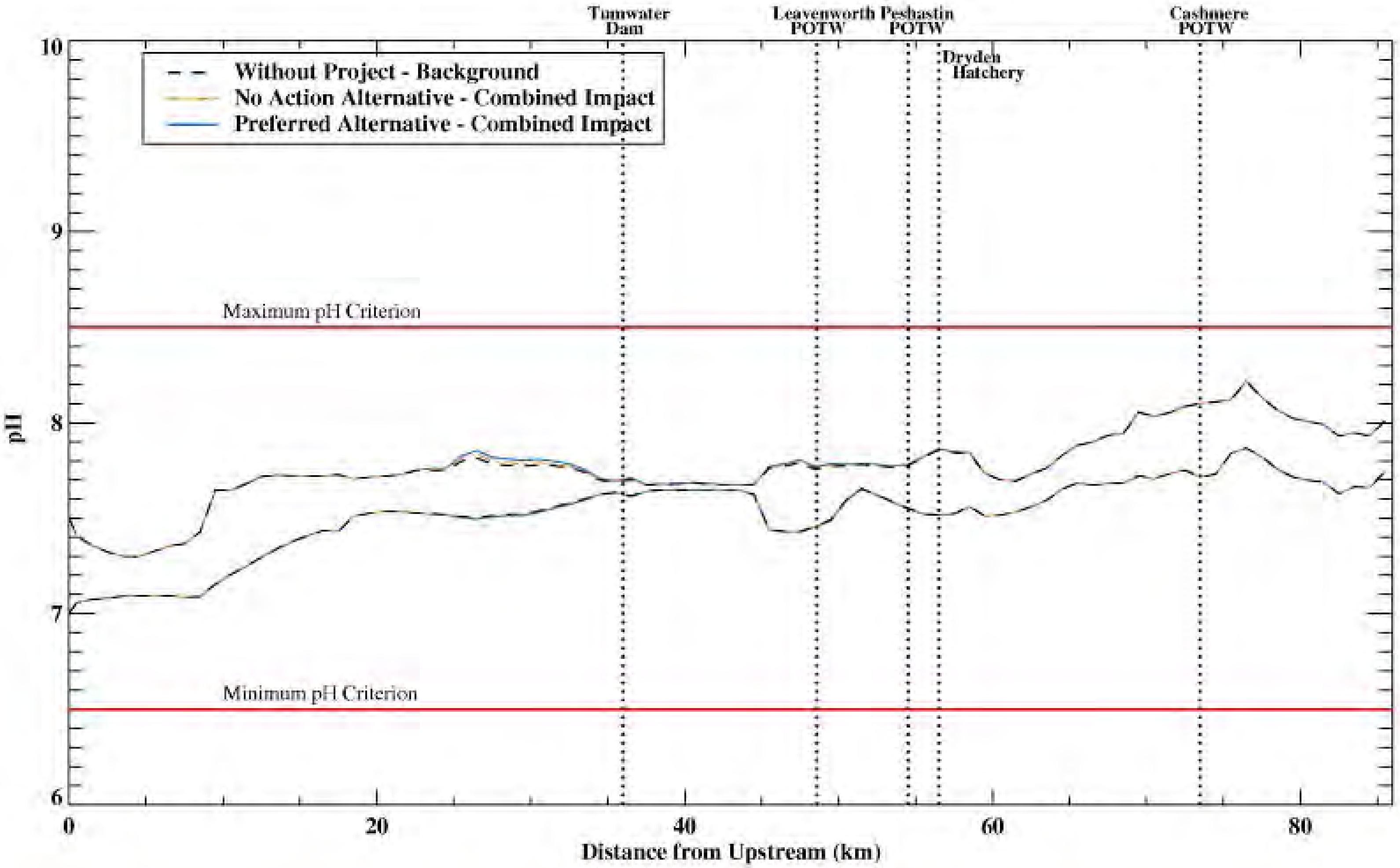

Figure 46

pHs simulated by QUAL-2K model shown compared for the No Action and Preferred alternatives for 7Q10 low-flow and March climatic condition with maximum background loadings determined in WDOE TMDL

Phosphorus concentrations from all sources set to background levels used in WDOE TMDL natural conditions simulation
Minimum and maximum values simulated by the model are shown

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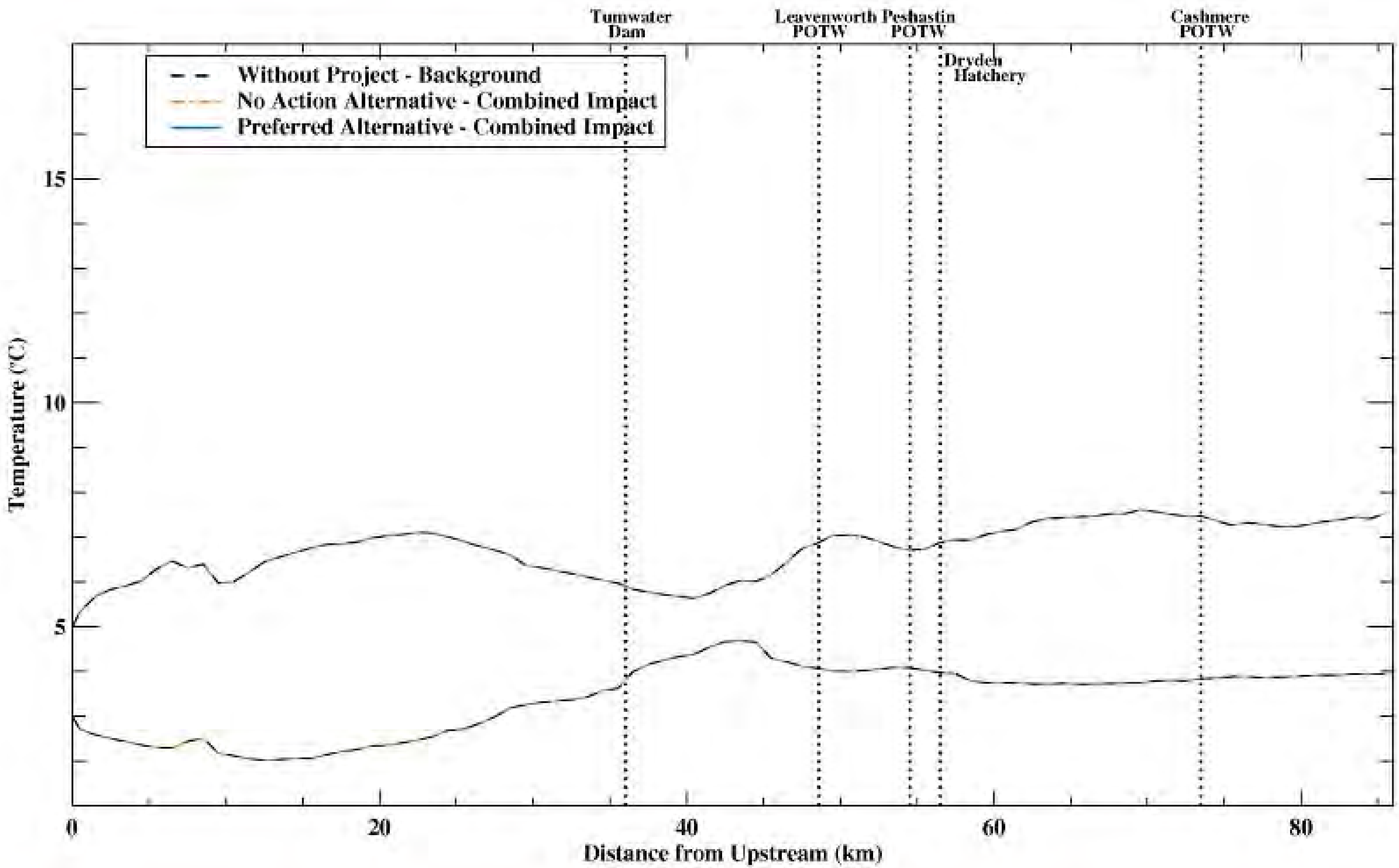

Figure 47

Temperatures simulated by QUAL-2K model shown compared for the No Action and Preferred alternatives for 7Q10 low-flow and March climatic condition with maximum background loadings determined in WDOE TMDL

Phosphorus concentrations from all sources set to background levels used in WDOE TMDL natural conditions simulation
Minimum and maximum values simulated by the model are shown

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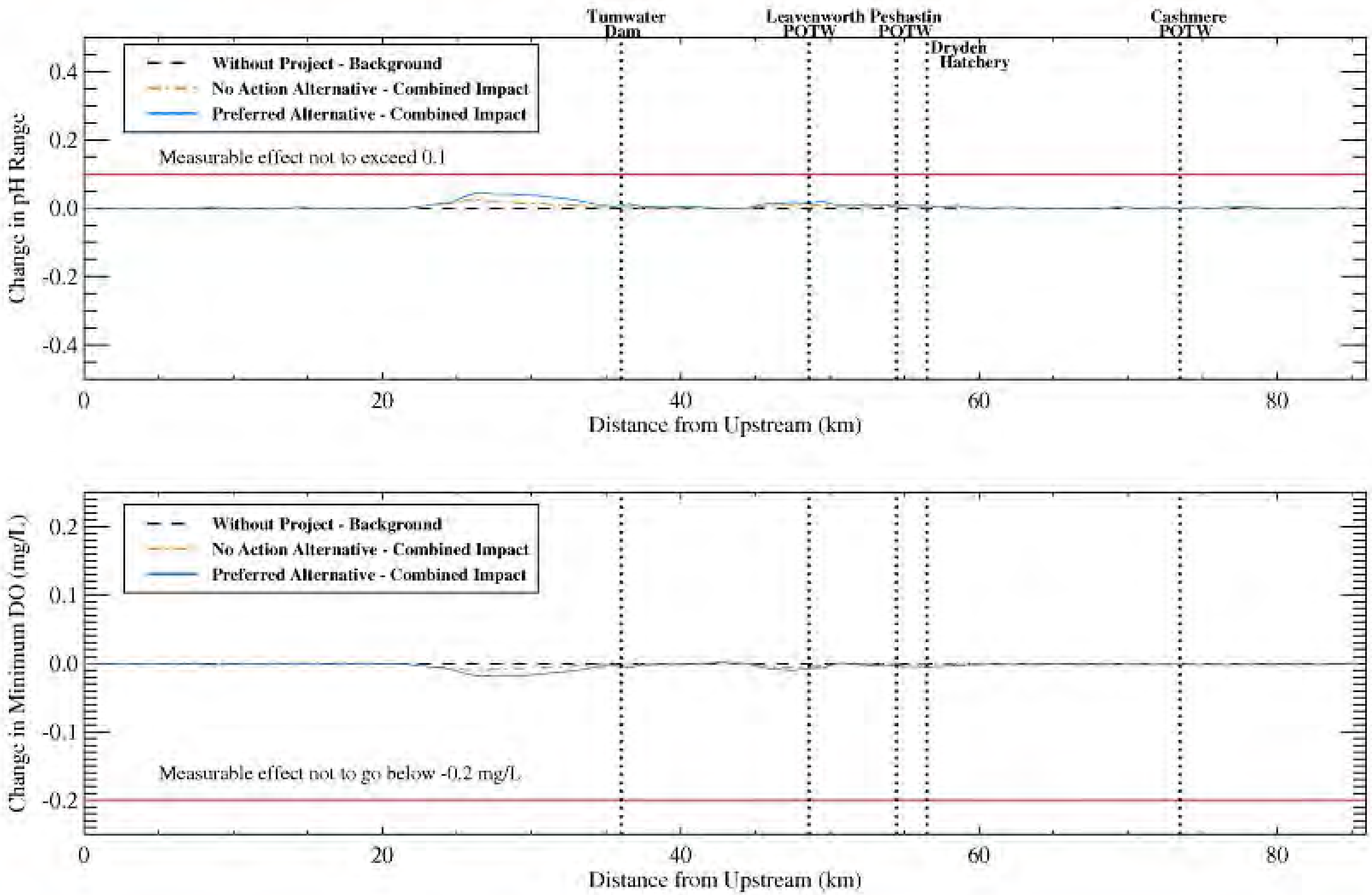

Figure 48

Difference from March background conditions in the range of pH and minimum dissolved oxygen in the Wenatchee subbasin for the No Action and Preferred alternatives

ANCHOR QEA

6.1.2 Cumulative Impacts

As with the preferred alternative, the impacts of discharges from the sites in the No Action alternative were assessed for the case when POTWs discharge at their design capacity, contributing a phosphorus load as allocated in the WDOE TMDL (corresponding to 90 μg/L). The spatial trends in water quality parameters (see Figures 49 to 52) were similar to those predicted for the preferred alternative. As expected, the changes in minimum DO and pH range over the background conditions were predicted to be milder than for the preferred alternative (Figure 53).

6.2 Assessment of Impacts for the Methow Subbasin

The No Action alternative involves acclimation of 200,000 fish (see Table 17), which is 20% of the number of fish for the preferred alternative (see Table 9). Therefore, the TP loads for the No Action alternative are expected to be lower by 80%. Based on the background and subbasin loads estimated for the Methow subbasin (Table 14), it is expected that the No Action alternative will contribute less than 0.2% of the subbasin loads. Therefore, water quality impacts on the Methow River are expected to be negligible if the No Action alternative is implemented as proposed.

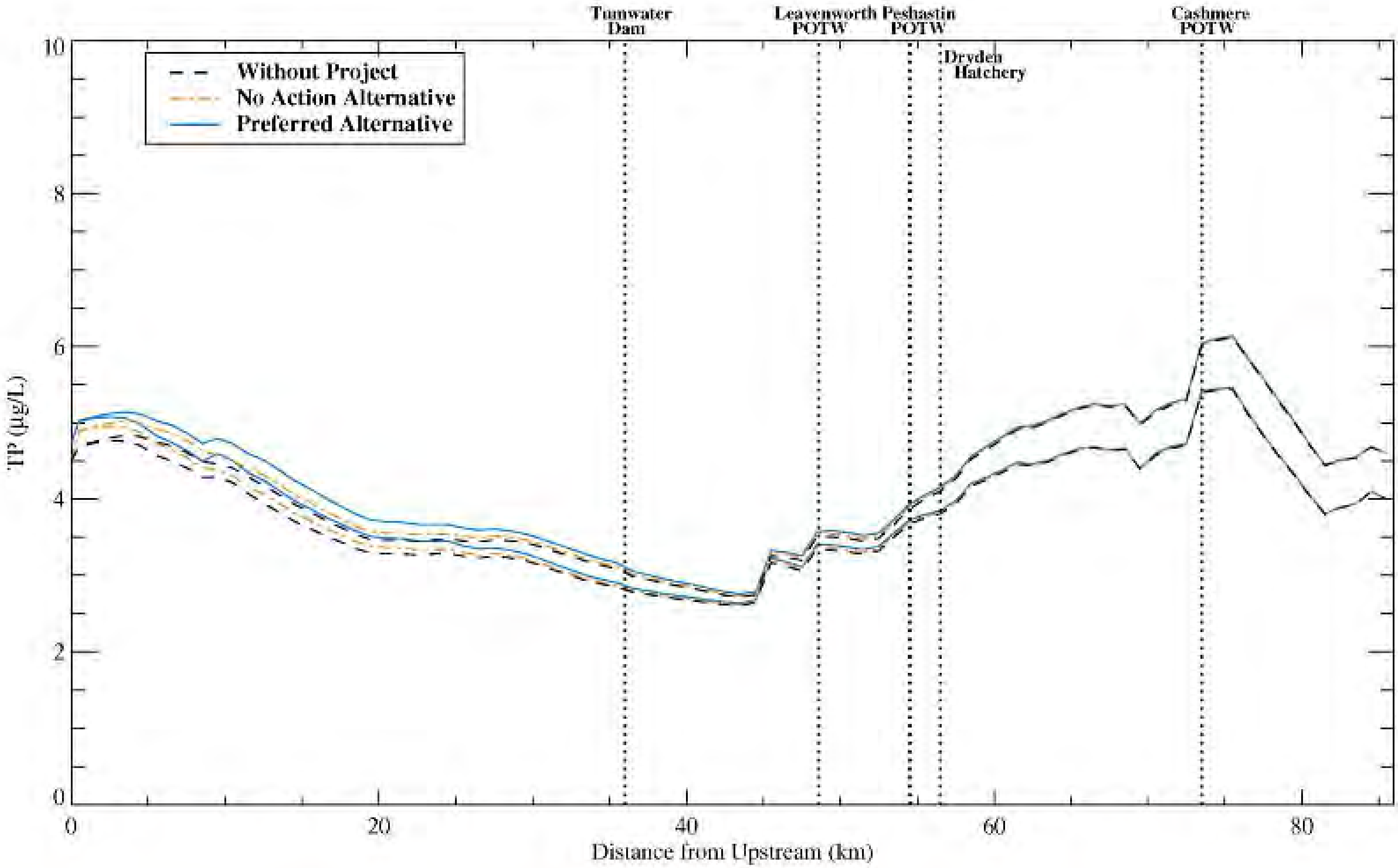

Figure 49

Total phosphorus concentrations simulated by QUAL-2K model shown compared for the Preferred and No Action alternatives for 7Q10 low-flow and March climatic condition with maximum POTW loading

Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
Phosphorus concentrations from all other sources set to background levels used in WDOE TMDL natural conditions simulation

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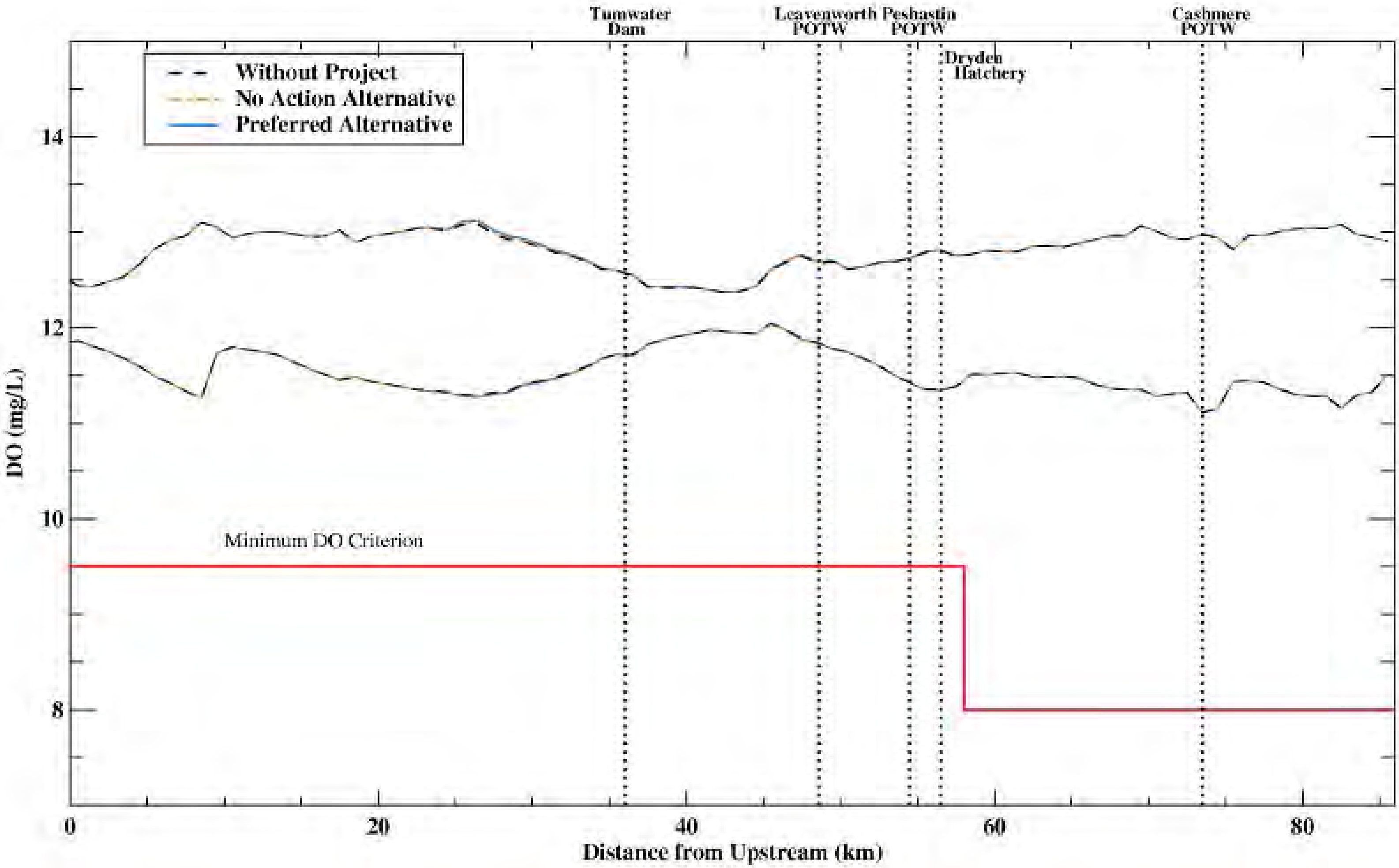

Figure 50

Dissolved oxygen concentrations simulated by QUAL-2K model shown compared for the Preferred and No Action alternatives for 7Q10 low-flow and March climatic condition with maximum POTW loading

Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
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Minimum and maximum values simulated by the model are shown

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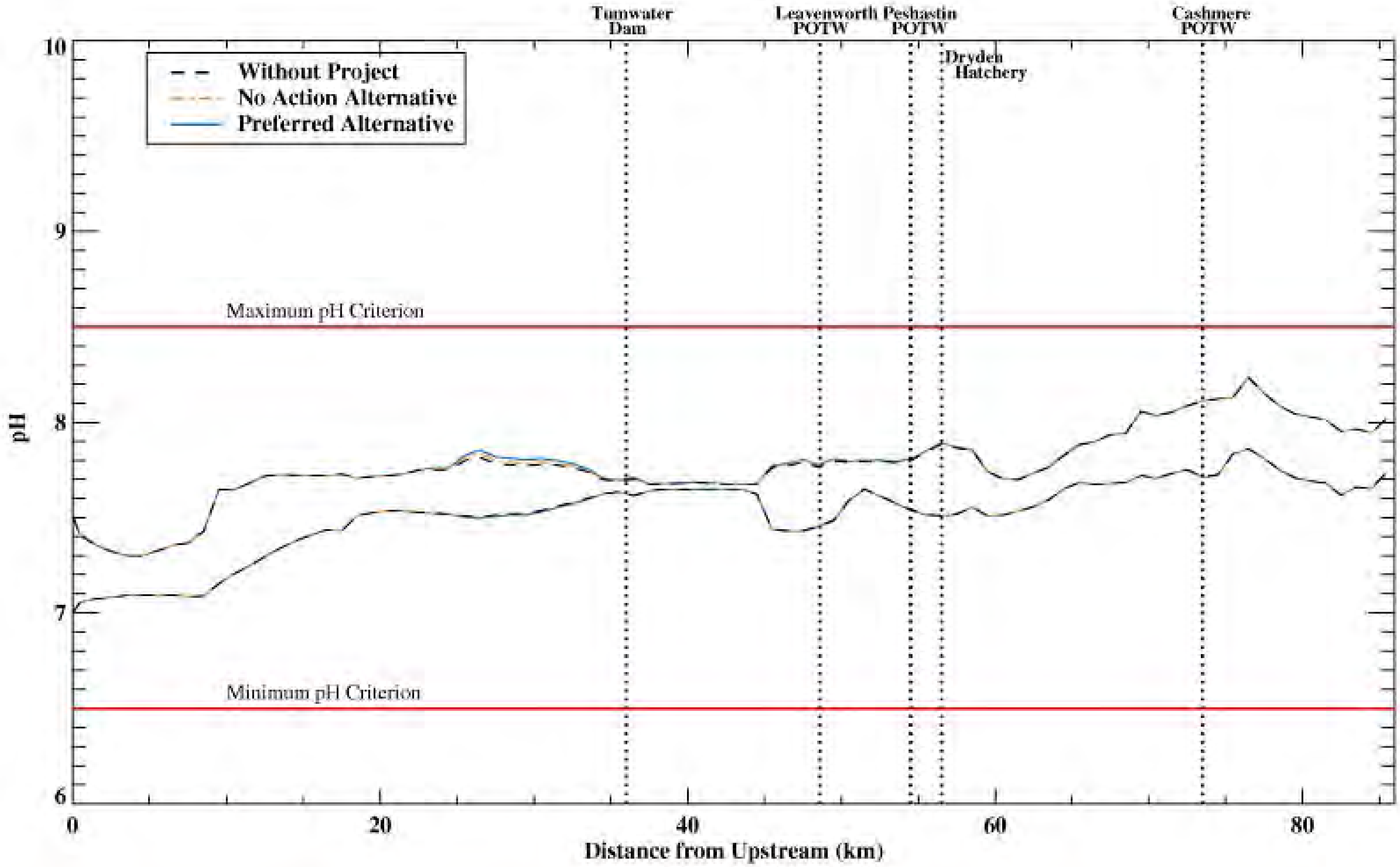

Figure 51

pHs simulated by QUAL-2K model shown compared for the Preferred and No Action alternatives for 7Q10 low-flow and March climatic condition with maximum POTW loading

Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
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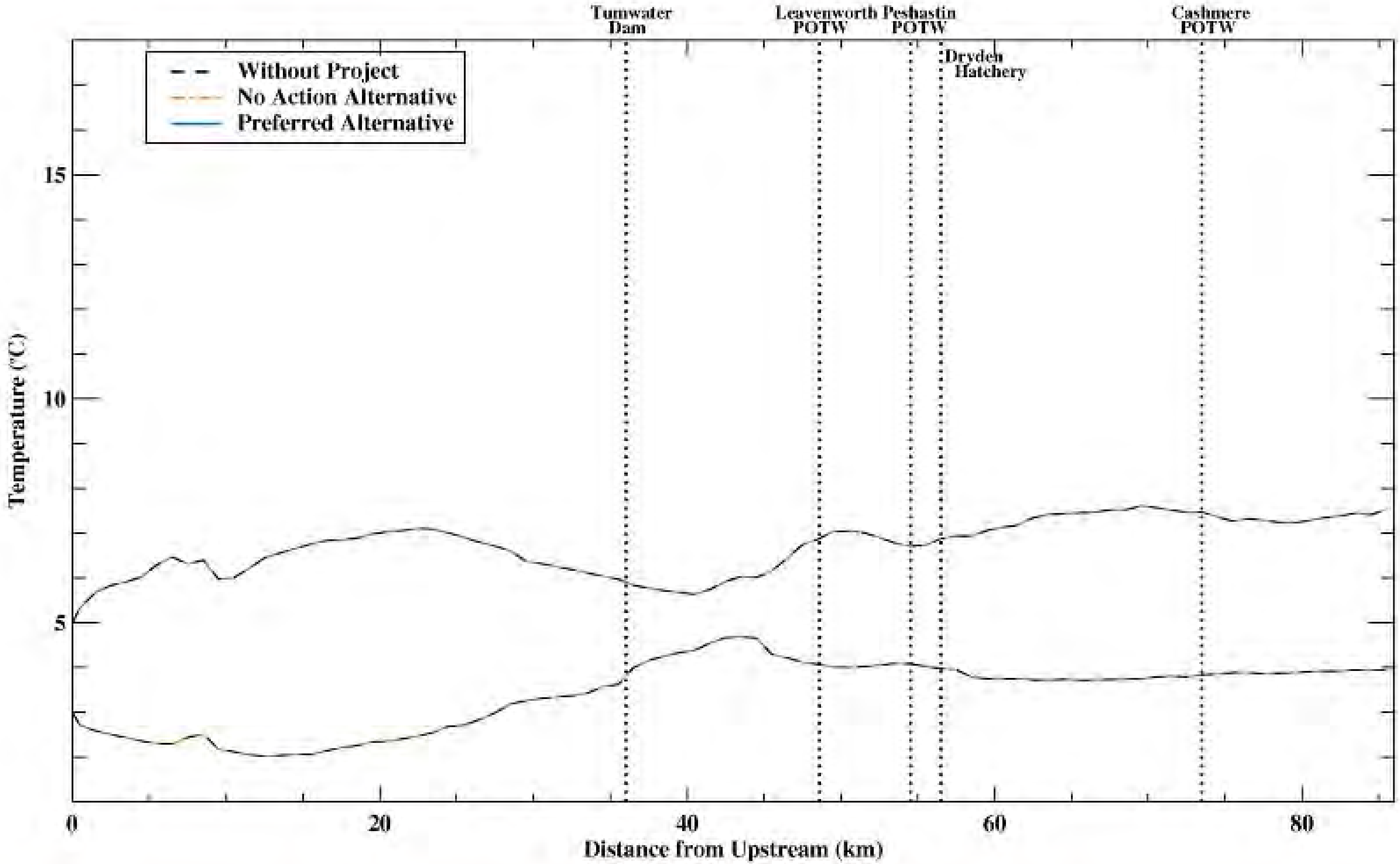

Figure 52

Temperatures simulated by QUAL-2K model shown compared for the Preferred and No Action alternatives for 7Q10 low-flow and March climatic condition with maximum POTW loading

Phosphorus discharges from Leavenworth, Peshastin and Cashmere POTWs occured at design flow and 90 ug/L concentration
Phosphorus concentrations from all other sources set to background levels used in WDOE TMDL natural conditions simulation
Minimum and maximum values simulated by the model are shown

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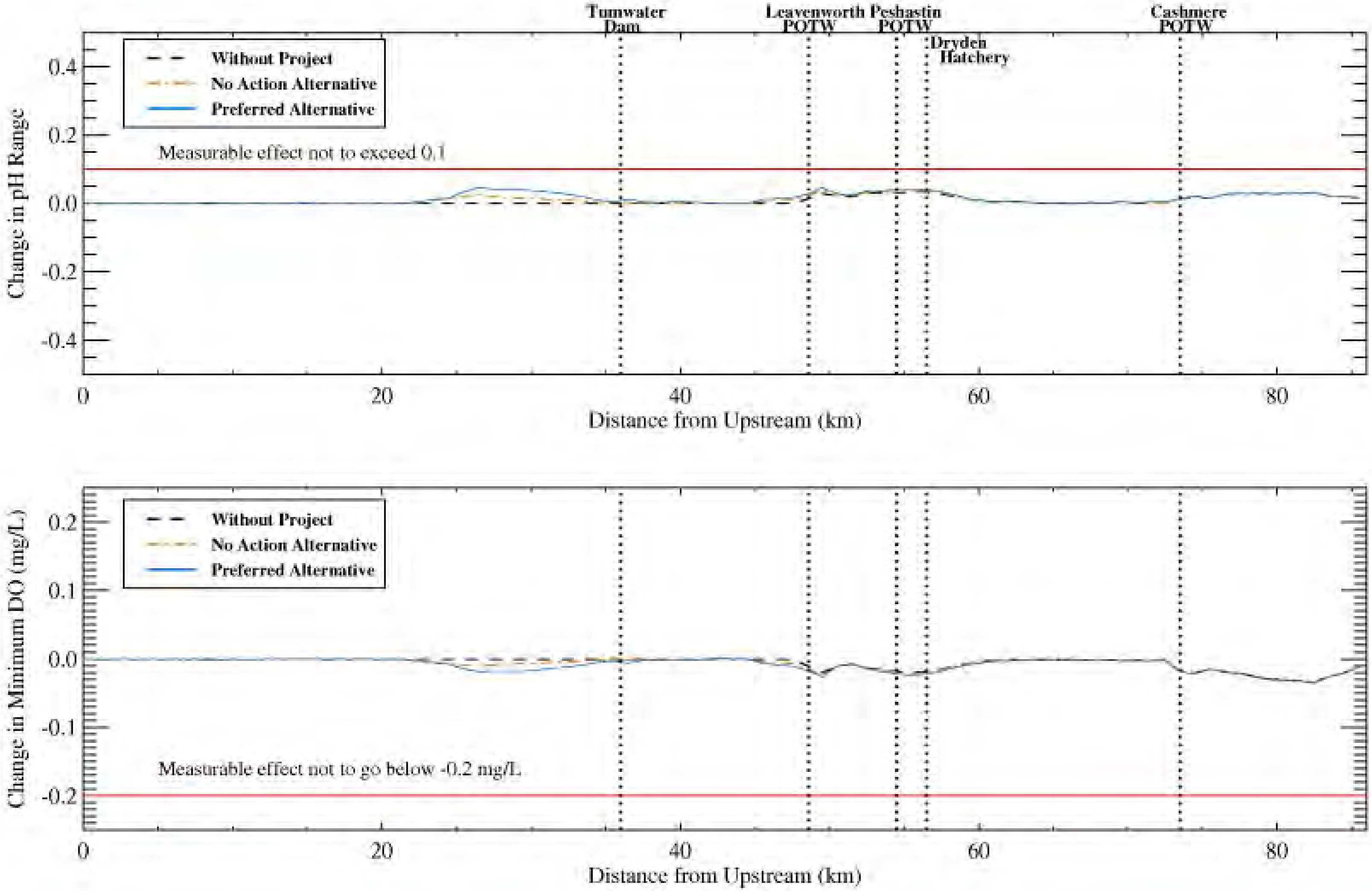

Figure 53

Difference from March background conditions in the range of pH and minimum dissolved oxygen for the Preferred and No Action alternatives in the Wenatchee subbasin with maximum POTW loading

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7 MITIGATION

The project is proposed with several practices listed below that are aimed at reducing nutrient efflux in the discharge:

- Acclimate and release small numbers of coho smolts from multiple sites. This dilutes the loads and reduces localized effects.
- Select ponds with flow rates that are higher than those used in constructed regional fish facilities so that there is substantial dilution of nutrients in the discharges.
- Acclimate in large, natural ponds. The higher water volumes in large ponds provide greater dilution of fish feed and wastes and buffer nutrient loading to the receiving stream.
- Feed high-phosphorus digestibility foods.
- Periodically remove sediments from some acclimation ponds, thereby eliminating potential long-term accumulation of nutrients.
- At the Dryden Hatchery, provide a level of treatment that is comparable to LNFH.

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APPENDIX 8.2
FLOOD IMPACT ANALYSIS

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October 2010

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1 SUMMARY

Implementation of the Mid-Columbia Coho Restoration Project (MCCRP) will likely have little or no effect on flood elevations. Where there is an effect, it is likely to be beneficial as the acclimation ponds will provide some small amount of additional floodplain storage (difference between the existing land surface elevation and the working water surface elevation). While minor construction activities will occur at some sites (excavation of ponds and ditches, grading of roads to improve winter access, or installation of buried water supply pipes), the spoil materials created by these activities will be disposed of outside the 100-year floodplain in accordance with the local grading and floodplain management ordinances. Consequently, there are not likely to be changes in grades that could direct or diverts flood flows affecting properties either upstream or downstream of the individual project sites.

2 INTRODUCTION

This Flood Impact Analysis report has been prepared to assist with an evaluation of the flooding impacts at proposed coho salmon acclimation sites for the Mid-Columbia Coho Restoration Project Environmental Impact Statement (EIS). Executive Order 11988 (Floodplain Management) directs federal agencies to evaluate the potential effects of their actions in 100-year flood hazard zones shown on Federal Emergency Management Agency (FEMA) flood insurance rate maps (FIRMs).

This report has been prepared as a companion document to support the EIS analysis. Consequently, project site details such as site locations; project descriptions; and associated maps, figures, and photographs are presented in the *Brood Capture and Rearing Site Descriptions* (Appendix 1 of the EIS), the *Wenatchee Acclimation Site Descriptions* (Appendix 2 of the EIS), and the *Methow Acclimation Site Descriptions* (Appendix 3 of the EIS), which were also prepared for the project, and the information is not duplicated in this report.

3 METHODS

Consistency of the proposed actions with rules and regulations and impacts to floodplains as a result of implementing the proposed actions are evaluated qualitatively. Existing flood hazards and potential flooding sources are identified. Where no floodplain mapping has occurred or no base flood elevation (BFE) established, potential sources of supplemental information are identified. No new hydrologic or hydraulic modeling was completed for this analysis.

Many of the acclimation sites described in the EIS and identified in Section 2 of this report are located in or adjacent to special flood hazard areas designated Zone A on FEMA FIRMs. As such, these areas do not have BFEs determined. Although BFEs are not provided, the community (e.g., Chelan County or Okanogan County) is still responsible for ensuring that new development within "approximate" Zone A areas is constructed using methods that will minimize flood damages. Additionally, community floodplain management programs typically extend their regulations to all lands subject to inundation from any sources; this means that in order to obtain grading, building, development, or possibly conditional use permits for individual projects of the proposed action, these projects may be required to go through the floodplain development permit process. If it were determined that the floodplain development permit process is required, there would be a need for substantially more detailed analysis performed by a professional civil engineer to determine the BFEs in areas mapped Zone A or unmapped areas, as well as to perform an analysis of floodplain impacts. These additional analyses would possibly include hydrologic as well as hydraulic modeling and surveying. These detailed floodplain analyses are not part of this impact evaluation and are beyond the scope of the EIS.

4 EXISTING ENVIRONMENT

4.1 Regulatory Environment

4.1.1 Federal Rules and Regulations

4.1.1.1 Executive Order 11988 – Floodplain Management

Executive Order 11988 (EO) requires federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. In accomplishing this objective, "each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities" for the following actions:

- Acquiring, managing, and disposing of federal lands and facilities
- Providing federally-undertaken, financed, or assisted construction and improvements
- Conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing activities

The guidelines address an eight-step process that agencies should carry out as part of their decision-making on projects that have potential impacts to or within the floodplain. The eight steps, which are summarized below, reflect the decision-making process required in Section 2(a) of the EO.

1. Determine if a proposed action is in the base floodplain (that area with a 1 percent or greater chance of flooding in any given year).
2. Conduct early public review, including public notice.
3. Identify and evaluate practicable alternatives to locating in the base floodplain, including alternative sites outside of the floodplain.
4. Identify impacts of the proposed action.
5. If impacts cannot be avoided, develop measures to minimize the impacts and restore and preserve the floodplain, as appropriate.
6. Re-evaluate alternatives.

7. Present the findings and a public explanation.
8. Implement the action.

Among a number of things, the Interagency Task Force on Floodplain Management clarified the EO with respect to development in floodplains, emphasizing the requirement for agencies to select alternative sites for projects outside the floodplains, if practicable, and to develop measures to mitigate unavoidable impacts.

4.1.1.2 National Flood Insurance Program

Congress, alarmed by increasing costs of disaster relief, passed the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. The intent of these acts is to reduce the need for large, publicly funded flood control structures and disaster relief by restricting development on floodplains.

FEMA administers the National Flood Insurance Program (NFIP), which provides subsidized flood insurance to communities that comply with federal regulations that limit development in floodplains. The agency issues FIRMs for communities participating in the flood insurance program. These maps delineate flood hazard zones in the community.

The primary requirement for community participation in the NFIP is the adoption and enforcement of floodplain management regulations that meet the minimum standards of the NFIP regulations in Title 44 of the Code of Federal Regulations (CFR) Section 60.3. These minimum standards are also codified by the State of Washington as described in the following section.

Flood zones are geographic areas that FEMA has defined according to varying levels of flood risk. These zones are depicted on a community's FIRM or Flood Hazard Boundary Map. Each zone reflects the severity or type of flooding in the area.

4.1.1.2.1 Moderate to Low Risk Areas

Zones B, C, and X include areas outside the 1 percent annual chance floodplain; areas of 1 percent annual chance sheet flow flooding where average depths are less than 1 foot; areas of

1 percent annual chance stream flooding where the contributing drainage area is less than 1 square mile; or areas protected from the 1 percent annual chance flood by levees. No BFEs or depths are shown within this zone.

4.1.1.2.2 High Risk Areas

Zone A includes areas with a 1 percent annual chance of flooding. Because detailed analyses are not performed for such areas, no depths or BFEs are shown within these zones.

Zones AE and A1-A30 include areas with a 1 percent annual chance of flooding. In most instances, BFEs derived from detailed analyses are shown at selected intervals within these zones.

Zone AH includes areas with a 1 percent annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. BFEs derived from detailed analyses are shown at selected intervals within these zones.

Zone AO includes river or stream flood hazard areas, and areas with a 1 percent or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. Average flood depths derived from detailed analyses are shown within these zones.

Zone AR includes areas with a temporarily increased flood risk due to the building or restoration of a flood control system (such as a levee or a dam).

Zone A99 includes areas with a 1 percent annual chance of flooding that will be protected by a federal flood control system where construction has reached specified legal requirements. No depths or BFEs are shown within these zones.

4.1.1.2.3 Undetermined Risk Areas

Zone D includes areas with possible but undetermined flood hazards, and no flood hazard analysis has been conducted. Flood insurance rates are commensurate with the uncertainty of the flood risk.

4.1.2 State Rules and Regulations

Chapter 86.16 Revised Code of Washington (RCW) establishes state-wide authority for floodplain management through the adoption and administration by local governments of regulatory programs that are compliant with the minimum standards of the NFIP. Chapter 86.16 RCW directs the Washington State Department of Ecology (Ecology) to establish minimum state requirements for floodplain management that equal the NFIP minimum standards; to provide technical assistance and information to local governments related to administration of their floodplain management ordinances and the NFIP; to provide assistance to local governments in identifying the location of the 100-year (base) floodplain; and to allow for the issuance of regulatory orders.

Floodplains are also regulated by both the Ecology and the Department of Commerce (Commerce) via the Shoreline Management Act of 1971 (SMA) and the Growth Management Act of 1990 (GMA), respectively. The SMA Guidelines translate the broad policies of RCW 90.58.020 into standards for regulation of shoreline uses including the floodplains of larger rivers.

Commerce regulates floodplain development through the GMA. Local governments, counties, and cities must develop Comprehensive Plans that guide and regulate development in the community. The GMA requires local communities to develop and implement Critical Areas Ordinances; floodplains are one such critical area.

The state agencies provide guidelines to local agencies and provide oversight to ensure that the minimum standards set forth in the rules and regulations are implemented at the local level.

4.1.3 Local Rules and Regulations

As described previously, the primary requirement for community participation in the NFIP is the adoption and enforcement of floodplain management regulations that meet the minimum standards. The intent of floodplain management regulations is to minimize the potential for flood damages to new construction and to avoid aggravating existing flood hazard conditions that could increase potential flood damages to existing structures.

4.1.3.1 Chelan County

Chelan County Code "Chapter 3.20 Flood Hazard Development" regulates development in flood prone areas of the county (Chelan County 2009). The ordinance prohibits development within the floodway, but allows development in the floodplain outside the floodway, as long the cumulative effect of the proposed and existing development does not increase water surface elevation of the BFE by more than 1 foot at any point. Special provisions apply for impacts inside the FEMA-designated shallow flooding areas (Zones AH and AO), where developments are allowed but restricted. The ordinance does not impose any restriction on a development in the FEMA-designated Zone X. Generally, Chelan County relies on the most recent FIRMs published by FEMA to designate areas of special flood hazard. When BFE data have not been provided or flood hazard areas established, the Chelan County shall obtain, review, and reasonably use any BFE data and floodway data available from federal, state, or other sources, in order to administer the development standards. Topographic data and hydrologic and hydraulic analyses by a professionally licensed surveyor and/or professionally licensed engineer are required to determine the BFE and floodway for a development permit.

4.1.3.2 Okanogan County

Okanogan County Code "Chapter 15.08 Floodplain Management" regulates development in flood prone areas of the county (Okanogan County 2008). The ordinance prohibits development within the floodway, but allows development in the floodplain outside the floodway, as long the cumulative effect of the proposed and existing development does not increase water surface elevation of the BFE by more than 1 foot at any point. Special provisions apply for impacts inside the FEMA-designated shallow flooding areas (Zones AH and AO), where developments are allowed but restricted. The ordinance does not impose any restriction on a development in the FEMA-designated Zone X. Generally, Okanogan County relies on the most recent FIRMs published by FEMA to designate areas of special flood hazard, but the best available information shall be used if these maps are not available or sufficient as required by the State of Washington (RCW 86.16.051). Topographic data and hydrologic and hydraulic analyses by a professionally licensed surveyor and/or professionally licensed engineer are required for development in non-detailed study areas (Zone A).

4.2 Existing Flood Information

4.2.1 Wenatchee Subbasin Primary Sites

The climate of Wenatchee subbasin is characterized by warm, dry summers and relatively cold winters. The average annual precipitation in the lower elevations is just greater than 11 inches, increasing with elevation to about 35 inches. The bulk of this precipitation falls as snow, which reaches 100 inches or more in the upper watersheds. The Wenatchee River and other perennial streams follow an annual cycle with peak stream flow in April and May and low stream flow in August and September. Normally, stream flow in many of the smaller drainages is seasonally intermittent, while drainages in lower elevations are often dry (Chelan County Department of Emergency Management 2006).

Two types of flooding common in the basin are stage and flash flooding. Stage flooding is usually seen during periods of heavy rains, especially upon existing snow packs during early winter and late spring. Stage flooding problem areas occur along the Wenatchee River near its confluence with Icicle Creek, the headwaters of the Wenatchee River, and the confluence area of the Wenatchee River (Chelan County Department of Emergency Management 2006).

Flash floods are more likely to occur during the summer months, in thunderstorm season. The primary cause of flash flooding, which can occur in any drainage area in the county, is high-intensity rainfall. Although infrequent, and usually of short duration, high-intensity rainfall has been seen in all seasons in the past. Depending upon the characteristics of a particular watershed, peak flows may be reached from less than 1 hour to several hours after rain begins. The debris flows and mudslides accompanying rapid runoff conditions make narrow canyons and alluvial fans at the mouths of the canyons extremely hazardous areas (Chelan County Department of Emergency Management 2006).

The most recent floodplain mapping information is available from the FEMA Flood Insurance Study (FIS) for Chelan County, Washington (FEMA 2004a) and the associated FIRMs. The following sections provide a brief narrative describing the location of each project site with respect to mapped floodplains as well as identifying the FIRM panel and effective date; the special flood hazard zone, if any; BFEs, if any; stream gage information that could be used to extrapolate the BFE, if any; and potential sources of additional information, which are typically county road crossings immediately upstream or downstream of the project that may have hydrologic and hydraulic data that were used in the crossing design.

Table 1 lists all the Wenatchee subbasin acclimation sites, the floodplain development activities associated with each project, and the likely need for a floodplain development permit. As stated previously, where the floodplain development permit process is required, there would be a need for a professional civil engineer to perform substantially more detailed analysis of floodplain impacts. These detailed floodplain analyses are not part of this impact evaluation and are beyond the scope of the EIS.

Table 1
Wenatchee Acclimation Sites with Floodplain Development Activities

Wenatchee River Subbasin, in Chelan County, Washington		
Site	**Development Activities in Floodplain**	**Floodplain Development Permit Required**
Butcher	Excavation of an open channel	Yes
Tall Timber	Excavation of Napeequa River bank and pipeline corridor	Yes
Chikamin	Excavation of a pond, Chikamin Creek bank, open channel, and pipeline corridor	Yes
Minnow	Excavation of bed and banks of Minnow Creek	Yes
Scheibler	Excavation of bed and bank of Chumstick Creek	Yes
Coulter	None	No
Rohlfing	None	No
White River Springs	None	No
Dirty Face	None	No
Two Rivers	None	No
Clear	None	No
Beaver	None	No
Brender	None	No
Leavenworth National Fish Hatchery	None	No
Squadroni	Excavation of pond and open channels	Yes
Dryden	Possible development of water quality treatment wetlands	Maybe

Wenatchee River Subbasin, in Chelan County, Washington		
Site	**Development Activities in Floodplain**	**Floodplain Development Permit Required**
Allen	None	No
Coulter/Roaring	None	No
McComas	None	No
George	Excavation and construction of a fish hatchery and associated facilities	Yes

4.2.1.1 Butcher

The Butcher site is located on Butcher Creek at its confluence with Nason Creek and lies just north of Highway 2. The property is in the 100-year floodplain, designated as Zone AH by FEMA (FEMA 1989b). It appears that the primary source of flooding is backwater from Nason Creek.

- Potential Sources of Flooding: Butcher Creek and Nason Creek
- FIRM: 530015 0775 B June 5, 1989 (Figure 1; FEMA 1989b)
- Special Flood Hazard Area (SFHA): AH
- BFE: 2,140-2,141 feet (National Geodetic Vertical Datum of 1929 [NGVD29])
- Stream Gage Data: None
- Potential Sources of Supplemental Information: Washington State Department of Transportation (WSDOT) – State Route (SR) 2 Crossing of Nason Creek; Chelan County Public Works – Nason Ridge Road crossing of Nason and Butcher Creeks

4.2.1.2 Tall Timber

The Tall Timber site is located on the Napeequa River near its confluence with the White River. FEMA has designated a special flood hazard area along the White River (Zone A) that extends upstream of this confluence (FEMA 1989a). The site is located outside the special flood hazard area.

- Potential Sources of Flooding: Napeequa River
- FIRM: 530015 0750 B June 5, 1989 (Figure 2; FEMA 1989a)
- SFHA: None
- BFE: None

- Stream Gage Data: None
- Potential Sources of Supplemental Information: Chelan County Public Works – County Road 167 crossing of Napeequa River

4.2.1.3 Chikamin

The Chikamin site is along Chikamin Creek, which is a tributary of the Chiwawa River. Chikamin Creek will supply water to the Chikamin Pond, which would be located in the right floodplain of Chikamin Creek. FEMA has not determined the 100-year special flood hazard areas on the Chiwawa River in the vicinity of the site.

- Potential Sources of Flooding: Chikamin and Minnow Creeks
- FIRM: None
- SFHA: None
- BFE: None
- Stream Gage Data: None
- Potential Sources of Supplemental Information: Chelan County Public Works – Chikamin Ridge Road crossing of Minnow Creek and Chiwawa River Road crossing of Chikamin Creek

4.2.1.4 Minnow

The Minnow site is along Minnow Creek South, which is tributary to Chikamin Creek. The outflow from a complex of beaver ponds located on Minnow Creek just downstream of the Chikamin Ridge Road crossing is conveyed by two creeks: Minnow Creek North and Minnow Creek South. Minnow Creek North discharges directly to the Chiwawa River. Minnow Creek South flows into Chikamin Creek. Minnow Pond is planned on Minnow Creek South before its confluence with Chikamin Creek. FEMA has not determined the 100-year special flood hazard areas on the Chiwawa River in the vicinity of the site.

- Potential Sources of Flooding: Chikamin and Minnow Creeks
- FIRM: None
- SFHA: None
- BFE: None
- Stream Gage Data: None

- Potential Sources of Supplemental Information: Chelan County Public Works – Chikamin Ridge Road crossing of Minnow Creek and Chiwawa River Road crossing of Chikamin Creek

4.2.1.5 Scheibler

The Scheibler site is located on Chumstick Creek, 8 miles upstream of its confluence with the Wenatchee River. FEMA has not studied or produced a floodplain map of this reach of the creek. It appears that the site is about 2,000 feet upstream of the limits of the FIS, where a BFE of 1,609 feet (NGVD29) was established.

- Potential Sources of Flooding: Chumstick Creek
- FIRM: 530015 0775 B June 5, 1989 (Figure 3; FEMA 1989b)
- SFHA: None
- BFE: None
- Stream Gage Data: None
- Potential Sources of Supplemental Information: Chelan County Public Works – Chumstick Road crossing of Chumstick Creek

4.2.1.6 Coulter

The Coulter site is located on a parcel of rural residential property adjacent to Coulter Creek, approximately 1,500 feet upstream from its confluence with Nason Creek. The property is in the 100-year floodplain, designated as Zone AH by FEMA (FEMA 1989b). It appears that the source of flooding may either be backwater from Nason Creek or undersized culverts through the railroad grade resulting in flooding from the combined flows of Coulter and Roaring Creeks.

- Potential Sources of Flooding: Coulter, Roaring, and Nason Creeks
- FIRM: 530015 0775 B June 5, 1989 (Figure 1; FEMA 1989b)
- SFHA: AH
- BFE: 2,142 feet (NGVD29)
- Stream Gage Data: None
- Potential Sources of Supplemental Information: WSDOT – SR 2 Crossing of Nason Creek; Chelan County Public Works – Coulter Creek Road crossings of Coulter and

Roaring Creeks, W. Dardenells Road crossing of Coulter Creek

4.2.1.7 Rohlfing

The Rohlfing site is located on an unnamed seasonal stream that discharges into Nason Creek, near its confluence with Mahar Creek. FEMA has designated the 100-year floodplain of Nason Creek as Zone A3 in the vicinity of the site. The proposed site is located outside the special flood hazard area (Zone A3)

- Potential Sources of Flooding: Unnamed Creek and Nason Creek
- FIRM: 530015 0750 B June 5, 1989 (Figure 4; FEMA 1989a)
- SFHA: None
- BFE: 2,230 feet (NGVD29)
- Stream Gage Data: None
- Potential Sources of Supplemental Information: Chelan County Public Works – White Pine Road crossing of unnamed tributary

4.2.1.8 White River Springs

The White River Springs site is located along the left bank of the White River (River Mile [RM] 8) downstream of the confluence of two unnamed creeks. The property is in the 100-year floodplain, designated as Zone A by FEMA (FEMA 1989a). It appears that the White River is the source of flooding.

- Potential Sources of Flooding: White River
- FIRM: 530015 0750 B June 5, 1989 (Figure 2; FEMA 1989a)
- SFHA: A
- BFE: None
- Stream Gage Data: U.S. Geological Survey (USGS) gage 12454000
- Potential Sources of Supplemental Information: Chelan County Public Works – County Road 167 intersection with National Forest Development Road (NFDR) 6434; U.S. Forest Service – NFDR 6435 crossing of the White River

4.2.1.9 Dirty Face

The Dirty Face site is located at the confluence of Dirty Face Creek and White River (near RM 7). The property is in the 100-year floodplain, designated as Zone A by FEMA (FEMA 1989a). It appears that the White River is the source of flooding.

- Potential Sources of Flooding: White River
- FIRM: 530015 0750 B June 5, 1989 (Figure 2; FEMA 1989a)
- SFHA: A
- BFE: None
- Stream Gage Data: USGS gage 12454000
- Potential Sources of Supplemental Information: Chelan County Public Works – County Road 167 crossing of Dirty Face Creek; U.S. Forest Service – NFDR 6435 crossing of the White River

4.2.1.10 Two Rivers

The Two Rivers site is located on the left overbank of Little Wenatchee River, approximately 1.5 miles upstream of its mouth at Lake Wenatchee. The site has been recently used as a gravel pit and settling basin. The property is in the 100-year floodplain, designated as Zone A by FEMA (FEMA 1989a). It appears that the site may be subject to flooding from either the Little Wenatchee River or Lake Wenatchee as a result of high flows in the White River and Little Wenatchee River.

- Potential Sources of Flooding: Little Wenatchee River, White River, Lake Wenatchee
- FIRM: 530015 0750 B June 5, 1989 (Figure 5; FEMA 1989a)
- SFHA: A
- BFE: None
- Stream Gage Data: None
- Potential Sources of Supplemental Information: Chelan County Public Works – Little Wenatchee River Road

4.2.1.11 Clear

The Clear site is located on Clear Creek, a tributary of the Chiwawa River, approximately 1/2 mile upstream of its confluence. There is no designated floodplain (FEMA 1989c).

