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MID-COLUMBIA COHO RESTORATION MASTER PLAN

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PREPARED FOR:

NORTHWEST POWER
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CONSERVATION COUNCIL

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Acronyms

AHA	All H's Analyzer (an analytical model)
BPA	Bonneville Power Administration
CCPUD	Chelan County Public Utility District
DCPUD	Douglas County Public Utility District
EDT	Ecosystem Diagnosis and Treatment (an analytical model)
ESA	Endangered Species Act
ISRP	Independent Scientific Review Panel
M&E	Monitoring and Evaluation
NEPA	National Environmental Policy Act
NMFS/NOAA Fisheries	National Marine Fisheries Service/National Oceanic & Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPPC/NPCC	Northwest Power Planning Council/Northwest Power and Conservation Council
NTTOC	Non-Target Taxa of Concern (sensitive species)
ODFW	Oregon Department of Fish and Wildlife
PUD	Public Utility District
TWG	Technical Work Group (Mid-Columbia TWG for this project)
UCSRB	Upper Columbia Salmon Recovery Board
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife
YN	Yakama Nation

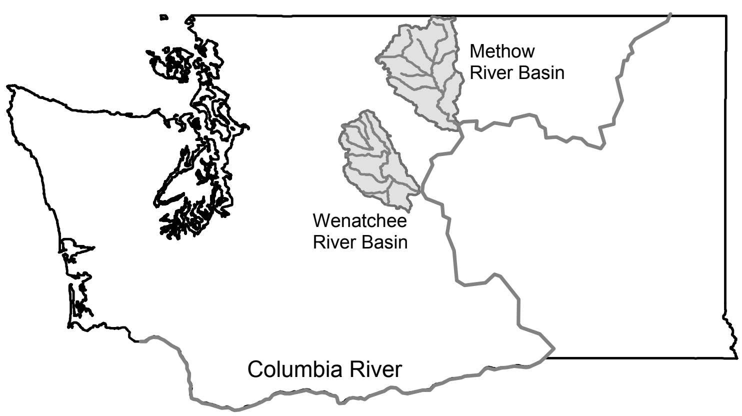
Executive Summary

Indigenous natural coho salmon no longer occupy the mid-Columbia river basins. Columbia River coho salmon populations were decimated in the early 1900s. For several reasons, including the construction and operation of mainstem Columbia River hydropower projects, habitat degradation, release locations, harvest management, and hatchery practices and genetic guidelines, self-sustaining coho populations were not re- established in mid-Columbia basins. Since that time, conditions and practices have changed. Some of the local habitat causes of coho depletion have been corrected, although there is still work to be done.

The Yakama Nation's long-term vision for coho reintroduction is:

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

The figure shows the location of the Mid-Columbia Coho Restoration Program within the State of Washington.



Mid-Columbia Coho Restoration Site Map

Restoration approaches are described in terms of biological objectives and numeric goals. Biological objectives include:

> ***1) Develop locally adapted, naturally spawning coho stock in the Wenatchee and Methow river subbasins by 2026.***
>
> ***2) Evaluate the efficacy of coho reintroduction in Mid-Columbia tributaries.***
>
> ***3) Increase the freshwater productivity of coho salmon in the Wenatchee and Methow subbasins.***

Coho reintroduction will be considered successful when the following numerical restoration goals are achieved:

> ***Goal 1 - The 3-year mean escapement of natural origin returns in the Wenatchee (upstream of Tumwater Dam) and the Methow river subbasins exceeds 1,500 per subbasin,***
>
> ***Goal 2 - A total harvest rate of 23%, which includes a 10% mixed stock harvest, 10% mainstem harvest, and 5% terminal harvest in most years.***

Studies of the feasibility of reintroducing coho in the Wenatchee and Methow subbasins began in 1996 and demonstrate that the vision of an optimistic future held by Yakama Nation (YN) and Washington Department of Fish and Wildlife (WDFW)is possible. The Yakama Nation along with project participants and the Mid-Columbia Technical Work Group (TWG) developed two goals from which to determine the feasibility of reintroduction coho to mid-Columbia tributaries:

> *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 and*
>
> *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.*

Both feasibility studies goals have been achieved. To test whether Feasibility Goal 1 could be met, researchers used as performance indicators coho survival at various stages, the spatial distribution of returning adults, and to a limited degree, reproductive success. To date, two generations of broodstock development have occurred and transfers of lower Columbia River coho have been discontinued. To address Feasibility Goal 2, critical uncertainties regarding species interactions, as planned in the HGMP (2002) were investigated. The issues identified in the HGMP are as follows: 1) Rate of predation by hatchery coho on spring chinook fry, 2) rate of predation by hatchery coho on sockeye fry, 3) amount of superimposition of spring chinook redds by spawning coho, 4) rates of residualism, and 5) amount of competition for space and food during freshwater rearing of naturally produced coho juveniles as measured through micro-habitat use and growth evaluations. The evaluations answered most of the critical uncertainties; and the ones that remain are addressed in the M&E program.