- Potential Sources of Flooding: Clear Creek
- FIRM: 530015 0575 B June 5, 1989 (Figure 6; FEMA 1989c)
- SFHA: None
- Stream Gage Data: None
- Potential Sources of Supplemental Information: Chelan County Public Works – Chiwawa River Road crossing of Clear Creek

4.2.1.12 Beaver

The Beaver site is located on Beaver Creek, approximately 1/2 mile upstream of its confluence with the Wenatchee River. The site is outside the designated floodplain (FEMA 1989c).

- Potential Sources of Flooding: Beaver Creek
- FIRM: 530015 0575 B June 5, 1989 (Figure 6; FEMA 1989c)
- SFHA: None
- BFE: None
- Stream Gage Data: None
- Potential Sources of Supplemental Information: Chelan County Public Works – Chiwawa River Road crossing of Beaver Creek

4.2.1.13 Brender

The Brender site is located on Brender Creek near the town of Cashmere. Brender Creek flows into Mission Creek, a tributary to the Wenatchee River (RM 10). The site is outside the designated floodplain (FEMA 2004c).

- Potential Sources of Flooding: Brender Creek
- FIRM: 53001502763 D September 30, 2004 (Figure 7; FEMA 2004c)
- SFHA: None
- BFE: None
- Stream Gage Data: None
- Potential Sources of Supplemental Information: Chelan County Public Works – Kimber Road or Evergreen Drive crossings of Brender Creek

4.2.1.14 Leavenworth NFH

The Leavenworth NFH site is located at the existing U.S. Fish and Wildlife Service (USFWS) hatchery on Icicle Creek, tributary to Wenatchee River, south of Leavenworth. The hatchery is outside the special flood hazard area (Zone AE). The Icicle Creek BFE just downstream of the hatchery was estimated at 1,122 feet NGVD (FEMA 2002b).

- Potential Sources of Flooding: Icicle Creek
- FIRM: 530015 0787 B July 2, 2002 (Figure 8; FEMA 2002b)
- SFHA: None
- BFE: 1,122 feet (NGVD29)
- Stream Gage Data: USGS gage 12458000
- Potential Sources of Supplemental Information: USFWS

4.2.2 Wenatchee Subbasin Back-up Sites

4.2.2.1 Squadroni

The Squadroni site is located adjacent to Nason Creek, near its confluence with Gill Creek. FEMA has designated the 100-year floodplain of Nason Creek as Zone A3 in the vicinity of the site (FEMA 1989a). The proposed site is located outside the special flood hazard area (Zone A3)

- Potential Sources of Flooding: Nason Creek
- FIRM: 530015 0750 B June 5, 1989 (Figure 1; FEMA 1989a)
- SFHA: None
- BFE: 2,156 feet (NGVD29)
- Stream Gage Data: None
- Potential Sources of Supplemental Information: Chelan County Public Works – Gill Creek Road crossing of Nason Creek

4.2.2.2 Dryden

The Dryden site is on Peshastin Creek near its confluence with the Wenatchee River. Evaluation of flow and water surface elevation at the Dryden site is provided in a separate document *Flood Evaluation Near Dryden Dam* (Appendix 8.1). FEMA has designated a special flood hazard area along Peshastin Creek (Zone A).

- Potential Sources of Flooding: Peshastin Creek and Wenatchee River
- FIRM: 530015 2740 D September 30, 2004 (Figure 9)
- SFHA: A
- BFE: 990 feet (NGVD29)
- Stream Gage Data: None
- Potential Sources of Supplemental Information: *Flood Evaluation near Dryden Dam* (Appendix 8.1)

4.2.2.3 Allen

The Allen site is located west of Peshastin Creek, just upstream of the confluence with Allen Creek. The site is outside the designated floodplain (FEMA 2004b).

- Potential Sources of Flooding: Peshastin Creek
- FIRM: 530015 0800D September 30, 2004 (Figure 10; FEMA 2004b)
- SFHA: AH
- BFE: None
- Stream Gage Data: None
- Potential Sources of Supplemental Information: Chelan County Public Works – Development permits for properties on Hansel and Allen Lanes

4.2.2.4 Coulter/Roaring

The Coulter/Roaring site is located on Roaring Creek near its confluence with Coulter Creek, which then discharges to Nason Creek. The property is in the 100-year floodplain, designated as Zone AH by FEMA (FEMA 1989b). It appears that the source of flooding may be either back water from Nason Creek or undersized culverts through the railroad grade resulting in flooding from the combined flows of Coulter and Roaring Creeks.

- Potential Sources of Flooding: Roaring, Coulter, and Nason Creeks
- FIRM: 530015 0775 B June 5, 1989 (Figure 1; FEMA 1989b)
- SFHA: AH
- BFE: 2,142 feet (NGVD29)
- Stream Gage Data: None
- Potential Sources of Supplemental Information: WSDOT – SR 2 Crossing of Nason

Creek; Chelan County Public Works – Coulter Creek Road crossings of Coulter and Roaring Creeks

4.2.2.5 McComas

The McComas site is located on the left overbank of White River near the confluence of Siverly Creek, approximately 1 mile upstream of its mouth at Lake Wenatchee. The property is in the 100-year floodplain, designated as Zone A by FEMA (FEMA 1989a). It appears that the site may be subject to flooding from either the White River or Lake Wenatchee as a result of high flows in the White River and Little Wenatchee River.

- Potential Sources of Flooding: Little Wenatchee River, White River, Lake Wenatchee
- FIRM: 530015 0750 B June 5, 1989 (Figure 5; FEMA 1989a)
- SFHA: A
- BFE: None
- Stream Gage Data: None
- Potential Sources of Supplemental Information: Chelan County Public Works – Little Wenatchee River Road crossing of the White River

4.2.2.6 George

The George site is located on the right overbank of the Wenatchee River. The property is in the 100-year floodplain, designated as Zone A3 by FEMA (FEMA 1989c). It appears that the site is subject to flooding from the Wenatchee River.

- Potential Sources of Flooding: Wenatchee River
- FIRM: 530015 0575B June 5, 1989 (Figure 6; FEMA 1989c)
- SFHA: A3
- BFE: 1871 feet (NGVD1929)
- Stream Gage Data: USGS 12455000, Wenatchee River below Wenatchee Lake, and 12457000, Wenatchee River at Plain
- Potential Sources of Supplemental Information: WSDOT – State Route 207 crossing of the Wenatchee River

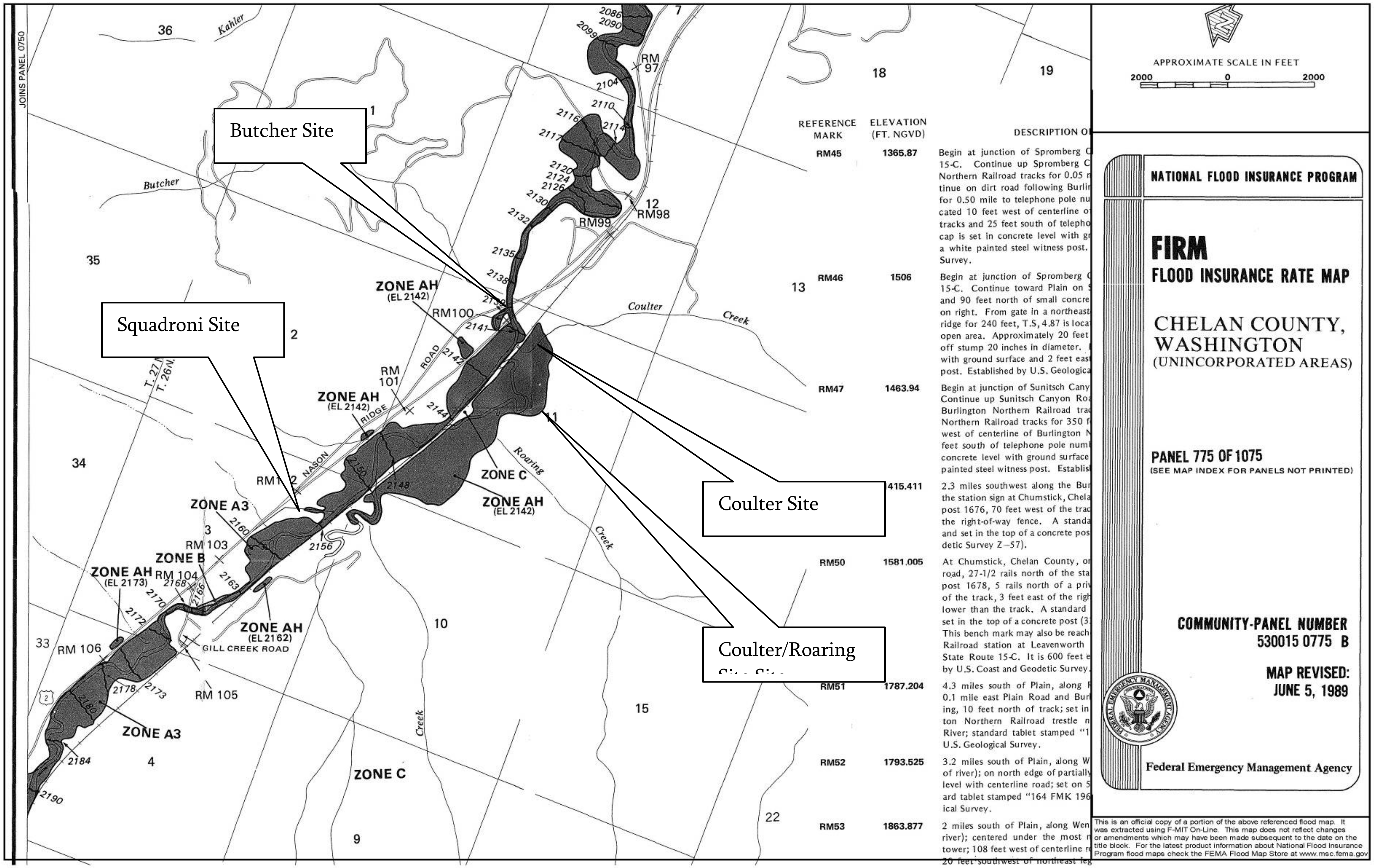

Figure 1

FIRM 530015 0775 B – June 5, 1989; Butcher, Coulter, Squadroni, and Coulter/Roaring Sites

Flood Impact Analysis

Mid-Columbia Coho Restoration Project

ANCHOR QEA

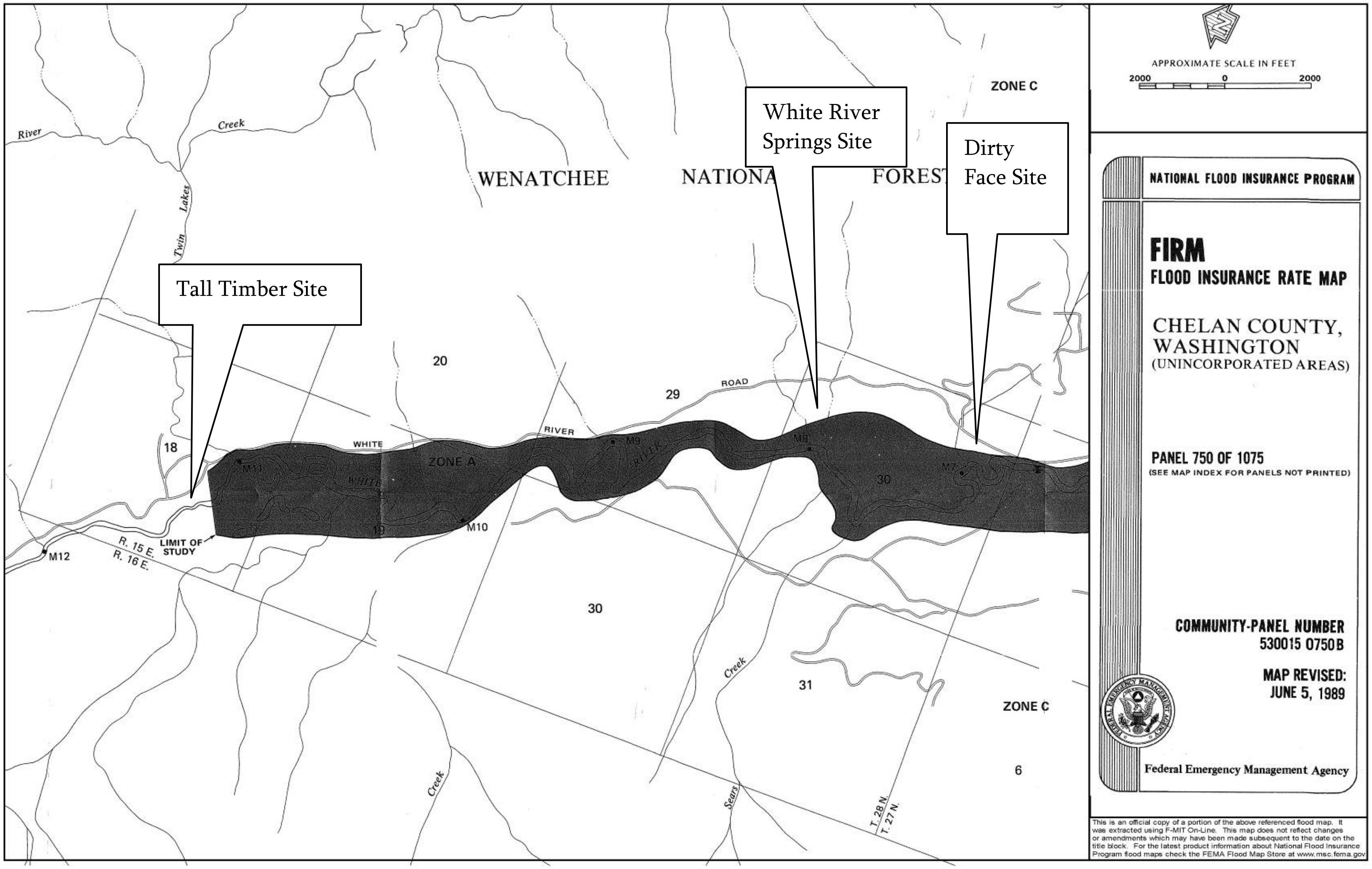

Figure 2

F FIRM 530015 0750 B – June 5, 1989; Tall Timber, White River Springs, and Dirty Face Sites

Flood Impact Analysis

Mid-Columbia Coho Restoration Project

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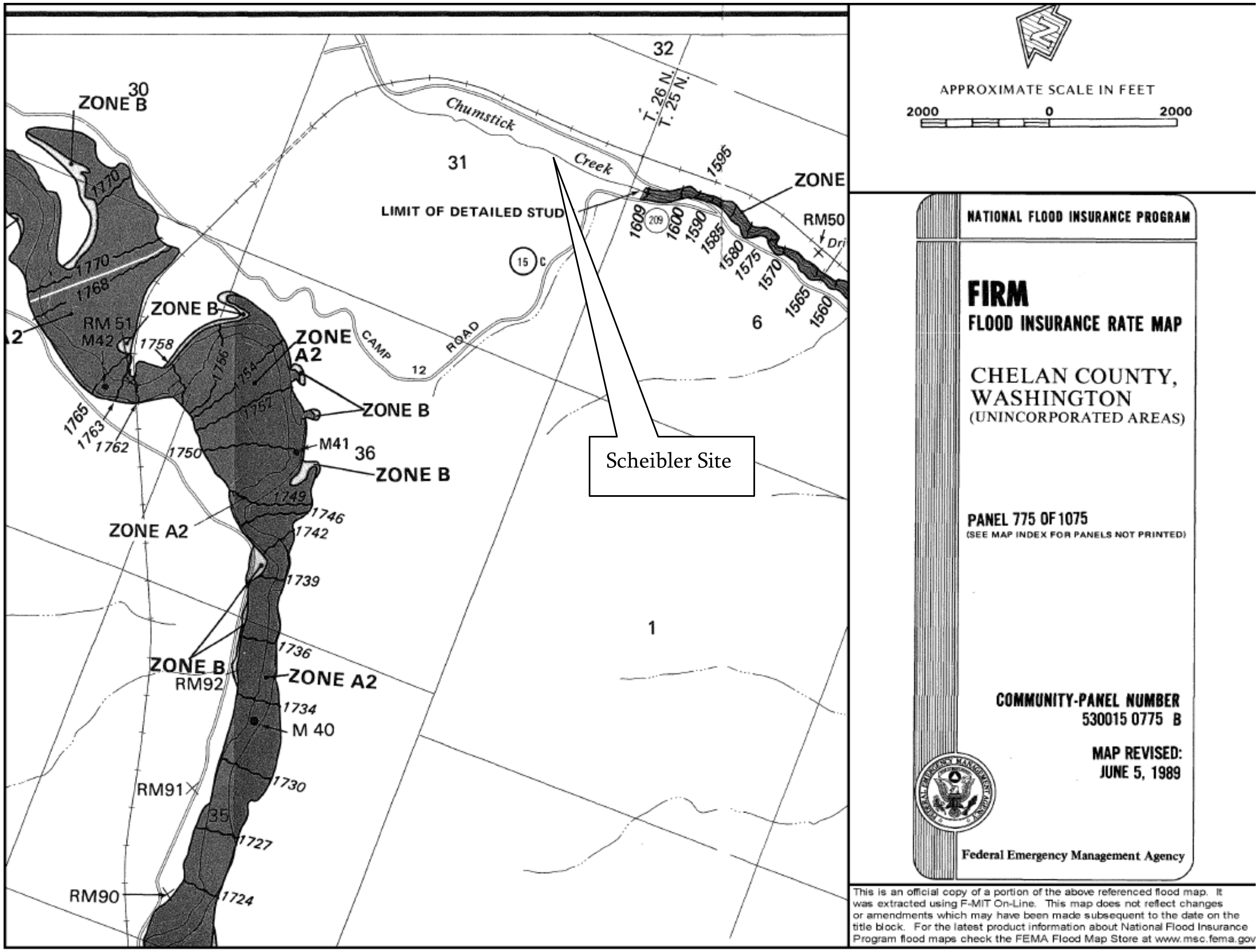

ANCHOR QEA

Figure 3

FIRM 530015 0775B – June 5, 1989; Scheibler Site

Flood Impact Analysis

Mid-Columbia Coho Restoration Project

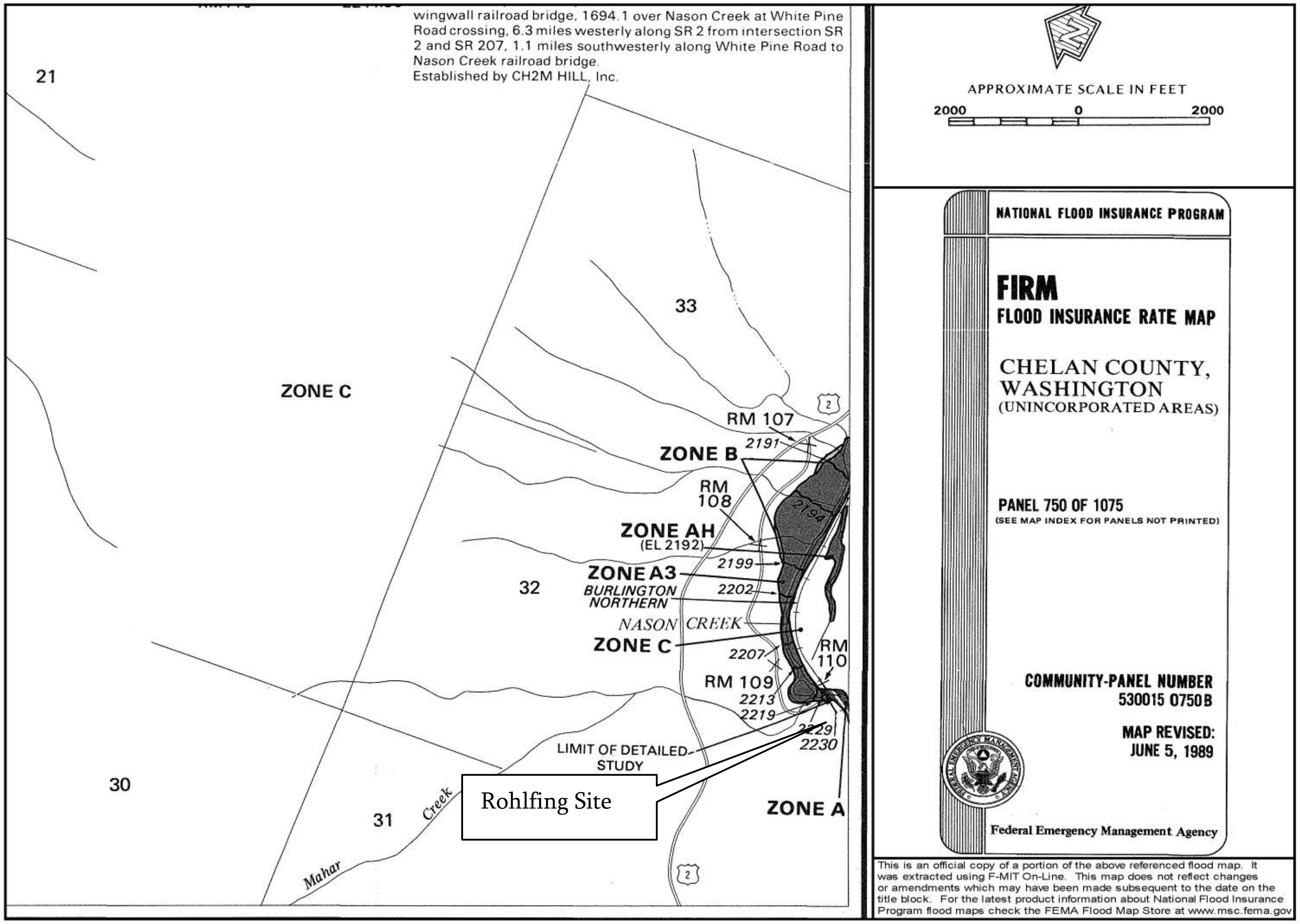

Figure 4
FIRM 530015 0750 B – June 5, 1989; Rohlfing Site
Flood Impact Analysis
Mid-Columbia Coho Restoration Project

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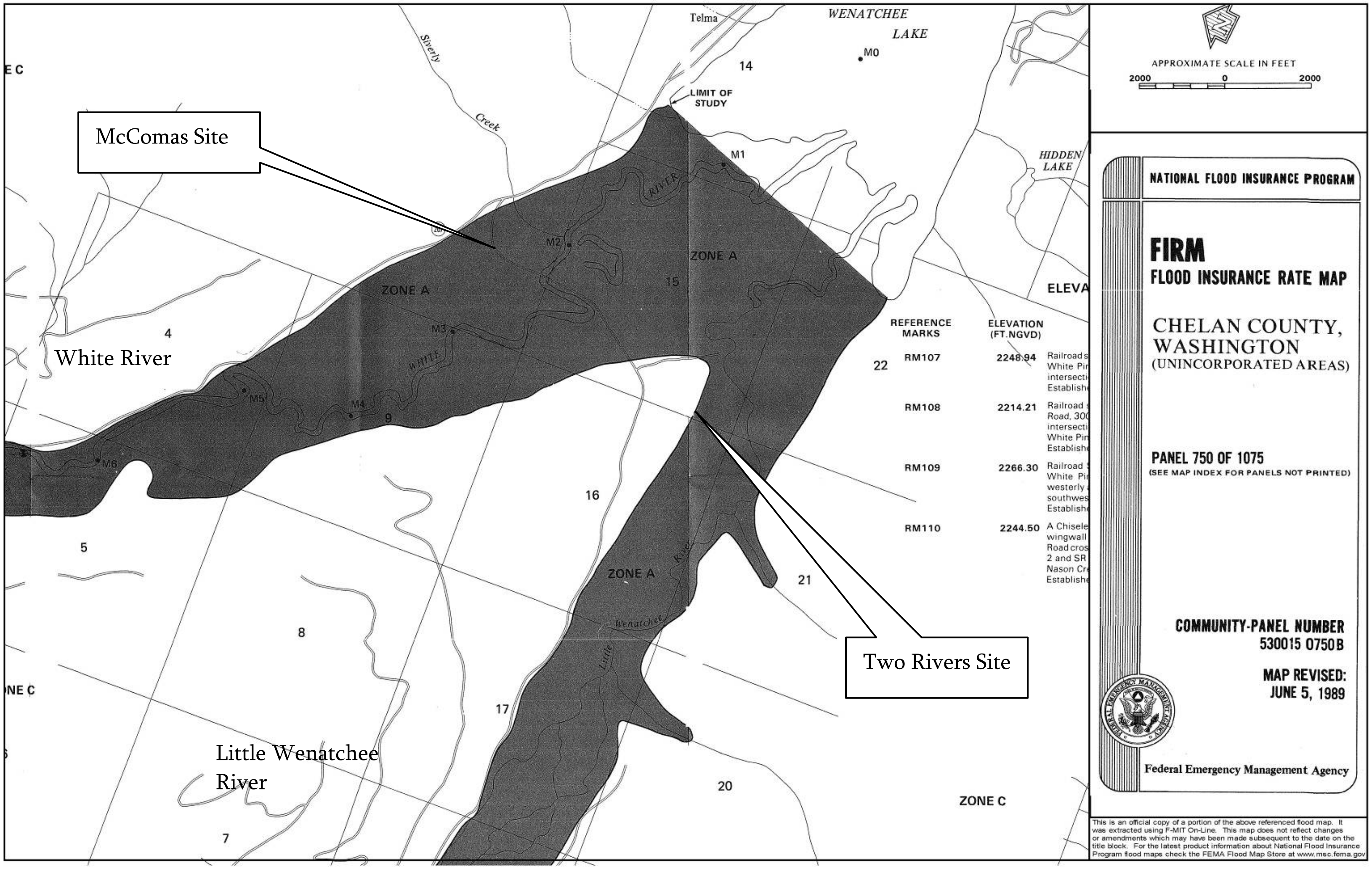

Figure 5

FIRM 530015 0750 B – June 5, 1989; Two Rivers and McComas Sites

Flood Impact Analysis

Mid-Columbia Coho Restoration Project

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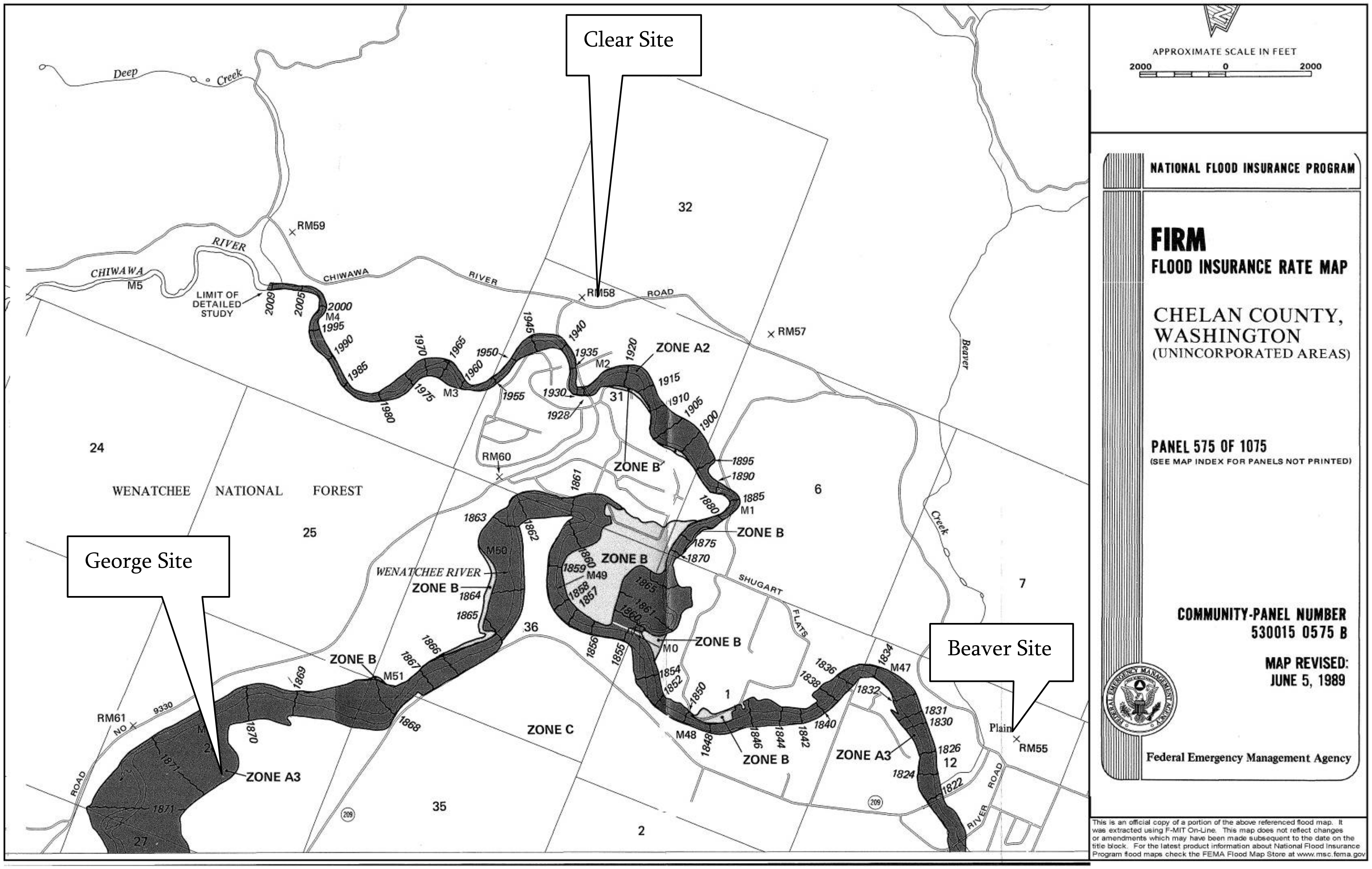

Figure 6

FIRM 530015 0575 B – June 5, 1989; Clear, Beaver, and George Sites

Flood Impact Analysis

Mid-Columbia Coho Restoration Project

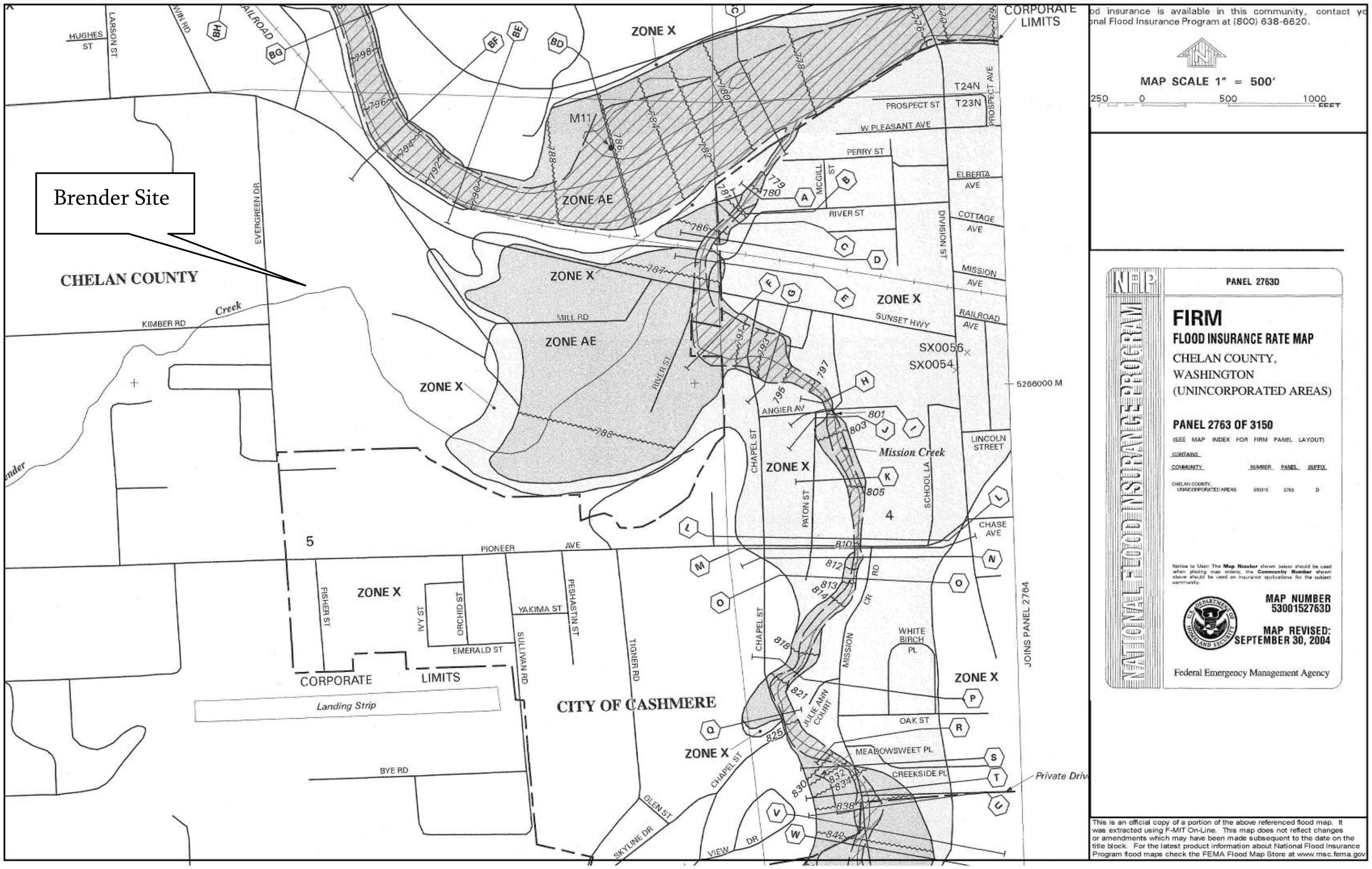

Figure 7

FIRM 53001502763 D – September 30, 2004; Brender Site
Flood Impact Analysis
Mid-Columbia Coho Restoration Project

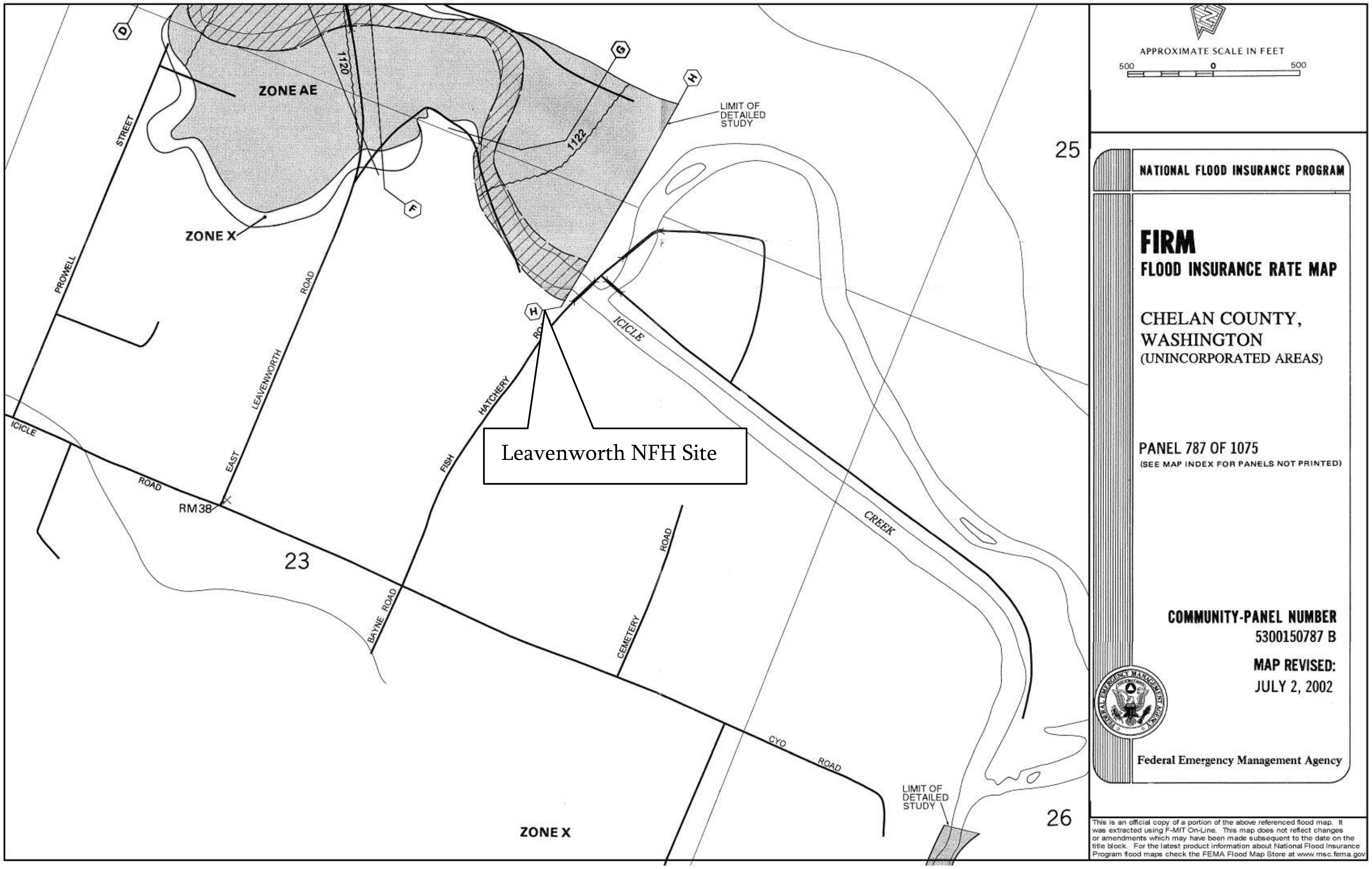

Figure 8
FIRM 530015 0787 B – July 2, 2002; Leavenworth NFH Site
Flood Impact Analysis
Mid-Columbia Coho Restoration Project

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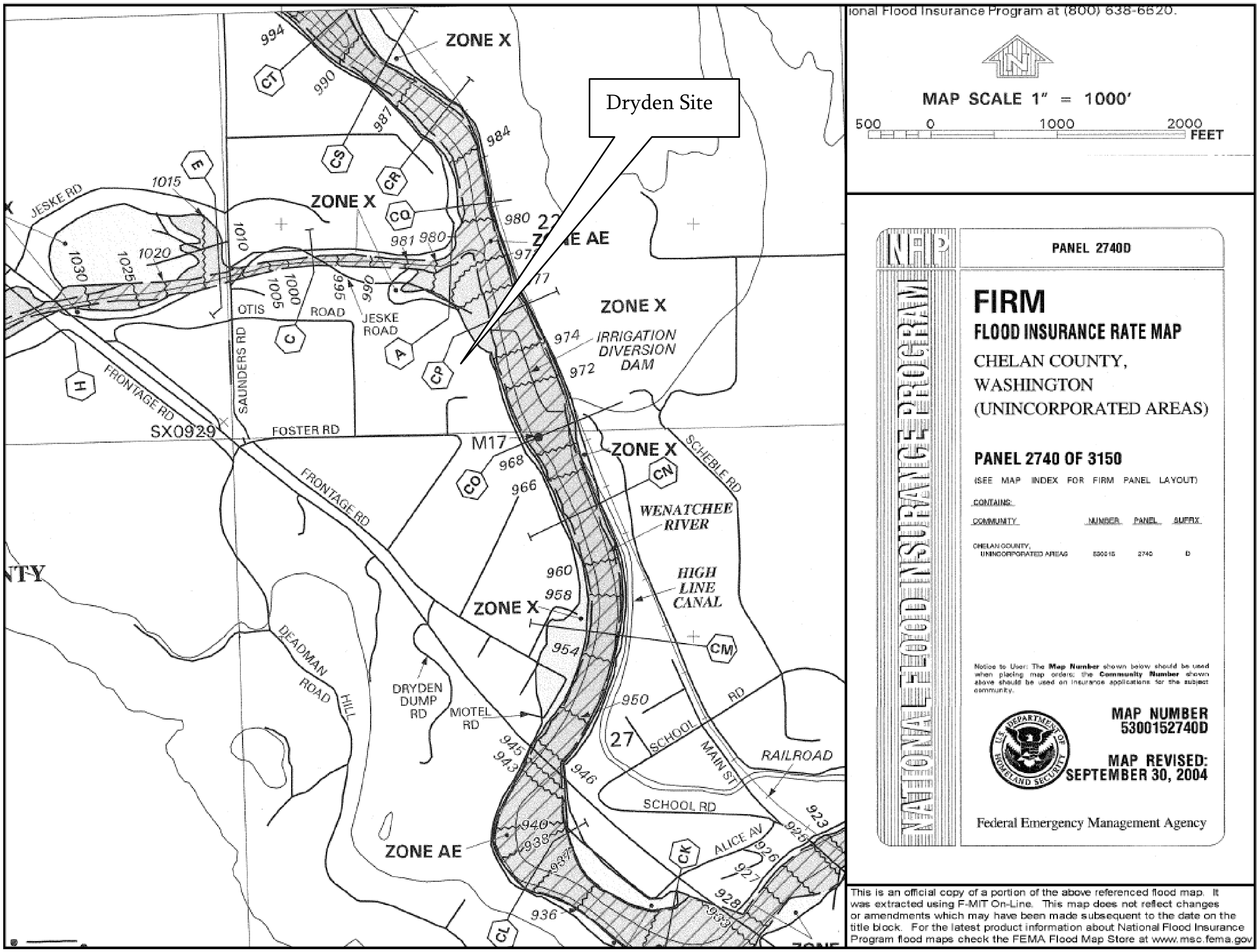

Figure 9
FIRM 5300152740D – September 30, 2004; Dryden Site
Flood Impact Analysis
Mid-Columbia Coho Restoration Project

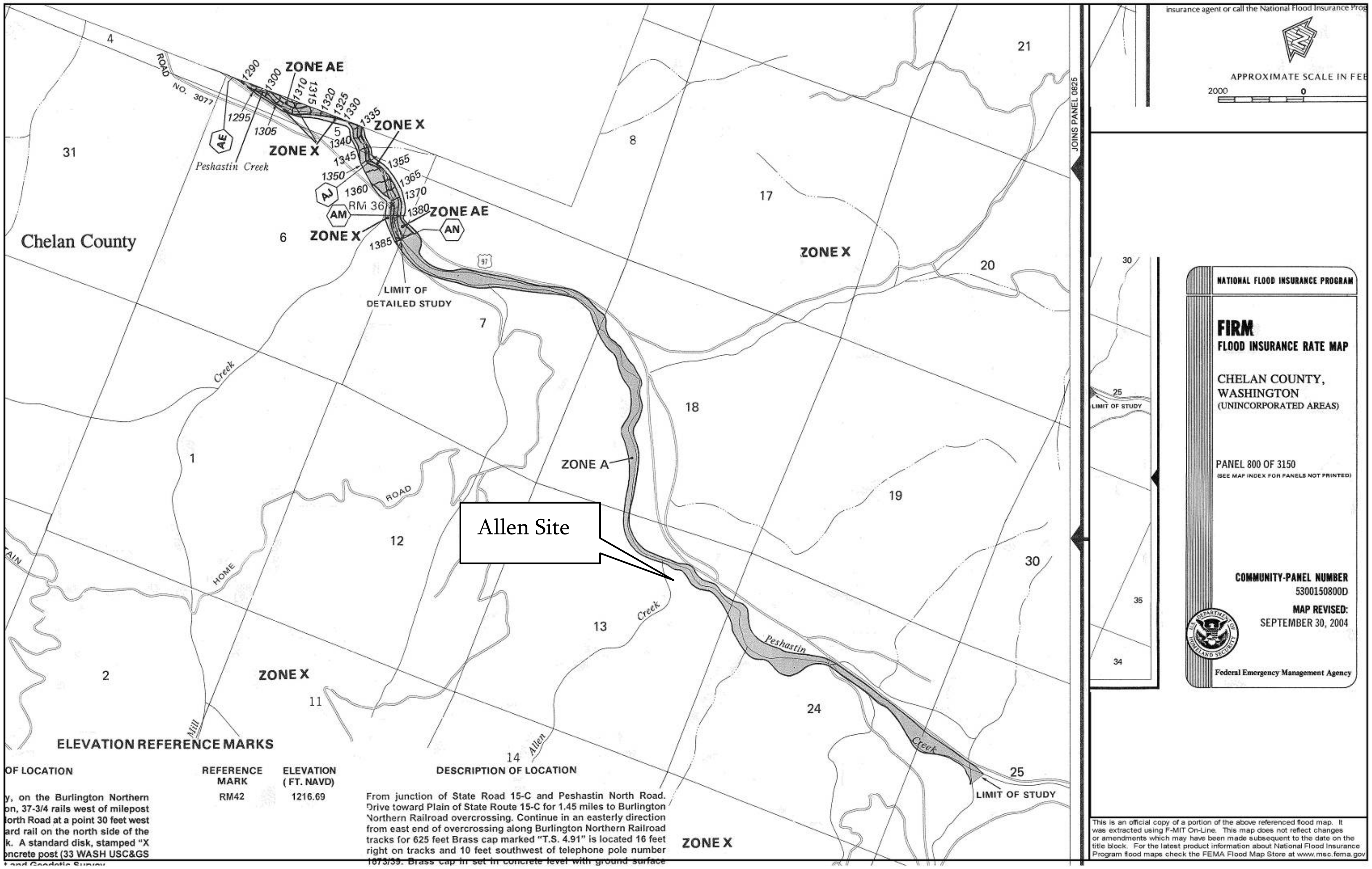

Figure 10
FIRM 530015 0800D – September 30, 2004; Allen Site
Flood Impact Analysis
Mid-Columbia Coho Restoration Project

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4.2.3 Methow Subbasin Primary Sites

The climate of Methow River subbasin is characterized by warm, dry summers and relatively cold winters. The average annual precipitation in the lower elevations is just greater than 11 inches, increasing with elevation to about 35 inches. The bulk of this precipitation falls as snow, which reaches 100 inches or more in the upper watersheds. The Methow River and other perennial streams follow an annual cycle with peak stream flow in April and May and low stream flow in August and September. Normally, stream flow in many of the smaller drainages is seasonally intermittent, while drainages in lower elevations are often dry (Okanogan County Department of Emergency Management 2009).

Two types of flooding common in the basin are stage and flash flooding. Stage flooding is usually seen during periods of heavy rains, especially upon existing snow packs during early winter and late spring. Stage flooding problem areas occur along the Methow River, especially where the Twisp River and Chewuch River join (Okanogan County Department of Emergency Management 2009).

Flash floods are more likely to occur during the summer months, in thunderstorm season. The primary cause of flash flooding, which can occur in any drainage area in the county, is high-intensity rainfall. Although infrequent, and usually of short duration, high-intensity rainfall has been seen in all seasons in the past. Depending upon the characteristics of a particular watershed, peak flows may be reached from less than 1 hour to several hours after rain begins. The debris flows and mudslides accompanying rapid runoff conditions make narrow canyons and alluvial fans at the mouths of the canyons extremely hazardous areas. Present problem areas for flash flooding include drainages in the Methow/Twisp area where forest fires occurred in the recent past (Okanogan County Department of Emergency Management 2009).

The most recent floodplain mapping information for the Methow subbasin sites was available from the FEMA FIS for Okanogan County, Washington (FEMA 2003), and the associated FIRMs. The following sections provide a brief narrative describing the location of each project site with respect to mapped floodplains as well as identifying the FIRM panel and effective date; the special flood hazard zone, if any; BFEs, if any; stream gage information that could be used to extrapolate the BFE, if any; and potential sources of additional information, which are typically county road crossings immediately upstream or downstream of the project that may have hydrologic and hydraulic data that were used in the crossing design.

Table 2 lists all the Methow subbasin acclimation sites, the floodplain development activities associated with each project, and the likely need for a floodplain development permit. As stated previously, where the floodplain development permit process is required, there would be a need for substantially more detailed analysis performed by a professional civil engineer to perform an analysis of floodplain impacts. These detailed floodplain analyses are not part of this impact evaluation and are beyond the scope of the EIS.

Table 2

Methow Acclimation Sites with Floodplain Development Activities

Methow River Subbasin, in Okanogan County, Washington		
Site	**Development Activities in Floodplain**	**Floodplain Development Permit Required**
Methow State Wildlife Area - Eightmile	None	No
Mason (Eightmile)	None	No
Lincoln	Excavation of an open channel and pipeline corridor	Yes
Twisp Weir	Excavation of pond and pipeline corridor	Yes
Gold	None	No
Goat Wall	None	No
Pete Creek Pond	None	No
Heath	None	No
Parmley	None	No
Lower Twisp	None	No
Hancock	None	No
Winthrop National Fish Hatchery	None	No
Methow Salmon Recovery Foundation - Lower Chewuch	Excavation of a pond and open channels	Yes
Chewuch Acclimation Facility	Excavation of the Chewuch River bank, pond and pipeline corridors	Yes
Canyon	None	No
Utley	Excavation of outlet channel to the Twisp River	Yes
Newby	Excavation of pond and pipeline corridors	Yes
Poorman	None	No
Biddle	None	No
Balky Hill	None	No

4.2.3.1 MSWA Eightmile

The MSWA Eightmile site is located on an existing, disconnected side channel of the Chewuch River, approximately 1/2 mile upstream of Eightmile Creek confluence with the Chewuch River. FEMA studied the Chewuch River from its confluence with the Methow

River upstream to the Cub Creek confluence, which is several miles downstream of the project site. FEMA has not mapped a special flood hazard zone near the site.

- Potential Sources of Flooding: Chewuch River
- FIRM: None
- SFHA: None
- BFE: None
- Stream Gage Data: None
- Potential Sources of Supplemental Information: Okanogan County Public Works and U.S. Forest Service – Forest Development Road (FDR) 51, possible bank stabilization projects along Chewuch River

4.2.3.2 Mason (Eightmile)

The Mason (Eightmile) site is located just downstream of the mouth of Eightmile Creek. FEMA studied the Chewuch River from its confluence with the Methow River upstream to the Cub Creek confluence, which is several miles downstream of the project site. FEMA has not mapped a special flood hazard zone near the site.

- Potential Sources of Flooding: Chewuch River
- FIRM: None
- SFHA: None
- BFE: None
- Stream Gage Data: None
- Potential Sources of Supplemental Information: Okanogan County Public Works and U.S. Forest Service – FDR 51, possible bank stabilization projects along Chewuch River

4.2.3.3 Lincoln

The Lincoln site is located on the Twisp River. The site appears to be within the special flood hazard area designated along the Twisp River (Zone A; FEMA 2000a).

- Potential Sources of Flooding: Twisp River
- FIRM: 530117 0850 C December 20, 2000 (Figure 11; FEMA 2000a)
- SFHA: A

- BFE: None
- Stream Gage Data: USGS Gage 12448998
- Potential Sources of Supplemental Information: U.S. Forest Service – NFDR crossing of Twisp River near War Creek Campground

4.2.3.4 Twisp Weir

The Twisp Weir site is located adjacent to the Twisp River. Portions of the site appear to be within the special flood hazard area designated along the Twisp River (Zone A, FEMA 2000a).

- Potential Sources of Flooding: Twisp River
- FIRM: 530117 0850 C December 20, 2000 (Figure 19; FEMA 2000a)
- SFHA: A
- BFE: None
- Stream Gage Data: USGS Gage 12448998
- Potential Sources of Supplemental Information: Twisp Valley Power and Irrigation Company, operators of the diversion weir on the Twisp River.

4.2.3.5 Gold

The Gold site, located on South Fork Gold Creek just upstream of its confluence with Gold Creek, is approximately 2 miles upstream from the Gold Creek confluence with the Methow River. No flow monitoring data are available for Gold Creek. FEMA has not studied Gold Creek or its tributaries. The Gold site is not within a designated special flood hazard area.

- Potential Sources of Flooding: South Fork Gold Creek
- FIRM: 530117 1200 B February 10, 1981 (Figure 12; FEMA 1981)
- SFHA: None
- BFE: None
- Stream Gage Data: None
- Potential Sources of Supplemental Information: Okanogan County Public Works – South Gold Creek Road crossing of Gold Creek

4.2.3.6 Goat Wall

The Goat Wall site is located at a disconnected side channel system on the Methow River (RM 70), upstream of the mouth of Gate Creek. The site appears to be within the special flood hazard area designated by FEMA (Zone A2; FEMA 1994).

- Potential Sources of Flooding: Gate Creek and Methow River
- FIRM: 530117 0450C May 2, 1994 (Figure 13; FEMA 1994)
- SFHA: A2
- BFE: 2,250 to 2,260 feet (NGVD29)
- Stream Gage Data: None
- Potential Sources of Supplemental Information: None

4.2.3.7 Pete Creek Pond

The Pete Creek Pond site is part of a disconnected side channel system of the Chewuch River located upstream of Pete Creek. The site is located within the special flood hazard area designated by FEMA (Zone A3; FEMA 1999).

- Potential Sources of Flooding: Chewuch River
- FIRM: 530117 0675 D January 20, 1999 (Figure 14; FEMA 1999)
- SFHA: A3
- BFE: 1,848 to 1,852 feet (NGVD29)
- Stream Gage Data: USGS gage 12448000
- Potential Sources of Supplemental Information: Okanogan County Public Works – development permits for the Windhaven Golf Club

4.2.3.8 Heath

The Heath site is part of the Heath Springs complex located between the Methow River (RM 55) and Highway 20. The site is within the special flood hazard area mapped by FEMA (Zone AE; FEMA 1999).

- Potential Sources of Flooding: Methow River
- FIRM: 530117 0675 D January 20, 1999 (Figure 15; FEMA 1999)
- SFHA: AE
- BFE: 1,830 (NGVD29)

- Stream Gage Data: USGS gages 12447370 and 12448500
- Potential Sources of Supplemental Information: Okanogan County Public Works – access roads from Highway 20

4.2.3.9 Parmley

The Parmley site is located on Beaver Creek, about 8 miles upstream of its confluence with the Methow River. USGS maintains several flow monitoring gages: Gage 12449600 (Beaver Creek below South Fork near Twisp) is close to the site. FEMA has not studied or designated special flood hazard areas for Beaver Creek. Anchor QEA, LLC, completed detailed hydrologic and hydraulic analysis of Beaver Creek between RM 6.2 and RM 7.0, downstream of this site (Anchor QEA 2008).

- Potential Sources of Flooding: Beaver Creek
- FIRM: None
- SFHA: None
- BFE: None
- Stream Gage Data: USGS Gage 12449600
- Potential Sources of Supplemental Information: Anchor QEA 2008; Okanogan County Public Works – Beaver Creek Road crossings of Beaver Creek

4.2.3.10 Lower Twisp

The Lower Twisp site is located in the Twisp River floodplain just upstream of the Town of Twisp and its confluence with the Methow River (RM 40). The site is within the FEMA designated special flood hazard area (Zone A3; FEMA 2000b).

- Potential Sources of Flooding: Twisp River
- FIRM: 530117 0875 C December 20, 2000 (Figure 16; FEMA 2000b)
- SFHA: A3
- BFE: 1,623 to 1,627 feet (NGVD29)
- Stream Gage Data: None
- Potential Sources of Supplemental Information: Okanogan County Public Works

4.2.3.11 Hancock

The Hancock site is located on Hancock Creek, a small spring-fed tributary of the Methow River (RM 60). Hancock Creek originates at a large spring 0.8 mile upstream from the Methow River. The site is located outside of the special flood hazard area designated by FEMA along the Methow River (Zone A2; FEMA 1999). The Methow River BFE is estimated between 1,922 feet and 1,925 feet (NGVD29) at the mouth of Hancock Creek.

- Potential Sources of Flooding: Hancock Creek
- FIRM: 530117 0675 D January 20, 1999 (Figure 17; FEMA 1999)
- SFHA: None
- BFE: None
- Stream Gage Data: None
- Potential Sources of Supplemental Information: Okanogan County Public Works – Wolf Creek Road crossing of Hancock Creek

4.2.3.12 Winthrop NFH

The Winthrop NFH site is located on the Methow River in the Town of Winthrop at an existing NFH site. Methow River flows have been recorded by USGS at the nearby gage (12448500). The NFH site is within the FEMA designated special flood hazard area (Zone A4; FEMA 1999).

- Potential Sources of Flooding: Methow River
- FIRM: 530117 0675 D January 20, 1999 (Figure 14; FEMA 1999)
- SFHA: A4
- BFE: 1,748 feet (NGVD29)
- Stream Gage Data: USGS Gage 12448500
- Potential Sources of Supplemental Information: Okanogan County Public Works

4.2.4 Methow Subbasin Back-up Sites

4.2.4.1 MSRF Lower Chewuch

The MSRF Lower Chewuch site is located on the Chewuch River approximately 1 mile upstream of its confluence with the Methow River. FEMA designated a special flood hazard area (Zone A5) along the Chewuch in the vicinity of the site, but the site is outside this flood hazard area (FEMA 1999). The Chewuch River BFEs are estimated between 1,757 and 1,760 feet (NGVD29) in the vicinity of the site.

- Potential Sources of Flooding: Chewuch River
- FIRM: 530117 0675 D January 20, 1999 (Figure 14; FEMA 1999)
- SFHA: None
- BFE: None
- Stream Gage Data: None
- Potential Sources of Supplemental Information: Okanogan County Public Works

4.2.4.2 Chewuch AF

The Chewuch AF site is located in the left floodplain of the Chewuch River on to the north of the Eastside Chewack Road bridge crossing. The site is located in a special flood hazard area (Zone A3; FEMA 1999).

- Potential Sources of Flooding: Coulter Creek and Nason Creek
- FIRM: 530117 0675 D January 20, 1999 (Figure 18; FEMA 1999)
- SFHA: A3
- BFE: 1,995 to 2,000
- Stream Gage Data: None
- Potential Sources of Supplemental Information: Okanogan County Public Works – Eastside Chewack Road crossing of the Chewuch River

4.2.4.3 Canyon

The Canyon site is located adjacent to the Twisp River. The site appears to be outside the special flood hazard area designated along the Twisp River (FEMA 2000a).

- Potential Sources of Flooding: Twisp River
- FIRM: 530117 0850 C December 20, 2000 (Figure 11; FEMA 2000a)
- SFHA: None
- BFE: None
- Stream Gage Data: USGS Gage 12448998
- Potential Sources of Supplemental Information: Okanogan County Public Works – West Buttermilk Creek Road crossing of the Twisp River.

4.2.4.4 Utley

The Utley site is located adjacent to the Twisp River. The site appears to be within the special flood hazard area designated along the Twisp River (Zone A, FEMA 2000a).

- Potential Sources of Flooding: Twisp River
- FIRM: 530117 0850 C December 20, 2000 (Figure 11; FEMA 2000a)
- SFHA: A
- BFE: None
- Stream Gage Data: USGS Gage 12448998
- Potential Sources of Supplemental Information: Okanogan County Public Works – Possible bank protection projects along the Twisp River to protect Twisp River Road.

4.2.4.5 Newby

The Newby site is located adjacent to the Twisp River. The site appears to be within the special flood hazard area designated along the Twisp River (Zone A, FEMA 2000a).

- Potential Sources of Flooding: Twisp River
- FIRM: 530117 0850 C December 20, 2000 (Figure 19; FEMA 2000a)
- SFHA: A
- BFE: None
- Stream Gage Data: USGS Gage 12448998
- Potential Sources of Supplemental Information: Okanogan County Public Works – Newby Creek Road crossing of the Twisp River; Twisp Valley Power and Irrigation Company, operators of the diversion weir on the Twisp River.

4.2.4.6 Poorman

The Poorman site is located on the Twisp River, downstream of the mouth of Poorman Creek. The site is within the FEMA designated special flood hazard area (Zone A2; FEMA 2000a).

- Potential Sources of Flooding: Twisp River
- FIRM: 530117 0850 C December 20, 2000 (Figure 19; FEMA 2000a)
- SFHA: A2

- BFE: 1,760 Feet (NGVD29)
- Stream Gage Data: None
- Potential Sources of Supplemental Information: Okanogan County Public Works

4.2.4.7 Biddle

The Biddle site is located on Wolf Creek, approximately 1 mile upstream of its confluence with the Methow River. FEMA has not studied or designated special flood hazard areas on Wolf Creek. The site is outside the special flood hazard area designated for the Methow River (FEMA 1999). The Methow River BFE was estimated at 1,802 feet NGVD at the Wolf Creek confluence. Wolf Creek flows are monitored by the USGS approximately 3 miles upstream of the site.

- Potential Sources of Flooding: Wolf Creek
- FIRM: 530117 0675 D January 20, 1999 (Figure 15; FEMA 1999)
- SFHA: None
- BFE: None
- Stream Gage Data: USGS Gage 12447397
- Potential Sources of Supplemental Information: U.S. Forest Service and Okanogan County Public Works – NFDR crossing of Wolf Creek

4.2.4.8 Balky Hill

The Balky Hill site is located on Beaver Creek, 5 miles upstream of its confluence with the Methow River. USGS maintained several flow monitoring gages: Gage 12449600 (Beaver Creek below South Fork near Twisp) is close to the site. FEMA has not studied or designated special flood hazard areas for Beaver Creek. Anchor QEA completed detailed hydrologic and hydraulic analysis of Beaver Creek between RM 6.2 and RM 7.0, upstream of this site (Anchor QEA 2008).

- Potential Sources of Flooding: Beaver Creek
- FIRM: None
- SFHA: None
- BFE: None
- Stream Gage Data: USGS Gage 12449600

- Potential Sources of Supplemental Information: Anchor QEA 2008; Okanogan County Public Works – State Route 20 crossing of Beaver Creek

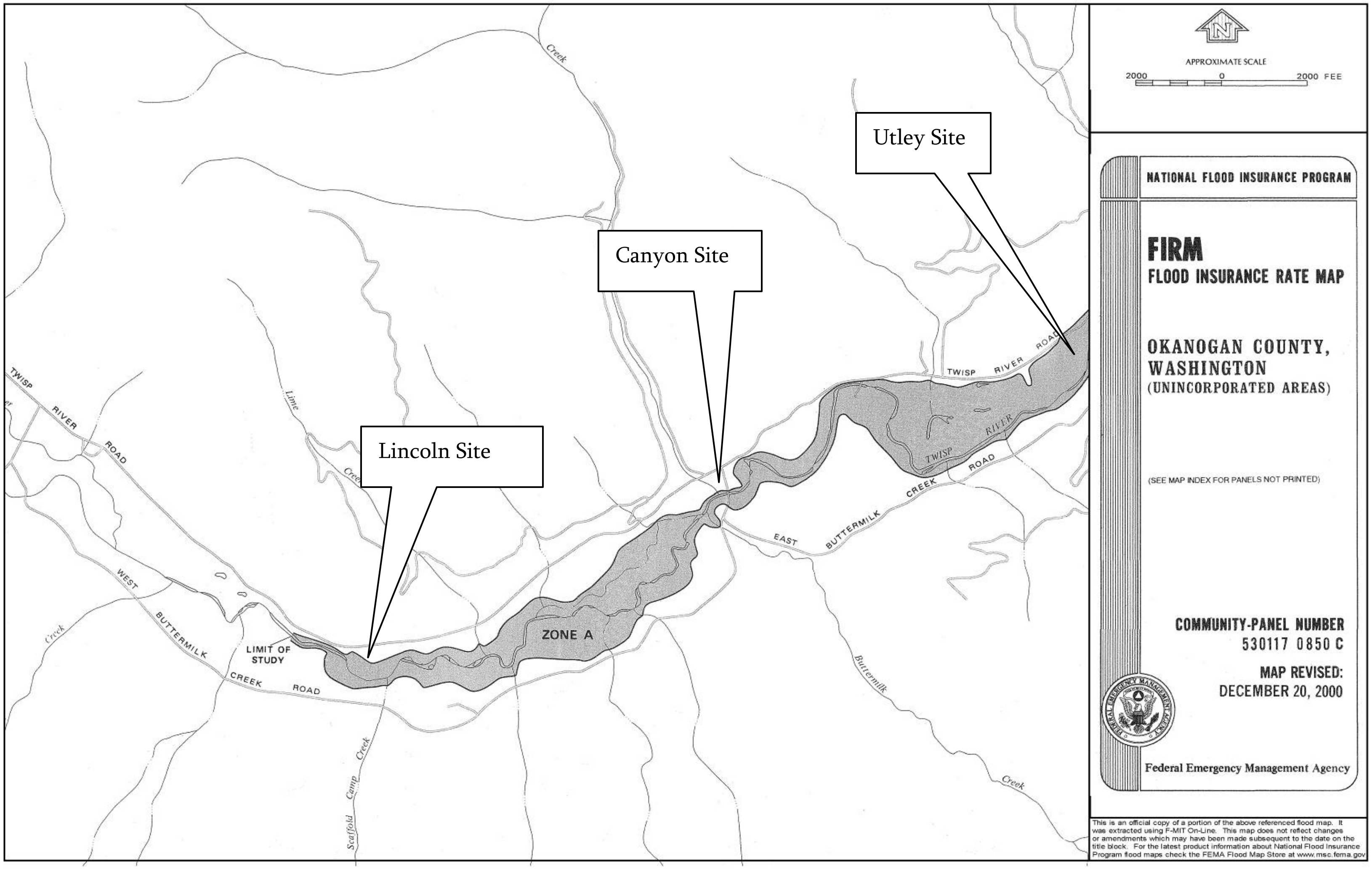

Figure 11

FIRM 530117 0850 C – December 20, 2000; Lincoln, Canyon, and Utley Sites

Flood Impact Analysis

Mid-Columbia Coho Restoration Project

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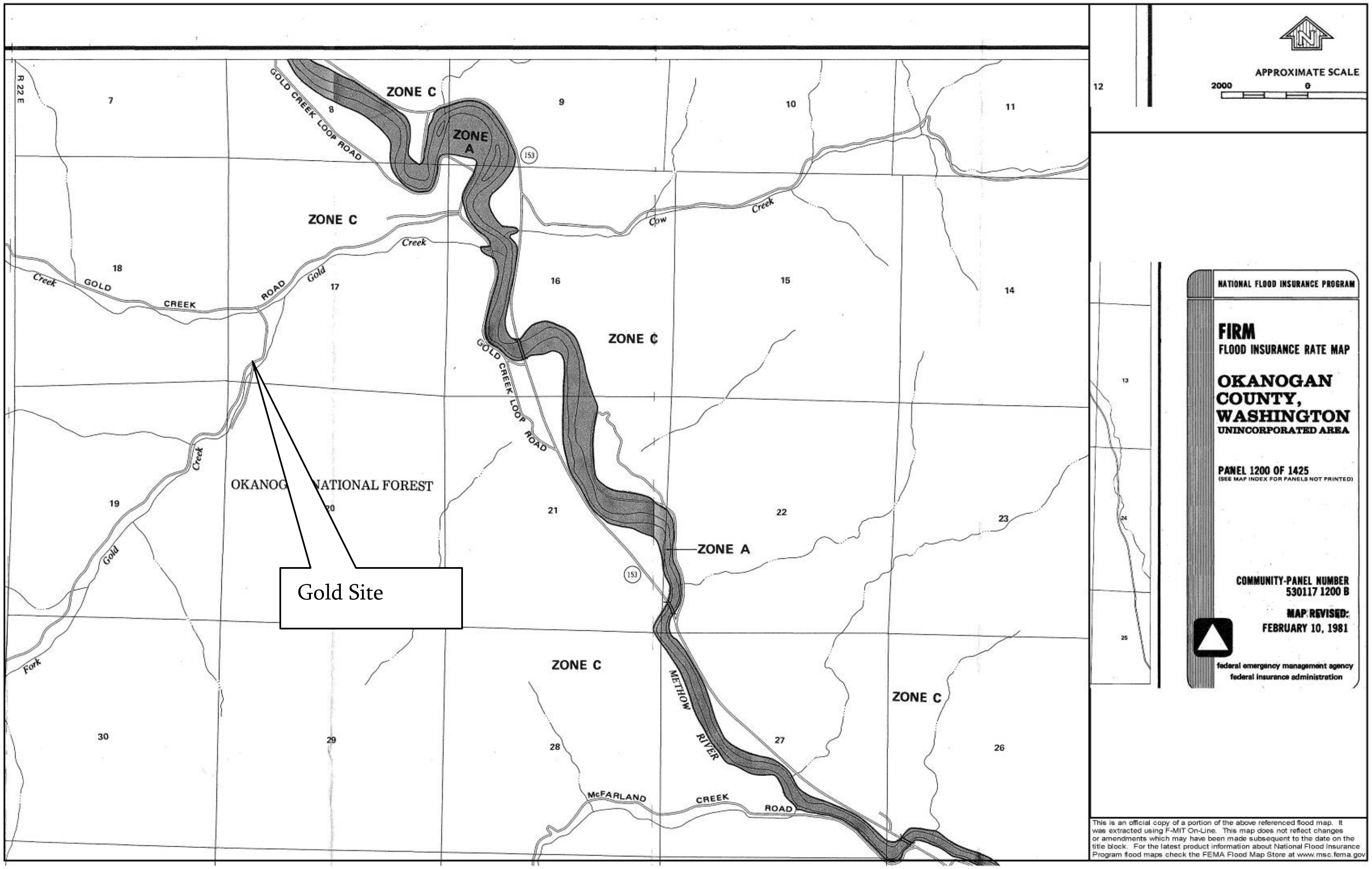

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Figure 12
FIRM 530117 1200 B – February 10, 1981; Gold Site
Flood Impact Analysis
Mid-Columbia Coho Restoration Project

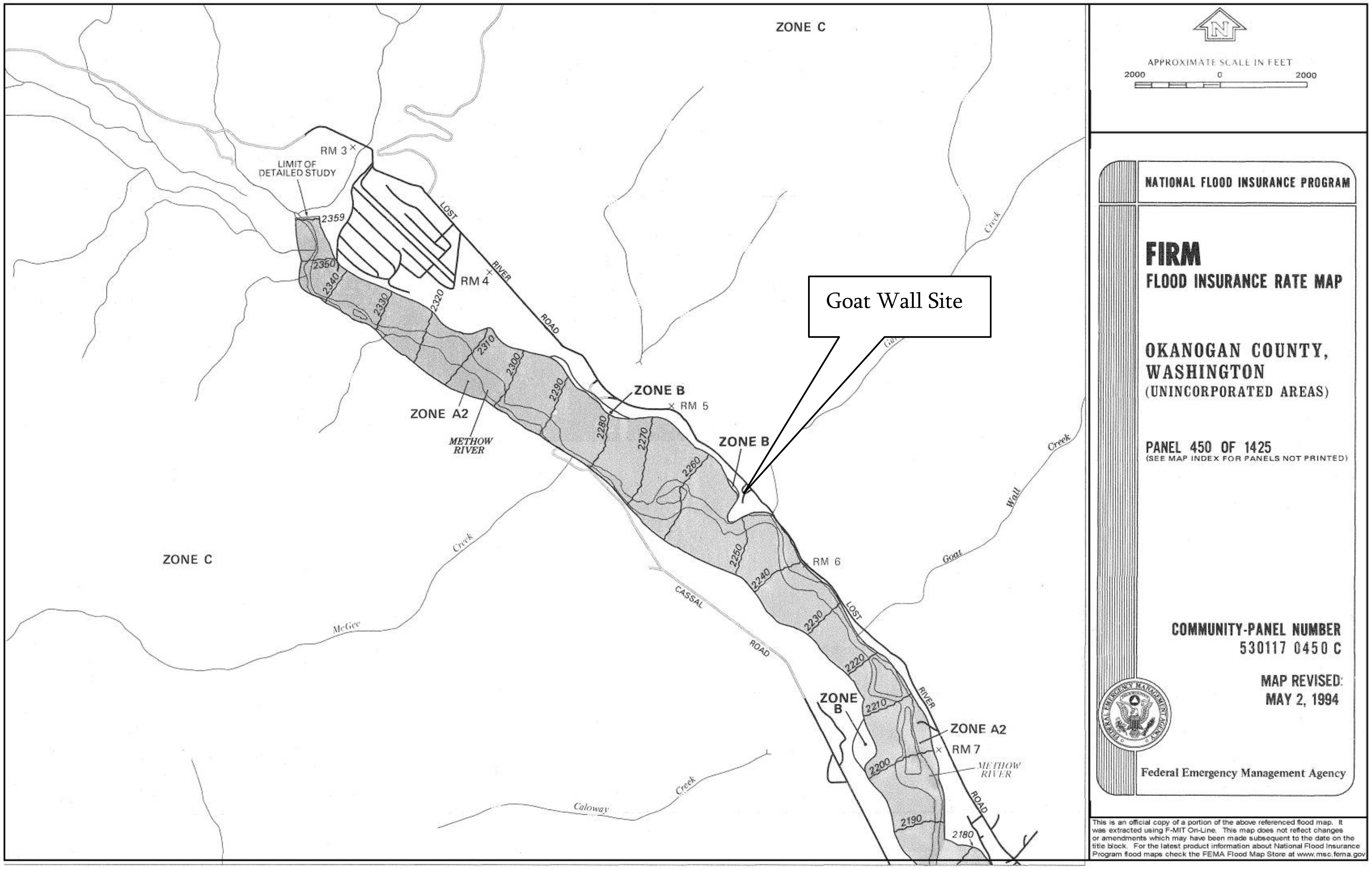


Figure 13
FIRM 530117 0450C – May 2, 1994; Goat Wall Site
Flood Impact Analysis
Mid-Columbia Coho Restoration Project

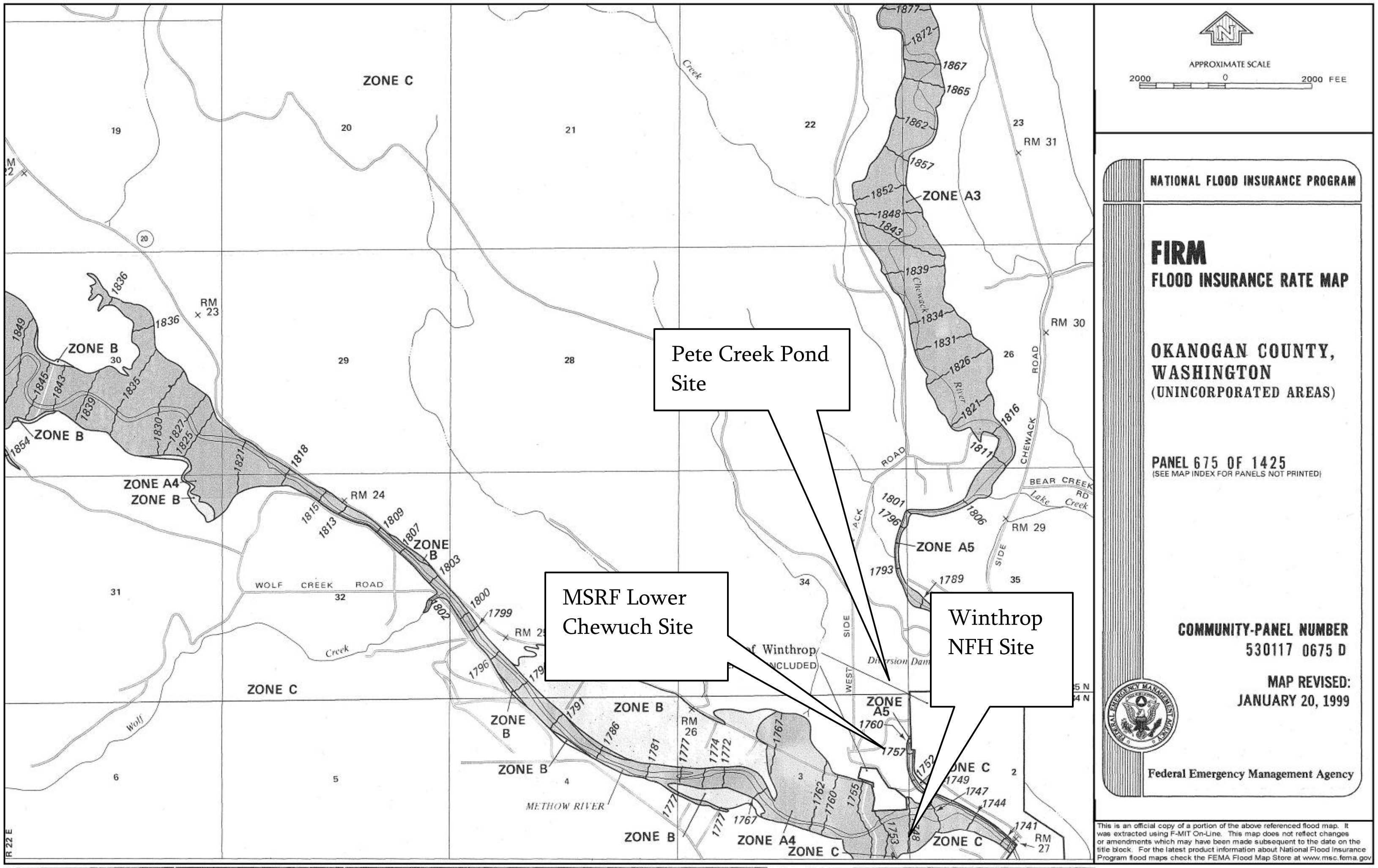
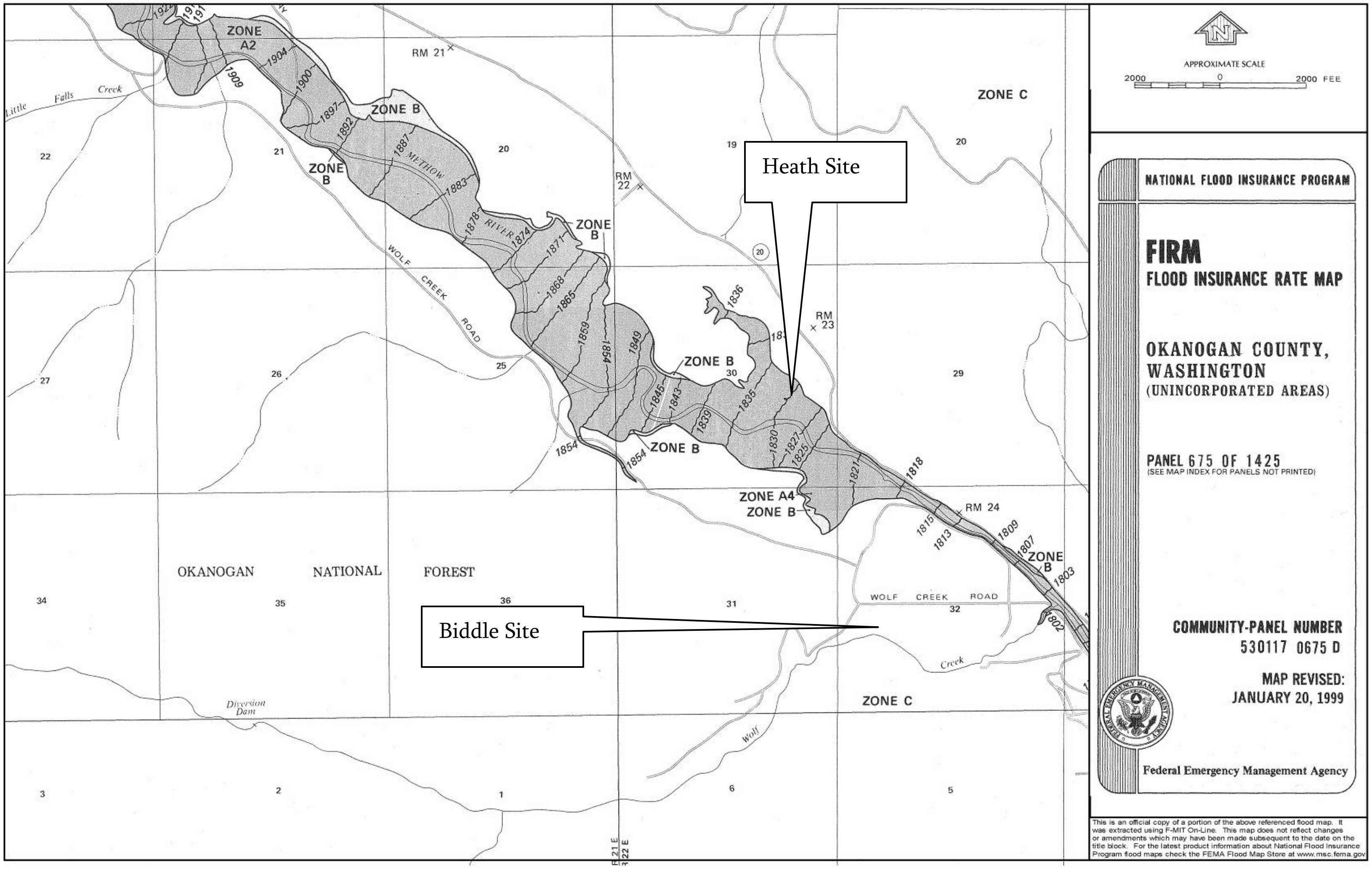


Figure 14
FIRM 530117 0675 D – January 20, 1999; Pete Creek, Winthrop NFH, and MSRF Lower Chewuch Sites
Flood Impact Analysis
Mid-Columbia Coho Restoration Project



ANCHOR QEA

Figure 15
FIRM 530117 0675 D – January 20, 1999; Heath and Biddle Sites
Flood Impact Analysis
Mid-Columbia Coho Restoration Project

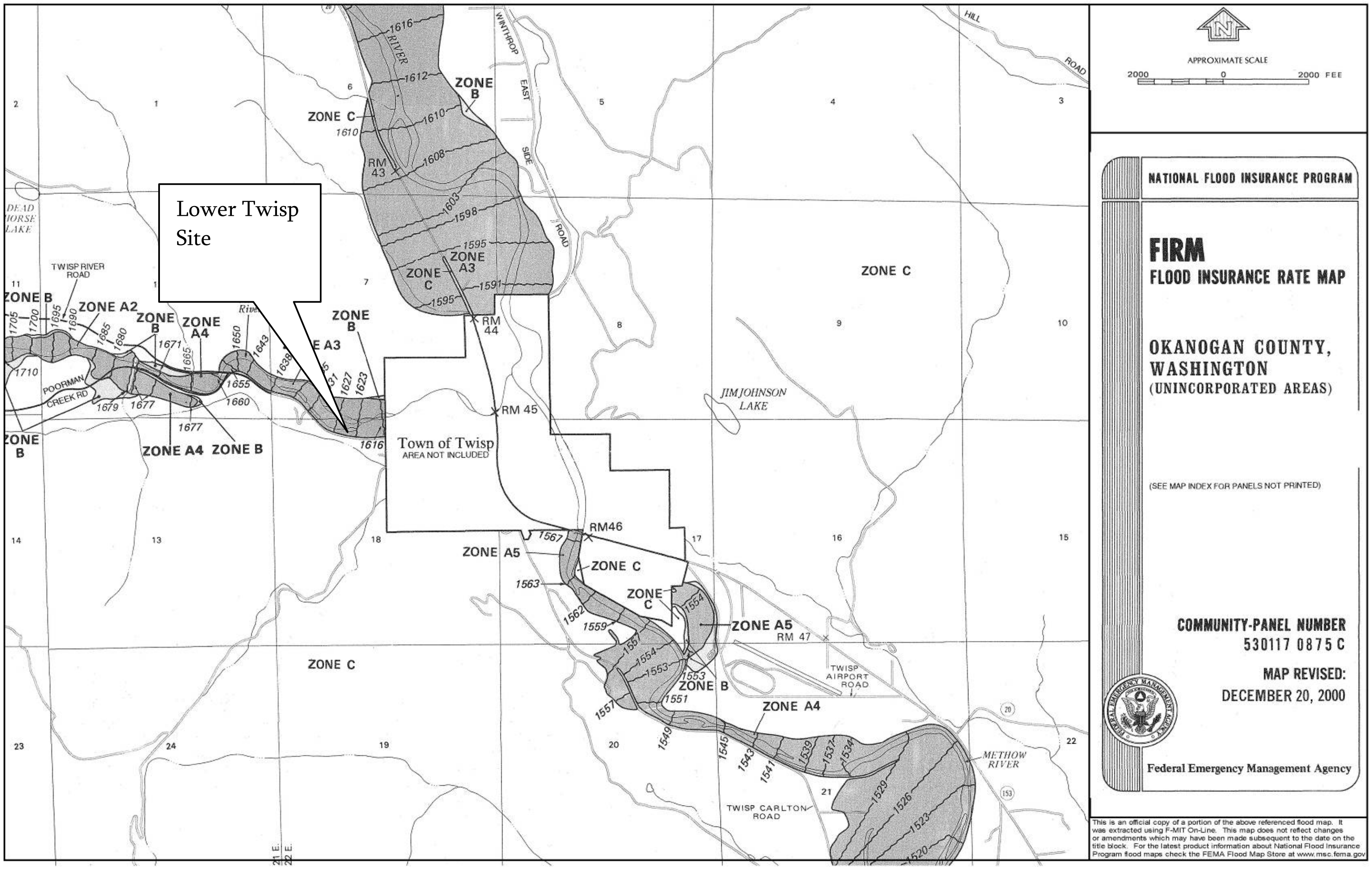


Figure 16
FIRM: 530117 0875 C – December 20, 2000; Lower Twisp Site
Flood Impact Analysis
Mid-Columbia Coho Restoration Project

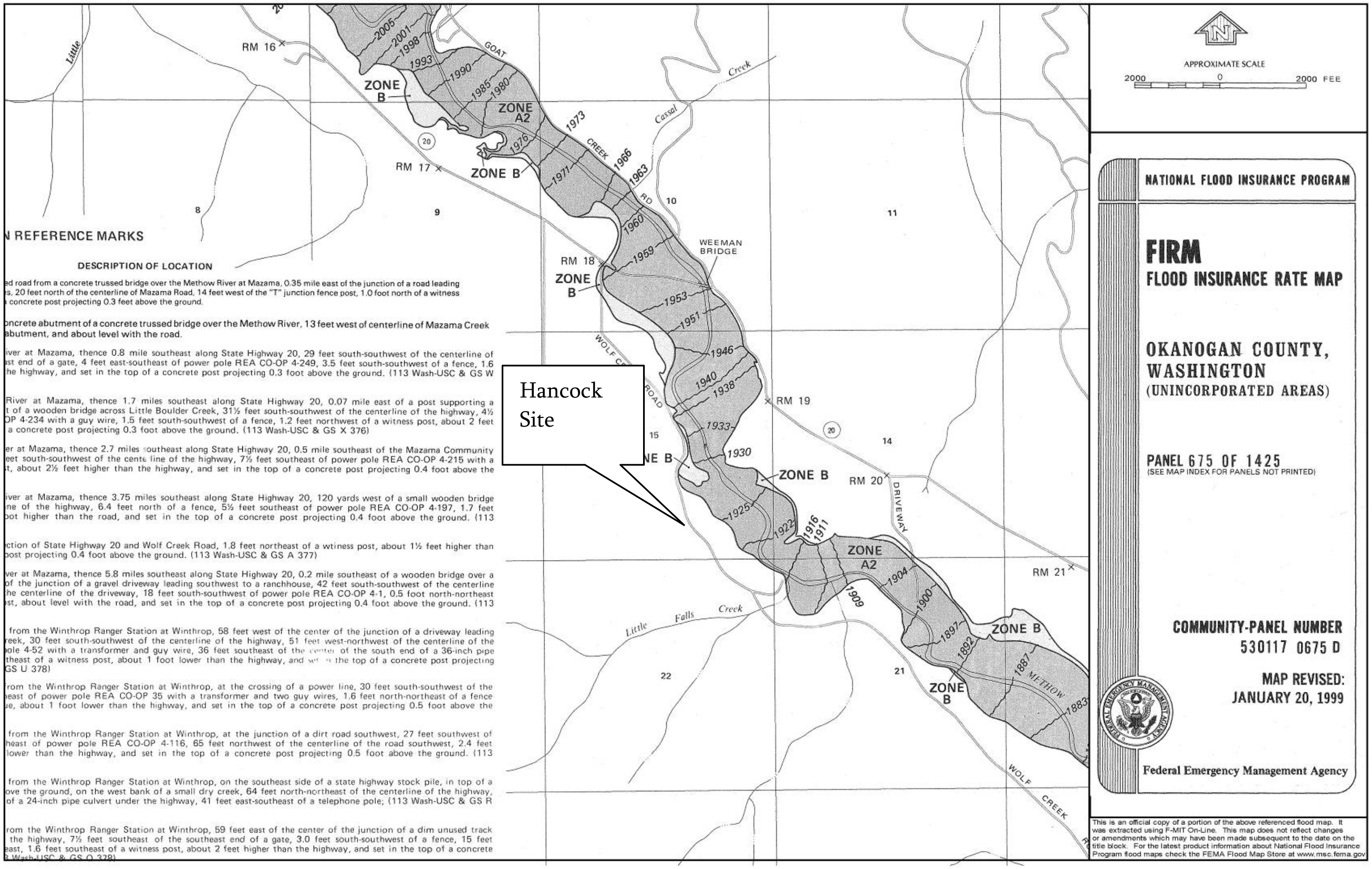


Figure 17
FIRM 530117 0675 D – January 20, 1999; Hancock Site
Flood Impact Analysis
Mid-Columbia Coho Restoration Project

ANCHOR QEA

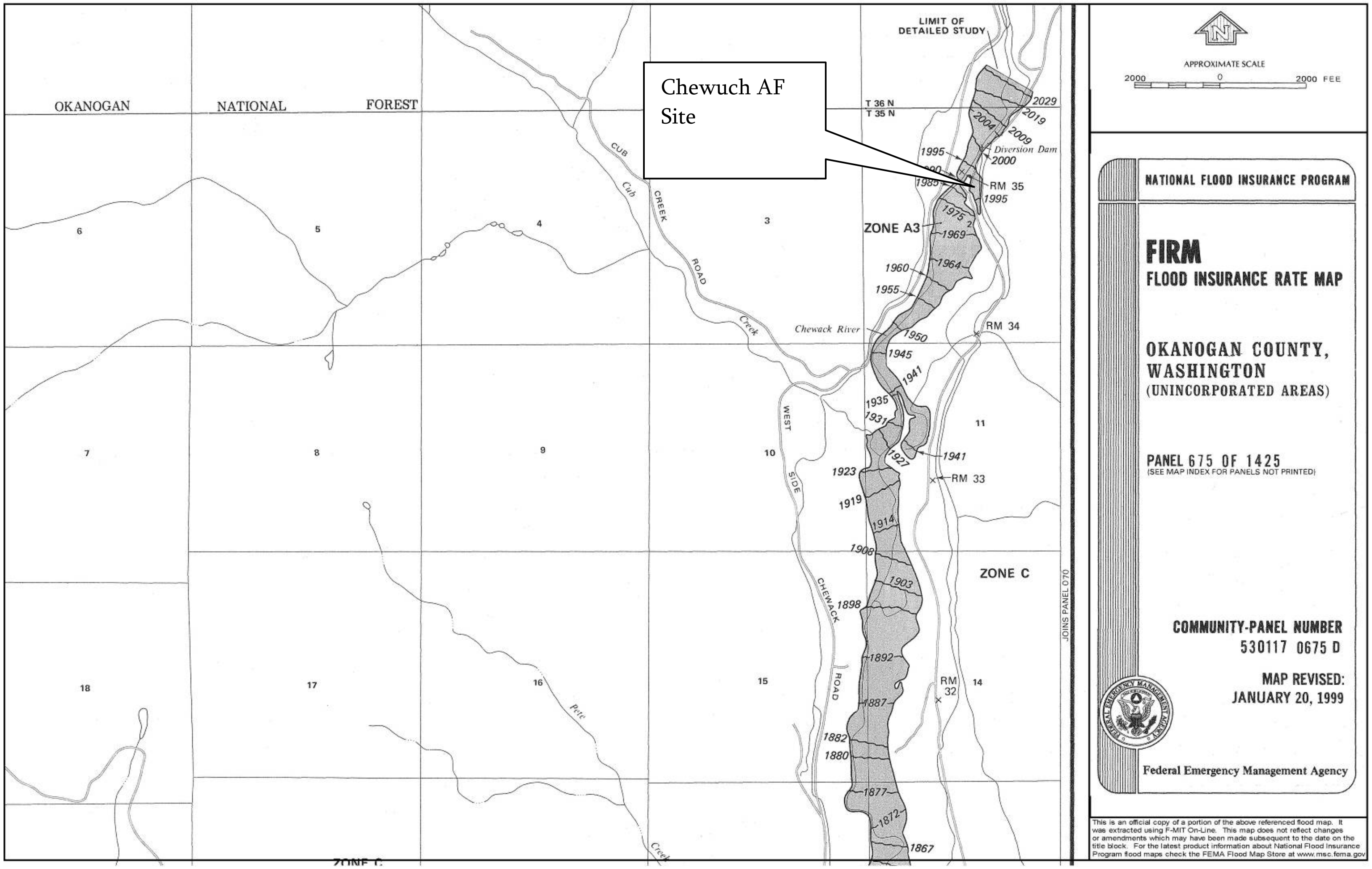


Figure 18
530117 0675 D – January 20, 1999; Chewuch AF Site
Flood Impact Analysis
Mid-Columbia Coho Restoration Project

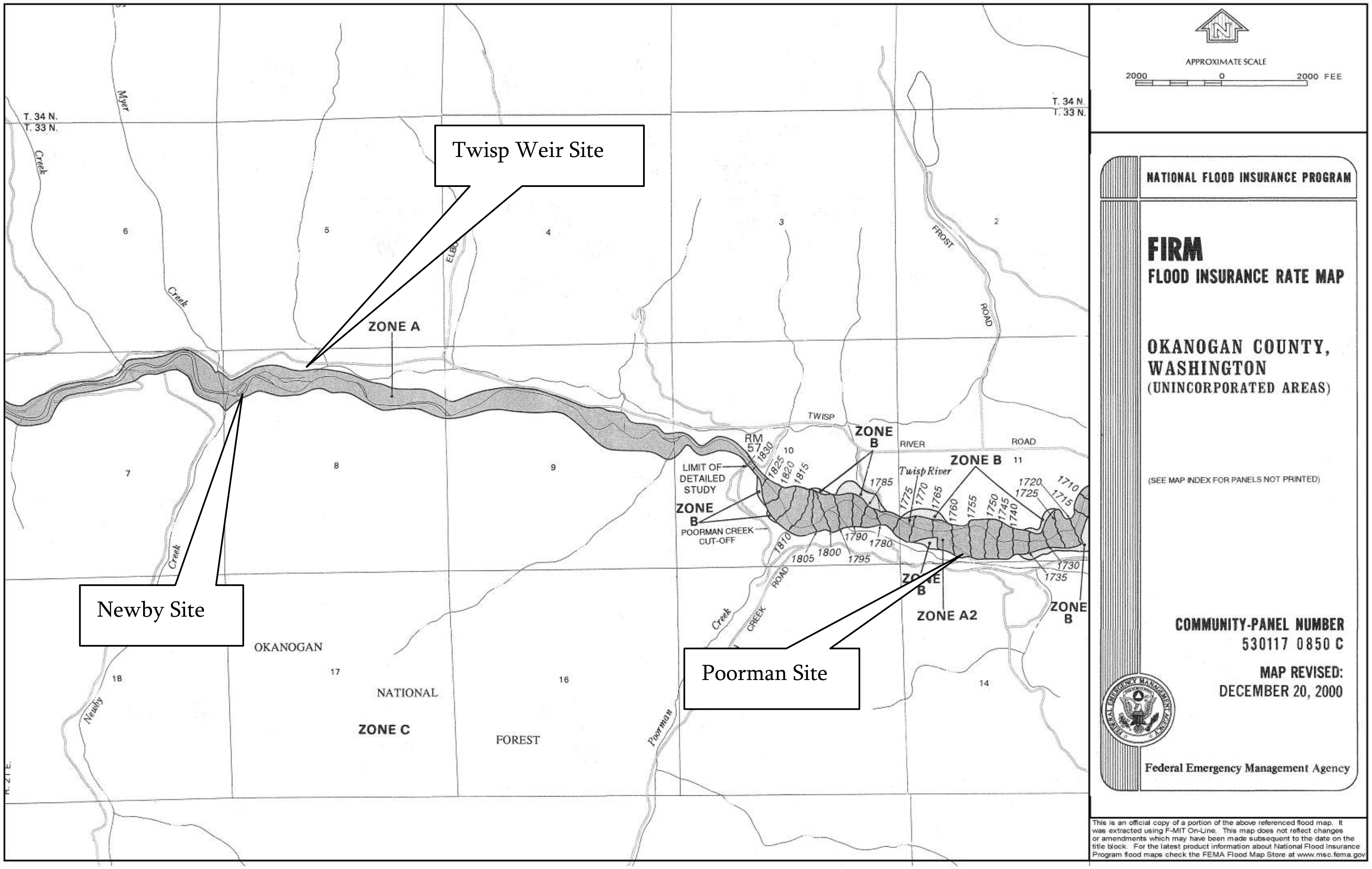


Figure 19
530117 0850 C – December 20, 2000; Twisp Weir, Newby, and Poorman Sites
Flood Impact Analysis
Mid-Columbia Coho Restoration Project

5 IMPACT OF FACILITIES ON FLOOD ELEVATIONS

5.1 Significance Criteria

The National Environmental Policy Act (NEPA) determination of "significant" impacts is defined in the Council Environmental Quality (CEQ) regulations at 40 CFR 1508.27. The definition of "significance" involves both the context and intensity of proposed project actions. A general discussion of context and intensity is presented in the EIS.

As described in Section 4.1, the primary goal of floodplain management is to restrict non-compatible development in the floodplain to avoid repetitive losses. FEMA delegates the responsibility of project review to the local regulatory agency through the NFIP program. Both Chelan and Okanogan Counties prohibit development within the floodway, but do allow development in the floodplain outside the floodway, as long the proposed development does not increase water surface elevation of the base flood by more than 1 foot. The context of significance estimates involves the local river basin floodplain and the intensity is measured by changes to flood elevations. Therefore, a project that would encroach into the floodway and increase the BFE or that would encroach upon the floodplain and increase the BFE by more than 1 foot would be determined to have a significant impact on flooding. A project that reduced the BFE would have a beneficial effect on flooding.

5.2 General Impacts

Sections 5.2.1 and 5.2.2 describe the general kinds of impacts that construction and operation of the proposed project could cause. Many of the proposed acclimation sites would not require construction activity or any permanent change to the landscape. Such sites would be subject only to impacts resulting from program operation. Potential site-specific impacts where there would be substantial construction activities are described in Sections 5.3 and 5.4.

5.2.1 Construction

Proposed construction activities include:

- Road building; clearing, grading, and surfacing with crushed rock.
- Surface water supply system construction, including intake structures, pipelines, and

open channels. New intakes will require some excavation along stream banks. Pipeline ditches will be excavated and refilled. Open channels will be surfaced with gravel and rock.

- Groundwater supply system installation, including wells, buried pipelines, open channels, power lines, and generators. Wells require temporary access roads and areas for storage of drilled materials. Pipelines and open channels require excavation. Power lines will be placed in conduits and buried. Generators will be mounted near the wells in secondary containment systems to prevent potential spills or leaks of fuel, oil, or other fluids to the environment.
- New pond creation or enlargement of existing ponds. Ponds will be excavated with heavy equipment. They will be earthen-bottomed and will have rock and gravel placed in areas where high flow rates may occur.

Potential impacts to flooding from these activities include:

- Obstruction of flood flows and alteration of local drainage patterns.
- Disposal of spoil materials, filling the floodplain.
- Pond creation or expansion, adding floodplain storage.

Construction details specific to the individual sites are provided in the *Brood Capture and Rearing Site Descriptions* (Appendix 1 of the EIS), the *Wenatchee Acclimation Site Descriptions* (Appendix 2 of the EIS), and the *Methow Acclimation Site Descriptions* (Appendix 3 of the EIS).

5.2.1.1 Impact Avoidance and Mitigation

Measures that could be implemented to minimize potential impacts to flooding include:

- Compensatory storage incorporated in the project design where aboveground facilities are located within the floodplain.
- Spoil materials removed and disposed of in uplands or at offsite locations outside of the floodplain.
- Infrastructure buried below grade not in elevated road prisms, preventing diversion or rerouting of floodwaters.
- Disturbed areas will be restored with native vegetation.

5.2.2 Operation

Activities required to operate the project acclimation and new rearing sites include:

- Setting and removing block nets
- Operating generators and wells
- Transporting salmon to each acclimation site for release
- Transferring salmon from vehicles into ponds using flexible hoses temporarily laid on the ground
- Daily feeding of juvenile fish and the non-lethal hazing of predators
- Monitoring the volitional release of migrants with tag detectors

Potential impacts on flooding from these activities include:

- Potential increase in flows due to discharge of groundwater

5.3 Site-Specific Impacts

Site-specific impacts are discussed only for the primary and back-up sites with substantial construction activities. Projects that only include minor improvements to existing ponds, access roads, or conveyance facilities are not expected to alter the potential for flooding at those sites and are therefore not discussed further. New wells, although providing additional flow through the acclimation sites, will be withdrawing water from shallow aquifers that are typically hydraulically connected to the adjacent creek or river (Appendix 12. *Ground Water Withdrawal Impacts*). Therefore, there is no real gain or loss of water. Additionally, the well discharge will be very minor compared to flood flows. Consequently, projects that only include flow augmentation from wells are not discussed further.

Surface water intakes proposed at the Tall Timber, Chikamin, and Dryden sites will be below grade and will match the existing contours of the river banks. They will be designed so they do not decrease flood storage volume and will not impede flow. Pipelines delivering water from these intakes will be buried and will have no impact on flood elevations.

5.3.1 Wenatchee Subbasin Primary Sites

Site construction for each program location is detailed in the *Brood Capture and Rearing Site Description* (Appendix 1 of the EIS) and the *Wenatchee Acclimation Site Descriptions* (Appendix 2 of the EIS). Primary sites with construction include: Butcher, Tall Timber, Chikamin, Minnow, Scheibler, and the Dryden Hatchery. One back-up site with construction is included: Squadroni.

5.3.1.1 Butcher

A new well is proposed for the Butcher acclimation site. The exact location has not yet been determined but it will be close to existing roads to minimize access disturbance. An approximately 50-foot-long, 5-foot-wide, rock-lined, open channel would deliver water from the well to Butcher Creek upstream of the existing pond. Although the site is within the 100-year floodplain (Zone AH), it appears that the source of flooding is backwater from Nason Creek rather than Butcher Creek. Construction or operation of the well and associated facilities would have no effect on flooding.

5.3.1.2 Tall Timber

The Tall Timber site is located on the unmapped section of the Napeequa River near its confluence with the White River. Although FEMA has designated a special flood hazard area along the White River (Zone A), the project site is located outside the special flood hazard area. The Tall Timber acclimation site would require a river intake and pipeline delivering water to an existing disconnected side channel. An 800-foot-long water supply pipeline from the intake to the side channel would be buried. An existing culvert would convey water from the side channel back to the river. Because the pipeline would be buried, it is expected that there would be no effect on flooding. Flood water elevations in the stream reach between the intake and the outlet of the acclimation diversion may be slightly reduced due to the withdrawal of water from the main channel.

5.3.1.3 Chikamin

Construction of an acclimation pond at the Chikamin site would require excavation of approximately 1,370 cubic yards of material. An intake would be constructed on the bank of

Chikamin Creek and a 200-foot-long water supply pipeline from the intake to the pond would be buried. A rock-lined open channel, 100 feet long and 5 feet wide, would be constructed to convey water from the pond back to the creek. The Chikamin site is not located in a FEMA mapped flood hazard area, but is likely in the 100-year floodplain of Chikamin Creek. The construction of a pond would likely lower flood elevations a small amount due the removal of excavated soils from the floodplain. Overall, the project would have little effect on flooding.

5.3.1.4 Minnow

Construction of an acclimation pond at the Minnow site would require excavation of approximately 1,370 cubic yards of material from the bed and banks of Minnow Creek, essentially widening and deepening the channel. The Minnow site is not located in a FEMA mapped flood hazard area, but is in the 100-year floodplain and floodway of Minnow Creek. During a flood event, the flows would be essentially the same because there is not a substantial amount of active storage in the pond. Consequently, there may be very small reduction in flooding and no change to the floodway.

5.3.1.5 Scheibler

An impoundment was built in the Chumstick Creek channel forming a pond. Project construction would include excavating 350 cubic yards of material and enlarging the existing pond. Material excavated from the pond would be spread at approved areas, outside the floodplain. The site is located on Chumstick Creek floodplain in an area that has not been studied by FEMA. Furthermore, FEMA has not produced a flood hazard map of this reach. Because the construction is limited to excavation and the spoils will be disposed of outside the floodplain, the project may reduce flooding slightly along Chumstick Creek.

5.3.2 Wenatchee Subbasin Back-up Sites

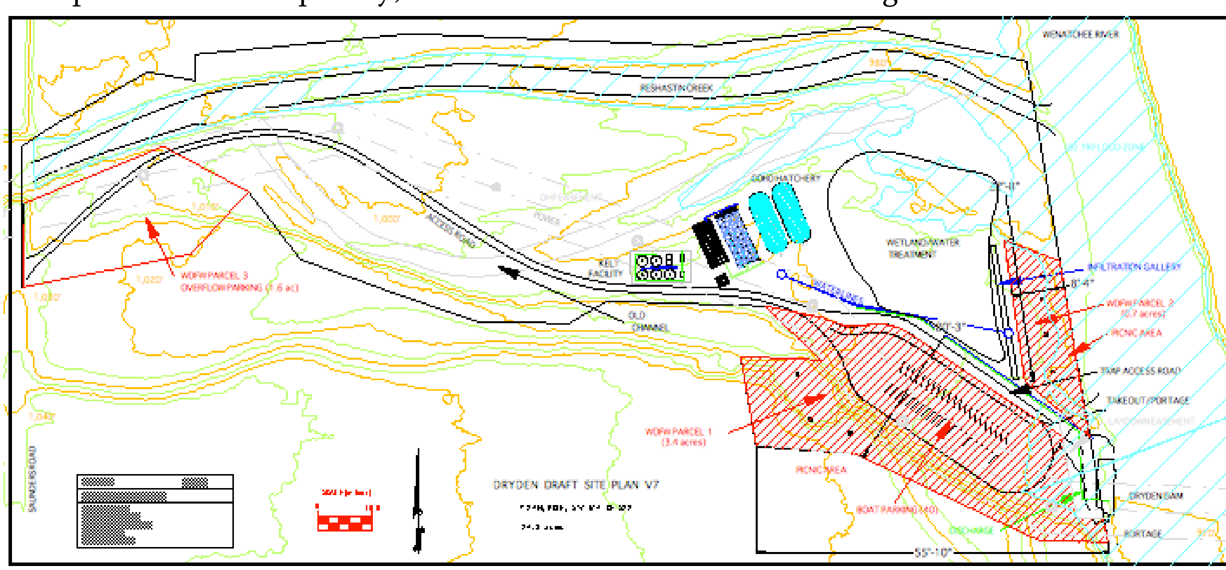
5.3.2.1 Squadroni

To construct the Squadroni acclimation pond site, 1,200 cubic yards of material would be excavated. The seasonal flow from an existing ditch would contribute surface water and a well would be constructed to supply additional water. Water from the well would be delivered through a 50-foot-long, rock-lined, open channel. A 20-foot-long discharge channel would return water from the pond to the ditch prior to discharge to Nason Creek. Spoil materials will be removed from the site for disposal outside the floodplain. Although the pond would provide some additional floodplain storage, the volume is very small compared to the flood flows. Consequently, the project may slightly reduce flooding on Nason Creek.

5.3.2.2 Dryden

The Dryden hatchery will require excavations to create rearing ponds, raceways, a hatchery building, an infiltration gallery, and an effluent treatment system. These excavations would occur outside the flood hazard area. A flood study of the site was completed (Anchor QEA, 2009) and 100-year flood boundaries were mapped. They are shown in blue in the following illustration. Some construction may occur in the floodplain if constructed wetlands are built to treat hatchery discharges. Treatment systems have not yet been designed but if constructed wetlands are used, they will be built at existing grade and will not impact flood elevations.

Approximately 2,050 cubic yards of material is proposed to be removed from areas outside the floodplain. Material disposal areas have not yet been located but they will be in approved locations that meet grading permit conditions and minimize potential for floodplain fill. Consequently, there would be no effect on flooding.



5.3.2.3 George

The George hatchery will require grading to create rearing ponds, raceways, a hatchery building, parking areas, back-up generator station, and an effluent treatment system. Four concrete raceways (100-foot by 10-foot by 4-foot) would be used for fish production. Also, two ponds measuring 40-foot by 120-foot by 3-foot deep would provide low density rearing space. The site would be fenced and an overhead net system installed over the rearing units. Discharge water treatment would likely require a high degree of nutrient removal to meet conditions of the Total Maximum Daily Load restrictions in place for the Wenatchee River. An off-line treatment tank measuring 10-foot by 20-foot by 4-foot will hold and settle wastes vacuumed from the rearing units. A 3,000 sf hatchery building will enclose the incubators, rearing troughs, offices, and a small shop. Generators will provide back-up power. Parking will be provided for up to 10 vehicles. The hatchery facilities will require a permanent footprint of 1.5 acres. Including pipelines, water supply construction, and hatchery facilities; a total of 4 acres of land will be disturbed during construction.

It appears that all permanent facilities would be located within, but near the limits of, the special flood hazard zone (A3) and be subject to inundation of less than 1 foot deep. As this is a back-up site, detailed engineering studies have not been completed. If this site were to be selected, it is expected that a detailed floodplain analysis would be completed to evaluate the project affects on flooding as well as to evaluate methods to flood proof the hatchery building and the back-up generator station to comply with the local floodplain ordinance. Although the raceways and ponds would be largely below grade, the hatchery building, fencing, and generator station would be located above grade and could be damaged by the 100-year or potentially lesser floods. Because the project is near the edge of the floodplain, at an elevation similar to the BFE, it is not expected that the project would measurably obstruct flood flows or reduce floodplain storage. The project would have not have a substantial adverse effect on flooding.

5.3.3 Methow Subbasin Primary Sites

Site construction for each program location is detailed in *Methow Acclimation Site Descriptions* (Appendix 3 of the EIS). Primary sites with construction include: MSWA

Eightmile, Mason (Eightmile), Lincoln, and Gold. Back-up sites with construction include: MSRF Lower Chewuch and Chewuch A.F.

5.3.3.1 MSWA Eightmile

The MSWA Eightmile site is located in an abandoned side channel of the Chewuch River, just upstream of the mouth of Eightmile Creek. Construction would include a well and a 100-foot-long, 5-foot-wide, rock-lined, open channel that would deliver water from the well to the side channel. FEMA has not mapped a special flood hazard zone near the site. There would be no effect on flooding.

5.3.3.2 Mason (Eightmile)

The Mason (Eightmile) site consists of three existing ponds adjacent to Eightmile Creek that are maintained by an irrigation diversion from the creek. A well is also proposed for the Mason (Eightmile) acclimation site. The exact location has not yet been determined, but it will be in a field near the existing ponds. A 50-foot-long, 5-foot-wide, rock-lined, open channel will deliver water from the well to the ponds. FEMA has not mapped a special flood hazard zone near the site. There would be no effect on flooding.

5.3.3.3 Lincoln

Proposed construction at the Lincoln site would involve two wells to provide water to the existing two-pond system when water levels in the river are below the existing surface water diversion. A 50-foot-long, 5-foot-wide, rock-lined, open channel will deliver water from the wells to the upper pond. Buried water lines (approximately 600 feet long) will deliver water from the wells to this open channel. Excavation of material that has accumulated in one of the ponds is proposed to be removed but the flood storage capacity of the pond will not be changed. The Lincoln site is located in a FEMA mapped special flood hazard area (Zone A) on the Upper Twisp River. Spoil materials from any of the excavations will be disposed of outside the floodplain in accordance with local floodplain management ordinance requirements. There would be no effect on flooding.

5.3.3.4 Twisp Weir

Proposed construction at the Twisp Weir site would include a 140-foot long, 50-foot wide, 3.5-foot deep, constructed, earthen pond, occupying approximately 0.2 acres. Because the pond will be below existing grade and material will be removed and disposed of outside the flood plain, there would be no effect on flooding.

5.3.3.5 Gold

The Gold site consists of several existing ponds located adjacent to Gold Creek. Construction activities would involve removing some accumulated sediment from the ponds to restore water depths adequately for acclimation. Excavated materials would be disposed of outside the floodplain in accordance with grading permits. The project site is not within a FEMA mapped special flood hazard area. The proposed construction would not alter the diversions from Gold Creek. Consequently, there would be no effect on flooding.

5.3.4 Methow Subbasin Back-up Sites

5.3.4.1 MSRF Lower Chewuch

Acclimation pond construction would include the excavation of approximately 890 cubic yards of material. A well would also be constructed. Rock-lined, open channels, a total of 320 feet long and 5 feet wide, will be constructed from the well to the pond and from the pond to the Chewuch River. FEMA designated a special flood hazard area (Zone A5) along the Chewuch River in the vicinity of the project, but the project is outside the flood hazard area. There would be a minor increase in floodplain storage capacity and potentially a slight reduction in flood elevations due to pond construction.

5.3.4.2 Chewuch AF

Acclimation pond construction would include the excavation of approximately 975 cubic yards of material. Water would be diverted from the Chewuch River. Water delivery pipelines with fish screens would also be constructed. The Chewuch AF site is located in the FEMA mapped flood hazard area (A3). Excavated materials would be removed from the site and disposed of in an upland location outside of the floodplain in accordance with local floodplain management ordinance requirements. Consequently, there would a minor increase in floodplain storage capacity and potentially a slight reduction in flood elevations due to pond construction.

5.3.4.3 Canyon

Approximately 200 cubic yards of material are proposed to be removed from an existing pond to deepen it and expanded it by 0.04 acres. Excavated materials will be disposed of outside the floodplain. The site is outside the special flood hazard area designated along the Twisp River. There would be no effect on flooding.

5.3.4.4 Utley

An 80-foot long, 3-foot wide channel from an pond to the Twisp River is proposed to allow acclimated smolts a route to the River. The existing pond and the proposed channel are within the special flood hazard area. Because excavated materials will be disposed of outside the floodplain there would be no effect on flooding.

5.3.4.5 Newby

A 140-foot long, 50-foot wide, 3.5-foot deep earthen bottom pond and an intake on Newby Creek are proposed for the site. Buried water delivery pipelines from the intake to the pond and from the pond back to the Twisp River would also be constructed. The construction activities would occur within the special flood hazard along the Twisp River. Because excavated materials will be disposed of outside the floodplain there would be no effect on flooding.

5.4 Combined Impacts

5.4.1 Proposed Alternative

The *Wenatchee Acclimation Site Descriptions* (Appendix 2 of the EIS) and *Methow Acclimation Site Descriptions* (Appendix 3 of the EIS) identify the primary acclimation site locations for the Proposed Alternative. Approximately half of the releases proposed are from acclimation sites capable of overwinter acclimation, having groundwater supplies that can provide secure flow during icing conditions. Back-up acclimation sites have also been identified, but may not be used.

The majority of the project sites are located in rural and undeveloped areas of Chelan County and Okanogan County with high quality forested, riparian, and wetland habitats within the sites, or in the vicinity of the sites. Site-specific potential impacts associated with the Methow and Wenatchee sites were described in Sections 5.3 and 5.4. A combined impact evaluation considers the potential collective effects of the total MCCRP, as opposed to individual site-specific impacts.

Combined impacts are summarized in Table 3. There are a total of 27 primary sites, including the Dryden hatchery, and 12 back-up sites. Combined impacts of the proposed project alternative will be evaluated only for the primary sites. Back-up sites will be used as replacements for primary sites that may become unavailable. A switch from a primary to a back-up site is not expected to alter the combined impact of the project on floods.

The total amount of ground disturbed during construction of all the primary sites is proposed to be less than 2.5 acres and will include four new water intake structures, seven new wells, and 650 feet of unpaved road. New ponds are proposed for the Dryden hatchery, three primary acclimation sites, and three back-up sites. The construction details for each project are described in either the *Wenatchee Acclimation Site Descriptions* (Appendix 2 of the EIS) or the *Methow Acclimation Site Descriptions* (Appendix 3 of the EIS). The new ponds will remove material from floodplains, slightly increasing floodplain storage capacity and potentially decreasing flood elevations.

Table 3
Combined Impacts of MCCRP Projects

	ACCESS	SURFACE WATER			GROUND WATER		EARTH						SITES	
	New road construction (ft)	New intake construction	Conveyance channel (ft)	Inlet water screen	New wells	Existing wells	Volume excavated (cy) - pond	Surface disturbance (acre) - pond construction	Surface disturbance (sf) - water systems, intakes	Surface disturbance (sf) - water systems, open channel	Buried water piepline (ft)	Buried power line (ft)	Primary	Back-ups
Wenatchee	650	3	2,080	7	3	2	4,791	1.6	700	1,000	2,500	500	15	5
Methow	-	1	-	7	4	1	2,685	0.9	350	2,000	1,200	950	12	7
TOTAL	650	4	2,080	14	7	3	7,476	2.5	1,050	3,000	3,700	1,450	27	12

Proposed clearing and grading during construction is limited to small areas relative to total floodplain areas. At each site, impacts to flooding would be avoided or compensatory floodplain storage would be created to offset facilities located above ground in the floodplain.

Overall, the combined effects to flooding due to proposed construction and operation of acclimation and rearing sites are not considered to be a significant impact because the projects individually have negligible or no effect, and the limits of effects are confined to the immediate project areas such that the effects of one do not overlap with the effects of another.

5.4.2 No Action

The No Action Alternative is described in the EIS. It includes operation of fewer of the same sites described for the Proposed Alternative. Because fewer sites would be operated and no new construction is involved, the combined effects would be less than those of the Proposed Alternative; consequently, the impacts of the combined projects are considered to be less than significant.

5.5 Cumulative Impacts

The EIS defines cumulative effects as the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Other, outside impacts could result from any development in the floodplain not associated with MCCRP actions, which could exacerbate flooding; for example, diking, road development, and residential/urban development.

5.5.1 Proposed Alternative

Because construction activities associated with the project are anticipated to result in very minor conversion of forested lands compared to the watershed as a whole, because the some acclimation sites would provide additional floodplain storage, and because new construction would be in accordance with floodplain development codes, the cumulative effects of these actions are not considered a significant impact. Additionally, many proposed county and state-funded road improvement projects include culvert replacements on existing roads having the potential to mitigate or reduce the effects of existing flooding. The known road improvement projects are identified in the following sections.

Habitat improvement projects are also proposed for implementation throughout the project area. These habitat projects are funded by federal and state dollars under multiple programs and implemented by local stakeholder groups, counties, and conservation districts. Habitat improvement projects that re-establish floodplain access to undeveloped floodplain habitat have the potential to further mitigate or reduce the effects of existing flooding. Habitat improvement projects funded and proposed for implementation in the Wenatchee and Methow subbasins using Washington State Salmon Recovery Funding Board (SRFB) grants can be tracked at the Upper Columbia Salmon Recovery Board's salmon habitat implementation website (http://uc.ekosystem.us//). Habitat improvement projects funded in the Wenatchee and Methow subbasins using Chelan County Public Utility District (PUD) and Douglas County PUD Habitat Conservation Plan (HCP) Tributary Fund dollars can be tracked at the Chelan County PUD HCP website (http://www.midcolumbiahcp.org/). Other projects may be implemented by various other public agencies or private parties that are not known at this time.

5.5.1.1 Wenatchee Subbasin Sites

Planned projects in the basin include road improvement projects throughout the watershed that could have localized effects on nearby creeks. These projects are Chelan County projects: CRP636-North Road and CRP612-Eagle Creek Road that could impact Chumstick Creek, CRP597-Old Blewett Highway that could impact Peshastin Creek; and Washington State Department of Transportation (WSDOT) projects: US 2 bridge over Chiwaukum Creek, US 2 Wenatchee River bridge at Tumwater, and road improvements along US 97 that could impact Peshastin Creek. It is anticipated that the County and WSDOT would implement mitigation measures and Best Management Practices (BMPs) according to the Highway Runoff Manual (WSDOT 2008) to minimize floodplain impacts from any of these projects. Consequently the cumulative effects of the Proposed Action and other known projects in the Wenatchee Subbasin are not considered to be a significant cumulative impact.

5.5.1.2 Methow Subbasin Sites

In the Methow subbasin, other known planned projects include road improvement projects throughout the watershed that could have localized effects on nearby creeks. These projects are Okanogan County and WSDOT road improvement projects such as Twisp River Road (affecting Twisp River), and Twin Lakes Road (affecting Methow River). It is anticipated that Okanogan County and WSDOT would implement mitigation measures and BMPs according to the Highway Runoff Manual (WSDOT 2008) to minimize floodplain impacts from any of these projects. Consequently, the effects of the Proposed Alternative combined with the effects of other known projects in the Methow Subbasin are not considered to create a significant cumulative impact.

5.5.2 No Action

As described for the Proposed Alternative, additional projects are likely to be implemented in the Wenatchee and Methow subbasins that may have floodplain effects. Because construction activities associated with these projects are anticipated to be conducted in accordance with floodplain development codes, the combined effects of the No Action Alternative and the other known projects are not considered to create a significant cumulative impact. Many culvert replacement projects on existing roads have the potential to reduce the effects of flooding, as do habitat improvement projects. The known road projects and links to funded habitat improvement projects are provided in Section 5.1.1.

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Appendix 9. Impact of Fish Culture on ESA-Listed Fish

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November 2010

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1.0 SUMMARY

The presence of ESA listed fish by life stage was assessed using a two-step process. First, existing data on fish distribution available in the Wenatchee and Methow Subbasins was compiled and reviewed. This information was used to identify sites where fish presence information was lacking. Second, snorkel surveys were conducted at those sites without sufficient information to determine the presence and life stages of ESA listed fish during the time of year of proposed acclimation activities. Life history information was used to determine what life stages and size ranges were likely to be present during overwinter rearing, spring acclimation and construction activities for each species. Results are summarized for the Wenatchee Subbasin in Table 11 and Methow Subbasin in Table 12.

Implementation of the Mid-Columbia Coho Restoration Project (MCCRP) proposed alternative could result in ESA listed fish temporarily being excluded from 0.3 acres of currently accessible habitat from December through early May, and an additional 0.9 acres from mid-March through early May in the Wenatchee Subbasin. In the Methow Subbasin, they could be temporarily excluded from 0.7 acres of currently accessible habitat from December through early May, and an additional 0.6 acres from mid-March through early May. These impacts will be balanced to some degree by newly constructed ponds. About 0.3 acres of new pond habitat in the Wenatchee Subbasin will be available to other fish for at least a portion of the year. The number of fish projected to be temporarily dislocated or excluded during rearing and acclimation is low (314 fish or less) and represents a small percentage of the average smolt production in each Subbasin (less than 0.5% in the Wenatchee, and less than 1.7% in the Methow). These fish would be excluded from acclimation sites but could potentially occupy other available habitat.

Other potential adverse impacts associated with coho acclimation on ESA listed fish are expected to be small. New site construction activities will be short-term and bank disturbances will be small. Hatchery coho could potentially prey on smaller fish including Chinook and bull trout fry but the incidence of predation has been low and other fish will be excluded from rearing and acclimation sites.

Potential negative impacts to ESA listed fish will be avoided or minimized using the following measures:

- Barrier nets will be used at acclimation sites where ESA listed fish do not reside or use to migrate through to existing habitat. This will minimize premature escape of coho salmon.
- Seine nets will be used at acclimation sites to partition off a portion of a water body while allowing free upstream and downstream passage of ESA listed fish to available habitat. In areas where emergent spring Chinook or bull trout fry will be present, predation will be minimized by using fine seine mesh to exclude fry from enclosed areas. Seines will be installed in a manner that excludes fry from the coho acclimation area by moving out from the bank to encapsulate the rearing area. The enclosed area will be snorkeled to verify no ESA listed fish are present before hatchery coho are added.
- Timing and methodology of construction activities will be coordinated with resource agencies to minimize disturbance to listed species and life-stages. Best management practices will be used and permit conditions will be followed during construction activities, to prevent sedimentation inputs.

2.0 INTRODUCTION

The objective of this study was to determine if and when fish listed under the Endangered Species Act (ESA) are present in selected sites within the Wenatchee and the Methow Subbasins and to assess the potential effects of acclimation, rearing, and adult holding activities related to the Yakama Nation's Mid-Columbia Coho Reintroduction Project on ESA listed fish. A list of all fish species documented in these Subbasins is found in Table 1.

ESA listed fish that are likely to be present at these sites include spring Chinook *Oncorhynchus tshawytscha*, summer steelhead *O. mykiss*, and bull trout *Salvelinus confluentus*. The Upper Columbia River spring-run Chinook salmon Evolutionary Significant Unit (ESU) was listed as endangered on March 24, 1999 (64 FR 14308), and its status was reaffirmed on June 28, 2005 (70 FR 37160). The ESU includes all naturally spawned populations of spring-run Chinook salmon (spring Chinook) in Columbia River tributaries upstream of the Rock Island Dam as well as six artificial propagation programs. The Upper Columbia River steelhead distinct population segment (DPS) was listed as endangered on August 18, 1997 (62 FR 43937) and subsequently upgraded to 'threatened" status in 2009 (74 FR 42605). Critical Habitat was designated in the Wenatchee and Methow basins for both Chinook and steelhead in 2005 (70 FR 52630). Columbia River bull trout were listed as threatened on June 10, 1998 (63 FR 31647). The Wenatchee, Entiat, and Methow Rivers have been identified as core bull trout habitats for the Upper Columbia Recovery Unit, and designated as Critical Habitat October 18, 2010 (75 FR 63898).

Information in this report has been prepared as a companion document to support the project analysis. Project site details such as their locations; project descriptions; and associated maps, figures, and photographs, are presented in the *Brood Capture and Rearing Site Descriptions* report (Appendix 1 of the EIS), the *Wenatchee Acclimation Site Descriptions* report (Appendix 2 of the EIS), and the *Methow Acclimation Site Descriptions* report (Appendix 3 of the EIS) prepared for the project, and are not duplicated in this report. Impacts to listed fish resulting from acclimation activities that affect surface waters are discussed in a separate report entitled *Effect of Surface Water Withdrawals on Listed Fish* (Appendix 10 of the EIS) prepared for the project.

Maps of the Wenatchee and Methow Subbasins showing the location of proposed acclimation and rearing sites are shown on Figures, 1-2 in Appendix 1, and Figures 1-1 in Appendix 2 and Appendix 3. Figures 2-1 in Appendix 2 and 3 include the site locations based on Section, Township, and Range as well as their latitude and longitude.

2.1 Life History of ESA Listed Fish

An understanding of a species life history is needed to predict impacts to the population from proposed activities. Life histories for the three ESA listed species are described below.

Spring Chinook

Chinook salmon life history patterns, including run timing, have evolved over thousands of years to match stream flow, water temperatures, and habitat in a particular stream. Spring Chinook are distinguished from late run Chinook salmon by an early adult entry into freshwater and a typical stream-type (yearling) juvenile life history. Both spring run and late run (summer) Chinook salmon spawn in the Wenatchee and Methow Subbasins. However, only spring Chinook are

Table 1. List of fish species documented in the Wenatchee[a] and Methow[b] Subbasins. An "X" indicates the species is present in the Subbasin.

Family & Species	Scientific Name	Wenat-chee	Met-how	Habitat	Origin
Lamprey Family	Petromyzontidae				
Pacific Lamprey	*Entosphenus tridentatus*	X	X	Larvae found in backwater silt	Native
Salmon Family	Salmonidae				
Mountain Whitefish	*Prosopium williamsoni*	X	X	Riffles in summer, pools in winter	Native
Brown Trout	*Salmo trutta*		X	Streams up to 75 degrees F.	Introduced
Cutthroat Trout	*Oncorhyncus clarki*	X	X	Cold water lakes and streams	Native
Rainbow/Steelhead	*O. mykiss*	X	X	Cold water lakes and streams	Native
Chinook Salmon	*O. tshawytscha*	X	X	Larger rivers and streams	Native
Sockeye/kokanee	*O. nerka*	X	X	Primarily lake rearing	Native
Coho Salmon	*O. kisutch*	X	X	Recently re-introduced	Native
Brook Trout	*Salvelinus fontinalis*	X	X	Cold water lakes and streams	Introduced
Bull Trout	*S. confluentus*	X	X	Cold water streams and pools	Native
Minnow Family	Cyprinidae				
European Carp	*Cyprinus carpio*	X	X	Shallow quiet water with dense vegetation	Introduced
Peamouth	*Mylocheilus cauinus*	X[c]		Lakes and slow stretches of rivers	Native
Chiselmouth	*Acrocheilus alutaceus*	X		Faster, warmer streams and rivers, and lakes	Native
Longnose Dace	*Rhinichthys cataractae*	X	X	Among stones at the bottom of swift streams	Native
Speckled Dace	*R. osculus*	X		Small clear well oxygenated streams	Native
Northern Pikeminnow	*Ptychocheilus oregonensis*	X	X	Lakes and slow streams	Native
Redside Shiner	*Richardsonius balteatus*	X	X	Warmer ponds, lakes, streams	Native
Sucker Family	Catostomidae				
Bridgelip Sucker	*Catostomus columbianus*	X	X	Bottom feeder in river backwaters and pools	Native
Largescale Sucker	*C. macrocheilus*	X	X	Bottom feeder in lakes, and pools in rivers	Native
Mountain Sucker	*C. platyrhynchus*	X		Bottom feeder in cool mountain streams	Native
Longnose Sucker	*C. catostomus*	X		Bottom feeder in lakes and streams	Native
Sunfish Family	Centrarchidae				
Smallmouth Bass	*Micropterus dolomieui*		X	Warm streams and lakes	Introduced
Largemouth Bass	*M. salmoides*		X	Shallow, warm weedy lakes and backwaters	Introduced
White Crappie	*Pomoxis annularis*	X	X	Lakes and streams with dense vegetation	Introduced
Catfish Family	Ctaluridae				
Brown Bullhead	*Ctalurus nebulosus*		X	Warm-water ponds, lakes, sloughs	Introduced
Sculpin Family	Cottidae				
Mottled Sculpin	*Cottus bairdi*	X[c]	X	Cold rivers	Native
Shorthead Sculpin	*C. confusus*	X[c]	X	Cold rivers	Native
Torrent Sculpin	*C. rhotheus*	X[c]	X	Cold rivers and lakes	Native
Perch Family	Percidae				
Stickleback	*Gasterosteus aculeatus*	X[c]		Lakes, sloughs, and slow moving streams	Native
Walleye	*Stizostedion vitreum*		X	Large lakes and streams	Introduced
Yellow Perch	*Perca flavescens*	X		Warm to cool clear lakes; slow weedy streams	Introduced

[a] Source: Wenatchee Subbasin Plan (NPCC 2004a) except where noted otherwise.
[b] Source: Methow Subbasin Plan (NPCC 2004b).
[c] Source: ISEMP database.

currently listed under ESA. Early entry of adults allows spring Chinook to reach snowmelt headwater tributaries that are generally only accessible during peak spring stream flows. Once they arrive at these upper reaches, adults hold for extended periods prior to spawning (Figure 1). Since spring Chinook enter freshwater well before the time of spawning, survival until the spawning period is primarily a function of body fat reserves at the time of freshwater entry.

Spawning distributions of spring run and late run Chinook salmon tend to be segregated from one another. While spring run fish tend to spawn in colder headwater streams, late run Chinook tend to spawn in larger, lower elevation rivers where water temperatures are warmer. Late run Chinook typically have an ocean-type life history where juveniles migrate to sea during the same year that they emerge from the gravel. Because spring run Chinook spawn in headwater streams that are much colder than lower elevation reaches, they tend to have a stream-type life history; rearing in freshwater for a full year. This extended freshwater residency is characteristic of Chinook that inhabit more productive watersheds where temperature and flow conditions are relatively consistent.

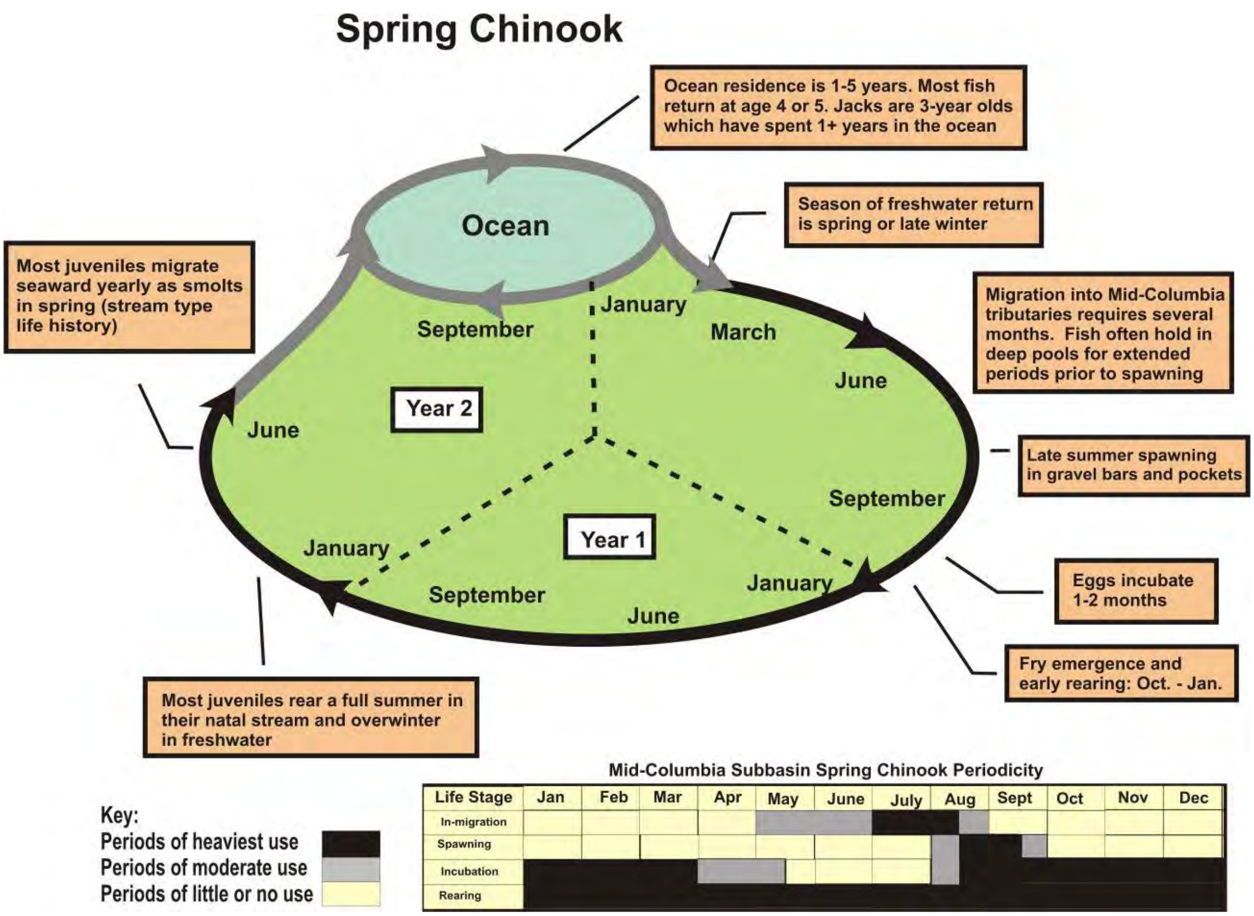

Figure 1. Life cycle of mid Columbia River spring Chinook salmon.

Adult spring Chinook enter the lower Columbia River from March through May, well in advance of spawning in August and September (Figure 1). Migration into the Wenatchee and Methow

Subbasins occurs between May and August. Snow et al. (2008) reported peak migration of upstream passage at Wells Dam in 2007 occurred between May 15 and June 19. However, peak spawning in the Methow Subbasin that year occurred much later, between August 27 and September 8 (Snow et al. 2008). Successful spawning depends on sufficient clean gravel of the right size, in addition to the constant need of adequate flows and water quality. The driving force in redd site selection appears to be the presence of good subgravel flow; this need is likely greater in Chinook than the other salmon species.

Chinook eggs incubate throughout the autumn and winter months with of fry emergence in early spring. Incubation and fry emergence timing depends primarily on water temperature, but are also influenced by dissolved oxygen concentrations, light intensities, and genetic variations (Beacham and Murray 1990, Bjornn and Reiser 1991). The time between egg fertilization and emergence for Chinook salmon was estimated to range between 191 days at 41^{o}F to 316 days at 36^{o}F (Quinn 2005). Chapman et al. (1995) reported fry emergence timing for the mid-Columbia basin ranging between mid-February and mid-April. Catches of newly emerged Chinook fry and sac fry in smolt traps operating in the Wenatchee Subbasin indicates emergence occurs between late February and mid-April (Todd Miller, Washington Department of Fish and Wildlife biologist, and Matthew Collins, Yakama Nation biologist, personal communications). Floods can have their greatest impact on salmon populations during incubation, as they can scour salmon eggs from the gravel or deposit sediment over spawning gravels (Wade 2002). Gravel conditions can also affect success of emergence. Shelton (1955) found that only 13% of hatched alevins emerged from fine gravel while 80-90% emergence was observed in coarse gravels. Dewatering can occur in regulated rivers where discharge is varied to satisfy domestic or industrial water needs but also occurs in natural systems.

Once fry emerge from the gravel there is a large dispersal of fry downstream, although most apparently take up residence near the spawning locations. The downstream dispersal of fry serves to distribute the fry among suitable freshwater nursery areas (Healey 1991). Emergent spring Chinook fry are rarely captured in smolt traps located greater than 0.6 miles (1 km) downstream of spawning locations within the Wenatchee Subbasin except during spring freshets (Todd Miller, Washington Department of Fish and Wildlife biologist, personal communication). After fry leave the gravel, they seek out suitable rearing habitat within side sloughs, side channels, spring-fed seep areas and along the outer edges of the stream. These quiet-water side margin and off-channel slough areas are vital for early juvenile habitat (Wade 2002). The presence of woody debris and overhead cover aid in food and nutrient inputs, and provide protection from predators primarily for the first 2 months of freshwater residence. As Chinook fry grow, they gradually move away from the quiet shallow areas to rear in deeper, faster areas of the stream (Lister and Walker 1966). Chinook salmon parr are typically associated with riverine habitats and are seldom found in beaver ponds or off-channel sloughs (Murphy et al. 1989, Healey 1991). High summer water temperatures in the lower reaches of the Wenatchee and Methow Subbasins limit survival of the stream-type juvenile life-history typical of spring Chinook salmon.

As stream temperatures decrease in the fall, many juveniles move downstream in search of suitable overwintering habitat (Bjornn 1971, Bustard and Narver 1975, Hillman et al. 1987). Others may move upstream in search of suitable habitat (Chapman et al. 1995). During the winter, juvenile spring Chinook tend to prefer pools with adequate concealment cover. Once water temperatures drop below 50^{o}F juvenile Chinook tend to conceal during the day and can be found near the substrate at night (Mullan et al. 1992, Hillman et al. 1987). Juveniles utilize a variety of cover types for overwintering habitat, including interstitial spaces amid the substrate (Hillman et al. 1987), large woody debris and rootwads (Bustard and Narver 1975), and overhanging banks and vegetation (Hillman et al. 1987). Van Dyke et al. (2009) found that winter biomass-density of juvenile Chinook salmon was positively associated with the amount of cobble substrate, and inversely associated with embeddedness in the Grande Ronde River Basin. While some may find suitable overwintering habitat in their natal tributaries, other juveniles migrate downstream into larger rivers, including the main stem Columbia River, where they are believed to over-winter before outmigration the next spring as yearling smolts. Within the Wenatchee River, Tumwater Canyon is an important overwintering area for juvenile spring Chinook (Hillman et. al. 1989).

Stream-type Chinook salmon migrate to sea during their second or, more rarely, their third spring. Wild smolts migrate out of the Wenatchee and Methow Rivers between February and June with peak migrations typically from mid March to mid April (Snow et al. 2008, Hillman et al. 2008). Migration timing progresses as the smolts move downstream through the Columbia River with peak migration through Bonneville Dam around the last week of May (Chapman et al. 1995). Once stream-type Chinook salmon leave freshwater, they usually move quickly through the estuary, into coastal waters, and ultimately to the open ocean (Healey 1983, Healey 1991). Adults migrate as far north as the Aleutian Islands and are widely distributed in the open ocean far from coastal waters. Spring Chinook originating from the Mid-Columbia Basin remain at sea from 1 to 5 years, with most returning after 2 winters (Chapman et al 1995).

Summer Steelhead

Steelhead are rainbow trout that migrate to and from the ocean. Resident and anadromous life history patterns are often represented in the same population and parents of one type may produce offspring of the other. Columbia River populations include summer and winter steelhead, however summer steelhead dominate inland populations upstream from Bonneville Dam including the mid-Columbia basin.

Summer steelhead return to the Columbia River from May to September (Figure 2), enter freshwater in a sexually immature condition, and require several months in fresh water to reach sexual maturity and spawn. Most adults returning to the mid-Columbia basin migrate into Subbasins between August and September. However, a portion of the run overwinters in main stem reservoirs, passing over the upper mid-Columbia dams in April and May of the following year (Chapman et al. 1994).

Spawning occurs when temperatures are cold but increasing in the late spring of the calendar year following entry into freshwater. Spawn timing optimizes competing risks from gravel-bed scour during periodic winter flood events and emergence when increasing temperatures support productive feeding conditions. During 2007, steelhead were observed spawning from mid-March through May with peak spawning in April in the Wenatchee and Methow Subbasins (Hillman et al. 2008, Snow et al. 2008). Steelhead spawn in clear, cool, well-oxygenated streams with suitable gravel and water velocity. A wide range of stream sizes are utilized, from small tributary streams to moderate sized mainstem areas. Adult steelhead, unlike salmon, do not necessarily die after spawning but can return to the ocean. However, repeat spawning is not common among steelhead migrating several hundred miles or more upstream from the ocean.

Egg incubation and timing of fry emergence is dependent on temperature and to a lesser extent on dissolved oxygen concentrations, light intensities, and genetic variation (Bjornn and Reiser 1991). Steelhead eggs hatch in 35–50 days depending on water temperature and alevins remain in the gravel 2 to 3 weeks until the yolk-sac is absorbed (Barnhart 1986). Chapman et al. (1994) noted that newly emerged steelhead fry have been observed in the Wenatchee Subbasin during June and July and speculated that in colder tributaries they may emerge as late as September. Following emergence, fry usually move into shallow and slow-moving margins of the stream, where they may aggregate in small schools of up to 10 individuals (Barnhart 1986) in waters 3-14 in (8 to 36 cm) deep (Bovee 1978). As they grow, juveniles cease schooling behavior and defend individual territories and inhabit areas with deeper water, a wider range of velocities, and larger substrate (Grant and Kramer 1990). Juvenile steelhead typically favor riffle habitats and are often more abundant in steeper stream reaches than juvenile Chinook or coho.

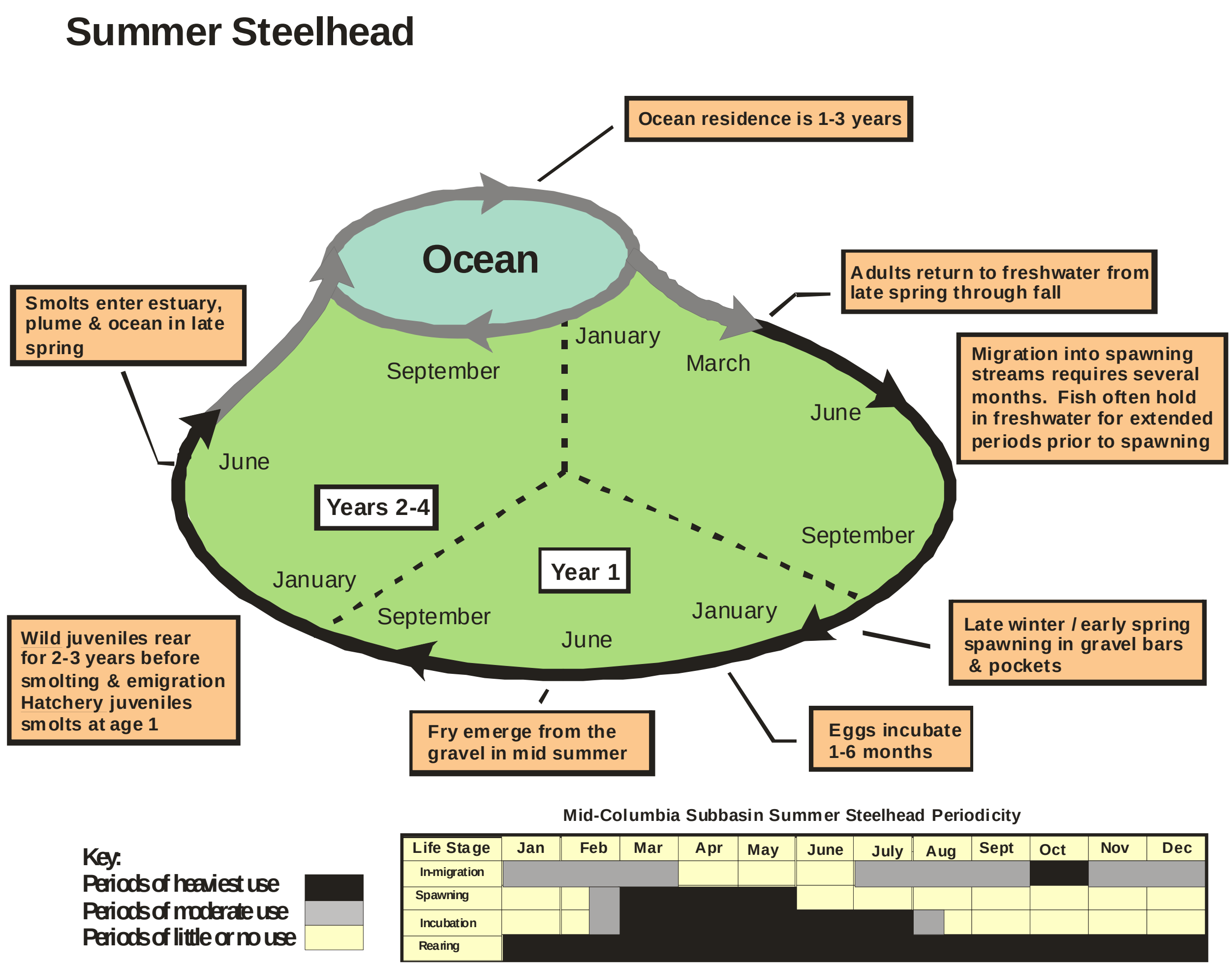

Figure 2. Life cycle of mid Columbia River summer steelhead.

Steelhead typically spend 1-3 years in freshwater before migrating to the ocean for the first time. Emigration of steelhead smolts out of the Wenatchee and Methow Rivers generally occurs from March to June, with peak migrations in April or May (Snow et al. 2008, Hillman et al. 2008).

Once they begin their migration, steelhead smolts actively migrate through the Columbia River mainstem and estuary to reach the ocean. In the ocean, steelhead generally migrate north along the continental shelf. Steelhead migrational patterns are generally believed to extend further out in the ocean than other salmonids; however, steelhead are seldom caught in ocean fisheries and limited CWT recovery data is available to conclusively confirm this belief. Individuals grow rapidly in the ocean. Size and age of maturation are related to ocean growth rates. Most adult steelhead return to freshwater after 1 or 2 years at sea.

Bull Trout

Bull trout in the Columbia River Basin exhibit resident and freshwater migratory life history patterns (Rieman and McIntyre 1993). Resident forms live out their lives in the tributary where they were born or in nearby streams. Freshwater migratory forms include both fluvial and adfluvial strategies (Fraley and Shepard 1989). The fluvial form migrates between main rivers and tributaries while the adfluvial form migrates between lakes and streams. Tagging studies have confirmed fluvial bull trout in the Wenatchee and Methow Subbasins sometimes migrate into the Columbia River mainstem (USFWS 2002). Resident and migratory forms may coexist in the same stream.

Researchers have consistently found that water temperature is a principal factor influencing distribution of bull trout (Rieman and McIntyre 1993, Baxter and McPhail 1996). Fraley and Shepard (1989) observed that water temperature above 59°F limited bull trout distribution in Montana. Studies in the John Day basin found bull trout present only when maximum summer temperatures were 61°F or below, and maximum densities occurred where maximum temperatures were 54°F or below (Buchanan et al. 1997).

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993). Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors (Fraley and Shepard 1989; Goetz 1989; Hoelscher and Bjornn 1989; Sedell and Everest 1991; Howell and Buchanan 1992; Pratt 1992; Rieman and McIntyre 1993, 1995; Rich 1996; Watson and Hillman 1997). As a result bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993).

Preferred spawning habitats include stream reaches with groundwater infiltration, loose clean gravel and cobble substrates, and temperatures 41-48°F in late summer and early fall (Fraley and Shepard 1989, Goetz 1989). Migrating forms may travel to spawning streams during spring or early summer freshets and reside in deep pools up to 2 months before spawning (Figure 3). Adults typically spawn at night from August to November during periods of decreasing water temperatures (McPhail and Baxter 1996). Peak spawning in the Wenatchee and Methow Subbasins occurs between mid-September through October (USFS *in prep.*, USFWS 2004). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989; Pratt 1992; Rieman and McIntyre 1996). Bull trout reach maturity in 4 to 7 years and may live longer than 12 years. Repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (Leathe and Graham 1982; Fraley and Shepard 1989; Pratt 1992; Rieman and McIntyre 1996).

Incubating and emergent bull trout require colder water than other salmonid species. Cool water during early life history results in higher egg survival and fry growth rates (Pratt 1992, McPhail and Murray 1979, Shepard et al. 1984). Incubation is normally 100 to 145 days depending on water temperature, (Pratt 1992). After hatching, juveniles remain in the substrate for up to 3 weeks before emerging from the gravel. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Pratt 1992; Ratliff and Howell 1992).

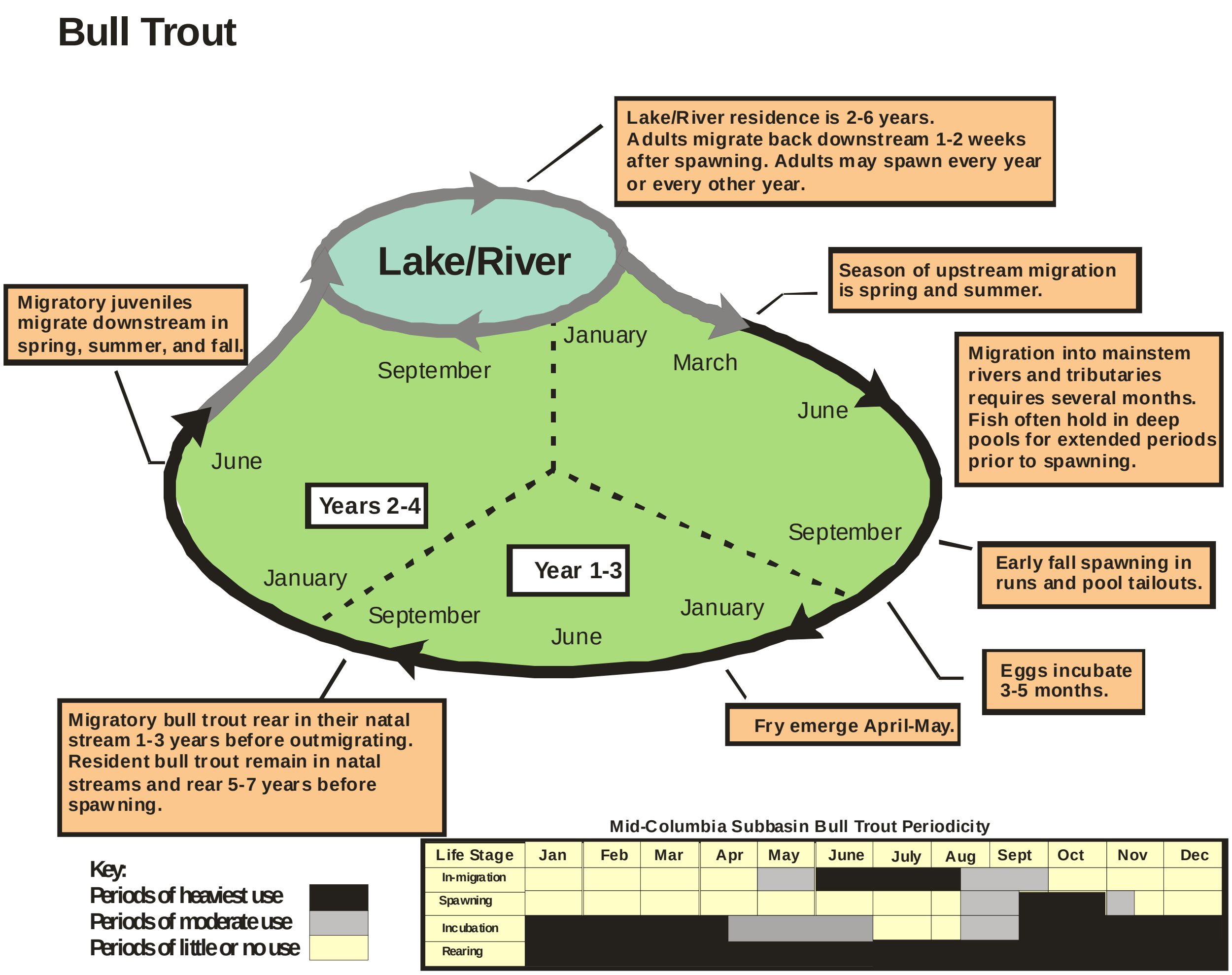

Figure 3. Life cycle of mid Columbia River bull trout.

Juvenile bull trout typically rear in their natal streams for several years although some may migrate out as fry (McPhail and Baxter 1996, USFWS 2002). Within the Wenatchee Subbasin, bull trout fry are not typically captured in smolt traps except within the White River drainage where they are thought to migrate downstream to rear in Wenatchee Lake (Todd Miller, Washington Department of Fish and Wildlife biologist, and Matthew Collins, Yakama Nation biologist, personal communications). Similarly, bull trout fry are not captured in smolt traps located in the lower Methow and Twisp Rivers (Alex Repp, Washington Department of Fish and Wildlife biologist, personal communication). Juvenile bull trout are associated with complex cover, including large wood, undercut banks, boulders, and pools (Fraley and Shepard 1989). In addition, they prefer shallow water depths with good cover, near faster-flowing water that delivers food particles (Baxter and McPhail 1996). Fry stay close to the streambed, perhaps as an adaptation to avoid being carried downstream before they are large enough to take up residence in a suitable feeding site. McPhail and Murray (1979) found that bull trout fry grew to larger sizes at lower temperatures, with maximum growth at about 39°F. Migratory bull trout generally leave their natal streams for the first time after 2 to 3 years when about 7.75 inches long. Although juvenile migration can occur any time of the year, it typically peaks during May and June. Once migratory bull trout leave the streams in which they are born, they travel to larger rivers and lakes throughout their range. Migratory corridors link seasonal habitats for all bull trout life histories and are important for the persistence of the species (USFWS 2002). At maturity, resident fish are generally smaller and less fecund than migratory fish (Fraley and Shepard 1989).

Bull trout are opportunistic feeders, with food habits primarily a function of size and life-history strategy. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macro-zooplankton, and small fish (Boag 1987; Goetz 1989; Donald and Alger 1993). Adult migratory bull trout feed on various fish species (Leathe and Graham 1982; Fraley and Shepard 1989; Brown 1992; Donald and Alger 1993).

2.2 Potential Life Stages Affected

Potential interactions between rearing coho and other fish will depend on the species and life-stages present at the time of the activity. There are three general classes of potential impacts considered in this analysis: opportunity for direct predation; temporary loss of habitat; and construction related.

Only spring Chinook and bull trout fry would be small enough to be potential prey for juvenile coho during rearing and acclimation. Because Chinook fry typically remain near spawning areas or disperse downstream after emergence, they would be expected to be present at, or within 0.6 miles downstream of, spawning areas. In contrast, juvenile bull trout tend to remain in their natal streams for 1 or more years (McPhail and Baxter 1996, USFWS 2002). Fry would only be expected to be present at sites near spawning locations, except within the White River where bull trout fry have been documented moving downstream. Within the White River drainage, bull trout fry would be assumed to be present in the mainstem down to Lake Wenatchee.

Temporary loss of habitat would potentially occur when barrier nets or seines are used to enclose juvenile coho during rearing and acclimation. Other fish would be excluded from the immediate site and potentially prevented from migrating upstream. Spring Chinook fry, parr, and smolts; summer steelhead adults, parr and smolts; and bull trout fry, juveniles (remaining in natal streams), and migratory subadults (larger immature fish) and adults could potentially be affected by these activities.

Construction is planned for a limited number of sites during the June through August time period. Spring Chinook adults, and parr; summer steelhead adults, fry, parr and smolts; and bull trout juveniles, and migratory subadults and adults could potentially be present during these activities.

A list of life stages and size ranges of ESA listed fish that could be present proposed overwinter rearing sites (December through early May), spring acclimation (mid-March through early May), and site construction activities is found in Table 2. The potential effects of these activities are discussed in greater detail under the Impact Analysis section.

Table 2. Life stages and size ranges of ESA listed fish that could be present in the Wenatchee and Methow Subbasins during proposed overwinter rearing periods (December-early May), spring acclimation periods (mid-March-early May) and site construction activities (June-September).

			Overwinter rearing		Spring acclimation		During construction		
Species	Life stage	Timing	Present	Size (in)	Present	Size (in)	Present	Size (in)	Reference
Spring Chinook	adult migration/holding	May-Aug	yes	12-36	yes	12-36	yes	12-36	Chapman et al. 2005
	adult spawning	Aug-Sep	no		no		yes	12-36	Snow et al. 2008
	eggs & alevin	Aug-Apr	yes	< 1.2	yes	< 1.2	yes	< 1.2	Chapman et al. 2005
	fry	Feb-May	yes	1.25-1.75	yes	1.25-1.75	no		Chapman et al. 2005
	parr	Jun-Mar	yes	2.75-4.75	yes	2.75-4.75	yes	1.75-4.75	Chapman et al. 2005
	smolts	Mar-Apr	yes	2.75-5.0	yes	2.75-5.0	no		Chapman et al. 2005
Summer steelhead	adult migration/holding	Aug-Mar	yes	20-34	yes	20-34	yes	20-34	Chapman et al. 2004
	adult spawning	Mar-May	yes	20-34	yes	20-34	no		Chapman et al. 2004
	eggs & alevin	Mar-Sep	yes	< 1.2	yes	< 1.2	yes	< 1.2	Chapman et al. 2004
	fry	Jun-Sep	no		no		yes	1.25-1.75	Chapman et al. 2004
	parr	Year-round	yes	2.75-6.25	yes	2.75-6.25	yes	1.75-6.25	Chapman et al. 2004
	smolts	Mar-Jun	yes	5.5-8.25	yes	5.5-8.25	yes	5.5-8.25	Chapman et al. 2004
Bull trout	adult migration/holding	May-Sep	yes	14-32	yes	14-32	yes	14-32	McPhail & Baxter 1996
	adult spawning	Aug-Nov	no		no		yes	6-32	USFS *in prep.*,USFWS 2004
	sub-adult/adult feeding	Year-round	yes	6-32	yes	6-32	yes	6-32	Pratt 1992
	eggs & alevin	Aug-Apr	yes	< 1	yes	< 1	yes	< 1	Pratt 1992
	young-of-year	Apr-Dec	yes	1.0-1.75	yes	1.0-1.75	no		Pratt 1992
	juveniles	Year-round	yes	2.25-7.75	yes	2.25-7.75	yes	2.25-7.75	Sexauer & James 1997

3.0 DETERMINING SPECIES PRESENCE

We determined the presence of ESA listed fish by life stage by reviewing existing data and literature on fish distribution for the Wenatchee and Methow Subbasins, and by snorkel surveys at selected sites.

3.1 Review of Existing Data

A variety of resources were used to obtain existing data on presence of ESA listed fish for rearing and acclimation sites proposed for the Wenatchee and Methow Subbasins (see Appendices 2 and 3 of the EIS for site descriptions). These included online interactive mapping tools, published reports, and contacting individuals associated with agencies and private organizations to acquire unpublished reports and databases.

The Washington Department of Natural Resources (DNR) in cooperation with the Departments of Fish and Wildlife, and Ecology, and in consultation with affected Indian tribes maintains and updates “fish habitat water typing maps” under WAC 222-16 (See section 031) to help landowners identify and type streams on their property. These maps include both modeled and field-verified stream types and can be viewed on the Forest Practices Application and Review System (FPARS) mapping website (Figure 4). DNR classifies streams, lakes and ponds into four types:

- Type S, shoreline
- Type F, fish bearing
- Type Np, non-fish bearing perennial, or
- Type Ns, non-fish seasonal waters.

In addition, codes used as placeholders include N (Non-fish where the Np or Ns determination has not been made), X (a water feature exists, but does not meet the definition of a typed water as described in WAC 222-16, and U (water type has not yet been presumed or field verified). Stream classifications for streams that would be affected by proposed acclimation sites are found in Figure 2-2 in Appendices 2 and 3. However, this site does not provide information on which species or life-stages are found in each stream.

Washington Department of Fish and Wildlife (WDFW) maintains SalmonScape, an online interactive mapping tool (Figure 5) that provides detailed information about fish distribution and status, habitat characteristics, smolt trapping locations, and passage barriers. Data used to create SalmonScape maps were collected by state, federal, tribal and local biologists as well as regional fisheries enhancement groups and watershed partners. We used SalmonScape to provide an initial list of sites with known fish presence information.

Because SalmonScape may not represent the most current or complete dataset available for fish presence in the Wenatchee and Methow Subbasins, we contacted a wide range of governmental, tribal, and private organizations to obtain additional site-specific fish survey data. A complete list of contacts is found in Table 3.

Within the Wenatchee Subbasin we found two large datasets with site specific information on fish sampling collected by state, federal, and tribal agencies. The Integrated Status and Effectiveness Monitoring Project (ISEMP) manages data on salmon and steelhead populations

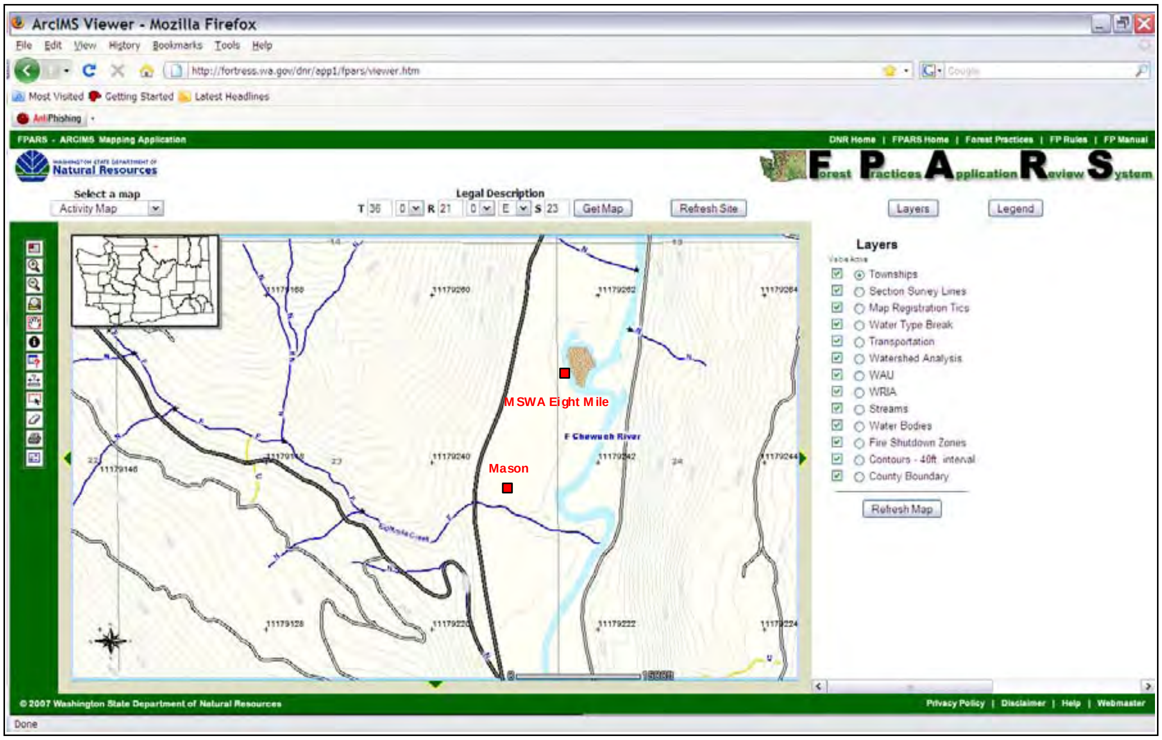

Figure 4. Map generated using the online DNR interactive mapping program at the FPARS website showing stream classifications near the Mason and MSWA Eight Mile acclimation sites in the Methow River basin.

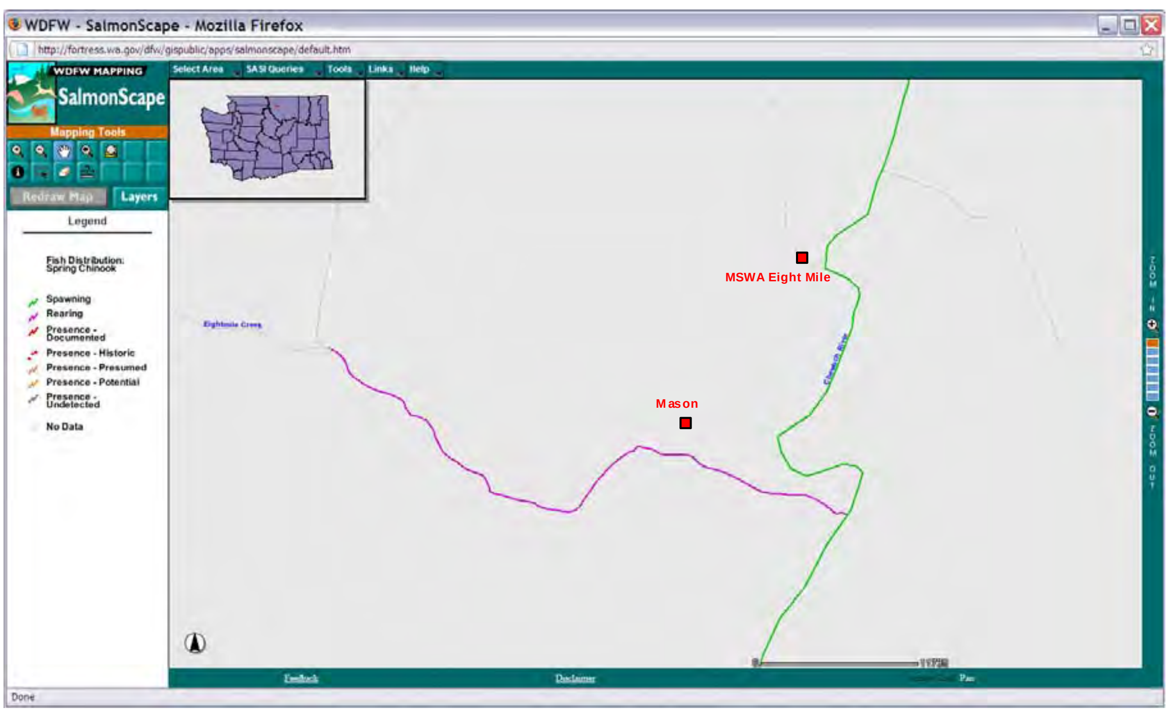

Figure 5. Map generated using the online WDFW interactive mapping program SalmonScape, showing the distribution of spring Chinook spawning (green) and rearing (purple) near the Mason and MSWA Eight Mile acclimation sites in the Methow River basin.

Table 3. List of contacts made to obtain fish survey data in the Wenatchee and Methow Subbasins by agency and location.

Contact	Agency	Location
Tracy Hillman	BioAnalysts, Inc.	Boise, ID
Jeff Osborn	Chelan PUD	Wenatchee
Shaun Seaman	Chelan PUD	Wenatchee
Pamela Nelle	Terraqua, Inc. (ISEMP)	Wenatchee
James White	Upper Columbia Salmon Recovery Board (ISEMP)	Wenatchee
Barbara Kelly Ringel	US Fish & Wildlife Service	Leavenworth
Judy De Lavergne	US Fish & Wildlife Service	Wenatchee
David Hopkins	US Forest Service	Winthrop
Gene Shull	US Forest Service	Winthrop
Pierre Dawson	US Forest Service	Wenatchee
Cindy Raekes	US Forest Service	Wenatchee
Dan Rife	US Forest Service	Deschutes
Patrick Connolly	US Geological Survey	Cook
Wes Tibbits	US Geological Survey	Twisp
Jennifer Molesworth	US Bureau of Reclamation	Twisp
Carol Volk	Volk Consulting (ISEMP)	Seattle
Andrew Murdoch	WDFW	Wenatchee
Casey Baldwin	WDFW	Wenatchee
Charlie Snow	WDFW	Twisp
Alex Repp	WDFW	Twisp
Mike Tonseth	WDFW	Wenatchee
Todd Miller	WDFW	Wenatchee
Bob Steele	WDFW	Ephrata
John Crandall	Wild Fish Conservancy	Duvall
Keely Murdoch	Yakama Nation	Wenatchee
Cory Kamphaus	Yakama Nation	Wenatchee
Matthew Collins	Yakama Nation	Wenatchee
Rick Alford	Yakama Nation	Winthrop

and habitat collected since 2004. The US Forest Service in Wenatchee maintains a similar database for sampling years 1936 to 2006. We used Geographic Information Systems (GIS) to overlay fish survey data from these two sources on acclimation site locations to determine if fish surveys had been conducted in the near vicinity of each acclimation site (Figure 6). Additional information was provided by Chelan PUD (Hillman et al. 2008) and USFWS (USFWS 2003, 2004).

Site-specific fish survey data for the Methow Subbasin was provided by a number of agencies. Spring Chinook and summer steelhead spawning ground survey and smolt monitoring data was provided by WDFW (Snow et al. 2008). Bull trout redd surveys were provided by the US Forest Service (USFS *in prep.*). Electrofishing and trapping data collected in Lower Methow tributaries between 2004 and 2006 was provided by the US Geological Survey (Martens and Connolly 2008). Additional fish survey data for selected sites was provided by Patrick Connolly (US Geological Survey, personal communication) and Gene Shull (US Forest Service, personal communication).

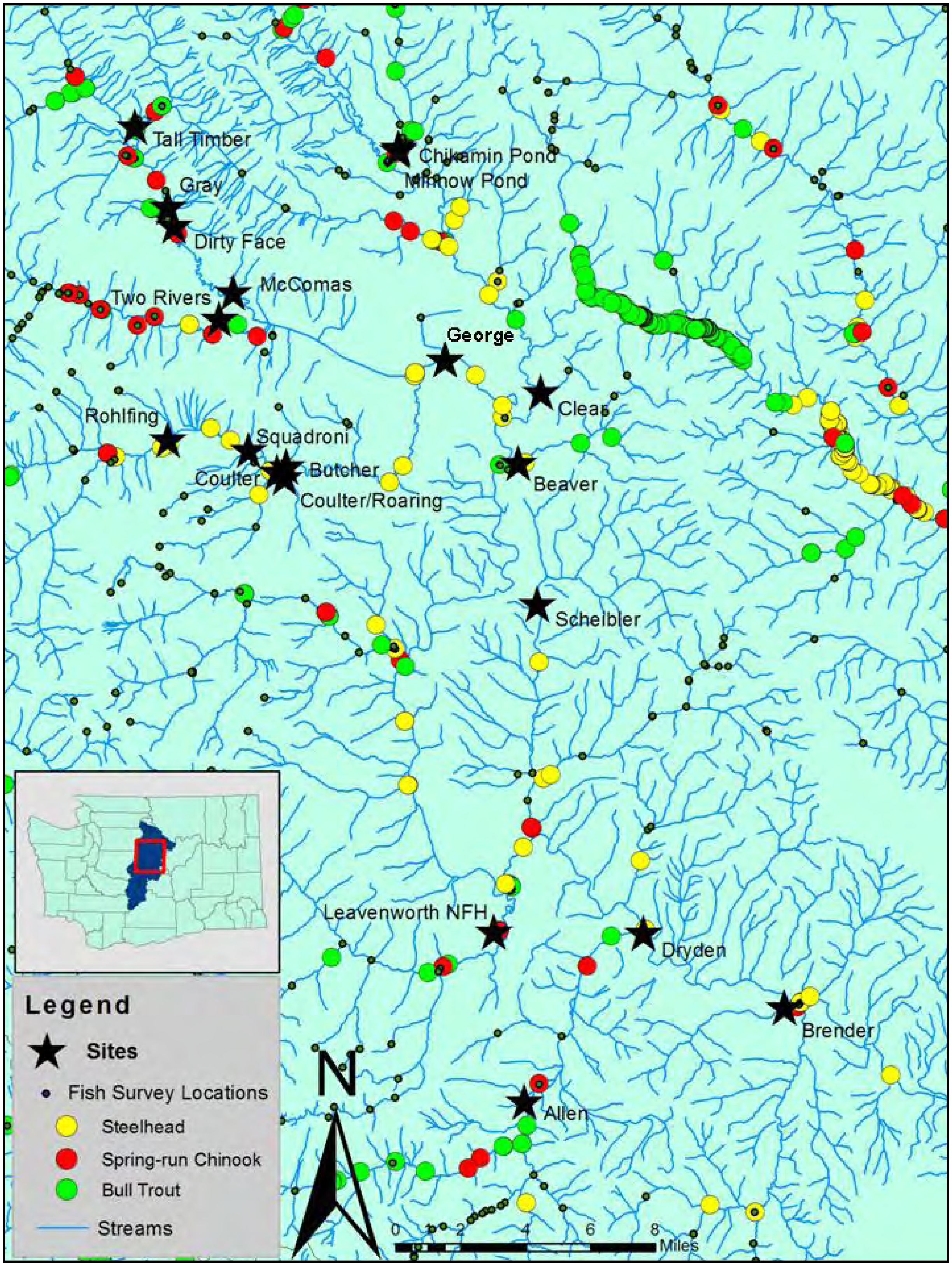

Figure 6. All acclimation sites in the Wenatchee basin (stars), fish survey sites (small dots), and survey sites with listed species observed. Fish survey data was supplied by USFS and ISEMP for survey years 1936-2007.

Protocols

In some cases the available data was insufficient to determine what life-stages were present for a given species. To deal with these circumstances we established a set of rules to assume which life stages were present as described below:

Presence documented: This common classification in SalmonScape did not provide any information on the size or timing of the fish. Unless other information was provided, we assumed these were rearing juvenile Chinook or steelhead, or migratory bull trout (juveniles and adults).

Presence presumed: We treated this SalmonScape classification the same as "presence documented" unless actual snorkel/electrofishing sampling in that stream failed to capture any of fish of this species. In that case, the sampling data was assumed correct.

Spawning: For all species, we assumed that if spawning was documented in the area, rearing also occurred there. In addition, we assumed that Chinook and steelhead rearing occurred within 0.6 miles downstream of a spawning reach. Because bull trout typically rear in their natal streams for 1-3 years, we did not assume fry would be present downstream of spawning tributaries (except as noted below).

Rearing: For Chinook and steelhead, we assumed that if rearing was documented in the area, but spawning was not documented upstream, that these fish had migrated upstream into the stream. We assumed that parr and smolts were present but fry were not because their ability to swim against the current is not fully developed. For bull trout we assumed that if rearing was listed but no spawning, that adult and sub-adult migratory fish were present. Bull trout fry tend to stay in their natal streams and were not assumed to be present in non-natal streams (except in the White River where bull trout fry have commonly been captured in smolt traps).

Migration: We assumed that adult Chinook and steelhead migrated through any reach downstream of spawning locations. We assumed that bull trout migrated anywhere they had been documented as present. Because migrating bull trout can include immature fish (sub adults) and adults, we assumed that areas classified as "rearing" were migratory fish unless it was a known spawning area.

3.2 On-site Surveys

We conducted snorkel surveys to determine presence or absence of ESA listed fish species at five acclimation sites following methods described in Thurow (1994) and Murdoch and Nelle (2008) (Table 3). All surveys were conducted between April 26-28 to correspond with the general time period during which acclimation sites would be active.

The snorkel crew completed a training exercise prior to conducting any stream surveys. Training consisted of reviewing snorkeling techniques, safety precautions, and photographs and descriptions of commonly observed fish species described in Thurow (1994). They also practiced fish identification and size estimation techniques in the field. Plastic fish cutouts of known length were used to help crew members estimate fish size underwater.

We designated sample reaches at each acclimation site of approximately 475 feet in length, and where appropriate, located such that water intake and discharge sites were encompassed within the sample reach. General site descriptions were made at each site prior to conducting any snorkel surveys. Basic habitat data included reach length (measured with a hip chain), wetted width (at five or more cross sections), and general channel type classification from Montgomery and Buffington (1993) (i.e., pool/riffle, plane-bed, step-pool, cascade, etc.). Upstream and downstream reach boundaries were initially marked with flagging and GPS coordinates were recorded. Information such as sample date (including start and stop time), water temperature, and visibility were recorded for each site. Visibility was measured using a 4 in Rapala fishing lure (Model # XRD-10RT) placed in the mid-water column and a snorkeler moved away from the lure until it was no longer identifiable. The snorkeler then moved towards the lure until it was identifiable again. The distance from the snorkeler to the lure was then measured using a measuring tape.

All snorkel surveys were conducted at night because nighttime snorkel surveys have been shown to be more accurate than daytime surveys during winter months (Roni and Fayram 2000). A glowstick was set at reach boundaries prior to each survey. Surveys were carried out by one or two snorkelers depending on the stream width, habitat complexity, and visibility. Snorkelers entered the river approximately 15 ft downstream of the reach start and proceed upstream. Fish counts started when the snorkeler had passed the glow stick marking the downstream end of the reach. To avoid inaccuracies or double counts, fish were not counted until the observer passed them. For reaches requiring two snorkelers, the two snorkelers held position in the center of the channel as they moved upstream. The observer on the left counted all fish to the left of center, and the observer on the right counted the remainder. All salmonids were identified to species, while dace, suckers, and sculpins were identified to genus. Fish were grouped into commonly observed size categories as described in Thurow (1994). Data was recorded on a slate during the survey and transcribed onto waterproof rite-in-rain paper immediately after completing the survey.

3.3 Results

3.3.1 Wenatchee onsite surveys

3.3.1.1 Butcher

The Butcher site was snorkeled between 10:10 and 11:40 PM on April 26, 2009. Water temperature was measured at 45^{o}F and visibility at 5.25 ft. Five distinct habitat reaches were identified (Figure 7), including a 30 ft length of stream downstream of the beaver pond (reach 1). The MCCRP was acclimating coho in the beaver pond at the time of the survey and the water visibility was poor due to fish and beaver activity. The number and sizes of fish observed during the survey are found in Table 4. Chinook salmon fry were observed only below the beaver dam in Butcher Creek near the confluence with Nason Creek. We assumed the beaver dam prevented Chinook salmon from accessing the acclimation site. In contrast, juvenile rainbow/steelhead were found in Butcher Creek above and below the beaver pond. While these fish were likely resident rainbow trout, we could not exclude the possibility that juvenile steelhead were able to access the pond above the beaver dam under some flow conditions.

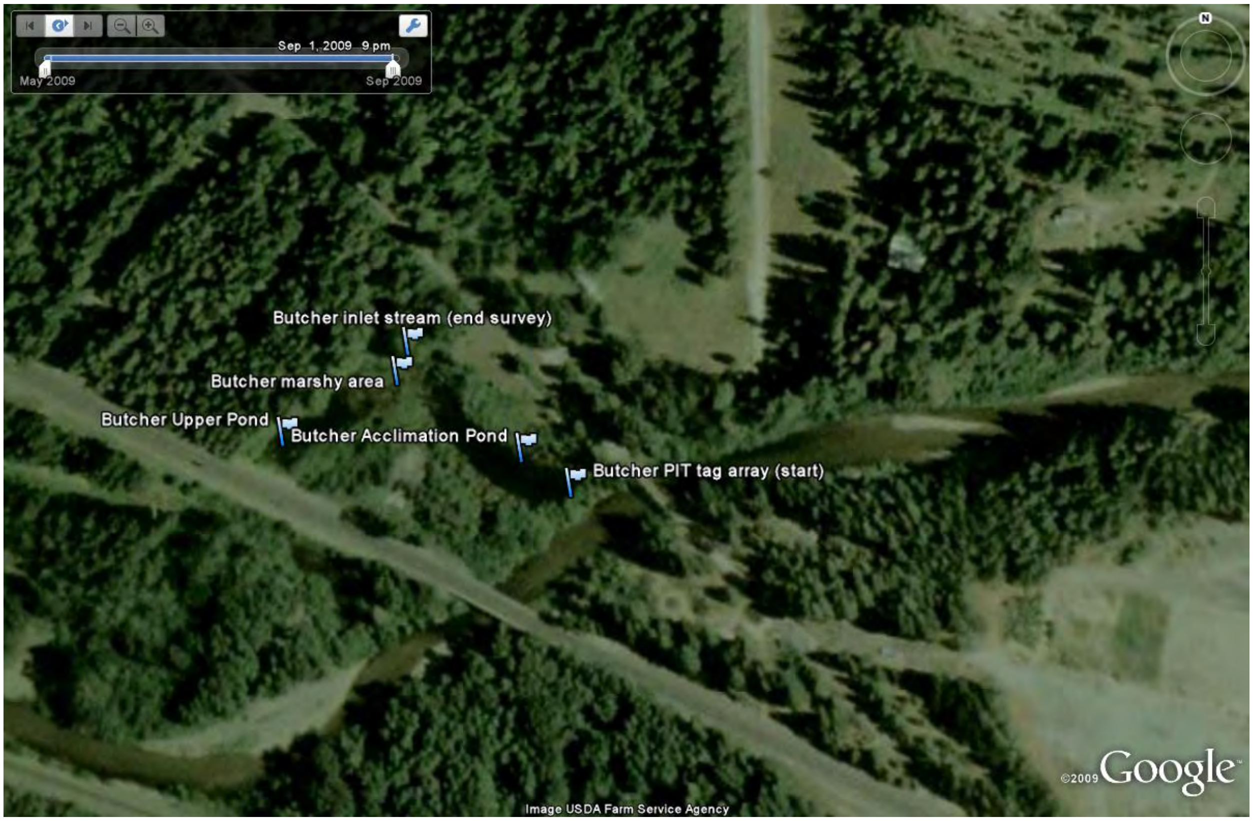

Figure 7. Aerial view of the Butcher site showing habitat reaches and snorkel survey locations.

Table 4. Summary of habitat reaches and fish observed during the snorkel survey at the Butcher site on April 26, 2009.

Reach number	Reach description	Length (ft)	Habitat type	Stream channel (ft)		Fish observed		
				avg width	avg depth	species[a]	size (in)	number
1	PIT tag array to beaver dam	30	glide	9.0	1.5	Chin	1.0-1.5	> 100
						Sthd	2.25-2.75	1
						Sthd	2.75-6.0	2
						RSS	< 2.75	10
						HCoho	2.75-6.0	2
2	Acclimation pond	322	pond	80	10	Poor visibility not surveyed		
3	Marshy area	46	backwater	105	0.3	Undefined channel not surveyed		
4	Upper pond	230	pond	78	5	Sthd	2.25-2.75	1
						Sthd	2.75-6.0	1
						RSS	< 2.75	14
						HCoho	2.75-6.0	6
5	Inlet stream	85	glide	7	0.75	HCoho	2.75-6.0	3

[a] Chin = Chinook, Sthd = rainbow/steelhead, RSS = red sided shiner, HCoho = hatchery coho

3.3.1.2 Coulter

The Coulter site was snorkeled between 9:15 and 10:10 PM on April 28, 2009. Water temperature was measured at 46°F and visibility at 6.5 ft. Two reaches were surveyed (Figure 8): a flowing section downstream of the acclimation site and beaver complex; and a representative section in the beaver complex above the acclimation site. The MCCRP was holding coho at the acclimation pond at the time of the survey and the water visibility was limited due to fish and beaver activity. The number and sizes of fish observed during the survey are found in Table 5.

Figure 8. Aerial view of the Coulter site showing snorkel survey boundaries in relation to the acclimation pond.

Table 5. Summary of habitat reaches and fish observed during the snorkel survey at the Coulter site on April 28, 2009.

Reach	Reach description	Length (ft)	Habitat type	Stream channel (ft)		Fish observed		
				avg width	avg depth	species[a]	size (in)	number
3	Flowing section upstream of road	251	glide	8.2	1.2	Sthd	2.75-6.0	1
						Sthd	6-12	1
						Brook	2.75-6.0	1
						Brook	6-12	3
						HCoho	2.75-6.0	8
2	Beaver complex up-stream of accl. pond	246	pond	10	5	RSS	2.75-6.0	13
						HCoho	2.75-6.0	60+

[a] Sthd = rainbow/steelhead, Brook = brook trout, RSS = red sided shiner, HCoho = hatchery coho.

Rainbow/steelhead and brook trout were observed in Coulter Creek below the acclimation site and beaver complex, but not above. We assumed that the series of beaver dams prevented upstream migration of these species.

3.3.1.3 Rohlfing

The Rohlfing site was snorkeled between 10:50 and 11:30 PM on April 28, 2009. Water temperature was measured at 44^{o}F and visibility at 10 ft. Two reaches of flowing stream were surveyed: one each above and below the acclimation pond (Figure 9) The MCCRP was holding coho at the acclimation pond at the time of the survey and the water visibility was poor due to fish activity. The number and sizes of fish observed during the survey are found in Table 6. Rainbow/steelhead trout were only observed downstream of the acclimation pond. Nevertheless, an adult steelhead was observed upstream of the acclimation pond in the past (Mike Tonseth, WDFW personal communication). However, because the stream goes dry during the summer, the importance of this habitat is likely minimal.

Table 6. Summary of habitat reaches and fish observed during the snorkel survey at the Rohlfing site on April 28, 2009.

	Reach	Length	Habitat	Stream channel (ft)		Fish observed		
Reach	description	(ft)	type	avg width	avg depth	species[a]	size (in)	number
1	Section of stream from Whitepine Rd to acclimation pond	295	glide	12.0	1	Sthd	2.25-2.75	2
						Sthd	2.75-6.0	2
						HCoho	2.25-2.75	1
						HCoho	2.75-6.0	4
2	Acclimation pond	95	pond	60.7	6.5	poor visibiility - no survey		
3	Stream upstream of acclimation pond	148	glide	6.9	0.75	HCoho	2.25-2.75	3

[a] Sthd = rainbow/steelhead, HCoho = hatchery coho

Figure 9. Aerial view of the Rohlfing site showing snorkel survey boundaries in relation to the acclimation pond.

3.3.2 Methow onsite surveys

3.3.2.1 Goat Wall

The Goat Wall site was snorkeled between 9:30 and 10:30 PM on April 27, 2009. Water temperature was measured at 45.5°F and visibility at 43 ft. One reach beginning just upstream of the Methow River and ending at a pipe crossing near the homestead (Figure 10) was surveyed. The number and sizes of fish observed during the survey are found in Table 7. Rainbow/steelhead and bull trout were scattered throughout the reach. This was surprising because, like the Methow River nearby, the stream was completely dry during a site visit on April 8, 2009.

Figure 10. Aerial view of the Goat Wall site showing snorkel survey boundaries.

Table 7. Summary of fish observed during the snorkel survey at the Goat Wall site on April 27, 2009.

Reach	Reach description	Length (ft)	Habitat type	Stream channel (ft)		Fish observed		
				avg width	avg depth	species[a]	size (in)	number
1	Upstream of Methow confluence to overhead pipeline	522	pool	42	3.3	Sthd	2.75-6.0	3
						Sthd	6-12	2
						Bull	2.75-6.0	1
						Bull	6-12	4
						Unid	6-12	1

[a] Sthd = rainbow/steelhead, Bull = bull trout, Unid = unidentified salmonid (probable Sthd) escaped before positive identification.

3.3.2.2 MSWA Eight Mile

The MSWA Eight Mile site was snorkeled between 11:30 PM April 27, 2009 and 12:10 AM on April 28, 2009. Water temperature was measured at 44°F and visibility at 14 ft. One reach beginning just upstream of the Chewuch River and ending 502 ft upstream was surveyed (Figure 11). The number and sizes of fish observed during the survey are found in Table 8. One lamprey and four rainbow/steelhead were observed just upstream (30 ft) of the Chewuch confluence. Upstream of that point, the channel was very wide and shallow, with lots of aquatic vegetation and no measurable flow. Only one rainbow/steelhead was observed in this upper section of the reach. The dominant fish species throughout the channel was the bridgelip sucker.

Figure 11. Aerial view of the MSWA Eight Mile site showing snorkel survey boundaries.

Table 8. Summary of fish observed during the snorkel survey at the MSWA Eight Mile site on April 27, 2009.

Reach	Reach description	Length (ft)	Habitat type	Stream channel (ft)		Fish observed		
				avg width	avg depth	species[a]	size (in)	number
1	Start upstream of Chewuch confluence	502	backwater	67	~1.5	Sthd	2.75-6.0	5
						Lamp	6-12	1
						Sckr	2.75-6.0	> 200
						Sckr	6-12	1

[a] Sthd = rainbow/steelhead, Lamp = lamprey, Sckr = bridgelip sucker.

3.3.3 Summary of fish presence

Summaries of the available data are found in Table 9 for the Wenatchee River Basin and Table 10 for the Methow River Basin.

Table 9. Summary of spawning (S), rearing (R), and migration (M) data documented for listed species at affected streams near acclimation sites in the Wenatchee Subbasin.

		Spring Chinook			Steelhead			Bull trout		
Site Name	Affected Stream	S	R	M	S	R	M	S	R	M
Primary Sites										
Beaver	Beaver		3		2	2,3			2b	2b
Brender	Brender		1a,2a			1a				
Butcher	Butcher					6				
Chikamin	Chikamin		1, 3		1	1,3a			1,3b	1,3b,5
Clear	Clear Creek				1,4	1,2				
Coulter	Coulter Creek					1a				
Dirty Face	unnamed					No Data				
Dryden	Peshastin/Wenatchee		1,3	1	2,4	1,3			1b,2b	1b,2b
White River Springs	unnamed					No Data				
Minnow	Minnow		1a, 3			3a			3b	3b
Rohlfing	unnamed					6c				
Scheibler	Chumstick					No Data				
Tall Timber	Napeequa	1,2	1,2		4	1a,2a			1b,2b	1b,2b
Two Rivers	none					No Data				
Backup Sites										
Allen	Allen					No Data				
Coulter/Roaring	Coulter/Roaring				1,2	1				
George	Wenatchee River	1,2,4	1,2,3		1,2,4	1,2,3			1b	1b,2b
McComas	White River	1	1			1	1		1	1
Squadroni	unnamed					No Data				

Data Source key:
1 = Salmon Scape, 2 = USFS database (1904-2006), 3 = ISEMP database (2004-2007), 4 = Hillman et al. (2008), 5 = USFWS 2003, 2004, 6 = onsite survey, a = Presence documented but size class not specified, b = Presence assumed, c = only found downstream of acclimation site, blanks indicate species/life stage not documented.

Table 10. Summary of spawning (S), rearing (R), and migration (M) data documented for listed species at affected streams near acclimation sites in the Methow Subbasin.

		Spring Chinook			Steelhead			Bull trout		
Site Name	Affected stream	S	R	M	S	R	M	S	R	M
Primary Sites										
Goat Wall	Cold Creek					6			6	6
Gold	S Fork Gold		1c		1,2,3	1,2				2
Hancock	Hancock Creek				1,3,5	1,5				
Heath	Heath ponds (spring)		2,4			2,4				2
Lincoln	Twisp River	1,3	1		1,3	1	3		1b	1b
Lower Twisp	Twisp River	1	1	3	1,3	1	3		1b	1b
Mason	Eight Mile		1		1,3	1,4			1b	1b,4
MSWA Eight Mile	Chewuch side channel					6				
Parmley	Beaver Creek				1,2,3	1,2			1	2
Twisp Weir	Twisp River	1,3	1	3	1,3	1	3		1b	1b
Pete Creek Pond	Chewuch River	1,4	1	3	1,4	1			1	4
Backup Sites										
Balky Hill	unnamed (Beaver trib)				No Data					
Biddle	Wolf Creek	1	1,4		1,3	1,4			1	1,4
Canyon	Canyon Creek				No Data					
Chewuch A.F.	Chewuch River	1	1	3	1,3	1			1	4
MSRF Chewuch	Chewuch River									
Newby	Newby Creek				No Data					
Poorman	Twisp River	1	1,4	3,4	1,3	1			1b	1b
Utley	unnamed (Twisp trib)				No Data					

Data Source key:
1 = Salmon Scape, 2 = USGS sampling, 3 = Snow et al. 2008 (WDFW), 4 = USFS sampling, 5 = Yakama Nation surveys, 6 = Onsite surveys, a = Presence documented but size class not specified, b = Presence assumed, c = Presence “presumed” in SalmonScape but not verified, blanks indicate species/life stage not documented.

Table 11. Summary of ESA listed fish by life stage assumed to be present[a] during overwinter rearing, spring acclimation, and construction activities in the Wenatchee Subbasin.

		Rearing/acclimation												Construction										
		Spring Chinook				Steelhead				Bull trout				Spring Chinook			Steelhead					Bull trout		
Site name	Affected stream	eggs/alevin	fry	parr	smolts	adults	eggs/alevin	parr	smolts	adults	eggs/alevin	young-of-year	sub-adults	adults	eggs/alevin	parr	adults	eggs/alevin	fry	parr	smolts	adults	eggs/alevin	sub-adults
Primary Sites																								
Beaver	Beaver Creek			U	U	P	P	P	P	U			U						none planned					
Brender	Brender Creek			U	U			P	P										none planned					
Butcher	Butcher Creek							A	A											A	A			
Chikamin	Chikamin Creek			P	P	P	P	P	P	P	A	P	P			P	P	P	P	P	P	P	A	P
Clear	Clear Creek					P	P	P	P										none planned					
Coulter	Coulter Creek																		none planned					
Dryden[b]	Peshastin/Wenatchee			A	P	P	P	P	P	A			A	A		A	P	P	P	P	P	A		A
White River Springs	unnamed			A	A			A	A	A			A						none planned					
Minnow	Minnow Creek			P	P			P	P	A			P			P				P	P	A		P
Rohlfing	unnamed							U	U															
Scheibler	Chumstick							A	A											A	A			
Tall Timber	Napeequa	P	P	P	P	U	U	U	U	A			A	P	P	P	U	U	U	U	U	A		A
Two Rivers	none																							
Backup Sites																								
Allen	Allen Creek																		none planned					
Coulter/Roaring	Coulter/Roaring					P	A	P	P										none planned					
George	Wenatchee River	P	P	P	P	P	P	P	P	A	U	U	A	P	P	P	P	P	P	P	P	A	U	A
McComas	White River	P	P	P	P	U		U	U	P		A	P						none planned					
Squadroni	unnamed																							

[a] Presence denoted by "P" indicates presence well documented, "A" presence is assumed, "U" presence possible but unlikely, and blanks indicate presence not expected.
[b] Dryden is listed as both a primary site for a small hatchery facility, and a backup overwinter rearing site.

Table 12. Summary of ESA listed fish by life stage assumed to be present[a] during overwinter rearing, spring acclimation, and construction activities in the Methow Subbasin.

		Rearing/acclimation												Construction										
		Spring Chinook				Steelhead				Bull trout				Spring Chinook			Steelhead					Bull trout		
Site name	Affected stream	eggs/alevin	fry	parr	smolts	adults	eggs/alevin	parr	smolts	adults	eggs/alevin	young-of-year	sub-adults	adults	eggs/alevin	parr	adults	eggs/alevin	fry	parr	smolts	adults	eggs/alevin	sub-adults
Primary Sites																								
Goat Wall	unnamed			U	U			A	P	A			P						none planned					
Gold	S Fork Gold					P	A	P	P	A			P				P	A	A	P	P	A		P
Heath	Heath ponds (spring)			P	P			P	P	P			P						none planned					
Lincoln	Twisp River	P	P	P	P	P	P	P	P	P			P	P	P	P	P	P	P	P	P	P		P
Lower Twisp	Twisp River	P	P	P	P	P	P	P	P	P			P						none planned					
Mason	Eight Mile			A	A	P	A	P	P	A			P			A	P	P	P	P	P	A		P
MSWA Eight Mile	Chewuch side channel			A	A			P	P	A			A							P	P			
Parmley	Beaver Creek					P	P	P	P	P			P				P	P	P	P	P	P		P
Twisp Weir	Twisp River	P	P	P	P	P	P	P	P	P			P	P	P	P	P	P	P	P	P	P		P
Pete Creek Pond	Chewuch River	A	A	P	P	P	P	P	P	A			P						none planned					
Backup Sites																								
Balky Hill	unnamed							U	U	U			U						none planned					
Biddle	Wolf Creek	A	A	P	P	P	P	P	P	P			P						none planned					
Canyon	Canyon Creek							A	A	A			A							A	A	A		A
Chewuch A.F.	Chewuch River	A	A	A	A	A	A	A	A	P			P	A	A	A	A	A	A	A	A	A		A
MSRF Chewuch	Chewuch River	A	A	A	A	A	A	A	A	P			P	A	A	A	A	A	A	A	A	A		A
Newby	Newby Creek																			U	U	U		U
Poorman	unnamed			U	U			U	U	U			U						none planned					
Utley	unnamed							U	U											U	U			

[a] Presence denoted by "P" indicates presence well documented, "A" presence is assumed, "U" presence possible but unlikely, and blanks indicate presence not expected.

4.0 IMPACT ANALYSIS

The potential effects described below are common to all acclimation sites although the extent and duration may vary between sites. Impacts due to water withdrawals are discussed in a separate report entitled *Effect of Surface Water Withdrawals on Listed Fish Report* (Appendix 10 of the EIS) prepared for the project. Potential impacts specific to the location of each acclimation site are further discussed in following sections. Impacts to listed and non-listed fish after coho have been released from the acclimation sites and impacts that result from naturally spawning populations being reintroduced are not evaluated in this Appendix.

In addition to listed fish, a number of other species are present in the Subbasins (Table 1) and could be impacted during acclimation and construction activities. Because the acclimation sites are located higher in the drainages, species with colder water preferences are more likely to be present than warm water species. These cold water associated fish include salmonids (sockeye salmon, Westslope cutthroat trout, non-native brook trout, and mountain whitefish), lamprey, suckers, sculpins and some species of minnows.

The most likely impact to fish that would result is related to access to habitat during rearing and acclimation periods. The amount of area that would be unavailable during rearing/acclimation would be limited to the area enclosed by seine or barrier nets at each acclimation site. The relative impact on listed species from being dislocated or excluded from this habitat will depend to some extent on the local availability of similar habitat which is discussed under each acclimation site in the following sections.

Two sites are proposed as adult holding areas: one in each Subbasin. Temporary weirs would be installed in these streams from early October through November. Adult coho salmon would be planted upstream of the weir to allow them to spawn in available habitat. Potential impacts to other fish would primarily occur to larger adults that would be blocked from migrating in and out of these streams when the weirs are in place. In addition, spawning coho salmon could disturb eggs deposited in spawning redds established earlier in the year. These impacts would be limited to species that spawn in late summer or early fall. Spring spawners such as steelhead and other trout will be able to access these areas and spawn well before the weirs are installed. Further, trout fry emerge during the summer so eggs and alevins would not be disturbed by coho spawning activities in October. Spring Chinook would spawn prior to weirs being installed so they would not be prevented from accessing these sites, but spawning coho salmon could potentially disturb their eggs. However, fall spawning fish such as salmon and bull trout have not been documented spawning in either tributary proposed for adult holding.

Construction is planned for 36% of the primary acclimation sites. Construction would occur during summer months (June – September). Potential impacts to fish would primarily occur from excavation and construction for acclimation ponds, water supply and discharge lines or channels, and electrical lines. Some additional impacts could result from road reconstruction and maintenance, although physical impacts would likely be limited to road crossings or other areas where fish bearing streams are in close proximity to the road prism. See Appendices 2 and 3 of the EIS for construction activities proposed for each site.

The physical impacts from construction are expected to be minimal for all fish species. The acclimation sites are generally disturbed environments regularly subject to human activity. Excavation of accumulated material is proposed at three existing ponds which are discussed in greater detail in following sections. All proposed new pond excavation and well drilling sites are in upland locations. The potential for impacts to listed fish is expected to be greatest when flow is provided to the site and discharged into the nearest stream. Permit conditions will be strictly followed during construction to prevent discharging suspended sediments into the stream. These measures will include but not limited to: use of a temporary revetment to prevent backwater from entering the work area; prior to release of water flow to the project area, any sediment laden water will be pumped out of the project area; and, upon return flow to the active channel, the sediment plume will not exceed 5 Nephelometric Turbidity Units (NTUs) above the background of 150 ft downstream of the project location. If these measures were not followed, a plume of suspended fine sediments could be discharged into the stream and dispersed downstream. These events are rarely lethal to fish, but their response can range from avoidance to temporary cessation of feeding activities (Hicks et al. 1991). Large amounts of fine sediment deposited on spawning gravels can reduce interstitial flow and dissolved oxygen levels causing mortality of eggs and alevins (Koski 1966, Meehan and Swanston 1977, Everest et al. 1987). The discharge of sediments into the stream will be prevented by lining new sites with gravel and rock, and slow filling of ponds to avoid suspending and mobilizing sediments. Localized bank and riparian disturbances will occur during construction of new surface water intake and acclimation discharge structures. The area impacted by these activities is small and the number of individual fish impacted would be few if any.

Juvenile coho salmon have been shown to prey on smaller fish but impacts to other fish populations are expected to be minimal during acclimation periods. Other fish will be physically separated from hatchery coho smolts during acclimation and rearing by barrier nets. Thus, any predation is likely to occur at the time coho are released. Coho salmon sampled in the coastal waters or in aquaria were able consume prey up to 50% of their body length (Brodeur 1991, Pearsons and Fritts 1999). However, they typically consumed prey less than 20% of their length (Brodeur 1991). Coho salmon have been shown to prey on sockeye salmon (Ricker 1941; Foerster and Ricker 1953; Ruggerone and Rogers 1992), and fall Chinook salmon fry (Thompson 1966; Pearsons and Fritts 1999). Assuming that coho will consume prey 1/3 of their body length (or 1/9 of their weight), fish less than 1.8 inches would be vulnerable to predation using the target coho smolt size of 5.5 inches (YNFRM 2009). Chinook and bull trout fry would be listed species of potential prey for hatchery coho during release (Table 2). Predation studies conducted during the feasibility phase of this project found that hatchery coho salmon fed primarily on insects and rarely prey on fish. Less than 0.28% of the 2,159 hatchery coho salmon sampled in Nason Creek over two years were found to have preyed on spring Chinook fry or other fish (Murdoch and LaRue 2002, Murdoch et al. 2005).

The Leavenworth National Fish Hatchery and Winthrop National Fish Hatchery are proposed as acclimation sites but no additional changes are expected as a result of the MCCRP. Impacts to fish due to construction and operations at these sites have been evaluated under past permitting processes. This is also the case for other facilities used for rearing MCCRP coho to pre-smolt sizes (i.e. Cascade and Willard Hatcheries).

4.1 Wenatchee Subbasin

Presence of ESA listed fish by life-stage during proposed acclimation and construction periods in the Wenatchee Subbasin is summarized by site in Table 11 and in the following sections.

Detailed descriptions of each site can be found in Appendix 2 of the EIS. For size ranges expected for each life stage and activity refer to Table 2.

Comprehensive quantitative data on rearing habitat available to ESA listed fish is generally lacking throughout the Wenatchee Subbasin. However, spawning survey data is available for these species (Figure 12). Although spawning surveys do not cover every potential spawning area and can be influenced by environmental factors such as high water, this information can be useful for evaluating potential impacts of a given site on Subbasin populations. Between 1989 and 2007, 44% of the spring Chinook redds were counted in the Chiwawa watershed (Hillman et al. 2008). The Nason watershed had the next highest proportion (24%), followed by Icicle, the upper Wenatchee River, White, Little Wenatchee and Peshastin watersheds. However, spring Chinook were considered extirpated from Peshastin Creek. Recent returns are believed to be progeny of adult outplants from non-listed spring Chinook returning to Leavenworth National Fish Hatchery (Cooper and Mallas 2004). An average of 40% of the summer steelhead redds were counted in the Wenatchee River between 2001 and 2007 (Hillman et al. 2008). The Nason watershed had the next highest proportion (33%), followed by Chiwawa, Peshastin, Icicle, Beaver, White, and Little Wenatchee watersheds. In contrast, 78% of the bull trout redds were counted in the upper Chiwawa watershed between 1989 and 2004 (USFWS 2004), followed by the White, Chiwaukum, Nason, White, and Little Wenatchee watersheds (Figure 12).

4.1.1 Brender

This is the only site located in the 59,712 acre Mission Creek watershed. No ESA listed fish have been documented spawning in the Mission Creek drainage but juvenile Chinook and steelhead rearing has been documented. SalmonScape lists spring Chinook presence in Brender Creek. We found one catch record of fish classified as spring Chinook in Brender Creek in 1998 (USFS database). A 2007 electrofishing survey conducted in Mission Creek captured 104 rainbow/steelhead but failed to capture any Chinook salmon (ISEMP database). It is likely that Chinook salmon observed in Mission Creek were summer Chinook which are not ESA listed. However, we can not rule out the possibility that juvenile spring Chinook occasionally rear in the drainage under some conditions. Brender Creek flows directly into the existing pond and the site is proposed as a spring acclimation site. The affected environment would include about 0.08 of the 0.27 acres (30%) of existing pond enclosed by the temporary seine net. This type of habitat is limited in the Mission Creek watershed due to development within the floodplain (NPCC 2004a). No additional construction is planned for this site. Based on available data, Chinook parr, and smolts; and steelhead parr and smolts are assumed to be present during the acclimation period. Juvenile Chinook and steelhead would not be able to use this portion of the pond for six weeks during the spring through 2027 or until project goals are met.

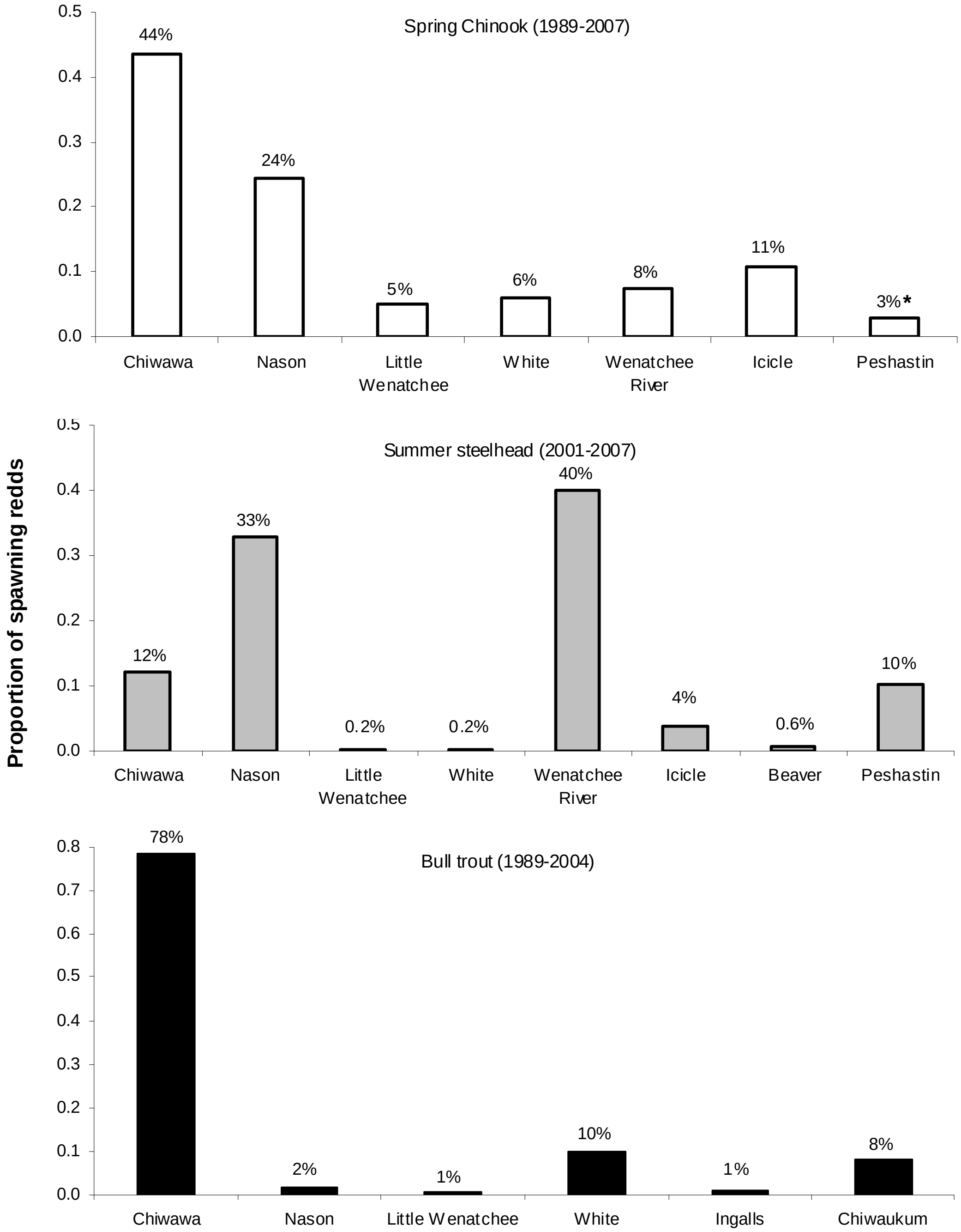

Figure 12. The average proportion of spring Chinook[1] (top), summer steelhead (middle) and bull trout (bottom) spawning in major tributaries of the Wenatchee Subbasin.

[1] Note: Spring Chinook were considered functionally extirpated from Peshastin Creek. Recent returns are thought to be progeny of adult outplants from non-listed Leavenworth National Fish Hatchery Chinook salmon.

4.1.2 Dryden (new hatchery)

A small hatchery is proposed to be constructed near Dryden Dam. Surface water could be diverted either from the Wenatchee River or Peshastin Creek. However, a well or infiltration gallery is also being considered as a source of groundwater for the hatchery. The affected environment would include the point of diversion to the point of discharge. SalmonScape indicates that non-listed summer Chinook spawn in the Wenatchee River and Peshastin Creek adjacent to this site, and spring Chinook rear in the area. During construction activities, spring Chinook adults, and parr; steelhead adults, eggs, fry, parr and smolts; and bull trout sub-adult and adult migrants are assumed to be present. The proposed hatchery will be located at an upland site and depending on the design, there may be localized bank disturbance during construction of the discharge pipe. Potential impacts due to surface water withdrawals are discussed in Appendix 10 of the EIS.

4.1.3 Scheibler

Scheibler is the only site proposed within the 47,000 acre Chumstick drainage. Until recently, most adult and all juvenile salmon passage into Chumstick was blocked at RM 0.3 by a perched culvert under North Road. This culvert was removed and replaced with a bridge in 2009. Few steelhead were able to migrate through this culvert before it was replaced, although adults had been documented spawning about 5.7 miles upstream (about 2 miles below Scheibler). Rainbow and steelhead were present in low numbers prior to the removal of the culvert and brook trout had been planted throughout the drainage (NPCC 2004a). Chumstick Creek flows directly into an existing pond which is planned to be enlarged. During acclimation periods the affected environment would include about 0.1 acres of habitat enclosed by a temporary seine net. During construction activities, the affected environment would include the entire excavation site. The Wenatchee Subbasin Plan (NPCC 2004a) indicates that fish habitat is degraded in Chumstick Creek and that instream flows sometimes go subsurface during August and September. This site will be evaluated now that the culvert has been replaced, although it is likely that steelhead parr and smolts will be present during rearing activities. These fish would not be able to use the enclosed portion of the pond from March though early May through 2027, or until project goals are met.

4.1.4 Butcher

Butcher is one of three primary sites, including Coulter and Rohlfing, located in the 69,000 acre Nason Creek Watershed. The Nason watershed represents 24% of the Chinook, 33% of the steelhead, and 2% of the bull trout spawning redds counted in the Wenatchee Subbasin (Figure 12). Butcher Creek flows directly into 0.56 acres of existing beaver pond currently used to acclimate coho. A new well is proposed to provide enough water to operate the acclimation site during the winter. The affected environment would include the existing pond upstream of the beaver dam near the confluence of Nason Creek. Although no ESA listed fish have been documented spawning in Butcher Creek, 54% of the steelhead spawning redds counted in Nason Creek in 2007 were upstream of the Butcher Creek confluence (Hillman et al. 2008). Juvenile Chinook salmon do not appear to be able to migrate past the beaver dam. During the onsite snorkel survey, juvenile rainbow/steelhead were observed in the beaver pond. These fish may have been resident rainbow trout but we can not rule out the possibility that juvenile steelhead were able to access the pond under some flow conditions. Therefore we assume that juvenile steelhead will be present during the acclimation period. Other fish would be prevented from migrating into and out of the ponds from December though early May, on alternate years through 2027, or until project goals are met. Although Nason Creek itself does not provide much off-channel habitat, accessible tributaries provide good off-channel habitat (NPCC 2004a).

4.1.5 Coulter

Coulter Creek flows into a series of beaver ponds, one of which is currently used to acclimate coho during the spring. No construction is planned for this site. The affected environment would include 0.37 acres of existing pond that would be blocked with barrier nets. Water spills over the beaver dams at multiple locations so if listed fish were able to migrate up past the beaver dams, they would only be excluded from the area blocked by the barrier nets. SalmonScape indicates steelhead are present upstream in Coulter Creek although no steelhead redds were counted in Coulter Creek in 2007 (Hillman et al. 2008). Based on onsite snorkel surveys, no ESA listed fish are expected to be present during the rearing period because a series of beaver dams appears to prevent upstream migration of anadromous fish to this site. Other fish would be prevented from migrating into and out of the enclosed pond during six weeks during the spring on alternate years through 2027 or until project goals are met. All of the accessible Nason Creek tributaries provide good off-channel habitat.

4.1.6 Rohlfing

An unnamed seasonal stream (“Rohlfing Creek”) flows directly into an existing pond currently used for coho acclimation. The affected environment would include 0.17 acres of existing pond and accessible upstream portions of Rohlfing Creek potentially blocked to fish access. SalmonScape does not show Rohlfing Creek within the distribution of ESA listed fish. However, an adult steelhead was observed upstream of the acclimation pond in the past (Mike Tonseth, WDFW personal communication). During the onsite snorkel survey, juvenile rainbow/steelhead were observed in the stream immediately below the acclimation pond. No other fish species were found above the acclimation pond. Because no steelhead were observed upstream of the pond, it is unlikely that they currently access the acclimation pond. The stream goes dry for much of the year, so it is unlikely that it provides critical rearing habitat. Other fish would be prevented from migrating into the pond and upstream from December through early May, through 2027 or until project goals are met.

4.1.7 Beaver

An existing intake on Beaver Creek diverts flow into a constructed pond currently used as a coho spring acclimation site. The existing culvert outlet is perched but other fish can access the pond through the inlet when screens are not in place. About 0.24 acres of existing pond would be affected, including the inlet and outlet which would be screened to prevent free passage of other fish into the acclimation site. No additional construction is planned for this site. Beaver Creek habitat information is limited so availability of similar off-channel habitat in the tributary is unknown. SalmonScape does not list Beaver Creek within the distribution of spring Chinook spawning and rearing, but 5 juvenile Chinook (out of 132 fish) were captured approximately

1,600 ft downstream of the acclimation site during an electrofishing survey on 9/25/2006 (ISEMP database). These fish were likely spring Chinook parr that were seeking overwintering habitat. No Chinook were captured (out of 125 fish) at this site on 7/23/2007, or about 300 ft further downstream (109 fish) on 7/6/2006. No other records for juvenile Chinook were found for Beaver Creek so presence of Chinook smolts during acclimation is viewed as possible but unlikely. Beaver Creek represents an average of 0.6% of the steelhead spawning redds counted in the Wenatchee Subbasin (Figure 12) although no steelhead spawning redds were observed in 2007. Based on available data, Chinook smolts; steelhead adults, eggs, parr and smolts; and bull trout sub-adult and adult migrants are assumed to be present during the acclimation period and would be excluded from the site from mid-March through early May through 2027, or until project goals are met.

4.1.8 Clear

Clear is one of three primary sites, including Chikamin and Minnow, located in the 117,000 acre Chiwawa Creek Watershed. The watershed represents 44% of the Chinook, 12% of the steelhead, and 78% of the bull trout spawning redds counted in the Wenatchee Subbasin (Figure 12). Clear Creek flows directly into a series of three constructed ponds, and the upper pond is proposed as an overwinter rearing site with no construction activities planned. The affected environment would include about 0.24 of 0.52 acres (46%) of the existing pond area enclosed by the temporary seine net. The Chiwawa Creek watershed has an extensive network of ponds, beaver canals, side channels, abandoned oxbows and other wetlands (NPCC 2004a). Based on available data, steelhead adults, eggs, parr and smolts are expected to be present during the rearing period. Eight steelhead spawning redds were counted in Clear Creek in 2007 (Hillman et al. 2008). Clear Creek is not part of the juvenile monitoring program in the Chiwawa drainage. Other fish would be excluded from the enclosure from December through early May through 2027, or until project goals are met.

4.1.9 Chikamin

A new pond would be constructed next to Chikamin Creek and would be fed with surface water from the creek. During construction, the affected environment would include two-ten foot sections along the bank of Chikamin Creek at the diversion and discharge sites. In addition, Chikamin Creek from the point of discharge downstream approximately 150 ft could potentially be affected. Chinook spawning has not been documented in Chikamin Creek. Summer steelhead spawning has been documented but no redds were counted in 2007 (Hillman et al. 2008). Bull trout redds have been observed in Chikamin Creek above and below the site (USFWS 2004). Chikamin (including the lower 0.2 miles of Minnow Creek) is part of the annual juvenile monitoring program in the Chiwawa Basin (Hillman et al. 2008). Chikamin Creek on average represents 3% of the subyearling Chinook, 8% of the subyearling and 5% of the yearling rainbow/steelhead abundance estimated in the Chiwawa drainage. This area also represented 13% of the juvenile bull trout abundance surveyed in the Chiwawa drainage in 2007, but the survey does not include many upper tributaries where bull trout likely reside (Hillman et al. 2008). Chinook parr; steelhead adults, eggs, fry, parr, and smolts; and bull trout adults, eggs, young-of-year, and sub adults are expected to be present in Chikamin Creek during construction activities. If permit conditions are not followed impacts to fish could potentially occur during bank excavation (one week) and when water is supplied to the pond and discharged back into the stream (one day). The inlet and outlet would be screened to prevent free passage of other fish into the acclimation site. This will not impact other fish because they do not currently use this habitat. Impacts due to surface water withdrawals are discussed in Appendix 10 of the EIS.

4.1.10 Minnow

A new pond would be constructed next to Minnow Creek and the entire stream would be diverted through the pond after completion. During construction, the affected environment would include Minnow Creek from the point of diversion to the point of discharge and 150 ft downstream. If permit conditions are not followed impacts to fish could potentially occur during when the stream is diverted through the pond (one day). During acclimation, the affected environment would include about 0.16 acres of the constructed pond enclosed by the temporary seine net. An area about the size of the existing channel would be left open to allow free upstream and downstream passage of fish. Based on available data, Chinook parr; steelhead parr and smolts; and bull trout sub-adult and adult migrants are expected to be present during the construction period and Chinook parr and smolts; steelhead parr and smolts; and bull trout sub-adult and adult migrants during the acclimation period. Other fish would not be able to use the enclosed portion of the stream for six weeks during the spring through 2027 or until project goals are met. During the rest of the year, other fish would have free access to the newly created pond.

4.1.11 Two Rivers

An existing constructed pond that has been used in the past for coho acclimation is proposed as an overwintering site in the Little Wenatchee River watershed. Water is pumped from an existing constructed lake located in an active gravel mine. Water is returned to the lake which drains into the Little Wenatchee River. The proposed acclimation pond is not connected to the Little Wenatchee River and is not accessible to anadromous fish. Thus, no ESA listed fish are assumed to be present during the acclimation period.

4.1.12 White River Springs

The White River Springs and Tall Timber primary acclimation sites and the Dirty Face adult holding area are located within the 99,956 acre White River Watershed. The watershed represents 6% of the Chinook, 0.2% of the steelhead, and 10% of the bull trout spawning redds counted in the Wenatchee Subbasin (Figure 12). The White River Springs site is an existing beaver pond that is fed by unnamed spring-fed streams. This is a proposed overwinter rearing site with no construction activities planned. The affected environment would include the entire 0.07 acres of existing pond blocked by barrier nets, and accessible upstream portions of streams potentially blocked to fish access. This site was added to the list after spring snorkeling surveys were completed, and no sampling data was found for this site. However, this stream is a tributary of the White River which is listed within the spawning and rearing distribution of Chinook, steelhead, and bull trout. We assume Chinook parr, and smolts, and bull trout sub-adult and adult migrants will migrate upstream and be present during the acclimation period. Although bull trout fry are assumed to be migrating down White River, we do not expect them to move upstream to this site. Because very few steelhead spawn in the White River drainage and no steelhead have been documented in this tributary, we do not expect steelhead to be present at this site. Other fish would be prevented from using the pond from December through early May, through 2027 or until project goals are met. The White River drainage still maintains high quality, complex habitat with refuge and rearing habitat for multiple life stages and life histories (NPCC 2004a).

4.1.13 Tall Timber

Surface water from the Napeequa River will be diverted into a 0.61 acre disconnected side channel for acclimating coho salmon. The affected environment would include 0.18 acres of the side channel enclosed by a temporary seine net, a ten foot section along the bank of the Napeequa River where a diversion pipe will be buried, and a 150 ft section of the Napeequa River downstream of the discharge pipe. ESA listed fish do not currently have access to the side channel because it is not connected to the Napeequa River. Steelhead are not common in the White River drainage. Between 2002 and 2007, only two spawning redds were counted in Napeequa River (both in 2003, Hillman et al. 2007). During construction activities, Chinook adults, eggs, and parr; steelhead adults, eggs, fry, parr and smolts; and bull trout sub-adult and adult migrants are assumed to be present. Potential impacts to fish could occur during bank excavation (one week) and when water is supplied to the channel and discharged back into the stream (one day). Based on available data, Chinook eggs, fry, parr and smolts; steelhead adults, eggs, parr and smolts; and bull trout sub-adult and adult migrants are assumed to be present during the acclimation period. Other fish will be excluded from the acclimation site enclosed by the seine net for six weeks during the spring through 2027 or until project goals are met. During this time the fish will have access to the remaining 0.43 acres of the previously inaccessible channel. Impacts due to surface water withdrawals are discussed in Appendix 10 of the EIS.

4.1.14 Dirty Face

A small unnamed spring-fed tributary of the White River is proposed as an adult holding area. A temporary weir would be installed near the mouth of the tributary from early October through November. Adult coho salmon would be planted upstream of the weir to allow them to spawn in available habitat. No ESA listed fish are known to spawn in this tributary and only bull trout spawn during this time period. Steelhead and spring Chinook spawn before October and would not be blocked by the weir. Nevertheless, any larger fish (adult salmon and steelhead) in the area would be prevented from migrating in or out of the tributary from early October through the end of spawning in November through 2027, or until project goals are met. Smaller fish would not be blocked by the temporary weir.

4.1.15 Wenatchee Backup Sites

4.1.15.1 Allen

The existing constructed pond is fed by a surface water diversion from Allen Creek, a tributary of Peshastin Creek. The pond was constructed by the community of Valley Hi and is seasonally filled and drained for the purpose of fire protection. This site is listed as a backup spring acclimation site with no construction planned. The affected environment would include 0.08 of the 0.72 acres of pond (11%) that would be enclosed by a seine net. Peshastin Creek near the Allen Creek confluence is listed within the distribution of spring Chinook spawning, rearing, migration; steelhead rearing and migration; and bull trout migration. However, spring Chinook were considered functionally extirpated from Peshastin Creek and non-listed spring Chinook adults from Leavenworth National Fish Hatchery were outplanted there from 2001-2004 (Cooper and Mallas 2004). This site was added to the list after spring snorkeling surveys were completed, and no sampling data was found for Allen Creek. However, ESA listed fish are not assumed to use the pond because they would have to ascend a high gradient reach of Allen Creek and the pond is seasonally drained every year (Keely Murdoch, Yakama Nation biologist, personal communication). Other fish would not be able to use the enclosed portion of the pond for six weeks during the spring.

4.1.15.2 Coulter/Roaring

Coulter and Roaring Creeks located in the Nason Creek Watershed flow directly into beaver dams near their confluence. If this site is used, the affected environment would include 0.17 of the 5.8 acres (3%) of available pond habitat enclosed by a temporary seine net. Based on available data, steelhead adults, eggs, parr and smolts are expected to be present during the acclimation period. Other fish would be excluded from the enclosed area for six weeks in the spring.

4.1.15.3 Dryden (rearing)

Overwintering rearing ponds could be constructed near Dryden Dam. Surface water could be diverted either from the Wenatchee River or Peshastin Creek, or groundwater could be used. If this site is used, the affected environment would include the point of diversion to the point of discharge. SalmonScape indicates that non-listed summer Chinook spawn in the Wenatchee River and Peshastin Creek adjacent to this site, and that spring Chinook rear in the area. Based on available data, spring Chinook parr and smolts; steelhead adults, eggs, fry, parr and smolts; and bull trout sub-adult and adult migrants are assumed to be present during the rearing period. Screens would block access to the site by other species. This would not impact other fish because they do not currently use this habitat. During construction activities, spring Chinook adults and parr; steelhead adults, eggs, fry, parr and smolts; and bull trout sub-adult and adult migrants are assumed to be present. The proposed rearing facilities would be at an upland location and depending on the design, there may be localized bank disturbance during construction of the discharge pipe. Impacts due to surface water withdrawals are discussed in Appendix 10 of the EIS.

4.1.15.4 George (back-up hatchery)

An alternate to the proposed Dryden hatchery is a located on the Wenatchee River just downstream of Lake Wenatchee. The facility would have the same water and space needs as the Dryden site. Both surface and groundwater sources are being evaluated. Ground water would be developed by drilling two or more wells. Surface water would be pumped from the Wenatchee through a screened intake built into an existing rock barb. The site is currently undeveloped so construction would include disturbance of 4 acres of upland to develop the hatchery building, raceways, excavation of two ponds, well drilling, installation of water lines, construction of a permanent access road, water treatment tank and other supporting infrastructure. During construction activities, spring Chinook adults and parr; steelhead adults, eggs, fry, parr and smolts; and bull trout sub-adult and adult migrants are assumed to be present in the Wenatchee River. The proposed facilities would be at an upland location, and depending on the design, there may be localized bank disturbance during construction of the intake line. Water is proposed to be discharged into an existing side channel which drains into the Wenatchee River. The side channel is classified as fish bearing on the FPARS, but is not within the distribution of ESA listed species according to SalmonScape. Screens would block access to the ponds by other species. This would not impact other fish because they do not currently use this habitat. Potential impacts due to surface water withdrawals are discussed in Appendix 10 of the EIS.

4.1.15.5 McComas

Grant PUD has proposed constructing overwintering ponds fed with surface water from the White River. Very few steelhead spawn in the White River drainage, so steelhead presence is viewed as possible but unlikely. Based on available data, spring Chinook eggs, fry, parr, and smolts; steelhead adults, parr and smolts; and bull trout fry, sub-adult and adult migrants are assumed to be present in the White River during the acclimation period. Fish screens would prevent other fish from accessing the acclimation pond. This would not impact other fish because they do not currently use the pond.

4.1.15.6 Squadroni

A pond would need to be constructed at this backup spring acclimation site and connected to a ditch that drains into Nason Creek. However, the ditch only has intermittent flow during snow-melt and rainwater events, so a new well would be needed to provide ground water for acclimation purposes. The affected environment would include the ditch from the point of diversion to the point of discharge. This ditch is not listed on FPARS or SalmonScape, and no survey data was found for this site. Because the ditch is dry during most of the year, it is unlikely that fish use the ditch and if they did, it would be short-term. If construction activities were conducted during dry periods, no ESA listed fish would be present.

4.2 Methow Subbasin

Presence of ESA listed fish by life-stage during proposed acclimation and construction periods in the Methow Subbasin is summarized by site in Table 12 and in the following sections. Detailed descriptions of each site can be found in Appendix 3 of the EIS. For size ranges expected for each life stage and activity refer to Table 2.

Comprehensive quantitative data on rearing habitat available to ESA listed fish is generally lacking throughout the Methow Subbasin. However, spawning survey data is available for these species (Figure 13). Although spawning surveys do not cover every potential spawning area and can be influenced by environmental factors such as high water, this information can be useful for evaluating potential impacts of a given site on Subbasin populations. Between 2000 and 2007, 61% of the spring Chinook redds were counted in the Methow River, followed by the Chewuch and Twisp watersheds (Snow et al. 2008). However, estimates of wild spawners show a more even distribution among the three areas (Figure 13). An average of 38% of the summer steelhead redds were counted in the Upper Methow River between 2000 and 2007 (Snow et al. 2008). Estimates of the proportion of hatchery steelhead spawning naturally in each basin are not currently available, although are thought to be high (Snow et al. 2008). The Twisp watershed had the next highest proportion (31%), followed by Lower Methow and Chewuch watersheds. In contrast, most (53%) of the bull trout redds were counted in the Twisp watershed between 2000 and 2007 (USFS *in prep.*), followed by the Upper Methow, Chewuch, Wolf, and Gold watersheds (Figure 13).

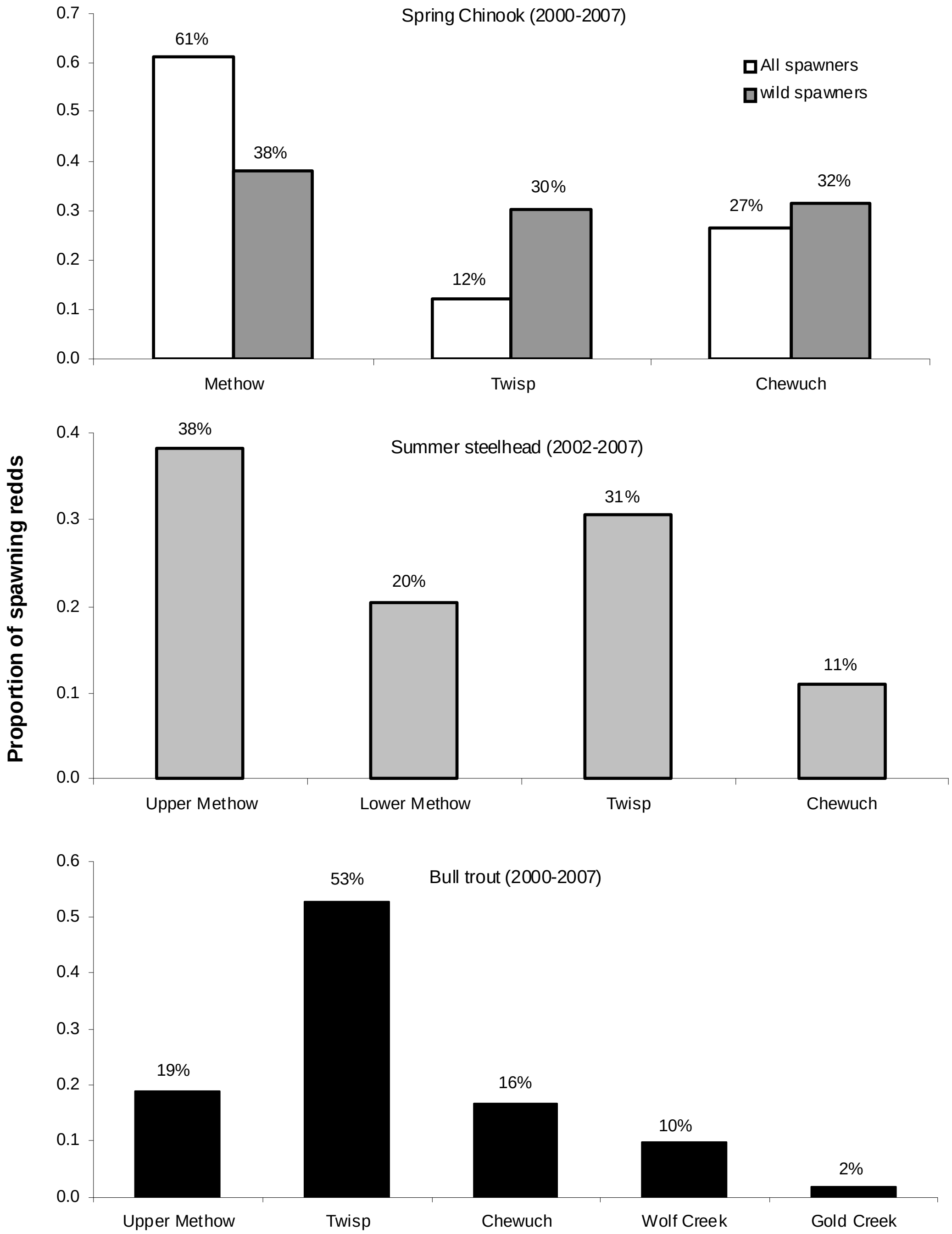

Figure 13. The average proportion of spring Chinook (top), summer steelhead (middle), and bull trout (bottom) spawning in major tributaries of the Methow Subbasin.

4.2.1 Gold

South Fork Gold Creek water is a tributary of Gold Creek located in the Lower Methow River. The Lower Methow represents an average of 20% of the steelhead redds counted in the Methow

Subbasin (Figure 13). A portion of South Fork Gold Creek flow at RM 1.6 is diverted into a series of man-made ponds proposed as a spring acclimation site. Some additional construction is planned to remove accumulated sediments and increase depth. During construction, the affected environment would include the ponds, and South Fork Gold Creek from the point of discharge downstream 150 ft. Based on available data, steelhead adults, eggs, fry, parr and smolts; and bull trout sub-adult and adult migrants are expected to be present in South Fork Gold Creek during construction activities. SalmonScape lists Chinook salmon presence as "presumed" in South Fork Gold Creek. However, we did not find any sampling data to confirm their presence near the acclimation site. USGS sampling confirmed the presence of rainbow/steelhead adults and juveniles, and bull trout juveniles in South Fork Gold Creek near the acclimation site (Pat Connolly, USGS, personal communication). South Fork Gold accounted for an average of 11% of the steelhead redds counted in the Lower Methow River between 2005 and 2007 (Snow et al. 2008). Although an average of 2% of the bull trout redds in the Methow Subbasin were counted in Gold Creek (Figure 13), South Fork Gold Creek was not surveyed (USFS *in prep*.). Impacts from construction activities are expected to last 1-2 days. During acclimation, the affected environment would include 0.08 of 0.10 acres (80%) of existing pond enclosed by a temporary seine net. Based on available data, steelhead adults, eggs, parr and smolts; and bull trout sub-adult and adult migrants are expected to be present during the acclimation period. The lower 3.5 miles of Gold Creek has had rip-rap placed along the banks. No habitat data was found for the lower 2.1 miles of South Fork Gold Creek where the proposed acclimation site is located. However, a survey of the stream was conducted on US Forest Service land upstream (RM 2.1-5.5) in 1996 (unpublished data, Gene Shull US Forest Service, personal communication). This survey indicated that off-channel habitat was limited to a small number of old beaver dams scattered throughout. Other fish would be excluded from the seine net enclosure for six weeks in the spring through 2027, or until project goals have been met.

4.2.2 Parmley

Parmley is the only primary site located in the Beaver Creek Watershed. A portion of the surface water from Beaver Creek is currently diverted into a farm pond proposed as a spring acclimation site. The affected environment would include 0.08 of 0.11 acres of pond enclosed by a temporary seine net. Based on existing data, steelhead adults, eggs, parr and smolts; and bull trout sub-adult and adult migrants are expected to be present in Beaver Creek during the acclimation period. Beaver Creek represented an average of 9% of the steelhead spawning redds counted in the Lower Methow between 2004 and 2007(Snow et al. 2008). The percent of steelhead redds counted in Beaver Creek above this site has varied from 4% in 2005 to 50% in 2007. Other fish would be excluded from the enclosure for six weeks each spring through 2027, or until project goals are met. A habitat assessment of Beaver Creek conducted by the USFS indicated that side channel/off-channel habitat is very limited from RM 5.8 to 9.3 (unpublished data, Gene Shull, US Forest Service, personal communication). The reach of Beaver Creek that includes the Parmley site (RM 6.6 to 7.5) contained some of the best side channel/off-channel habitat surveyed.

4.2.3 Lower Twisp

Three primary acclimation sites are proposed for the 157,000 acre Twisp Watershed; Lower Twisp, Twisp Weir, and Lincoln. The watershed represents 30% of the wild Chinook, 31% of the steelhead, and 53% of the bull trout spawning redds counted in the Methow Subbasin (Figure 13). Surface water is diverted from the Twisp River to a series of man-made ponds owned by the Methow Salmon Recovery Foundation currently used for steelhead and coho acclimation. Other fish currently have access to these ponds during non-acclimation times. No construction activities are planned for this site. The affected environment would include 0.14 acres of pond that would be confined by a temporary barrier net. Over 95% of the Chinook and steelhead spawning in the Twisp River typically occurs upstream of this site (Snow et al. 2008). Based on existing data, Chinook eggs, fry, parr and smolts; steelhead adults, eggs, parr and smolts; and bull trout sub-adult and adult migrants are expected to be present in the Twisp River during the acclimation period. We assume that Chinook parr and smolts, steelhead parr and smolts, and bull trout sub-adult and adult migrants would access the pond during the overwinter period. A temporary barrier net would be used to prevent other fish migrating into the site. Habitat data is lacking for the lower Twisp River (below RM 2.1). However, the lower Twisp River from Buttermilk Creek to the mouth has been diked and riprapped in places, resulting in a highly simplified channel and disconnected side channels (NPCC 2004b). This combined with the fact that beaver activity is very limited in the lower Twisp, suggests that the availability of off-channel habitat in this reach is low. Other fish would be excluded from the acclimation pond from December though early May through 2027, or until project goals are met.

4.2.4 Twisp Weir

Surface water is currently diverted from the Twisp River to an existing spring Chinook acclimation pond through a screened irrigation ditch. A 0.2 acre pond is proposed to be constructed adjacent to the existing pond to overwinter coho salmon. On average 91% of the Chinook and 84% of the steelhead spawning in the Twisp River occurs upstream of this site (Snow et al. 2008). Construction plans include excavating an earthen pond, drilling new wells, and installing water delivery pipelines from the irrigation channel to the pond and from the pond back to the river. During construction, the affected environment would include the Twisp River from the discharge site downstream 150 ft. Chinook adults, eggs, and parr; steelhead adults, eggs, fry, parr and smolts; and bull trout sub-adult and adult migrants are expected to be present in the Twisp River during construction activities. Impacts to fish are expected to occur when water is supplied to the pond and discharged into the Twisp River (one day). Other fish would be excluded from the irrigation ditch and acclimation pond by inlet and outlet screens. This will not impact other fish because they do not currently use this habitat.

4.2.5 Lincoln

Surface water is currently diverted from the Twisp River during high flows to a side channel which includes two ponds. The lower pond is proposed as an overwinter rearing site. On average 64% of the Chinook and 41% of the steelhead spawning in the Twisp River occurs upstream of this site (Snow et al. 2008). Construction plans include deepening the lower pond, drilling new wells, excavating an inflow channel and power line burial. During construction, the affected environment would include the lower pond and the Twisp River from the discharge site downstream 150 ft. Chinook adults, eggs, and parr; steelhead adults, eggs, fry, parr and smolts; and bull trout sub-adult and adult migrants are expected to be present in the Twisp River during construction activities. A recent snorkel survey found juvenile Chinook and steelhead present in the existing ponds (Rick Alford, Yakama Nation, personal communication). Impacts to fish are expected to occur during pond and inflow channel excavation (1-3 days) and when water is supplied to the side-channel and discharged back into the Twisp River (one day). During acclimation, the affected environment would include 0.2 of 0.31 acres (65%) of the existing pond habitat enclosed by a temporary seine net used to hold coho salmon. Other fish would be excluded from the enclosed area from December through early May through 2027, or until project goals are met. Side channel habitat is relatively abundant in this reach of the Twisp River (RM 13.7 to 17.6), consisting of about 11% of the available habitat (unpublished data, Gene Shull, US Forest Service, personal communication).

4.2.6 Mason

Mason is one of three primary sites, including MSWA Eight Mile and Pete Creek Pond, located in the 340,000 acre Chewuch River Watershed. The watershed represents 32% of the wild Chinook, 11% of the steelhead, and 16% of the bull trout spawning redds counted in the Methow Subbasin (Figure 13). Surface water from Eight Mile Creek is seasonally diverted into a series of man-made ponds that have been used in the past to acclimate coho salmon. Construction activities may include developing a new well and channel to supplement flow into the ponds during the winter. The affected environment would include a 10 ft section of pond bank where the new channel would deliver water from the well. Chinook salmon spawning has not been documented but SalmonScape indicates that spring Chinook rear in Eight Mile Creek. Between 2004 and 2007, 11% of the steelhead redds in the Chewuch watershed were counted in Eight Mile Creek (Snow et al. 2008). However, the percentage drops to 4% if 2005 is excluded (nearly 50% were counted in Eight Mile that year). Based on existing data, Chinook parr; steelhead adults, fry, parr and smolts; and bull trout sub-adult and adult migrants are expected to be present in Eight Mile Creek during construction activities. Impacts to fish are expected to occur during channel construction (1 day). Screens will prevent other fish from using the ponds from December through early May. Because the ponds are normally dry during this period and thus not available for rearing, acclimation should not impact other fish.

4.2.7 MSWA Eight Mile

A spring acclimation site is proposed at a side channel to the Chewuch River. Construction plans include drilling a well and building a rock lined channel from the well to the site. During construction, the affected environment would include a 10 ft section of bank along the existing side channel and the side channel to the confluence with the Chewuch River. Based on the onsite snorkel survey, steelhead fry and parr are expected to be present during the construction period. Based on existing data for the Chewuch River at this site, we assume that Chinook parr, and smolts, steelhead parr and smolts, and bull trout sub-adult and adult migrants will be present during acclimation periods. SalmonScape indicates that spring Chinook and steelhead spawn and bull trout rear in this section of the Chewuch River. USGS confirmed the presence of spring Chinook adults and juveniles, rainbow/steelhead juveniles in this section of the Chewuch River (Pat Connolly, USGS, personal communication). On average, 47% of the Chinook and 36% of the steelhead spawning redds in the Chewuch River were counted upstream of this site (Snow et al. 2008). Impacts to fish are expected to occur during channel construction (3 days). During acclimation, the affected environment will include 0.14 of the 0.64 acres (22%) of existing side channel habitat enclosed by the seine net. Other fish would be excluded from the enclosed area for six weeks during the spring each year through 2027, or until project goals are met. Beavers are active in this reach of the Chewuch River (RM 11.8 to 14.1, unpublished data, Gene Shull, US Forest Service, personal communication), indicating that off-channel habitats are relatively common.

4.2.8 Pete Creek Pond

The Methow Salmon Recovery Foundation is planning to reconnect the Chewuch River to a disconnected side channel that forms a series of ponds. The existing ponds are currently fed by Pete Creek, a seasonal stream. The affected environment would include 0.2 of 0.23 (87%) existing acres of pond enclosed by a temporary seine net. Based on available data, Chinook eggs, fry, parr and smolts; steelhead adults, eggs, parr and smolts; and bull trout sub-adult and adult migrants are present in the Chewuch River. On average, over 90% of the Chinook and 95% of the steelhead spawning redds in the Chewuch River were counted upstream of this site. The additional flow will likely attract Chinook parr and smolts; steelhead parr and smolts; and bull trout sub-adult and adult migrants into the side channel to rear. Other fish would be excluded from the enclosed area for six weeks during the spring through 2027, or until project goals have been met. A US Forest Service habitat assessment of this reach of the Chewuch River (RM 2.2 to 5.6) found numerous backwater pools and some beaver activity that provided excellent rearing habitat (unpublished data, Gene Shull, US Forest Service, personal communication). However, the available side channel habitat was low compared to other streams with similar gradient depositional reaches without rip-rap or other hardened structures.

4.2.9 Heath

Heath and Goat Wall are primary acclimation sites and Hancock is an adult holding site proposed for the 322,385 Upper Methow River Watershed (above the Chewuch River confluence). The Upper Methow represents 38% of the wild Chinook, 38% of the steelhead, and 19% of the bull trout spawning redds counted in the Methow Subbasin (Figure 13). At the Heath site, spring water provides flow to a series of large ponds that drain into the Methow River. The lowest pond is proposed as an overwinter acclimation site. Juvenile Chinook salmon, rainbow/steelhead, and adult and juvenile bull trout rear in the lower pond (Pat Connolly, USGS and Gene Shull, US Forest Service, personal communication). No construction activities are planned for this site. The affected environment would include 0.32 of the 0.72 acres (44%) of existing pond enclosed by a temporary seine. No ESA listed spawning fish have been documented in the stream, but on average 79% of the Chinook and 96% of the steelhead spawning redds counted in the Upper Methow were upstream of this site (Snow et al. 2008). Based on existing data, Chinook parr, and smolts; steelhead parr and smolts; and bull trout sub-adult and adult migrants are expected to be present in the lower pond during rearing activities. Other fish would be excluded from the enclosed area each year from December through early May until 2027, or when project goals are met. Habitat data is lacking for the Upper Methow River to assess the availability of similar habitat.

4.2.10 Hancock

Hancock Creek is a spring-fed tributary of the Upper Methow River proposed as an adult holding area. A temporary weir would be installed near the mouth of Hancock Creek (RM 0 to 0.5) from early October through November. Adult coho salmon would be planted upstream of the weir to allow them to spawn in available habitat. Steelhead are known to spawn in this stream, and 23 spawning redds were counted in the lower 0.7 miles of Hancock in 2007 (Snow et al. 2008). Adult steelhead are not expected to be present when the weir is in use and any steelhead fry will have emerged from the gravel well before coho spawn. Spring Chinook and bull trout have not been documented in Hancock Creek. In addition, spring Chinook spawn before October and would not be blocked by the weir. Nevertheless, any larger fish (adult salmon and steelhead) in the area would be prevented from migrating in or out of the tributary from early October through the end of spawning in November through 2027, or until project goals are met. Smaller fish would not be blocked by the temporary weir.

4.2.11 Goat Wall

A disconnected side channel of the Methow River is fed by ground water and surface water diverted from Gate Creek. The site is located in a portion of the Methow River that has no surface flow during some fall and winter months. No construction is planned for this site. The affected environment would include 0.08 acres of approximately 0.63 acres (13%) of accessible channel enclosed by a seine net system. No ESA listed fish have been documented spawning in this stream. On average 7% of the Chinook and 8% of the steelhead spawning redds counted in the Upper Methow were upstream of this site (Snow et al. 2008). Based on an onsite snorkel survey, steelhead parr and smolts, and bull trout sub-adult and adult migrants are expected to be present during the spring acclimation period. These fish would be excluded from the enclosed area for six weeks during the spring through 2027, or until project goals are met. Habitat data is lacking for the Upper Methow River to assess the availability of similar habitat.

4.2.12 Methow Backup Sites

4.2.12.1 Balky Hill

An unnamed groundwater fed Beaver Creek tributary was previously dammed to create a pond on private farm property. This backup site would need no construction. The affected environment would include the groundwater stream from the pond to the origin of the spring water. This site was added to the list after spring snorkeling surveys were completed, and no sampling data was found for this stream. However, the existing dam is likely a barrier to fish migration except during high water events. Beaver Creek near the stream is listed within the distribution of steelhead spawning, rearing and migration; and bull trout migration. If this site is used, other fish would be excluded from the acclimation site for six weeks during the spring.

4.2.12.2 Biddle

Wolf Creek surface water is diverted into two existing constructed ponds of which one is proposed as a backup spring acclimation site. The affected environment would include 0.08 of the 0.17 acres (47%) of pond habitat enclosed by a temporary seine net. No additional construction is planned for this site. Based on available data, Chinook fry, parr, and smolts; steelhead parr and smolts; and bull trout sub-adult and adult migrants may be present in the ponds during the acclimation period. If this site is used, other fish would be excluded from the enclosed area for six weeks during the spring.

4.2.12.3 MSRF Lower Chewuch

If this site is used, a 0.2 acre pond would be constructed on land owned by the Methow Salmon Recovery Foundation. Ground water would be supplied from an existing well. Proposed construction activities would include excavation of an earthen bottom pond and two rock lined channels: from the well to the pond; and from the pond to the Chewuch River. The affected environment during construction would include one 10 ft Chewuch bank section at the discharge site and the Chewuch River from the point of discharge 150 ft downstream. Based on available data, Chinook adults, eggs, and parr; steelhead adults, eggs, fry, parr and smolts; and bull trout sub-adult and adult migrants are expected to be present in the Chewuch River during construction activities. Impacts to fish are expected to occur when the pond is filled and discharged into the river the first time (1 day). Screens would block access to the site by other species. Listed fish are not expected to be impacted during acclimation because they are not currently using this habitat.

4.2.12.4 Chewuch Acclimation Facility

If this site were used, a pond would be constructed downstream of an existing Chinook acclimation pond. Chewuch River surface water would be delivered from an existing irrigation diversion through a pipeline. Proposed construction activities would include excavation of an earthen bottom pond and installation of water delivery lines from the existing intake to the Chewuch River. The affected environment during construction would include one 10 ft bank section at the discharge site and the Chewuch River from the point of discharge 150 ft downstream. Based on available data, Chinook adults, eggs, and parr; steelhead adults, eggs, fry, parr and smolts; and bull trout sub-adult and adult migrants are expected to be present in the Chewuch River during construction activities. Impacts to fish are expected to occur during the installation of pipelines and when the pond is filled and discharged into the river the first time (1 day). Listed fish are not expected to be impacted during acclimation because they are not currently using this habitat.

4.2.12.5 Poorman

Surface water is currently diverted from a screened irrigation intake in the Twisp River to a series of constructed ponds proposed as a backup acclimation site. No additional construction activities are planned for this site. This site was added to the list after spring snorkeling surveys were completed, and no sampling data was found for this site. Two juvenile salmonids (likely rainbow/steelhead) were observed in the westernmost pond (David Hopkins, US Forest Service, Fisheries Bio Tech, personal communication), and Chinook eggs, fry, parr and smolts; steelhead adults, eggs, parr and smolts; and bull trout sub-adult and adult migrants are expected to be present in the Twisp River during the acclimation period. Fish access from the Twisp River is currently blocked by irrigation screens so impacts to ESA listed fish are not expected.

4.2.12.6 Newby

This site is a potential backup to other Twisp acclimation sites. If this site is used, a pond would be constructed adjacent to Newby Creek a non-fish bearing, high gradient, small tributary to the Twisp River. SalmonScape does not list Newby Creek within the distribution of listed fish. The proposed backup site would be located above a series of cascades (Figure 14) which make the site inaccessible to salmonids. A habitat survey conducted by CFS personnel revealed that there were natural fish passage barriers throughout the stream and the substrate was comprised mostly of fines (Ian Courter, fisheries biologist, Cramer Fish Sciences, personal communication). Based on this information we believe that listed fish do not currently access this site. The effect of water withdrawals on other fish are discussed in Appendix 10 of the EIS.

Figure 14. Confluence of Newby Creek and the Twisp River depicting the first of several fish passage impediments.

4.2.12.7 Utley

An existing constructed spring fed pond drains into a wetland area adjacent to the Twisp River about 3.75 miles upstream of Twisp Weir. The wetland area has no direct connection to the Twisp River. This site is a backup to other Twisp acclimation sites and would require construction of an 80 ft channel connecting the pond to the Twisp River. This site was added to the list after spring snorkeling surveys were completed, and no sampling data was found for this stream. However, because there is no direct connection to the Twisp River it is unlikely that ESA fish currently access the pond. The Twisp River near the stream is listed within the distribution of spring Chinook spawning, rearing and migration; steelhead spawning, rearing and migration; and bull trout migration. It is possible but unlikely that steelhead parr and smolts access the site during high flows. However, if the channel is constructed to the Twisp River it is likely that ESA listed fish will access the pond. If this site is used, other fish would be excluded from the area enclosed by the seine net for six weeks during the spring.

4.2.12.8 Canyon

An unscreened diversion on Canyon Creek, a tributary of the Twisp River, provides water to a 0.4 acre constructed pond. If this site is used, the pond would be deepened and enlarged to 0.8 acres. During construction, the affected environment would include the pond, and Canyon Creek from the point of discharge downstream 150 ft. SalmonScape does not show Canyon Creek within the distribution of spring Chinook salmon, steelhead, or bull trout. However, the pond is located within 200 ft of the Twisp River within the distribution of spring Chinook spawning, rearing and migration; steelhead spawning, rearing and migration; and bull trout migration. Based on this information, we assume that juvenile steelhead and migratory bull trout may use the pond. Impacts from construction activities are expected to last 1-2 days. During spring acclimation, the affected environment would include 0.08 acres pond enclosed by a temporary seine net. The remainder of the year, other fish would have free access to the enlarged pond.

4.3 Combined Impacts

4.3.1 Proposed Alternative

The most likely impact to fish that would result is related to access to available habitat during rearing and acclimation periods. Disturbance activities would be limited to the amount of area excluded by seine or barrier nets at each acclimation site. Other fish species would be blocked from 1.22 of the 1.69 acres of habitat currently accessible to ESA listed fish at primary sites in the Wenatchee Subbasin, and 1.24 of the 2.88 acres of those in the Methow Subbasin during a portion of the year (Table 13). Other fish would be dislocated or excluded from about 54% of the existing accessible habitat at the Wenatchee primary sites and 20% at the Methow primary sites from mid-March through early May. An additional 18% at the Wenatchee and 23% at the Methow sites would be inaccessible to other fish from December through early May. These impacts will be balanced to some degree by newly constructed habitat. About 0.26 acres of new habitat in the Wenatchee Subbasin will be available to other fish for at least a portion of the year (Table 13).

The relative impact on listed species from being dislocated or excluded from this habitat will depend to some extent on the availability of similar habitats within each Subbasin. Because a comprehensive habitat database was not available for these subbasins, an alternate method was needed to evaluate the relative magnitude of these impacts to ESA listed populations.

Table 13. Amount (acres) of existing pond or side channel habitat at primary sites that is currently accessible to listed fish or proposed to be added for new sites, versus the amount that would be potentially excluded during overwinter rearing and spring acclimation activities, by Subbasin.

		Habitat excluded (acres)			Accessible
	Habitat (acres)	Overwinter	Spring	Total	off-season[a]
Wenatchee Subbasin					
Existing habitat	2.23	0.48	1.28	1.76	2.06
Currently accessible[b]	1.69	0.31	0.91	1.22	1.69
Area added	1.03	0.00	0.60	0.60	0.26
Methow Subbasin					
Existing habitat	2.88	0.66	0.58	1.24	2.88
Currently accessible[b]	2.88	0.66	0.58	1.24	2.88
Area added			None		

[a] Rohlfing goes dry during the summer and early fall so is not considered accessible to fish during most of the off season.
[b] Accessible to ESA listed fish.

Cramer and Ackerman (2009) demonstrated that the carrying capacity of various salmonids can be predicted based on channel units (e.g. pool, riffle, glide) and maximum fish densities based on a species life-stage and habitat preference. The proposed rearing and acclimation sites are similar to beaver pond and backwater habitats. In the natural environment coho salmon prefer these slower velocity habitats above other habitats with more current (Solazzi et al. 1998). While other salmonid parr use these habitats, many prefer pools in streams or other channel habitats with more velocity (Cramer and Ackerman 2009). For the purposes of this analysis, we assumed average fish (parr) densities for each species based on literature values for similar habitats, or average values observed in the Chiwawa Watershed (Hillman et al. 2008). We assumed a value of 291 Chinook parr per acre based on average densities in Chiwawa pool habitats (720/ha) between 1992 and 2007 (Hillman et al. 2008). This assumption is likely high because juvenile Chinook are rarely found in off-channel habitats or beaver ponds (Murphy et al. 1989). Further during the winter, Chinook are usually associated with cobble substrate (Hillman et al. 1987, Van Dyke et al. 2009) rather than fine sediments typically associated with backwater habitats. Therefore, juvenile Chinook are unlikely to be found in the acclimation ponds and our estimate of 291 parr/acre should be considered very conservative. We assumed 162 steelhead per acre based on average winter densities of similar habitat in Oregon (Johnson et al. 1993). Finally, we assumed a density of 7.6 subadult or adult bull trout per acre wherever migratory fish were expected to occur, and 23.6 juvenile bull trout per acre wherever spawning and rearing was expected to occur. The bull trout densities were based on sampling in the Chiwawa Watershed (Hillman et al. 2008). We acknowledge fish densities vary seasonally and annually depending on environmental conditions and population abundances. Further, excluding ESA listed fish from these habitats would presumably only affect the populations if the available habitat is fully seeded. If the habitats are not at carrying capacity, dislocated fish could occupy other underutilized habitat. However, this analysis provides a context to assess the relative magnitude of impacts due to acclimation and rearing on listed species.

Our analysis suggests that the number of juvenile ESA listed fish potentially excluded during acclimation and rearing would be relatively small compared to overall Subbasin populations. Less than 250 juveniles of each species were projected to be excluded from sites in the

Wenatchee Subbasin (Table 14). This compares with the range of wild production estimated of 55,619 – 311,669 for Chinook and 17,499 - 85,443 for steelhead smolts from the entire Wenatchee Subbasin between 2002 and 2007 (Hillman et al. 2008). Using an average smolt to adult survival rate of 0.00465 for hatchery spring Chinook and 0.0105 for summer steelhead from the Wenatchee Subbasin (Hillman et al. 2009), the number of juveniles excluded would represent 0.5 Chinook and 2.5 steelhead adult equivalents. In the Methow Subbasin, less than 270 juveniles of each species were projected to be excluded from acclimation and rearing sites (Table 15). This compares with the range of wild production 15,306 – 33,710 estimated for Chinook and 8,809 - 15,003 for steelhead smolts from the entire Methow Subbasin between 2000 and 2008 (data provided by Alex Repp, Washington Department of Fish and Wildlife, personal communication). Using the same smolt to adult survival rates used above, the number of juveniles potentially excluded from acclimation sites in the Methow basin would represent 1.5 spring Chinook and 2.1 summer steelhead adult equivalents. No Subbasin juvenile bull trout abundance estimates are available but the number of juveniles projected to be excluded from sites in each Subbasin was very small (10 or less). It is important to understand that excluding juveniles from rearing and acclimation sites does not necessarily mean these fish will not survive. As previously noted, the acclimation and rearing sites are not ideal habitat for listed species. Juveniles displaced or excluded from these habitats will seek out other suitable habitat in the area. Assuming that other habitats are not fully occupied by other fish, these fish will likely continue to rear in these areas.

Table 14. Potential juvenile Chinook, steelhead, and bull trout dislocated from currently accessible habitat at proposed primary rearing and acclimation sites in the Wenatchee Subbasin based on assumed fish densities.

		Accessible area	Potential juveniles dislocated		
Site name	Overwinter	excluded (acres)	Chinook	steelhead	bull trout
Beaver	N	0.24	70	39	2
Brender	N	0.08	23	13	0
Butcher	N	0.56	0	91	0
Chikamin	N		0	0	0
Clear	Y	0.24	0	39	0
Coulter	N	0.37	0	0	0
White River Springs	Y	0.07	20	11	1
Minnow	N		0	0	0
Rohlfing	Y	0.17	0	28	0
Scheibler	N	0.03	0	16	0
Tall Timber	N		0	0	0
Two Rivers	Y		0	0	0
Total dislocated			113	237	3
Wenatchee smolt production range (2002-2007)[a]			55,619 - 311,669	17,499 - 85,443	not applicable

[a] Data source Hillman et al. (2008).

Table 15. Potential juvenile Chinook, steelhead, and bull trout dislocated from currently accessible habitat at proposed primary rearing and acclimation sites in the Methow Subbasin based on assumed fish densities.

		Accessible area	Potential juveniles dislocated		
Site name	Overwinter	excluded (acres)	Chinook	steelhead	bull trout
Goat Wall		0.08	23	13	1
Gold		0.08	0	13	1
Heath	Y	0.32	93	52	2
Lincoln	Y	0.20	58	32	2
Lower Twisp	Y	0.14	41	23	1
Mason	Y	0.00	0	0	0
MSWA Eight Mile		0.14	41	23	1
Parmley		0.08	0	13	1
Twisp Weir	Y	0.00	0	0	0
Pete Creek Pond		0.20	58	32	2
Total dislocated			314	201	11
Methow smolt production range (2000-2008)			15,306 - 33,710	8,809 - 15,003	not applicable

[a] Data source Alex Repp Washington Department of Fish and Wildlife, personal communication.

4.3.2 No Action

The No Action Alternative described in the EIS includes operation of fewer of the same sites described for the Proposed Alternative. Because fewer sites would be operated and no new construction is involved, the combined effects would be less than those of the Proposed Alternative; consequently, the impacts of the combined projects are considered to be less than significant.

4.4 Cumulative Impacts

The EIS defines cumulative impacts as the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Past and present activities that may have affected fish habitat in the Wenatchee and Methow Subbasins include diversions and dams, agricultural activities, stream channelization and diking, roads and railways, timber harvest, and urban and rural development (Mullan et al. 1992; Chapman et al. 1994, 1995; NPCC 2004a-b). A hydro-power dam constructed on the lower Methow River near Pateros in 1915 was blocked upstream anadromous fish passage until it was removed in 1929 (Mullan et al. 1992; Peven 1992; Andonaegui 2000).These human induced habitat alterations have primarily occurred in the lower gradient, lower reaches of the subbasins (Andonaegui 2000, 2001) and have resulted in blocked access to habitat, loss of habitat complexity, off-channel habitats, and large, deep pools. Extensive use of rip rap to stabilize streambanks has decreased the channel sinuosity and recruitment of large woody debris (LWD). Chronic sedimentation from land and water management activities has caused habitat degradation in some areas. In contrast, upper reaches of these subbasins are in relatively good condition (Andonaegui 2000, 2001; NMFS et al. 1998).

Habitat conditions have improved in recent years and further improvements are expected in the future. Some of the factors that have affected habitat of ESA listed fish been partially addressed through changes in land-use practices (UCSRB 2007). These include improving fish passage at dams, installing irrigation diversion screens, culvert replacement, riparian buffer strips, and improved livestock management. Two major habitat restoration efforts are being been funded by BPA in the Wenatchee and Methow Subbasins. The Yakama Nation will be receiving 6-7 million dollars annually over ten years for habitat restoration in these Subbasins. In addition, the Upper Columbia Salmon Recovery Board will be receiving about 3.5 million dollars for habitat restoration projects beginning in 2011 (Bruce will provide citation). These efforts should result in substantial habitat improvements over the next decade.

The proposed action would result in reduced seasonal access to existing off-channel habitats used for acclimation and rearing of hatchery coho salmon, and potential short term delivery of additional sediment from bank disturbance and pond construction. Because these off-channel habitats are not preferred by spring Chinook, steelhead and bull trout, the impacts from the proposed seasonal use of small areas for acclimation and rearing purposes will not be additive to cumulative effects of past, present, and anticipated future anthropogenic impacts to habitat. In addition, permit conditions will require that sediment be strictly controlled during construction, and the small areas affected during construction, any unforeseen increased sediment delivery is likely to be minimal and highly localized. Also the construction is not expected to result in conditions that cause chronic sediment loads to increase. Therefore although there may be some short-term localized contribution to the cumulative effects, it would not persist more than 1-2 weeks past construction.

4.4.1 Proposed Alternative

The amount of habitat excluded during acclimation and rearing activities or added through additional sites under the proposed alternative is not likely to have a measureable impact compared to past and current impacts and those likely to occur.

4.4.2 No Action

The no action alternative would have less impacts than the proposed alternative.

5.0 IMPACT AVOIDANCE OR MITIGATION

- Barrier nets (see Appendix 2 of the EIS for a description) will be used at acclimation sites where ESA listed fish do not reside, or use to migrate to existing habitat. This will minimize premature escape of coho salmon.
- Seine nets (see Appendix 2) will be used at acclimation sites to partition off a portion of a water body while allowing free upstream and downstream passage of ESA listed fish to available habitat. In areas where emergent spring Chinook or bull trout fry will be present, predation will be minimized by using fine seine mesh to exclude fry from enclosed areas. Seines will be installed in a manner that excludes fry from the coho acclimation area by moving out from the bank to encapsulate the rearing area. The

enclosed area will be snorkeled to verify no ESA listed fish are present before hatchery coho are added.

- Nets will be removed at a time of year when coho reach a size that maximizes the ratio of fully smolted fish. Smolts will migrate from the acclimation area quickly, reducing potential interactions with other species.
- Timing and methodology of construction activities will be coordinated with resource agencies to minimize disturbance to listed species and life-stages. Best management practices will be used and permit conditions will be followed during construction activities, to prevent sedimentation inputs.

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Appendix 10. Effect of Surface Water Withdrawals on ESA-Listed Fish

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November 2010

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1.0 SUMMARY

A total of five proposed primary sites in the Wenatchee and five in the Methow Subbasin require new water sources. Three primary sites within the Wenatchee Subbasin (Dryden, Chikamin, and Tall Timber) and one within the Methow Subbasin (Twisp Weir) will require surface water withdrawals. These withdrawals will have local impacts to surface water from the point of withdrawal to the point of discharge. The impacts to listed fish will be limited to the affected portion of the stream and will vary depending on stream flow, species and life-stage.

Depending on the final design of the proposed hatchery at Dryden, water withdrawals could have no measureable impact, or increase available habitat in a 200 ft section of Peshastin Creek during low flows.

The maximum amount of water proposed for withdrawal at the Chikamin site would result in a very small reduction in weighted useable area (WUA) for all species. The reduction due to the withdrawal was less than one square foot of habitat for all species and life-stages.

The effect of the proposed withdrawal at the Tall Timber site on ESA listed fish varied with the flow and species. The maximum proposed withdrawal at this site generally resulted in small decreases in WUA for most species at extreme low flows, and slight increases in WUA at higher flows. However, the modeled withdrawal generally increased WUA for Chinook salmon rearing.

The proposed surface water withdrawal at the Twisp Weir site was projected to generally decrease the WUA of habitat for most species during low flows by a small amount.

We caution readers that the absolute values presented in this report are presented to evaluate the relative effect of surface water withdrawals. The model predictions for the amount of WUA under the different scenarios should be used with caution, because the difference in flow between the two scenarios is small and model analyses are most useful for evaluating a broad range of flows. Specific values are provided to demonstrate that the relative change in WUA for all species and life-stages.

The remaining sites require groundwater withdrawals that are expected to have some localized impacts to surface waters that will be completely offset by water discharged into the acclimation site. Because water is returned to the site, there will be no watershed impacts to surface water flow.

The amount of habitat reduced through water withdrawals under the proposed alternative is not likely to have a measureable impact compared to past and current impacts and those likely to occur.

Potential negative impacts to ESA listed fish can be avoided or minimized by:

- Using existing sites wherever possible.
- Minimizing the distance between surface water withdrawals and returns.
- Returning ground water to surface streams at locations that minimize pumping impacts.
- Constructing and operating intakes that meet guidelines for juvenile fish screens.

2.0 INTRODUCTION

Information in this report has been prepared as a companion document to support the Environment Impact Statement (EIS) of the Yakama Nation's Mid-Columbia Coho Reintroduction Project (MCCRP). The objective of this technical report was to evaluate the effect of project related water withdrawals on fish listed under the Endangered Species Act (ESA). Project site details such as their locations; project descriptions; and associated maps, figures, and photographs, are presented in the *Brood Capture and Rearing Site Descriptions* report (Appendix 1 of the EIS), the *Wenatchee Acclimation Site Descriptions* report (Appendix 2 of the EIS) and the *Methow Acclimation Site Descriptions* report (Appendix 3 of the EIS) prepared for the project, and are not duplicated in this report. Maps of the Wenatchee and Methow Subbasins showing the location of proposed acclimation and rearing sites are shown on Figure 1-2 in Appendix 1, and Figures 1-1 in Appendix 2 and Appendix 3. Figures 2-1 in Appendix 2 and 3 include the site locations based on Section, Township, and Range as well as their latitude and longitude. Site specific information on the presence of listed fish and effects of acclimation activities are discussed in *Presence and Impact of Fish Culture on Listed Fish* (Appendix 9 of the EIS). The effect of groundwater withdrawals on surface water is found in *Groundwater Withdrawal Impact Report* (Appendix 11 of the EIS).

The Washington Department of Ecology (WDEC) is charged both with administering state water rights laws and the federal Clean Water Act. Chapters 90.54 and 90.22 RCW require WDEC to maintain instream flows sufficient to protect and preserve fish and wildlife habitat, scenic and aesthetic values, navigation and other environmental values (WDFW and WDOE 2004). The Washington Department of Fish and Wildlife (WDFW) recommends instream flows to be conditions of water rights or Clean Water Act Section 401 certification (issued by WDEC). When a major water project is planned, WDFW and WDEC request that the project proponent conduct an instream flow study to provide adequate information on which to base an instream flow recommendation or requirement. WDFW defines a major water project as a project that:

a) diverts at least 1.0 cubic feet per second (cfs), and

b) changes flow by at least 10% of the monthly 90% exceedence flow (the flow that is equaled or exceeded 90 percent of the time) at any point along the stream channel.

The proposed surface water withdrawals are greater than 1.0 cfs, but less than 10% of the monthly 90% exceedance flows and are therefore not considered major water projects.

ESA listed fish that are likely to be present at these sites include spring Chinook *Oncorhynchus tshawytscha*, summer steelhead *O. mykiss,* and bull trout *Salvelinus confluentus*. The Upper Columbia River spring-run Chinook salmon Evolutionary Significant Unit (ESU) was listed as endangered on March 24, 1999 (64 FR 14308), and its status was reaffirmed on June 28, 2005 (70 FR 37160). The ESU includes all naturally spawned populations of spring-run Chinook salmon (spring Chinook) in Columbia River tributaries upstream of the Rock Island Dam as well as six artificial propagation programs. The Upper Columbia River steelhead distinct population segment (DPS) was listed as endangered on August 18, 1997 (62 FR 43937) and subsequently upgraded to 'threatened" status in 2009 (74FR 42605). Critical Habitat was designated in the Wenatchee and Methow basins for both Chinook and steelhead in 2005 (70 FR 52630). Columbia River bull trout were listed as threatened on June 10, 1998 (63 FR 31647). The Wenatchee, Entiat, and Methow Rivers have been identified as core bull trout habitats for the

Upper Columbia Recovery Unit, and designated as Critical Habitat October 18, 2010 (75 FR 63898).

3.0 METHODS

A total of five primary sites in the Wenatchee and five in the Methow Subbasin require new water sources (Table 1). Three primary sites within the Wenatchee Subbasin (Chikamin, Tall Timber and Dryden) and one within the Methow Subbasin (Twisp Weir) will require surface water withdrawals. The affected environments for these sites include the affected stream from the point of diversion to the point of discharge, unless noted otherwise. The impact of these surface withdrawals on the affected environment is analyzed in detail below. The remaining sites will require new groundwater sources. The effect of these groundwater withdrawals on surface water flows is discussed in *Groundwater Withdrawal Impact Report* (Appendix 11 of the EIS). Only the impacts resulting from the change in surface flows on ESA listed fish are discussed in this report.

Table 1. Proposed sites within the Wenatchee and Methow Subbasins that require new water sources.

Site name	Affected stream	Water source	Purpose[a]
Wenatchee primary sites			
Butcher	Butcher	ground	overwinter
Chikamin	Chikamin	surface	spring
Rohlfing	unnamed	ground	overwinter
Tall Timber	Napeequa	surface	spring
Dryden[b]	Peshastin/Wenatchee	ground/surface	hatchery/overwinter
Wenatchee backup			
George	Wenatchee	ground/surface	hatchery
Squadroni	unnamed	ground	spring
Methow primary sites			
Lincoln	Twisp River	ground	overwinter
Lower Twisp	Twisp River	ground	overwinter
Mason	Eight Mile	ground	overwinter
MSWA Eight Mile	Chewuch side channel	ground	spring
Twisp Weir	Twisp River	ground/surface	overwinter
Methow backup			
MSRF Chewuch	Chewuch River	ground	overwinter
Newby	Twisp River	surface	spring

[a] Overwinter rearing, spring acclimation, or proposed hatchery site.
[b] Dryden is a proposed hatchery site that is still under design. It would use either groundwater or surface water depending on the ongoing evaluations. The site is also listed as a backup overwinter acclimation site.

A small hatchery facility is proposed for the Dryden site for coho and steelhead adult capture and culture purposes. This site is also a backup overwinter rearing site. Both surface water and groundwater (wells and/or infiltration galleries) sources are being considered. The effect of surface water withdrawals on listed fish at the Dryden site was evaluated using previous Physical

Habitat Simulation System (PHABSIM) modeling for the lower Wenatchee River and Peshastin Creek (EES Consulting 2005). A backup hatchery facility is proposed for the George site in the event that the Dryden site is not developed. A similar PHABSIM analysis was conducted for this site.

The effects of surface water withdrawal on listed fish at the Chikamin and Tall Timber sites were evaluated using a two-dimensional hydraulic and habitat model (River2D) intended for use on natural streams and rivers; this program was developed at the University of Alberta with funding provided by numerous governmental agencies including the United States Geological Survey (Steffler and Blackburn 2002). Two-dimensional modeling produces similar results to PHABSIM; however, River 2D is also able to model complex flow conditions which PHABSIM cannot (Gard 2009a). The model predicts the relative change in fish habitat at different flows; and compared to other models, River2D is regarded as more robust and capable of reproducing results (Gard 2009b). Model inputs included bed topography for the active channel and adjacent floodplain, bed roughness and transverse eddy viscosity distributions, boundary conditions, and initial flow conditions. Using model inputs, a discrete mesh, or grid, was designed to capture active channel flow variations. The preliminary mesh was refined to interpolate data for areas with poor resolution to increase modeling accuracy. From the refined mesh, the hydraulic component predicts velocities and depths throughout the channel to be used in the fish habitat component of the model.

The fish habitat component of River2D was based on the Weighted Usable Area (WUA) (Bovee, 1982) concept used in PHABSIM and other fish habitat models. The WUA was calculated as an aggregate of the product of a composite suitability index (CSI, range 0.0 - 1.0) evaluated at every point in the domain and the "tributary area" associated with that point. The suitability index for each parameter is evaluated by linear interpolation from an appropriate fish preference curve. The Chinook and steelhead preference curves used in these analyses were developed in Washington State for each target species and life stage as presented in WDFW and WDOE (2004). The preference curves for juvenile and adult bull trout used in this analysis (see Appendix A of EES Consulting 2005) were developed specifically for the Wenatchee Basin and utilized more data sets than Washington standard criteria (WDFW and WDOE 2004). To determine the overall wetted area, we used a 100% preference curve for suitability at depths greater than zero. WUA was calculated for each species and life stage. Further River2D model details can be found in Steffler and Blackburn (2002).

The Twisp Weir site is the only primary acclimation site located in the Methow Subbasin that would require a new surface water withdrawal. The effect of surface water withdrawals on listed fish at the proposed Twisp Weir site was assessed using PHABSIM analysis.

The model predictions for the amount of WUA under the different scenarios should be used with caution, because the difference in flow between the two scenarios is small and model analyses are most useful for evaluating a broad range of flows. Specific values are provided to demonstrate that the relative change in weighted useable area (WUA) is expected to be extremely small for all species and life-stages.

4.0 IMPACT ANALYSIS

The potential effects described below are common to all acclimation sites where new water sources impact surface water, although the extent and duration may vary between sites. Other impacts due to fish culture are discussed in a separate report entitled Presence and Impact of Fish Culture on Listed Fish (Appendix 9 of the EIS) prepared for the project. Potential impacts specific to each primary site listed in Table 1 are further discussed in following sections.

The impact of water withdrawals on fish will depend on the type of water (surface or ground water), the length of stream affected, the amount of water withdrawn, the time of year, and the amount of surface water available. In general, potential impacts are expected to be greater where surface water is withdrawn directly from the stream, rather than groundwater withdrawals where the effect on surface water is dispersed over a larger area. Where surface water is withdrawn directly from a stream, the affected reach will include that portion of stream from the point of diversion to the discharge site. Withdrawing water during low flow periods has the potential to affect fish migration, and availability and quantity of habitat. Withdrawing water during high flow periods can improve habitat by reducing depth and velocities that are greater than optimal for fish. However the volume of water proposed to be diverted is relatively small and is not expected to substantially reduce instream flow quantities, change habitat availability including hiding/resting/foraging habitats, or affect migratory movements (fry, juvenile, and adult) of listed salmonids.

Another potential impact to listed fish due to surface water withdrawals is entrainment in the intake system. If allowed to pass through the intake screens, fry of a small enough size could be subject to predation by coho in the acclimation ponds, and all entrained fish could have free migration delayed by the pond discharge fish screens. Fish entering the Dryden intake could be harmed by pump impellor blades and by rapid pressure changes in the water supply system.

Fish screen guidelines have been published by the National Marine Fisheries Service (NMFS 1996) that minimize risks to anadromous fish. Structure placement, approach velocity, sweeping velocity, screen material, structural features, operation, and maintenance criteria have been developed. The intake systems at all sites will meet these screen guidelines to reduce threats to all fish.

4.1 Surface Water Withdrawal Impacts

4.1.1 Wenatchee Subbasin

4.1.1.1 Dryden Site

A small hatchery is proposed to be developed at this site. A combination of surface and groundwater sources is being explored to supply of up to 7.4 cfs (4.5 cfs surface water) to the site. The amount needed changes over the year (Figure 1). The impact of groundwater withdrawals on surface water is expected to be small as discussed in section 4.2.1.2 of this report.

An intake located on the Dryden fishway is currently the preferred source for surface water. Two options are being considered for the return flow. One is to discharge return water into Peshastin Creek upstream of the fishway, and another is in a pipeline on the river bottom in the vicinity of the fishway near the proposed intake. The Peshastin discharge could help adult salmon navigate the mouth during low flow and would increase flow from the discharge site to the intake site downstream. Discharge near the fishway could help flush rock away from the fishway but would essentially result in minimal change in flow because water would be discharged near the intake.

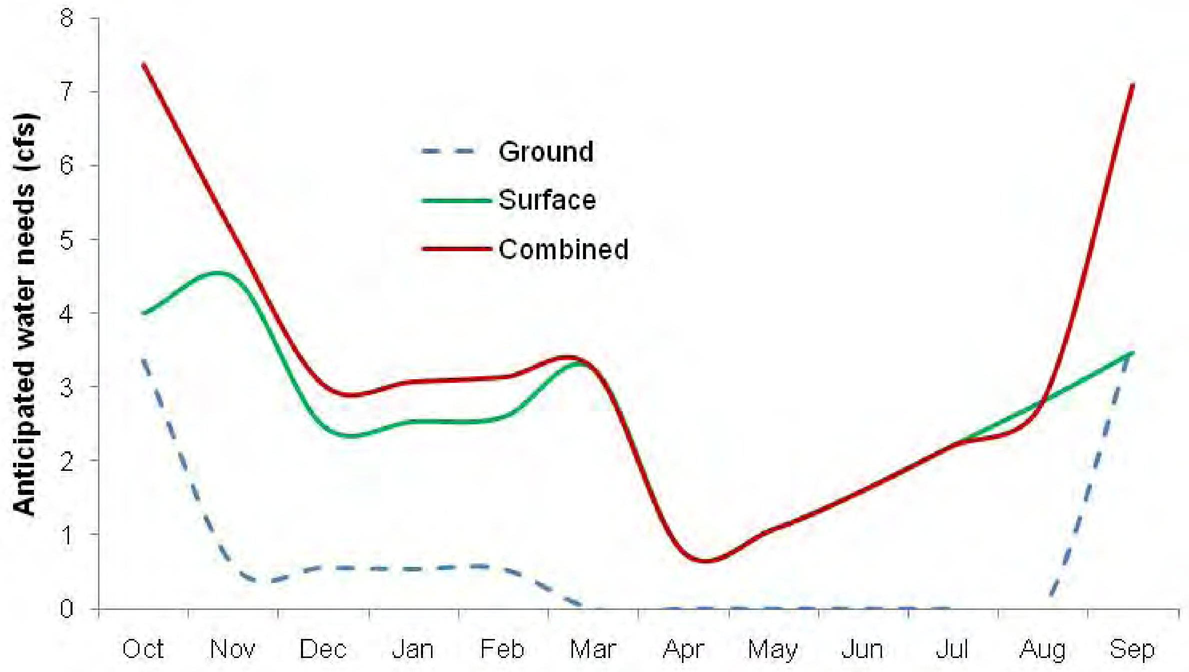

Figure 1. Proposed water needs for all species at the proposed MCCRP Dryden hatchery.

We used the PHABSIM analysis developed by EES Consulting to assess the potential impacts of the proposed MCCRP component of the Dryden hatchery water use on ESA listed fish in Peshastin Creek and Wenatchee River. We analyzed the Peshastin discharge option because it has the largest possible impact on stream flow, and therefore represents the greatest potential to affect fish and fish habitat. The affected environment would include Peshastin Creek from the point of discharge downstream to the proposed intake at the fishway in the Wenatchee River. This includes about 200 lineal feet of Peshastin Creek, and 650 feet of the Wenatchee River. The daily mean flow in Peshastin Creek ranges from a low of around 10 cfs in mid-August to over 500 cfs in May (Figure 2). The daily mean flow in the Wenatchee River ranges from a low of around 750 cfs in September to nearly 10,000 cfs by late May (Figure 2).

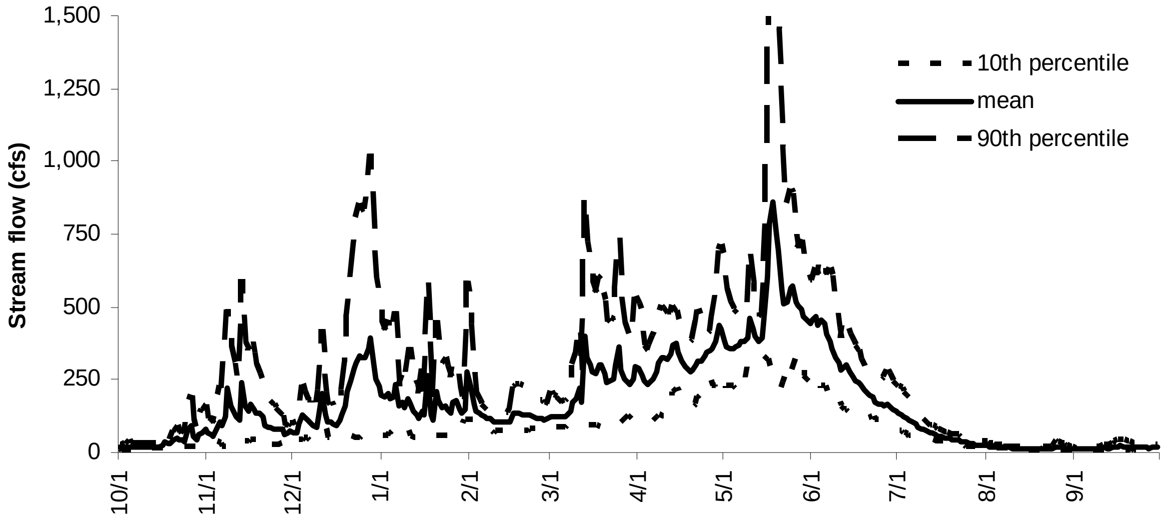

Figure 2. Peshastin Creek stream gage data collected at Green Bridge Rd by Washington Department of Ecology, 2002-2009 (Data source: https://fortress.wa.gov/ecy/wrx/wrx/flows/station.asp?sta=45F070).

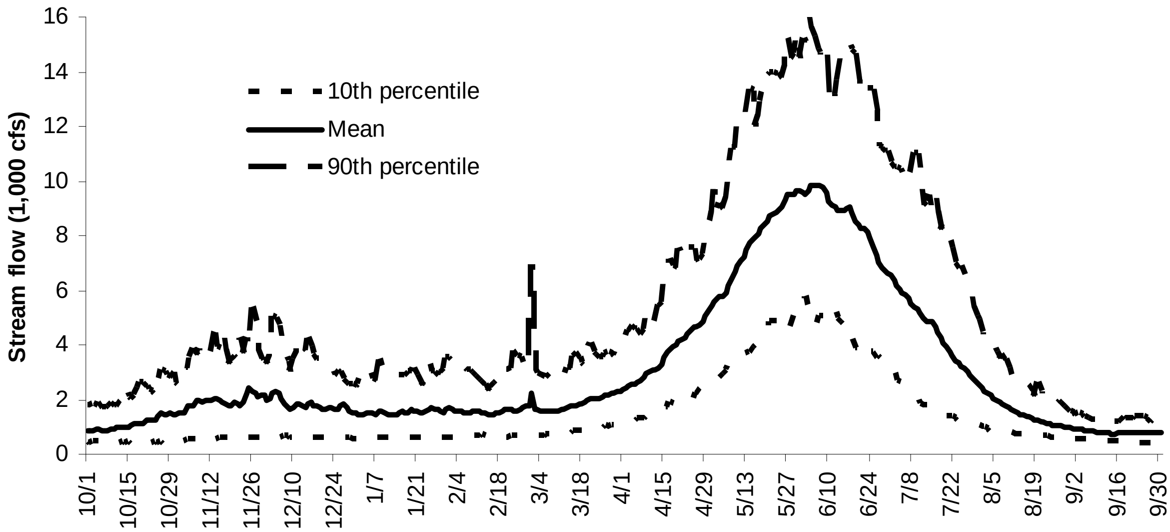

Figure 3. Wenatchee River stream gage data collected at Peshastin by US Geological Survey, 1930-2008 (Data source: http://waterdata.usgs.gov/wa/nwis/inventory/?site_no=12459000&agency_cd=USGS&).

EES Consulting (2005) completed PHABSIM analyses of four reaches of the mainstem Wenatchee River from the Leavenworth National Fish Hatchery downstream to its mouth, and the lower reach of Peshastin Creek from approximately RM 5.0 downstream to its mouth. They estimated that spawning habitat WUA was maximized at Peshastin Creek flows of 80 cfs for non-ESA listed summer Chinook salmon (spring Chinook do not spawn in the affected portions of the Wenatchee River and Peshastin Creek) and 120 cfs for ESA listed summer steelhead (Figure 4 top). Estimated rearing habitat was maximized at flows of 55 cfs for Chinook, 130 cfs for steelhead, and 19 cfs for bull trout (Figure 4 bottom).

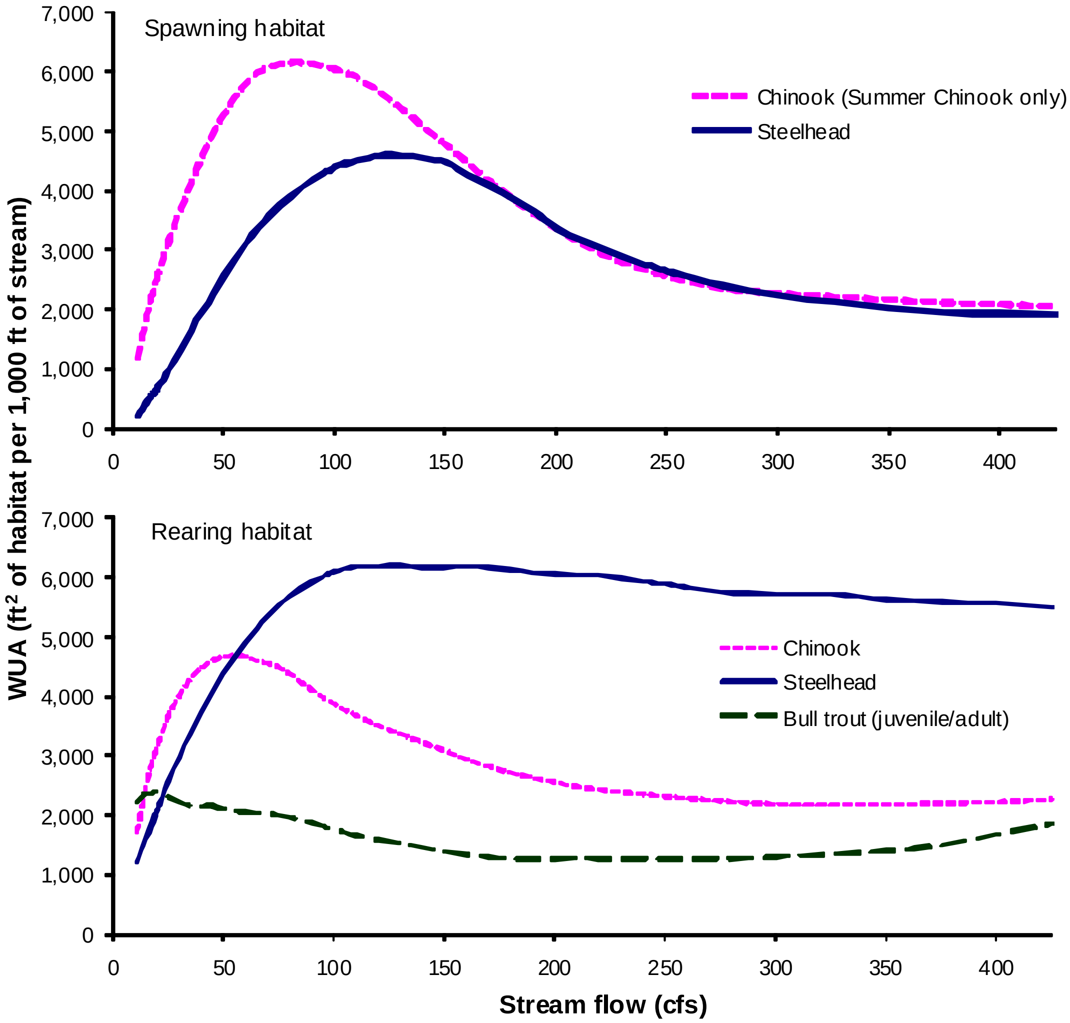

Figure 4. Estimated weighted useable area (WUA) of spawning habitat (top) and rearing habitat (bottom) as a function of stream flow in Peshastin Creek. Figure derived from EES Consulting (2005).

The portion of the Wenatchee River from Peshastin Creek down to Dryden Dam was encompassed in Reach 1 of their analysis. EES Consulting (2005) estimated that spawning habitat was optimized in this reach of the Wenatchee River at flows of 2,800 cfs for Chinook and 2,400 cfs for steelhead (Figure 5 top). Estimated rearing habitat was maximized at flows of 400 cfs for Chinook, 900 cfs for steelhead, and 220 cfs for bull trout (Figure 5 bottom).

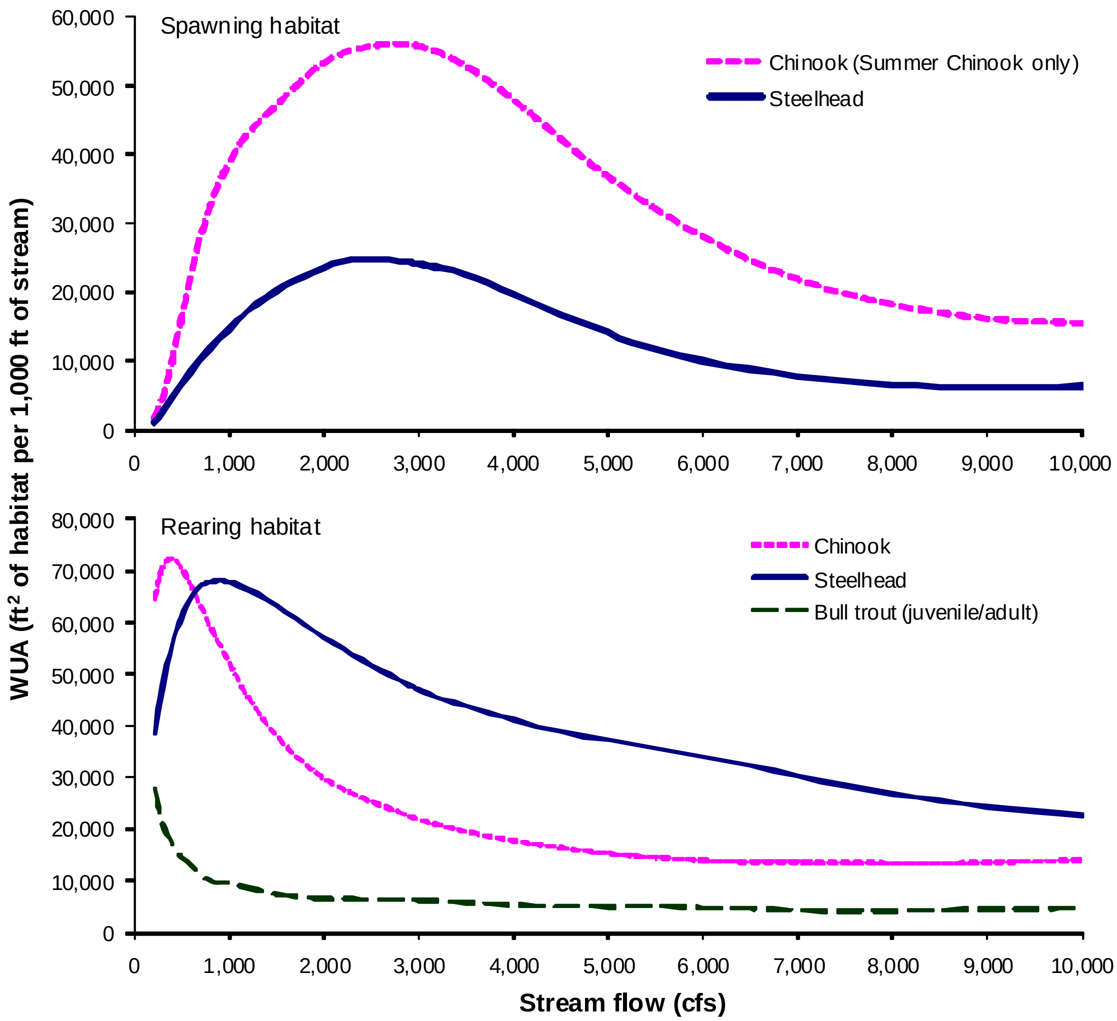

Figure 5. Estimated weighted useable area (WUA) of spawning habitat (top) and rearing habitat (bottom) as a function of stream flow in the Wenatchee River. Figure derived from EES Consulting (2005).

For modeling purposes, we assumed that 6.2 cfs (approximately 40% above the maximum proposed surface water needs, Figure 1) of water was drawn from the proposed intake site at the Dryden fishway and discharged upstream into Peshastin Creek (impact reach). This would result in a net increase of 6.2 cfs flow from the point of discharge to the intake site and that downstream flows would not be affected (because the increased flow would be offset by the intake). In reality, the amount of water needed will vary depending on the time of year (Figure 1) so the change in flow will be substantially less during some months than others. We evaluated WUA of spawning habitat for summer Chinook salmon during August and September, and steelhead from March through May. WUA of rearing habitat was evaluated over the entire year for all species. For each time period, we evaluated the minimum and maximum mean daily flows and the extreme low flow (minimum 10th percentile flow) where possible. For Peshastin Creek, the extreme low flow and maximum mean flows were sometimes beyond the range of flows used in the PHABSIM analysis (EES Consulting 2005). The Peshastin River extreme low flows were outside the range of flows used in the PHABSIM analysis so we were not able to evaluate the impact on habitat at these flows .

Table 2. Estimated percent of weighted useable area (WUA) of habitat for various flow values in Peshastin Creek compared to the additional flow resulting from a discharge of 6.2 cfs into Peshastin Creek from the proposed MCCRP component at the Dryden hatchery.

Species	Lifestage	Timing	Flow type	Flow (cfs)	% of WUA	+6.2cfs % of WUA
Chinook	Spawning	Aug-Sep	Optimal	80	100.0%	
			Extreme low[a]	1		
			Mean low	10	15.9%	34.8%
			Mean high	22	45.9%	57.1%
	Rearing	All year	Optimal	55	100.0%	
			Extreme low[a]	1		
			Mean low	10	32.5%	58.2%
			Mean high[b]	425	48.2%	48.4%
Steelhead	Spawning	Mar-May	Optimal	120	100.0%	
			Extreme low	74	80.7%	85.7%
			Mean low	120	100.0%	99.9%
			Mean high[b]	425	41.6%	41.5%
	Rearing	All year	Optimal	130	100.0%	
			Extreme low[a]	1		
			Mean low	10	17.7%	28.3%
			Mean high[b]	425	88.8%	88.6%
Bull trout	Rearing	All year	Optimal	19	100.0%	
			Extreme low[a]	1		
			Mean low	10	91.1%	98.6%
			Mean high[b]	425	77.3%	79.4%

[a] The extreme low represented by the minimum 10th percentile of daily flows for that period, was more than 10% less than the lowest flow used in the PHABSIM analysis by EESConsulting. No estimates of WUA were available.

[b] The mean high was greater than 10% of the highest flow used in the PHABSIM analysis by EES Consulting. We used the highest value they evaluated in this analysis.

The increased flow had very little effect on the modeled percent of WUA in the Wenatchee River (Table 3). Although there were both positive and negative effects on the percent of WUA, the difference was always less than 1%.

The increased flow typically resulted in a modeled increase in the percent of WUA in Peshastin Creek but varied with species and lifestage (Table 2). The increased flow had a greater effect on WUA at low flows than during high flow periods. Optimal flow for summer Chinook salmon spawning (80 cfs) is typically not reached during the spawning season so any increase in flow had a positive effect on amount of WUA. The increased flow during the mean low flow increased the percent of WUA of summer Chinook salmon spawning habitat from 15.9 to 34.8%. In a few scenarios, the increased flow resulted in slight reductions (less than 1%) in the percent of WUA.

Table 3. Estimated percent of weighted useable area (WUA) of habitat for various flow values in the Wenatchee River compared to the additional flow resulting from a discharge of 6.2 cfs into Peshastin Creek from the proposed MCCRP component at the Dryden hatchery.

Species	Lifestage	Timing	Flow type	Flow (cfs)	% of WUA	+6.2cfs % of WUA
Chinook	Spawning	Aug-Sep	Optimal	2,800	100.0%	
			Extreme low	405	17.2%	17.9%
			Mean low	751	53.5%	54.0%
			Mean high	2,310	98.4%	98.5%
	Rearing	All year	Optimal	400	100.0%	
			Extreme low	397	99.9%	99.9%
			Mean low	751	84.6%	84.3%
			Mean high	9,840	19.3%	19.3%
Steelhead	Spawning	Mar-May	Optimal	2,400	100.0%	
			Extreme low	664	37.9%	38.4%
			Mean low	1,570	83.6%	83.8%
			Mean high	9,660	24.8%	24.8%
	Rearing	All year	Optimal	900	100.0%	
			Extreme low	397	81.2%	81.9%
			Mean low	751	99.1%	99.2%
			Mean high	9,840	33.8%	33.7%
Bull trout	Rearing	All year	Optimal	220	100.0%	
			Extreme low	397	62.7%	61.9%
			Mean low	751	38.0%	37.7%
			Mean high	9,840	16.2%	16.2%

The results of this analysis indicated that withdrawing water from the Dryden fishway and discharging it into Peshastin Creek would generally have a positive effect on ESA listed fish in Peshastin Creek and little to no effect on those in the Wenatchee River. The effects will be limited to the impact reach and the magnitude will depend on the amount of water involved.

Fish passage at the mouth of Peshastin Creek has been identified as being limited by low flow conditions in the late summer and early fall (Andonaegui 2001, NPCC 2004). Discharge of hatchery water into the creek during these periods could improve hydraulic conditions for returning adults.

4.1.1.2 Chikamin Site

Chikamin Creek is a tributary of the Chiwawa River which accounts for 44% of the Chinook, 12% of the steelhead, and 78% of the bull trout spawning redds counted in the Wenatchee Subbasin (see Appendix 9 of the EIS for more information). Chinook spawning has not been documented in Chikamin Creek although summer steelhead and bull trout have been documented spawning in the stream. Chikamin Creek on average represents 3% of the subyearling Chinook, 8% of the subyearling and 5% of the yearling rainbow/steelhead abundance estimated in the Chiwawa drainage. Chikamin Creek also represented 13% of the juvenile bull trout abundance in the Chiwawa drainage in 2007, but the survey does not include many upper tributaries where bull trout likely reside (Hillman et al. 2008). A new pond is proposed to be constructed next to Chikamin Creek and would be fed with surface water from the creek. The affected reach would include Chikamin Creek from the intake downstream about 450 feet of channel to the discharge pipe (Figure 6).

Model inputs for the Chikamin analysis (Table 4) were based on onsite topographic survey and data from a stream gage located immediately downstream of the site. Topographic data from the affected reach of the creek (Figure 6) was collected during the fall of 2009. A second survey was conducted on April 27, 2010 to gather additional flow and channel data.

Table 4. Topographic survey dates and model inputs used in the River2D model to evaluate surface water withdrawal impacts to listed fish.

	Chikamin	Napeequa
Channel topography survey dates	Oct. 19-20, 2009	Oct. 5 - Nov. 5, 2009
Date water edge surveyed	Oct. 19, 2009	Oct. 7, 2009
Flow during water edge survey	13.7	34.4
Date second survey	Apr. 27, 2010	Apr. 26-27, 2010
Flow during second survey	81.6	242
Minimum withdrawal (cfs)	1.5	1.7
Maximum withdrawal (cfs)	2.3	2.6
Withdrawal period	Mid March to early May	Mid-March to early May
Mean flow range (cfs)	20-68	109-372
Extreme low flow (cfs)	8.5	47

Surface water is proposed to be withdrawn from Chikamin Creek from mid March through early May to provide water to the acclimation pond. A minimum flow of 1.5 cfs is required for coho acclimation at this site (Appendix 2 of the EIS) and assumed withdrawals 50% greater (2.3 cfs) for modeling purposes. Juvenile Chinook salmon, and adult and juvenile steelhead and juvenile and adult bull trout are expected to be present in Chikamin Creek during this time (Appendix 9 of the EIS). Daily flows typically start to increase around mid March and peak between mid May and early June (Figure 7). Mean flows during the acclimation period ranged between 20 and 68 cfs between 2000 and 2008, with the 10^{th} percentile flows as low as 8.5 cfs and 90^{th} percentile as high as 105 cfs.

The model results indicated that the amount of habitat in the affected reach of Chikamin Creek would generally increase with flow during the spring acclimation period (Figure 8). However, the amount of WUA of habitat for all species was very small (0.1% or less) compared to the wetted channel area (Table 5). This is due primarily to a lack of finer substrate (gravel and small cobbles) in this reach. As a result, the model did not predict any WUA for steelhead spawning in the affected reach at any flow levels (Table 5). Because WUA generally increased with flow, the modeled water withdrawal of 2.3 cfs tended to reduce the WUA of habitat for all species. The reduction due to the withdrawal was less than one square foot of habitat for all species. Thus, the maximum amount of water proposed for withdrawal would result in a very small reduction in WUA for all species.

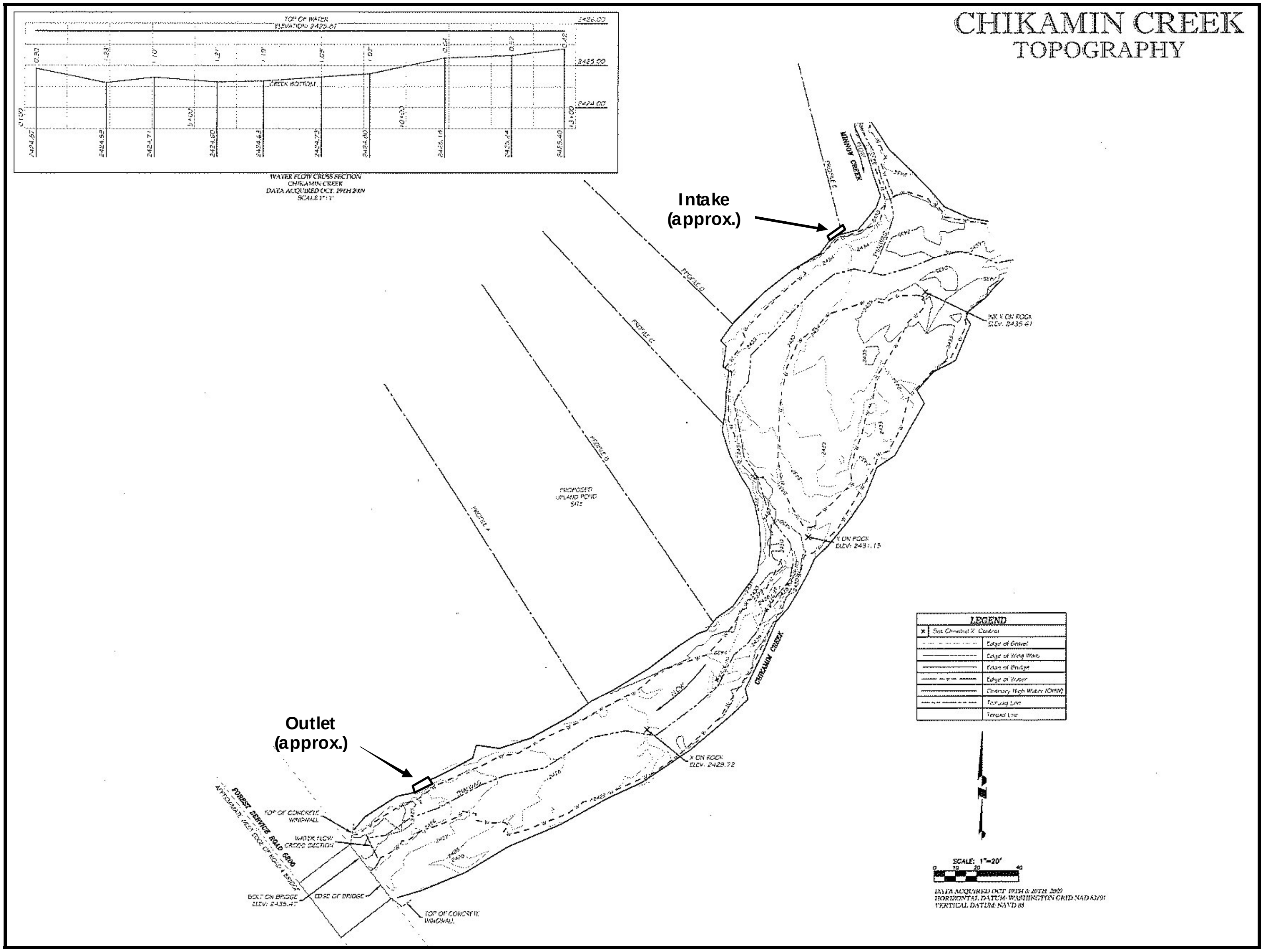

Figure 6. Chikamin Creek channel topography of the affected reach.

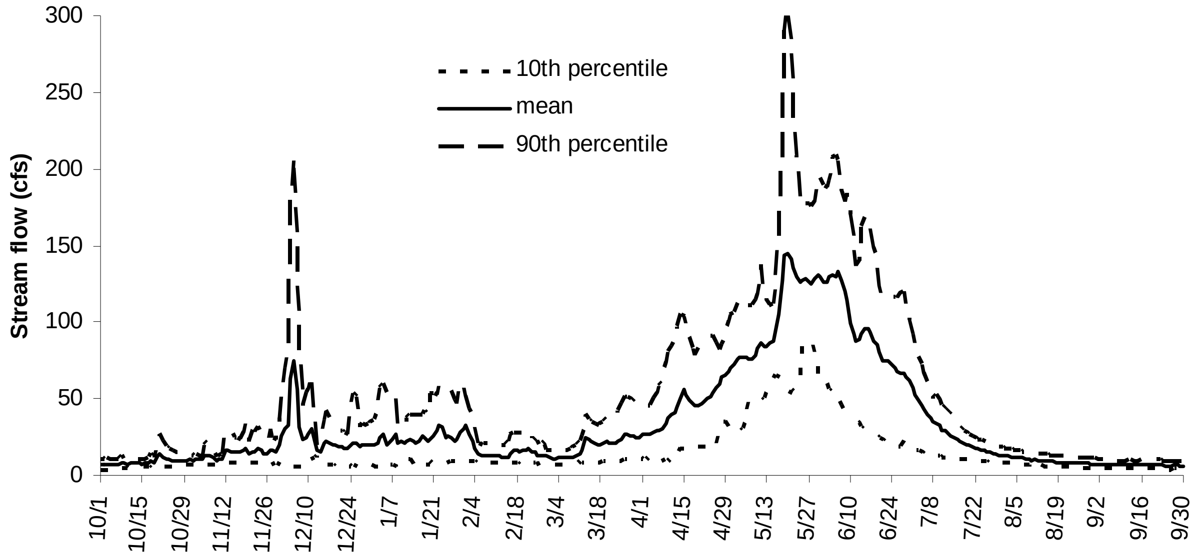

Figure 7. Chikamin Creek stream gage data collected by the US Forest Service, 2000 – 2008.

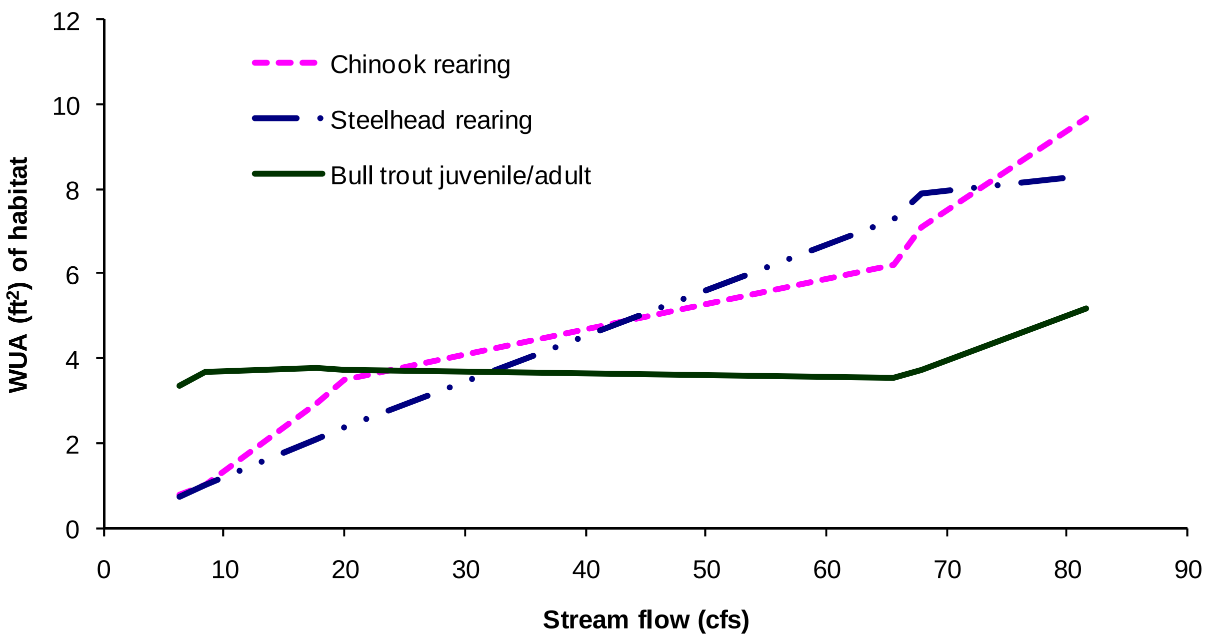

Figure 8. Estimated weighted useable area (WUA) of habitat as a function of stream flow in the affected reach of Chikamin Creek.

Table 5. Modeled weighted useable area (WUA) of habitat in the affected reach of Chikamin Creek for expected flow values during the spring acclimation period and with a maximum withdrawal of 2.3 cfs.

Flow type	Model type	Flow (cfs)	Water surface elevation (ft)	Wetted surface area (ft^2)	Weighted usable area (ft^2)			
					Chinook rearing	Steelhead spawning	Steelhead rearing	Bull trout juvenile/adult
Extreme low	-2.3 cfs	6.2	2,425.5	6,056	0.8	0	0.7	3.4
	normal	8.5	2,425.0	7,194	1.0	0	1.0	3.7
Mean low	-2.3 cfs	17.7	2,425.8	9,045	2.9	0	2.1	3.8
	normal	20.0	2,425.8	9,373	3.5	0	2.4	3.7
Mean high	-2.3 cfs	65.7	2,426.3	12,848	6.2	0	7.3	3.5
	normal	68.0	2,426.4	12,909	7.1	0	7.9	3.7

4.1.1.3 Tall Timber Site

The proposed Tall Timber acclimation site is located adjacent to the glacially fed Napeequa River, a tributary of the White River. The White River watershed represents 6% of the Chinook, 1% of the steelhead, and 10% of the bull trout spawning redds counted in the Wenatchee Subbasin (see Appendix 9 of the EIS for further details). The White River drainage still maintains high quality, complex habitat with refuge and rearing habitat for multiple life stages and life histories (NPCC 2004). Both Chinook and steelhead have been observed spawning in the Napeequa River but few redds have been counted there in recent years (Hillman et al. 2008). No bull trout have been documented spawning in Napeequa River. A portion of the surface water from the Napeequa River is proposed to be diverted into disconnected side channel for acclimating coho salmon. The affected environment would include the Napeequa River from the intake downstream about 1,800 feet of channel to the outlet culvert (Figure 9).

Model inputs for the Tall Timber (Napeequa) analysis (Table 4) were based on onsite topographic survey and a combination of onsite discharge measurements and White River stream gage data. Topographic data from the affected reach of the river (Figure 9) was collected during the fall of 2009. A second survey was conducted on April 26 and 27, 2010 to gather additional flow and channel data.

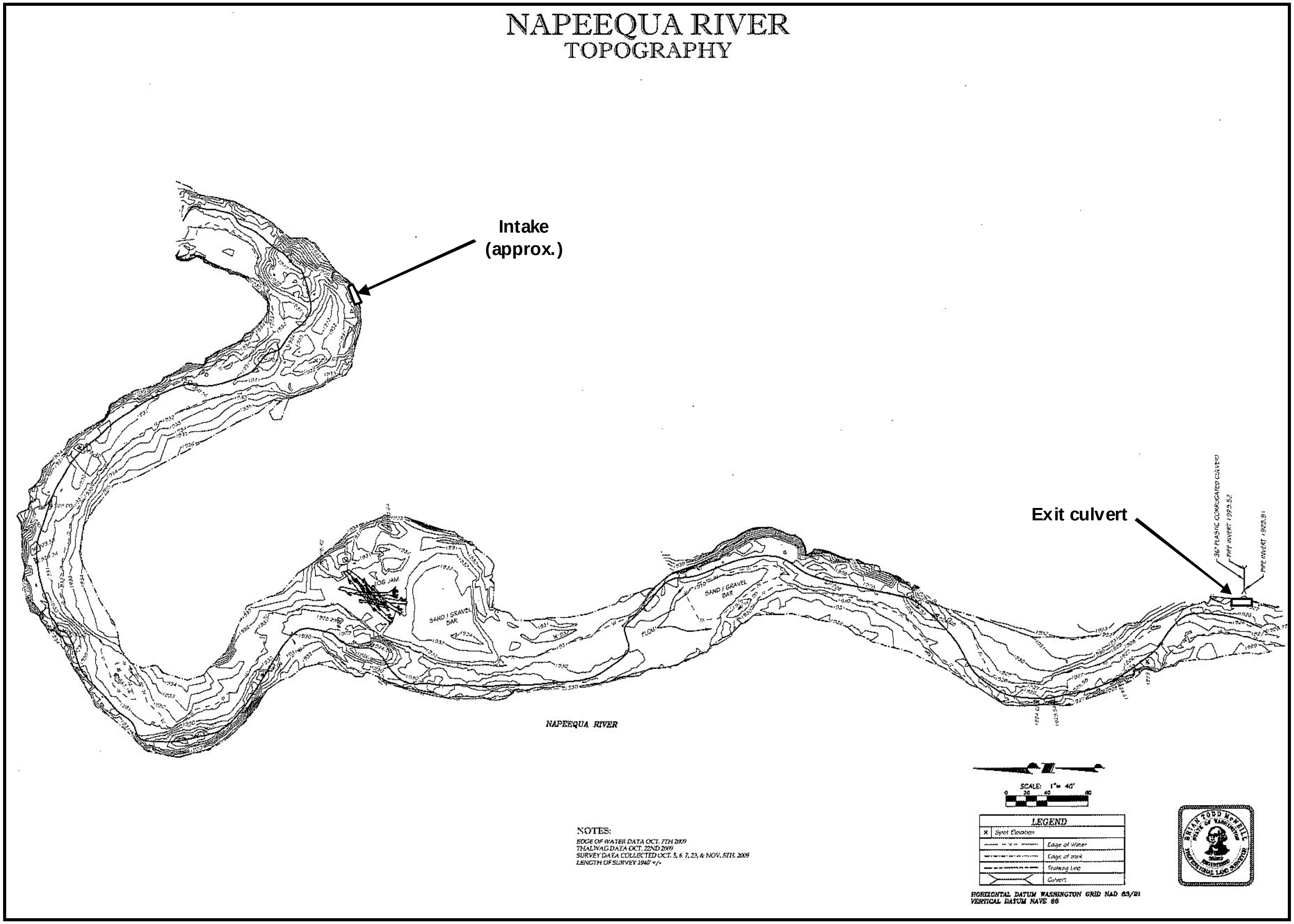

Figure 9. Napeequa River channel topography of the affected reach.

Surface water is proposed to be withdrawn from the Napeequa River from mid March through early May. A minimum flow of 1.7 cfs is required for coho acclimation at this site (Appendix 2 of the EIS) and withdrawals were assumed to be 50% greater (2.6 cfs) for modeling purposes. Juvenile Chinook salmon, and adult and juvenile steelhead and migrant bull trout are assumed to be present in Napeequa River during this time (note that steelhead are uncommon in the White River drainage, see Appendix 9 of the EIS). Stream gage data is not available for the Napeequa River. However, a stream gage was operated on the White River at about river mile 6.5 between 1955 and 1983 (Figure 10) by the US Geological Survey (USGS). Washington Department of Ecology has operated a stream gage at the same site beginning in 2002. Daily flows in the White River typically start to increase around the end of March and peak in June (Figure 10). We compared seven flow measurements collected by the USGS between September 1975 and October 2001 (provided by John Clemens, USGS, Tacoma, Washington) and one collected by Cramer Fish Sciences in October 2009, with corresponding White River stream gage data (Figure 11). Flows from the two rivers were highly correlated (R^2 = 0.94). This is not surprising because they are both glacially fed rivers, and the Napeequa is the largest tributary in the White River Watershed (NPCC 2004). Based on the regression on the White River stream gage, we estimated that mean flows in the Napeequa River during the acclimation period will range between 109 and 372 cfs with the 10th percentile as low as 47 cfs and the 90th as high as 732 cfs.

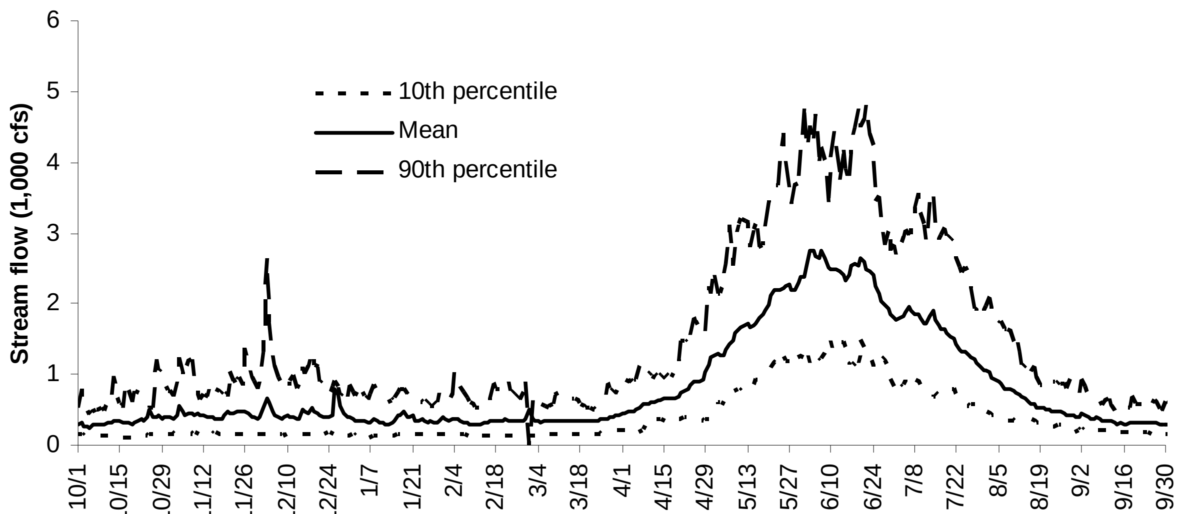

Figure 10. White River stream gage data collected by the US Geological survey, 1955-1983 (Data source: http://waterdata.usgs.gov/wa/nwis/inventory/?site_no=12454000&agency_cd=USGS&).

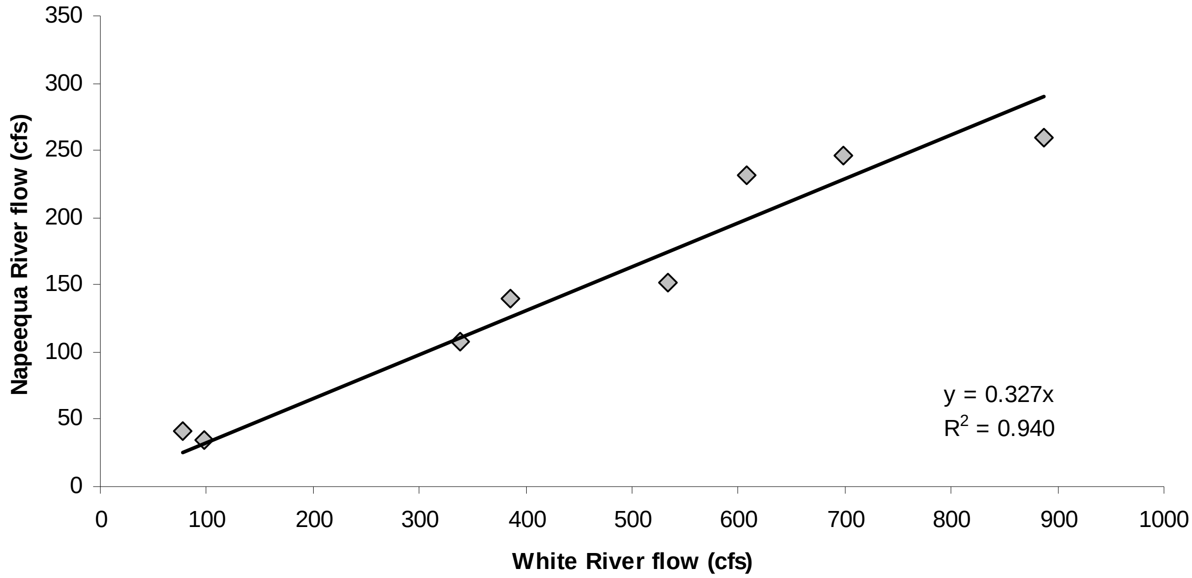

Figure 11. Relationship between Napeequa and White River flows.

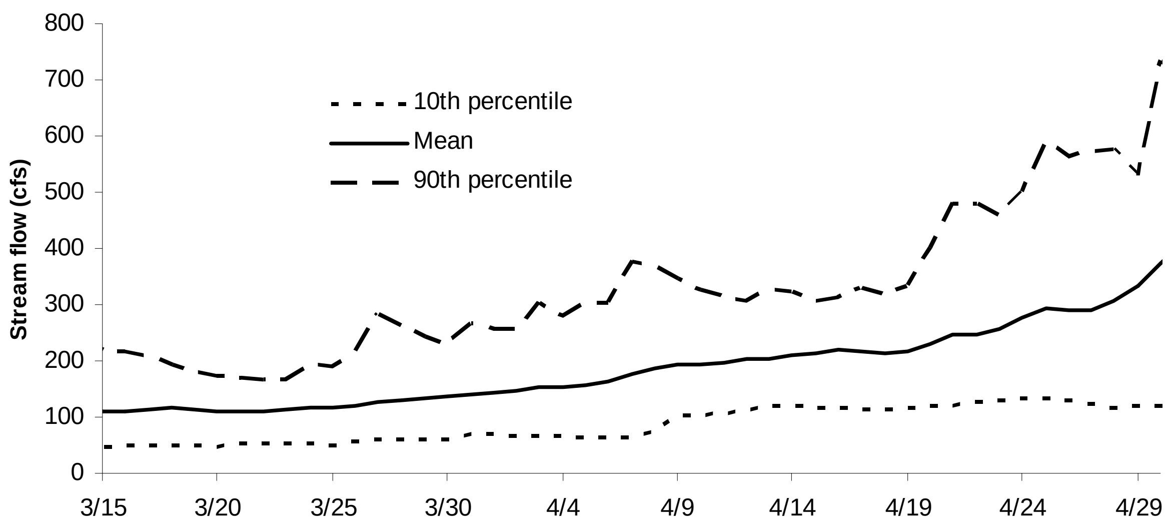

Figure 12. Estimated Napeequa River flows during the spring acclimation period based on the regression on White River gage data.

The modeled effect of flow on WUA of habitat in the affected reach of the Napeequa River varied with the species and lifestage during the spring acclimation period (Figure 13). The substrate in the affected reach was dominated by gravel and therefore was more suitable habitat for all species than was modeled for the affected reach of Chikamin Creek. The amount of steelhead spawning WUA peaked at about 13,000 ft^2 at 242 cfs and then decreased with increased flow (Table 6). The WUA of Chinook rearing habitat generally decreased with flow until about 180 cfs and then increased slightly. The modeled water withdrawal of 2.6 cfs tended to reduce the WUA of habitat for most species except at the highest flows which showed a slight increase for all species except bull trout which decreased by 3% (Table 6). The withdrawal generally increased WUA for Chinook salmon rearing. The change in WUA due to the water withdrawal was typically 1% or less for each modeled flow type except for the extreme low flow. The modeled 2.6 cfs withdrawal at the extreme low flow resulted in a 3% increase in Chinook rearing, a 5% decrease in steelhead spawning, a 2% reduction in steelhead rearing, and less than 1% decrease in bull trout WUA. Thus, the maximum proposed withdrawal at this site would generally decrease WUA for most species at extreme low flows by a small amount, and slightly increase WUA at higher flows.

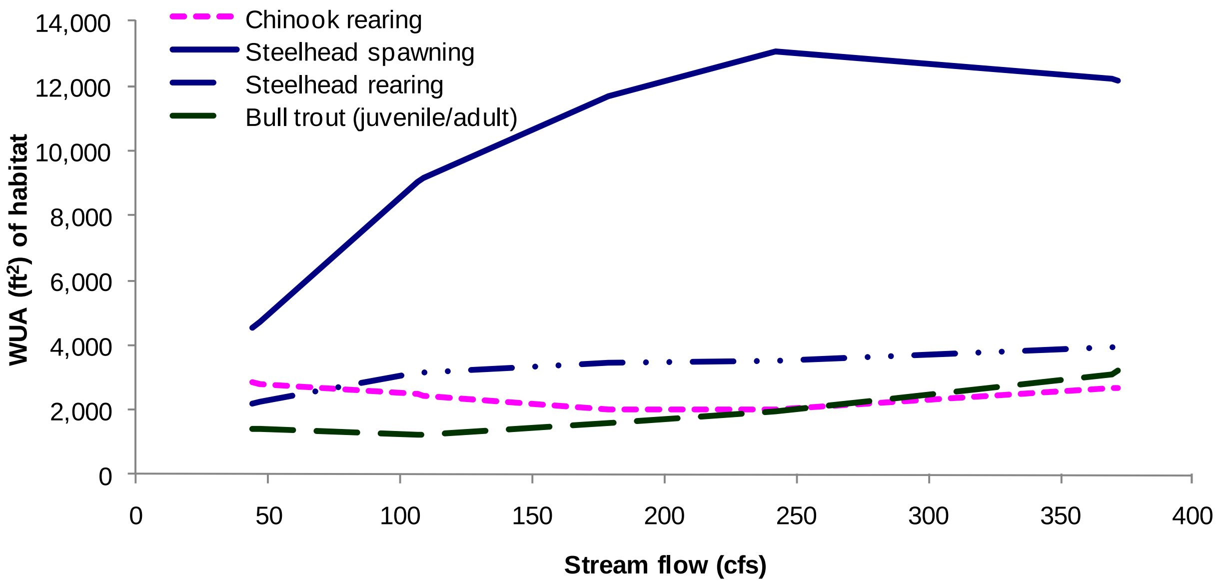

Figure 13. Estimated weighted useable area (WUA) of habitat as a function of stream flow in the affected reach of Napeequa River.

Table 6. Modeled weighted useable area (WUA) of habitat in the affected reach of the Napeequa River for expected flow values and a maximum withdrawal of 2.6 cfs.

Flow type	Model type	Flow (cfs)	Water surface elevation (ft)	Wetted surface area (ft²)	Weighted usable area (ft²)			
					Chinook	Steelhead		Bull trout
					rear	spawn	rear	juvenile/adult
Extreme low	-2.6 cfs	44.4	1,927.9	81,388	2,858	4,514	2,199	1,414
	normal	47.0	1,927.9	81,949	2,781	4,741	2,245	1,416
Mean low	-2.6 cfs	106.4	1,928.4	96,432	2,472	9,013	3,154	1,209
	normal	109.0	1,928.5	96,753	2,445	9,134	3,164	1,204
Mean high	-2.6 cfs	369.4	1,930.8	131,228	2,692	12,218	3,963	3,098
	normal	372.0	1,930.8	132,520	2,674	12,168	3,925	3,196

The design of the Tall Timber site allows use of the side channel by other species during coho acclimation (see Appendix 2 of EIS). Diverting flow into the system may increase off-channel habitat.

4.1.1.4 George (backup hatchery site)

The George hatchery site offers a potential alternative to the Dryden hatchery site. Located approximately 1.25 miles downstream of Lake Wenatchee, the George hatchery would be positioned just south of the Wenatchee River main stem. The Wenatchee River provides spawning and/or rearing habitat for ESA listed spring Chinook salmon, steelhead, and bull trout (Appendix 9 of the EIS). We evaluated potential impacts of hatchery surface water withdrawals on microhabitat availability for ESA listed fish using the PHABSIM methodology. This approach was chosen to enable direct comparison to flow effects quantified for the Dryden hatchery site.

Wenatchee River mean discharge below Lake Wenatchee ranges between 200 cfs and 8,000 cfs annually (Figure 14). A total of 8 cfs of water would be supplied to the George hatchery via ground and surface water sources. Surface water, approximately 4.7 cfs, would be withdrawn from the Wenatchee River and piped to the hatchery. Hatchery discharge would be returned to the river 3,800 feet downstream of the withdrawal via a historic side channel that maintains hyporheic (subsurface) connectivity to the main stem. Discharged hatchery water would travel 5,600 feet before reaching the main stem, and some water would likely be lost to the ground depending on the river's flow stage. For simplicity, we assumed that returned flows would be equivalent to the amount of surface flow withdrawn; thus, our study reach was defined by the upstream withdrawal and downstream discharge locations (Figure 15).

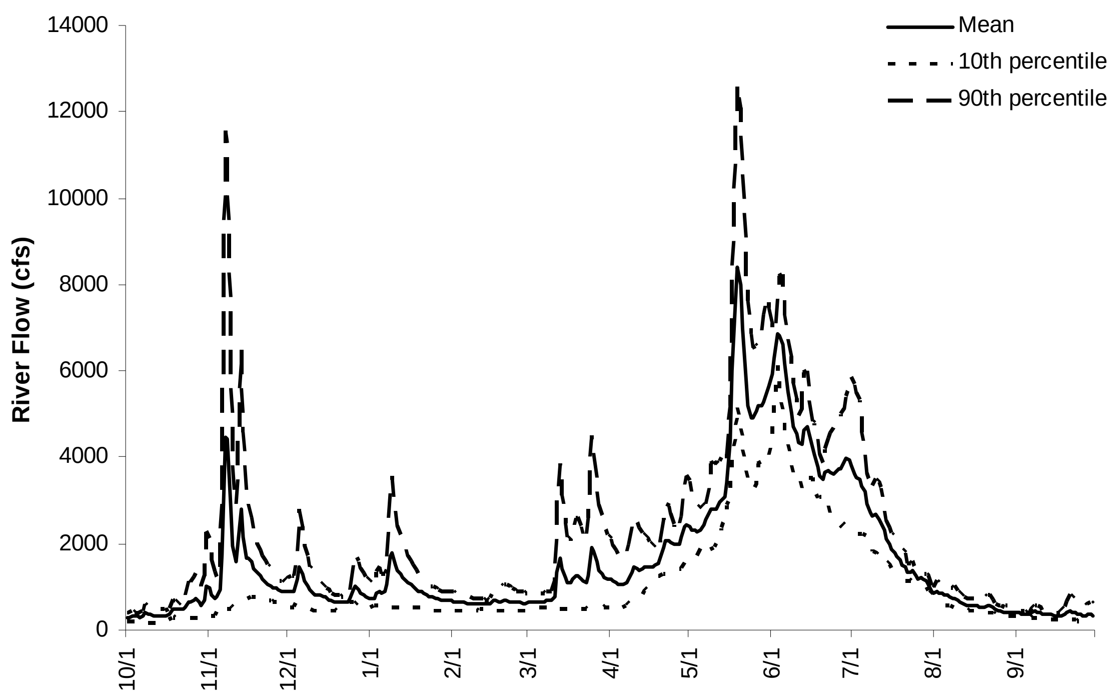

Figure 14. Wenatchee River discharge below Lake Wenatchee, water years 2005-2010. Washington Department of Ecology stream gage 45A240.

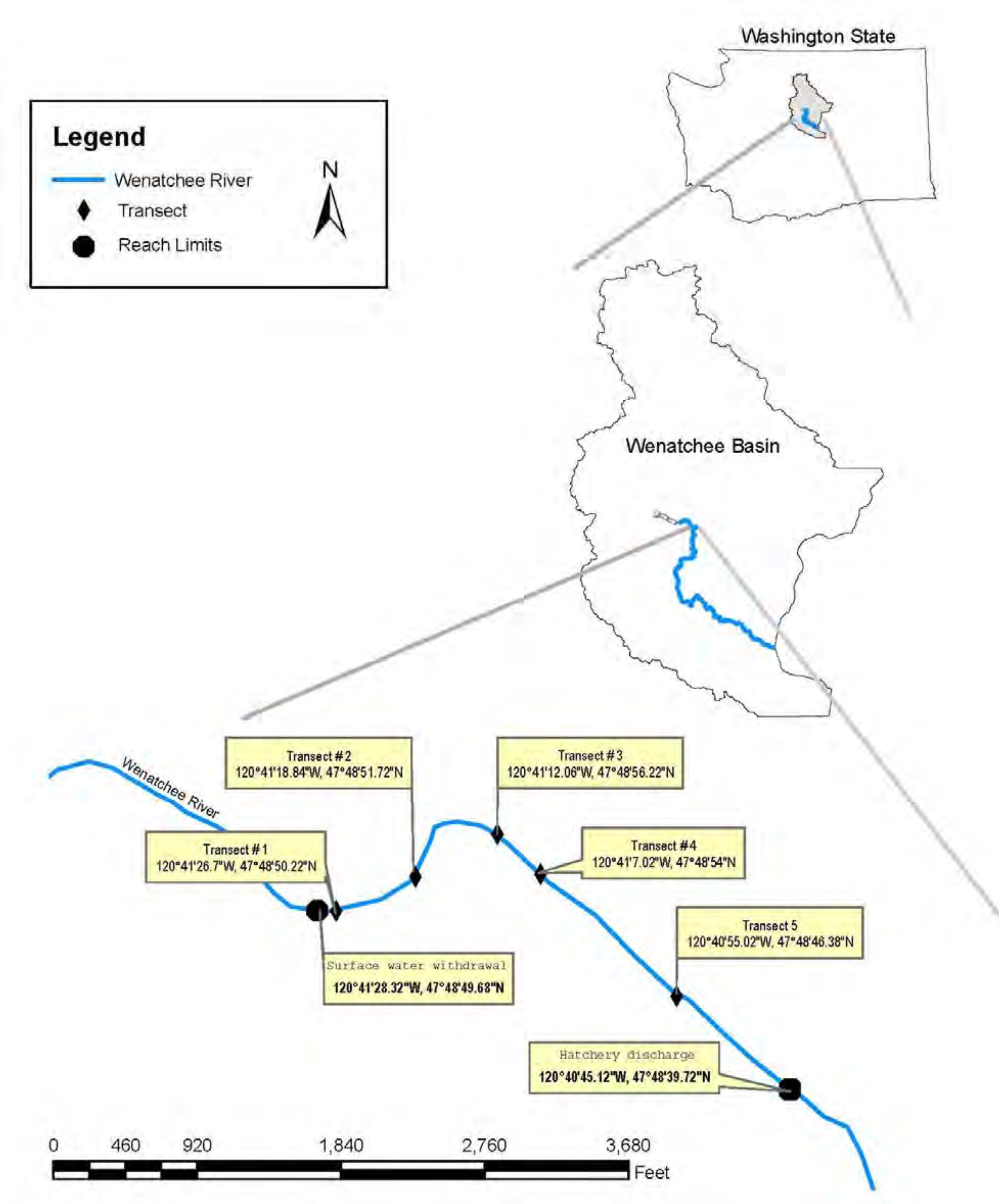

Figure 15. Map of the study reach adjacent to the George hatchery site. The reach was defined by the locations of surface water withdrawal and discharge. Locations of data collection transects are provided for reference.

The majority of the study reach was comprised of glide habitat (~60%), followed by pool (~30%) and riffle (~10%) habitat types. Stream substrate in pools was composed of equal proportions of fines, gravel, and cobble with a small amount of boulder. Riffles had primarily gravel and cobble substrate. Glides were composed of near equal parts of fines, gravel and cobble. In-stream wood complexity was judged to be fair throughout the reach, and a total of 69 pieces of large wood were counted. Following completion of the stream habitat survey, five transects were selected in locations representative of the observed habitat composition within the study reach (Figure 15). Channel profile and water velocity data were collected at each transect in October 2010 and used to define the hydraulic characteristics of the study reach at base flows.

Field data was used to parameterize the IFG4 hydraulic model following the “one-velocity” method described by Milhous (1984). Habitat Suitability Criteria recommended by the State of Washington (WDFW and WDOE 2004) for steelhead, spring Chinook salmon and bull trout were coupled with IFG4 program output to simulate relative changes in microhabitat availability across a range of flows. Figure 16 provides PHABSIM results across the range of flows simulated. Note that simulations were not completed for flows above 450 cfs and, therefore, our analysis was limited to low flow periods. The effect of flow withdrawals on WUA was expected to be greatest during the low flow season. Results of comparisons between the no-withdrawal and 4.7 cfs withdrawal scenarios are presented in Table 7. We caution readers not to overuse the absolute values presented in Table 7 because the difference in flow between the two scenarios is small and PHABSIM analyses are most useful for evaluating a broad range of flows. Specific values are provided in Table 7 to demonstrate that the relative change in weighted useable area (WUA) was extremely small (less than 1.5%) for all species and life-stages. Thus, a 4.7 cfs flow change during low and extreme low flows in the Wenatchee River had negligible effects on WUA simulated for spring Chinook, steelhead and bull trout.

A secondary discharge location just downstream of the withdrawal site is being considered for the George hatchery (see Appendix 1 of the EIS). The close proximity of “Discharge 2” to the intake leads us to conclude that if this option is chosen there would be no measurable effect on fish habitat in the Wenatchee River.

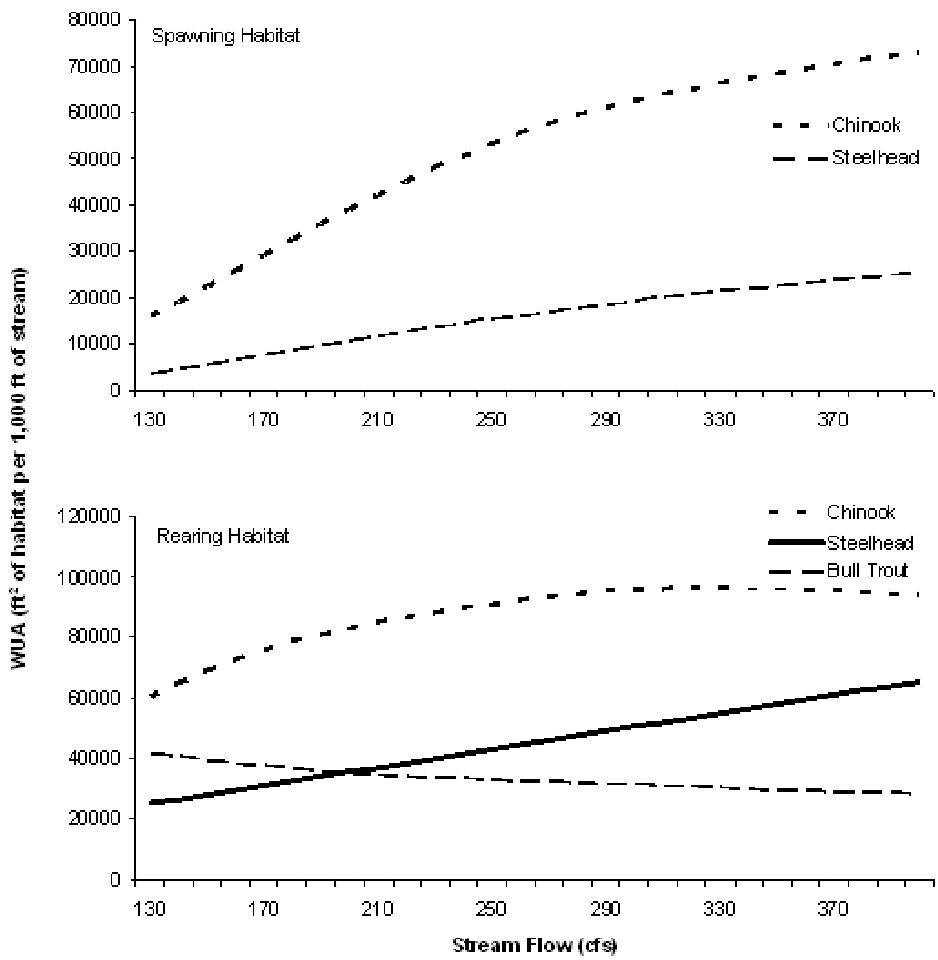

Figure 16. Estimated weighted useable area for spawning and rearing habitat as a function of fall stream flow in the Wenatchee River study reach.

Table 7. Estimated percent of weighted usable area for ESA listed species in the Wenatchee River study reach under low flow and extreme low flow conditions. Low flows for the study reach were calculated from available WDOE stream gauge data. Values are provided for current conditions and conditions expected if flows are reduced by 4.7 cfs.

Species	Lifestage	Timing	Flow type	Flow (cfs)	% of WUA	- 4.7cfs % of WUA
Chinook	Spawning	Aug-Sep	Extreme low	136	13.2%	12.1%
			Mean low	263	37.5%	36.7%
	Rearing	All year	Extreme low	136	44.8%	43.4%
			Mean low	263	62.4%	62.0%
Steelhead	Spawning	Mar-May	Extreme low	136	3.2%	2.9%
			Mean low	263	11.0%	10.7%
	Rearing	All year	Extreme low	136	18.5%	18.0%
			Mean low	263	30.1%	29.6%
Bull trout	Rearing	All year	Extreme low	136	28.2%	28.6%
			Mean low	263	22.1%	22.2%

4.1.2 Methow Subbasin

4.1.2.1 Twisp Weir

The proposed Twisp Weir acclimation site is located adjacent to an existing spring Chinook salmon acclimation site operated by WDFW on the Twisp River (see Appendix 3 of the EIS). Mean discharge downstream of the Twisp Weir near Twisp, WA ranges between 60 cfs and 2,000 cfs annually (Figure 17). The new coho acclimation pond would be fed by a combination of ground and surface water sources. In total, the site requires 1.7 cfs of water: 0.5 cfs of ground water and 1.2 cfs of surface water withdrawn from the Twisp River. Withdrawals would be discharged back into the river approximately 450 feet downstream of the acclimation pond intake. Water would be diverted from the Twisp River to the acclimation pond from approximately December 1 through early May. The Twisp River provides spawning and/or rearing habitat for ESA listed spring Chinook salmon, steelhead, and bull trout (Appendix 9 of the EIS). We evaluated potential impacts of surface water withdrawals on relative changes in microhabitat availability for ESA listed fish using PHABSIM.

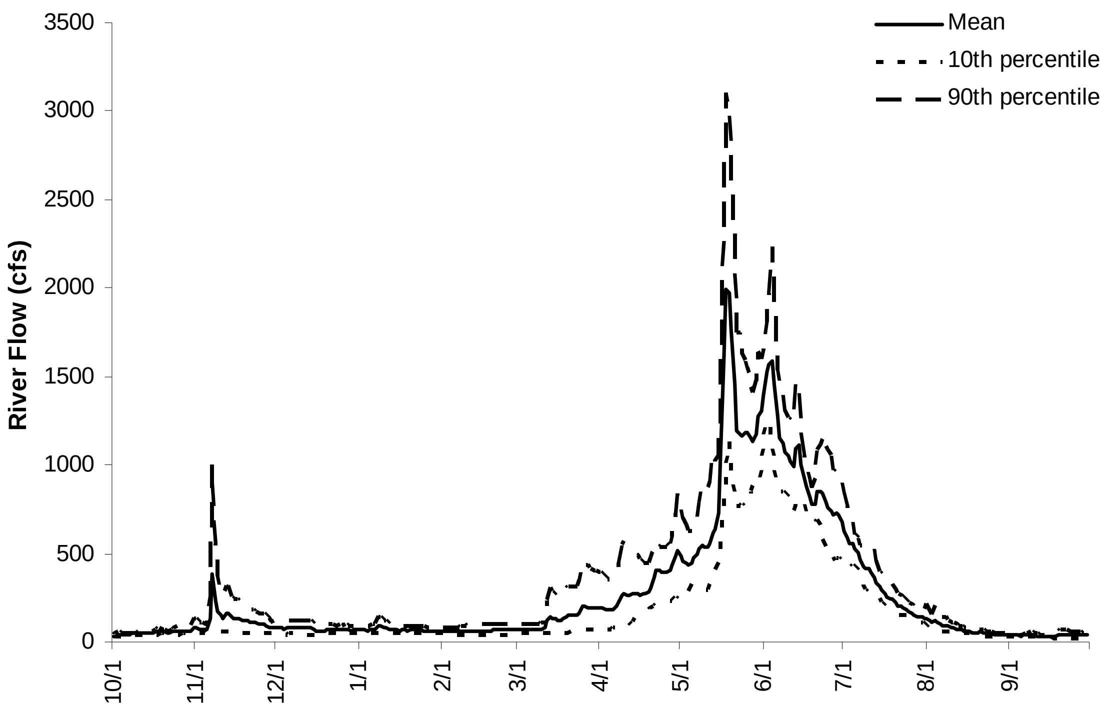

Figure 17. Twisp River discharge near Twisp, WA, water years 2005-2010. USGS stream gage 12448998.

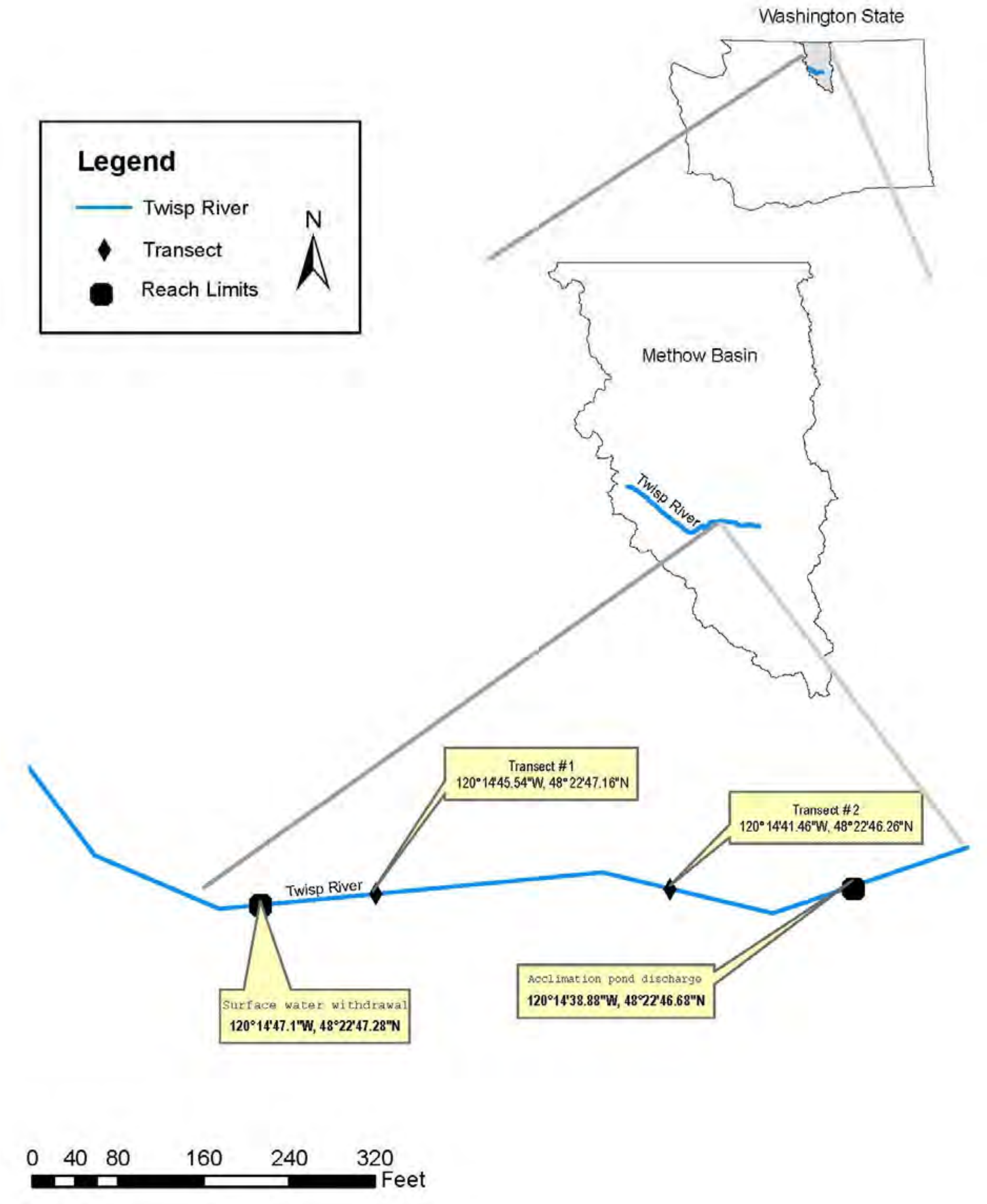

Figure 18. Map of the study reach adjacent to the Twisp Weir acclimation site. The reach was defined by the locations of surface water withdrawal and discharge. Locations of data collection transects are provided for reference.

Mesohabitat composition within the study reach was ~70% riffle and ~30% glide habitat types. Stream substrate was composed primarily of cobble and boulders with a small amount of gravel and fines. In-stream wood complexity was judged to be low, with a total of two pieces of large wood counted. After completion of the habitat survey, two transects were selected in representative locations within the study reach (Figure 18), one upstream and one downstream of the Twisp Valley Power and Irrigation District Diversion. Channel profile and water velocity data were collected at each transect in October 2010 and used to define the hydraulic characteristics of the study reach at base flows. Since the location of withdrawal occurred in a portion of the river with multiple side channels, our data collection and analysis focused exclusively on the side channel that would be affected by the withdrawal.

Field data was used to parameterize the IFG4 hydraulic model following the "one-velocity" method described by Milhous (1984). Habitat Suitability Criteria recommended by the State of Washington (WDFW and WDOE 2004) for steelhead, spring Chinook salmon and bull trout were coupled with IFG4 program output to simulate microhabitat availability across a range of flows in the affected side channel. Figure 19 provides PHABSIM results across the range of flows simulated. Note that simulations were not completed for flows above 40 cfs in the study reach and, therefore, our analysis is limited to the low flow period when juvenile coho would be held overwinter. The effect of flow withdrawals on WUA was expected to be greatest during the low flow period when the proportion of flow diverted from the side channel would be highest. Results of comparisons between the no-withdrawal and 1.2 cfs withdrawal scenarios are presented in

Table 8. We caution readers not to overuse the absolute values presented in

Table 8 because the difference in flow between the two scenarios is small and PHABSIM analyses are most useful for evaluating a broad range of flows. Specific values are provided to demonstrate that the relative change in WUA was small, 1.5% or less, for all species and life-stages. Therefore, a 1.2 cfs flow change during low and extreme low flows in the Twisp River had negligible effects on WUA simulated for spring Chinook, steelhead and bull trout.

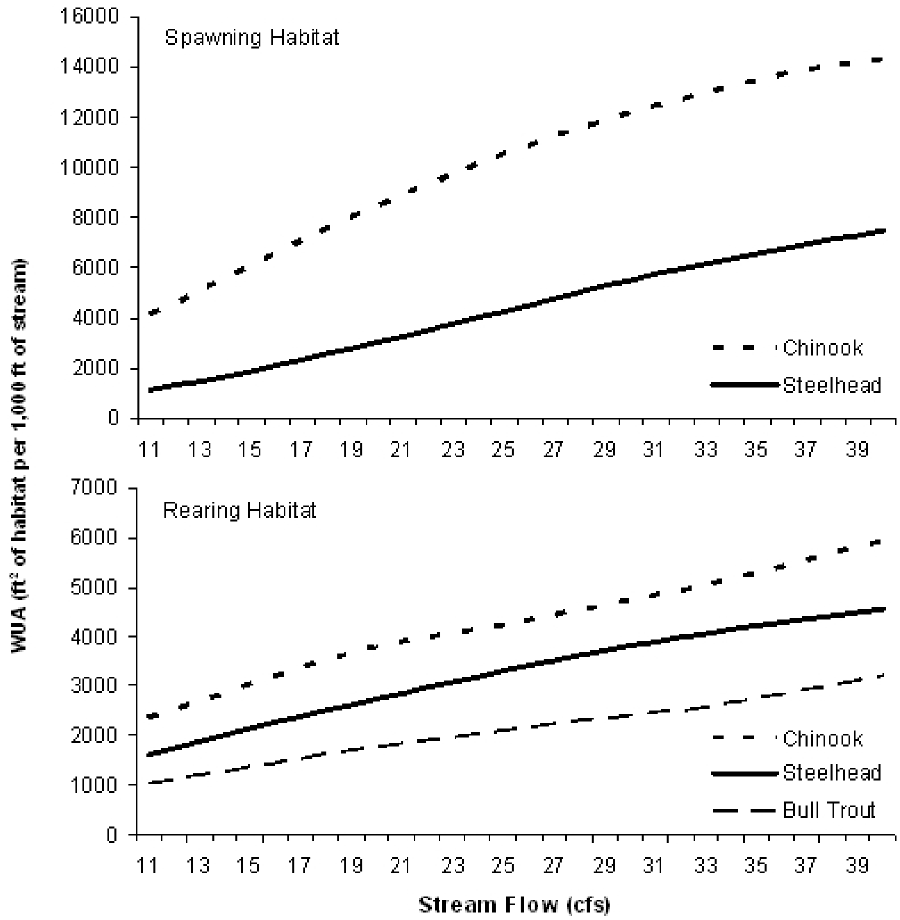

Figure 19. Estimated weighted useable area for spawning and rearing habitat as a function of fall stream flow in the Twisp River study reach.

Table 8. Estimated percent of weighted usable area for ESA listed species in the Twisp River study reach under low flow and extreme low flow conditions. Low flows for the study reach were calculated from available USGS stream gauge data. Values are provided for current conditions and conditions expected if flows are reduced by 1.2 cfs.

Species	Lifestage	Timing	Flow type	Flow (cfs)	% of WUA	-1.2cfs % of WUA
Chinook	Spawning	Aug-Sep	Extreme low	12	18.7%	17.0%
			Mean low	22	35.3%	33.8%
	Rearing	All year	Extreme low	12	10.3%	9.7%
			Mean low	22	15.1%	14.8%
Steelhead	Spawning	Mar-May	Extreme low	12	5.3%	4.6%
			Mean low	22	13.3%	12.4%
	Rearing	All year	Extreme low	12	7.1%	6.6%
			Mean low	22	11.3%	10.9%
Bull trout	Rearing	All year	Extreme low	12	4.5%	4.3%
			Mean low	22	7.2%	7.0%

4.1.2.2 Newby (backup acclimation site)

Newby Creek is a non-fish bearing, high gradient, small tributary to the Twisp River (Appendix 9 of the EIS). The proposed backup acclimation site, including the proposed water intake and discharge sites, would be located adjacent to Newby Creek above a series of cascades, which makes the site inaccessible to migratory fish. We estimated flow to be less than 1 cfs in October 2010 based on depth and velocity measurements taken at three sites within the creek. The accuracy of the flow estimate is questionable due to the fact that it was difficult to find locations deep enough to fully submerge the flow meter. A habitat survey revealed that there were natural fish passage barriers throughout the stream and the substrate was comprised mostly of fines. Based on these facts we conclude that a diversion of flow from Newby Creek into an acclimation pond and return of water to Newby Creek would have no adverse affects on ESA listed spring Chinook salmon, steelhead or bull trout.

4.2 Groundwater Impacts

A complete analysis of the effect of groundwater withdrawals on surface water can be found in the *Groundwater Withdrawal Impact Report* (Appendix 11 of the EIS). The following section discusses the potential impacts to listed fish due to groundwater withdrawals.

4.2.1 Wenatchee Subbasin

4.2.1.1 Butcher

A new well is proposed for this site to facilitate overwinter rearing of coho. A pump would draw 225 gpm from the well to provide an additional 0.5 cfs of flow to the pond. The well will likely be less than 250 feet? deep and is expected to be in hydraulic continuity with Nason Creek. There may be localized impacts to stream flow that will be completely offset by return flows from the acclimation pond. The magnitude of this localized impact cannot be estimated until the well has been dug and tested. Because of the water-balance neutrality of the proposed withdrawal of groundwater from an aquifer in hydraulic continuity with the stream and discharge of the groundwater back into the stream, there will be no regional impacts to stream flow within the Wenatchee Subbasin. Thus, there are likely to be little to no impacts to fish from the groundwater withdrawal at this site.

4.2.1.2 Dryden Hatchery

A small hatchery is proposed to be developed at this site. A combination of surface and groundwater sources is being explored to supply of up to 2,775 gpm (6.2 cfs) to the site. Potential groundwater sources include an infiltration gallery or production wells. Groundwater levels are shallow and expected to be in hydraulic continuity with the Wenatchee River and Peshastin Creek. The effect of groundwater withdrawals on surface water will depend on the percentage of the demand supplied by wells and on the discharge site. As discussed in section 4.1.1, if return water is discharged upstream in Peshastin Creek there will be a small increase in flow from the discharge site to the Dryden fishway. This is expected to provide some benefits to ESA listed fish in the affected reach of Peshastin Creek but little to no impact to those in the Wenatchee River. If return water is discharged at the Dryden fishway, the impacts to surface water from groundwater withdrawals are expected to be localized and completely offset by return flows from the facility. Therefore, there are likely to be little to no negative impacts to fish from groundwater withdrawals at this site.

4.2.1.3 Backup Sites

4.2.1.3. SQUADRONI

A new well would be developed to provide 1.6 cfs needed for overwinter rearing if this site is needed. It is anticipated that 720 gpm will be drawn from the aquifer to meet this demand. The wells are likely to be in hydraulic continuity with Nason and Gill Creeks. There may be localized impacts to stream flow that will be completely offset by return flows from the acclimation pond. The magnitude of this localized impact cannot be estimated until the wells have been dug and tested. Because of the water-balance neutrality of the proposed withdrawal of groundwater from an aquifer in hydraulic continuity with the stream and discharge of the groundwater back into the stream, there will be no regional impacts to stream flow within the Wenatchee Subbasin. Thus, there are likely to be little to no impacts to fish from the groundwater withdrawals at this site.

4.2.2 Methow Subbasin

4.2.2.1 Lincoln

Two wells will likely to be needed to provide 2.6 cfs needed for overwinter rearing at this site. It is anticipated that 1,170 gpm will be drawn from the aquifer to meet this demand. The wells are in hydraulic continuity with the Twisp River. There may be localized impacts to stream flow which will be completely offset by return flows from the acclimation pond. The magnitude of the localized impact cannot be estimated until the wells have been dug and tested. Because of the water-balance neutrality of the proposed withdrawal of groundwater from an aquifer in hydraulic continuity with the stream and discharge of the groundwater back into the stream, there will be no regional impacts to stream flow within the Methow Subbasin. Thus, there are likely to be little to no impacts to fish from the groundwater withdrawals at this site.

4.2.2.2 Lower Twisp

An existing well is proposed to be used at this site to facilitate overwinter rearing of coho. A pump would draw 225 gpm from the well to provide an additional 0.5 cfs of flow to the pond. The well is likely in hydraulic continuity with the Twisp River. There may be localized impacts to stream flow that will be completely offset by return flows from the acclimation pond. The magnitude of this localized impact cannot be estimated until the well has been dug and tested. Because of the water-balance neutrality of the proposed withdrawal of groundwater from an aquifer in hydraulic continuity with the stream and discharge of the groundwater back into the stream, there will be no regional impacts to stream flow within the Methow Subbasin. Thus, there are likely to be little to no impacts to fish from the groundwater withdrawal at this site.

4.2.2.3 Mason

A new well may be needed at this site to facilitate overwinter rearing of coho. A pump would draw 225 gpm from the well to provide an additional 0.5 cfs of flow to the pond. The well is likely in hydraulic continuity with Eight Mile Creek and possibly the Chewuch River. There may be localized impacts to stream flow (perhaps a few gallons per day) which will be completely offset by return flows from the acclimation ponds. Because of the water-balance neutrality of the proposed withdrawal of groundwater from an aquifer in hydraulic continuity with the stream and discharge of the groundwater back into the stream, there will be no regional impacts to stream flow within the Methow Subbasin. Thus, there are likely to be little to no impacts to fish from the groundwater withdrawal at this site.

4.2.2.4 MSWA Eight Mile

A new well is proposed at this site to facilitate overwinter rearing of coho. An estimated 800 gpm would be drawn from the aquifer to provide 1.8 cfs of flow to the existing side channel. The aquifer is likely in hydraulic continuity with the Chewuch River. There may be localized impacts to stream flow (perhaps a few gallons per day) which will be completely offset by return flows from the acclimation ponds. Because of the water-balance neutrality of the proposed withdrawal of groundwater from an aquifer in hydraulic continuity with the stream and discharge of the groundwater back into the stream, there will be no regional impacts to stream flow within the Methow Subbasin. Thus, there are likely to be little to no impacts to fish from the groundwater withdrawal at this site.

4.2.2.5 Backup Sites

4.2.2.5. MSRF CHEWUCH

An existing well and likely one or more additional wells will be required to provide 1.9 cfs for overwinter rearing if this site is needed. It is anticipated that 850 gpm will be drawn from the aquifer to meet this demand. The well(s) are likely to be in hydraulic continuity with the Chewuch River. There may be localized impacts to stream flow (perhaps hundreds of gallons per day) which will be completely offset by return flows from the acclimation pond. Because of the water-balance neutrality of the proposed withdrawal of groundwater from an aquifer in hydraulic continuity with the stream and discharge of the groundwater back into the stream, there will be no regional impacts to stream flow within the Methow Subbasin. Thus, there are likely to be little to no impacts to fish from the groundwater withdrawals at this site.

4.3 Combined Impacts

4.3.1 Proposed Alternative

The impact of the proposed alternative on surface waters is expected to be small. The combined surface water withdrawals at the primary sites proposed for the Wenatchee River Subbasin total 4.0 to 11.1 cfs, and 1.2 cfs for the Methow Subbasin. An additional 7 cfs of groundwater is proposed to be withdrawn at primary sites in the Wenatchee Subbasin, and 5.4 cfs at primary sites in the Methow River Subbasin (see Appendix 11 of the EIS). The effect on surface water from these groundwater withdrawals is expected to be minor. Because withdrawn water will be returned to the stream, there will be no regional impacts to flow. There will be localized impacts to stream flow but impacts to listed fish are expected to be small and seasonal.

Depending on the final design for the Dryden hatchery, impacts could range from increased spawning and rearing habitat during low flows in a 200 ft section of lower Peshastin Creek, to undetectable changes in a 650 ft section of the Wenatchee River. The proposed water withdrawal at the Chikamin site would result in small decreases in available WUA (generally less than 1 ft^2)

for all species. The proposed surface water withdrawal for the Tall Timber site would generally decrease the amount of available WUA of habitat for most species at the extreme low flow and increase WUA of habitat at higher flows. The proposed surface water withdrawal at the Twisp Weir site was projected to generally decrease the WUA of habitat for most species during low flows by a small amount. These effects would occur between mid-March through early May at the Chikamin and Tall Timber sites, and between December and early May at the Twisp Weir site. The effects at the Dryden site would occur year-round but vary seasonally.

4.3.2 No Action

The No Action Alternative is described in the EIS. It includes operation of fewer of the same sites described for the Proposed Alternative. Because fewer sites would be operated and no new construction is involved, the combined effects would be less than those of the Proposed Alternative.

4.4 Cumulative Impacts

The EIS defines cumulative impacts as the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Past and present water rights exist in the Wenatchee and Methow Subbasins for industrial, irrigation, and domestic uses. In general, the lower portions of the subbasins are more affected by withdrawals for irrigation, commercial, industrial, municipal and domestic uses, and other activities (Montgomery Water Group et al. 1995, MBPU 2004). Streamflows in the upper portions of the subbasins are relatively unaffected by anthropogenic actions because these areas are largely mountainous and undeveloped.

Substantial water use rights exist in both subbasins. Within the Wenatchee Subbasin, users have 420 cfs in water rights permits and certificates (357 cfs surface water, 63cfs ground water) (NPCC 2004). The largest user is the Wenatchee Reclamation District, which serves over 9,000 users by diverting up to 200 cfs at Dryden Dam. In the Methow Subbasin, total irrigation deliveries are estimated to be on the order of 200 – 250 cfs (MBPU 2004). Of the irrigation water withdrawn, approximately 30 60% of this use is consumptive (not water-balance neutral) and the remaining 40% returns to the aquifer as groundwater (MBPU 2004). Additional quantities of water are diverted from the Wenatchee River for consumptive use outside of the watershed (NPCC 2004).

Irrigation water uses constitute the majority of withdrawals in the Wenatchee and Methow Subbasins (NPCC 2004, MBPU 2004). Irrigation use is greatest during the summer months exacerbating natural low flow conditions during July, August, and especially September (Andonaegui 2000, Andonaegui 2001). Other proposed groundwater withdrawals or surface water diversions, if consumptive, could impact the stream flows in the two basins.

Water withdrawals due to proposed MCCRP activities would occur between December and early May when irrigation use is low. In addition, the water would be returned to the river near the point of withdrawal so that the affects will be localized and negated by the return flow. Thus, the impacts from the proposed water withdrawals would not be additive to cumulative effects because anthropogenic withdrawals occur at different time periods.

4.4.1 Proposed Alternative

The amount of habitat reduced through water withdrawals under the proposed alternative is not likely to have a measureable impact compared to past and current impacts and those likely to occur. In addition, the proposed water withdrawals would occur primarily during the winter and spring (with the exception of the Dryden hatchery which would occur year-round and result in a slight increase in flow) not during the low flow summer and early fall period.

4.4.2 No Action

The No Action Alternative is described in the EIS. It includes operation of fewer of the same sites described for the Proposed Alternative. Because fewer sites would be operated and no new construction is involved, the combined effects would be less than those of the Proposed Alternative; consequently, the impacts of the combined projects are considered to be less than those of the Proposed Alternative.

5.0 IMPACT AVOIDANCE OR MITIGATION

Potential negative impacts to ESA listed fish will be avoided or minimized by:

- Using existing sites wherever possible.
- Minimizing the distance between surface water withdrawals and returns.
- Returning ground water to surface streams at locations that minimize pumping impacts.
- Constructing and operating intakes that meet guidelines for fish screens.

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Appendix 11 — Climate Change Adaptation

Overview

As described in Chapter 2 of the EIS, project changes might become necessary to address potential effects from regional climate change in the coming years. Global changes in climate, specifically temperature, have occurred naturally throughout history; however, there has been a significant increase over the last 100 years (Brekke et al. 2009), and "human-induced emissions of heat-trapping gases" have been identified as the primary contributors to this increase (Karl et al. 2009). Water resources and ecosystems have been identified as specific sectors that are and will be affected by changes in climate. In the Pacific Northwest, these sectors include salmon habitat. Specific issues that could affect salmon stem from changes in summertime stream temperature, seasonal low flows, and flooding frequency and magnitude (Mantua et al. 2009).

The University of Washington (UW) Climate Impacts Group has developed two regional climate change models based on two greenhouse gas emission scenarios (A1B and B1), as recommended by the Intergovernmental Panel on Climate Change. The B1 scenario depicts a lower emissions scenario than the A1B scenario, based partly on the projected development of cleaner and more efficient technologies with B1. However, as shown in Figure 1, both models predict significant state-wide increases in August water temperatures beginning in about 10 years and continuing into the future (Mantua et al. 2009).

Water temperature is a critical component of salmon habitat (Mantua et al. 2009). When temperatures rise too high, aspects of the salmonid life cycle such as migration, spawning, and population distributions can be affected. High temperatures can also result in an increased risk of disease and even death. The maximum upper temperature within which fish can survive varies among salmonid species. Based on the best available evidence, for coho salmon the upper limit of water temperature is 74.1˚ F (23.4˚ C) (Eaton and Scheller 1996). However, even water temperatures as low as 59˚ F (15˚ C) can subject salmon to increased predation and an inability to compete with warm-water species. Table 1 describes EPA recommended temperature thresholds during different life history phases for Pacific salmonid species. Based on this data, the temperature increases predicted by the climate change models described above would likely result in more frequent and persistent thermal migration barriers and thermally stressed waters for salmon. Summer water temperatures are also predicted to start earlier and last longer (Mantua et al. 2009). These higher temperatures would likely have the most severe impacts on summertime fish migrations.

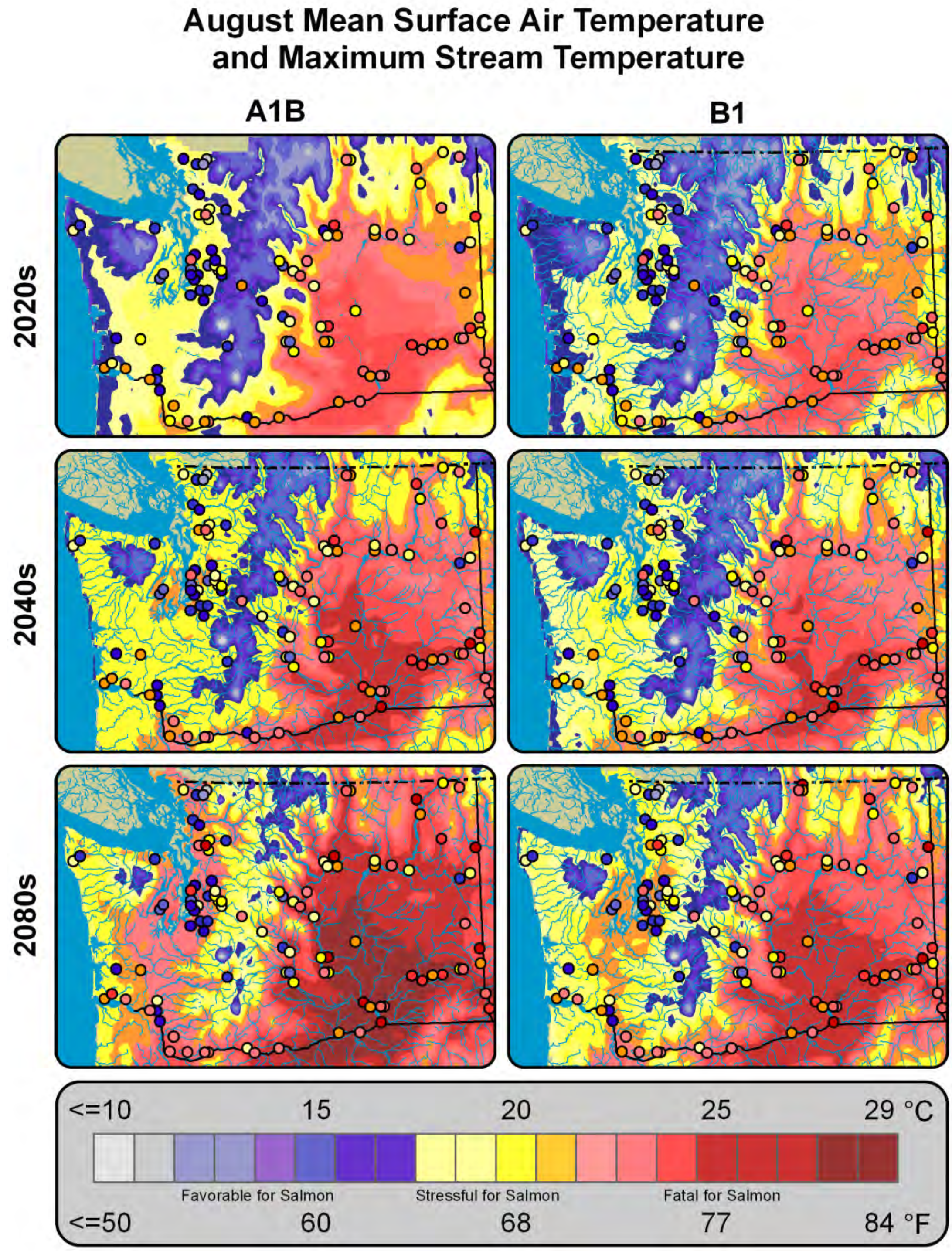

Figure 1. Future climate scenarios for several decades including the 2020s, 2040s, and 2080s are provided based on both climate scenarios (A1B and B1). Circles represent water temperatures (Figure from Mantua et al. 2009, pg 228).

Table 1. Recommended temperature thresholds for Pacific salmon by life history phase.

Salmonid Life History Phase Terminology	EPA-Based Recommended Temperature Thresholds to Protect Salmon and Trout[1]
Adult migration	<68°F (<20°C) for salmon and trout migration
Incubation	<55°F (<13°C) for salmon and trout spawning, egg incubation, and fry emergence
Juvenile rearing (early year)	<61°F (<16°C) for salmon "core" juvenile rearing
Smoltification	<59°F (<15°C) for salmon smoltification <57°F (<14°C) for steelhead smoltification
Juvenile rearing (late year)	<64°F (<18°C) for juvenile salmon and steelhead migration

[1]The EPA identified temperature unit is: Seven day average of the daily maximum water temperature.
Source: EPA 2003.

Climate change is also predicted to affect seasonal stream flows and flooding frequency and magnitude through changes to the watershed. Both the Wenatchee and Methow basins currently are snowmelt-dominant watersheds. Model predictions suggest that the those watersheds will become largely transient–runoff (transition) dominant in the future, with the change occurring sooner in the Wenatchee basin than in the Methow (see Figure 2 below).

There are several repercussions to this change in watersheds. Flooding, both frequency and magnitude, is predicted to increase in December and January in transient–runoff watersheds. In transient–runoff dominant watersheds, the size of summer low flows is predicted to decrease, while their duration is expected to increase (Mantua et al. 2009). These watershed changes could result in changes to groundwater recharge rates and in the availability of water from local springs, further exacerbating water temperature issues. Changes in stream flows could also result in increased erosion rates, which could lead to increased sedimentation and further temperature changes.

In order to put this in context, the UW Climate Center developed a graphic illustrating the potential climate-related impacts on freshwater habitat for both steelhead and salmon. This illustration is re-created in Figure 3. All of these potential changes could affect acclimation sites and hatchery infrastructure, operations, and production as water temperature and hydrology change from current conditions.

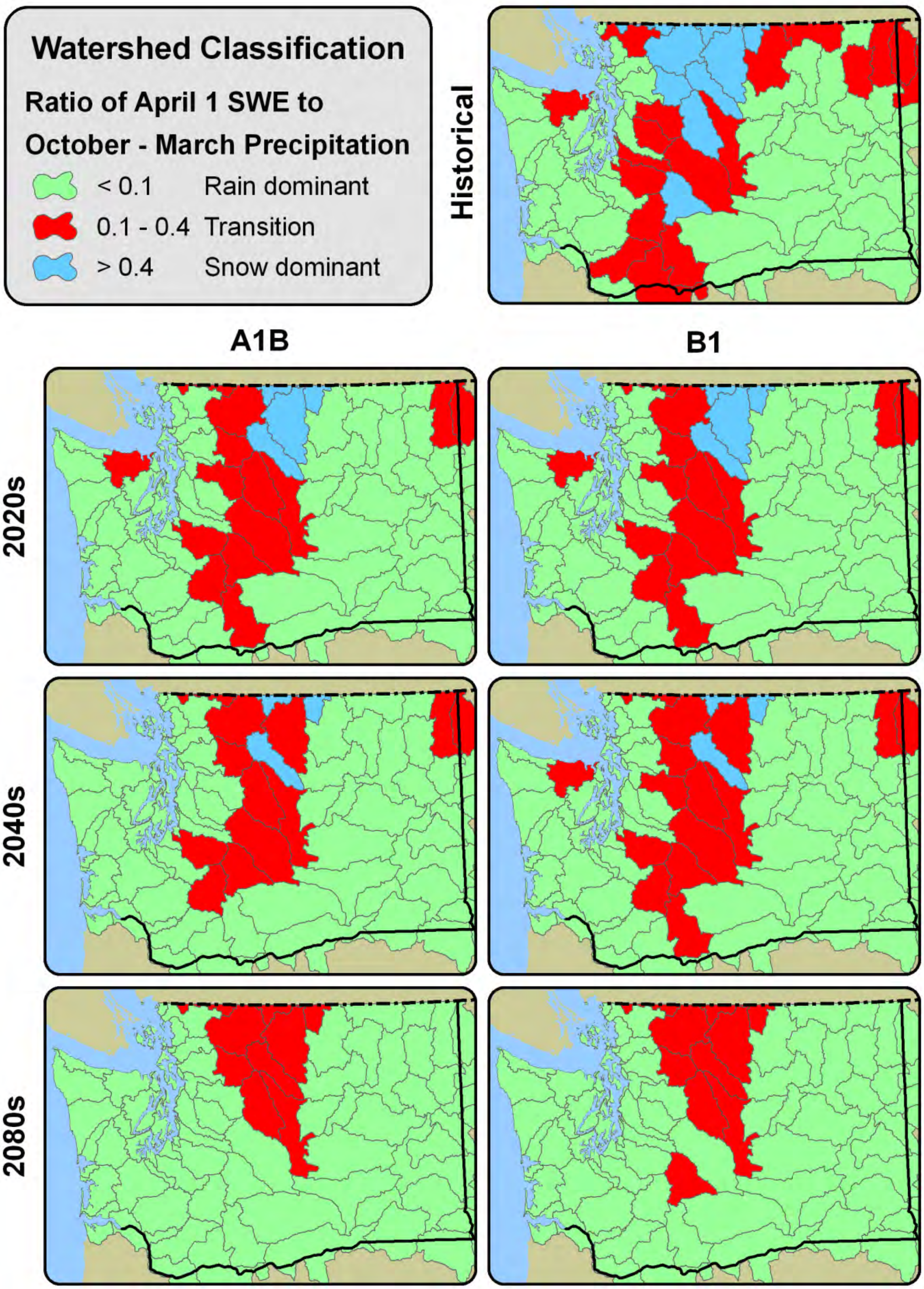

Figure 2. Watershed classification maps for simulated runoff in the historic period (1970-99), 2020s, 2040s, and 2080s. Simulations both climate scenarios (A1B and B1; Figure from Mantua et al. 2009, pg 234).

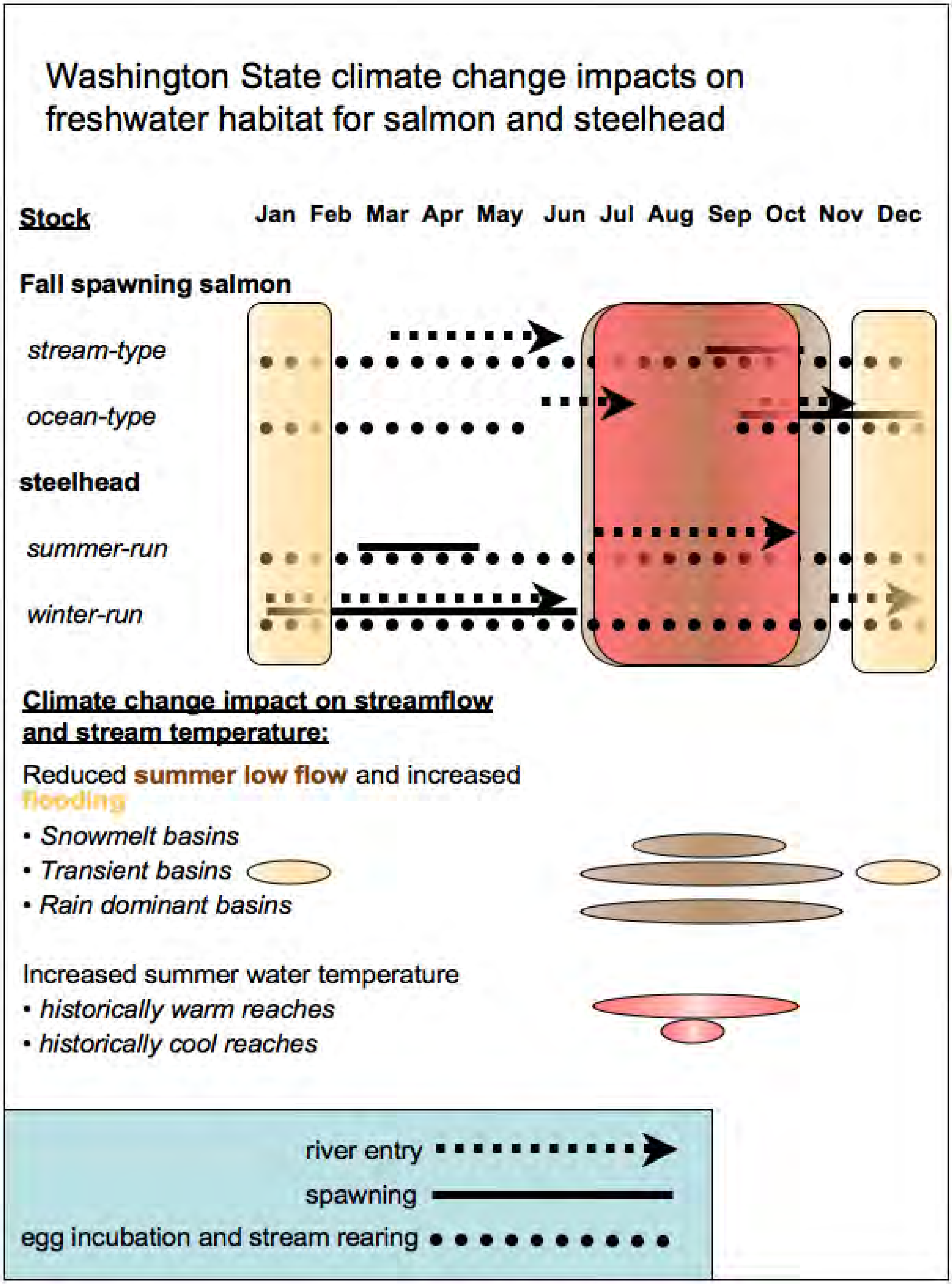

Figure 3. Potential climate change impacts of increased flooding, summer temperatures, and reduced summer low flow in freshwater habitat for salmon and steelhead. Example life history stages are shown for adult river entry (broken arrows), spawning (solid lines), and egg incubation and rearing periods (dotted lines) for generalized stocks. Tan shading highlights periods of increased flooding, brown shading indicates periods with reduced summer/fall low flows, and red shading indicates periods with increased thermal stress (Mantua et al. 2009, pg. 239).

Potential Future Responses

The reduction in habitat for naturally spawning coho and thermal exceedances that migrating fish could experience downstream of the facilities as a result of climate change are largely outside of the project's control. However, some actions might be necessary in the future to ensure that project operations can be maintained if environmental conditions change before the project's proposed conclusion in 2028. As described in Chapter 2, these actions would likely require additional environmental review and permitting, but are described here to illustrate changes that might be necessary in the future.

Infrastructure changes

Water Intake—Water intake structures and pumps may need to be modified (e.g., extended deeper, relocated, etc.) as seasonal changes in stream flows and lower flows are experienced, especially in summer months.

Water Intake—Water intakes may need to be modified (e.g., installation of filters, settling pools, etc.) as sedimentation increases to reduce turbidity levels in hatchery water.

Adult ladders—Adult fish ladder entrances may need to be modified (e.g., extensions added, flows changed, etc.) to address changes in seasonal flows.

Flood protection—Additional measures may be required to reduce the risk of flood damage to the hatchery facilities.

Spring Intake—Intake and pumps may need to be modified to ensure necessary water supply over time.

Water Discharge—Water discharges may need to be carefully monitored and manipulated to ensure the proper temperature is maintained for hatchery water discharges as stream temperatures increase over time.

Operation and Production changes

Acclimation Areas—Areas for acclimating fish may need to be re-evaluated to ensure appropriate water temperatures.

Acclimation Timing—Timing for fish acclimation and releases may need to shift as a result of changes in stream flow and temperature.

Hatchery Water Use—Depending on the air temperature and water temperatures, changes in the mixing ratios for water used in the hatchery and raceways may need to be modified.

Monitoring

Future monitoring of climate change will rest primarily with experts in the region. Project staff will be able to review monitoring data as it becomes available and use it to assist them in making changes to infrastructure, operations, and production. Using the updated monitoring data will allow staff to compare predictions to actual changes in the local environment and allow them to better meet changing conditions through time.

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