The proposed Master Plan builds on the success of the feasibility phase and is designed to achieve coho restoration goals as identified in the Tribal Restoration Plan (*Wy-Kan-Ush-Mi Wa-Kish-Wit*) and in the Wenatchee and Methow subbasin plans. We present a phased approach to restoration which incorporates development of a mid-Columbia hatchery broodstock, local adaptation to tributaries in the Wenatchee and Methow basins, and habitat restoration that will benefit coho as well as ESA-listed spring chinook, steelhead, and bull trout.

The **broodstock development phases** are designed to eliminate transfers of lower Columbia River stocks and then encourage adaptation of the broodstock so that returning coho can reach key habitat within the subbasins.

Once broodstock development goals are met, **natural production phases** will focus on decreasing domestication selection and increasing fitness in the natural environment. In these phases, hatchery coho will be introduced to habitat areas where Ecosystem Diagnosis and Treatment (EDT) analysis predicts coho would be the most successful; and hatchery and natural broodstock compositions will be managed to increase the proportion of natural influence (PNI) in the population with the goal of having a PNI value > 0.5—that is, the natural environment must have a greater influence on the population than the hatchery environment.

The **habitat improvement phase** is expected to last 15 years, concurrent with the broodstock development and natural production phases. It represents a comprehensive effort to increase the productivity and capacity of coho salmon in the natural environment by coordinating with other entities to help implement the habitat improvement schedule developed for the Upper Columbia Salmon Recovery Board (UCSRB). A 50% cost-share position would identify, solicit funds for, and implement habitat improvement projects.

The M&E program is designed 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 is structured 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 closely coordinated with other monitoring efforts in the Wenatchee and Methow subbasins, resulting in cost sharing and preventing the duplication of efforts.

The Mid-Columbia Restoration Plan continues the reintroduction of coho salmon in the Wenatchee and Methow subbasins through the artificial production and acclimation/release of the progeny of locally captured broodstock. Proposed releases decline from a peak of 2,155,000 smolts in 2012 to no releases at program termination in 2026.

Multiple rearing and acclimation systems have been evaluated during the master plan process. Systems and site locations are proposed that are cost effective, that maximize adult return rates, that return adults to suitable habitat, that minimize environmental impacts, and that will be capable of adapting to changing program requirements. The proposed plan that best meets these criteria emphasizes the use of existing facilities. Adult traps that are currently operating or that will be constructed by other agencies will be used, 85% of all program pre-smolts will be produced in three existing hatcheries, and most of the 18 acclimation/release sites have ponds that currently exist. However, to fully meet program objectives, some new facility development is proposed: a small adult holding and incubation site in the Wenatchee subbasin, two constructed habitats for rearing in the Methow subbasin, and a combination of five acclimation sites involve varying degrees of construction. The proposed restoration plan is based on an innovative system of multiple, low cost, natural acclimation sites located near coho habitat. Although this technique is not in wide spread use, it has been well tested during the feasibility phase of the Mid-Columbia and Yakima basin coho restoration projects.

Yakama Nation Fisheries Resource Management will have primary responsibility for implementing the proposed reintroduction plan. Some plan activities, including fish rearing, transportation would be contracted to U.S. Fish & Wildlife Service, Oregon Department of Fish and Wildlife (ODFW), and WDFW. Other activities including facilities planning and design, National Environmental Policy Act (NEPA) analyses, and environmental studies will be contracted to consulting firms.

The project planning schedule supports the phased reintroduction approach and coincides with the Northwest Power and Conservation Council (NPCC) Step process. New facilities are not required in the Broodstock Development phases. Natural Production Phases start in 2011 in the

Wenatchee and 2012 in the Methow. To have the required facilities completed by these dates, construction would begin in 2010 after the completion of the Step 3 review at the end of 2009.

Estimates of the capital and operating costs cover the project's lifetime. Capital cost estimates for the proposed fish facilities system include: program planning; preliminary and final designs; project-level evaluations; facility development permits; land purchase; construction; and capital equipment.

Total MCCRP capital costs

Planning and Design	$1,040,975
Permits	$875,355
Capital Equipment	$1,280,130
Multi-Function Facilities	$3,473,294
Acclimation Facilities	$3,252,439
TOTAL	**$9,922,193**

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 will change over time. Expenses during years when release numbers and operating costs are at their maximum are estimated to be:

Peak annual operating expenses (2012)

Operation and Maintenance	$2,282,110
Monitoring and Evaluation	$1,255,476
Tagging	$653,417
General and Administrative	$428,620
SUBTOTAL	**$4,619,623**
Cost Share	$1,211,200
TOTAL	**$3,408,423**

The proposed program currently shares rearing costs with National Oceanic and Atmospheric Administration (NOAA) through the Mitchell Act and monitoring and evaluation costs with WDFW and the region's Public Utility Districts (PUDs). Additional funding support may be available in the future through these agencies and others in the region.

CHAPTER 1. BACKGROUND

Photo courtesy of Shafer Museum, Winthrop, WA.
From Mullan. 1992. Production and habitat of salmonids in mid-Columbia River tributary streams.

Chapter 1. Background

1.1 Purpose of this Plan

This Master Plan presents a proposal for the future of coho reintroduction efforts in two mid-Columbia subbasins, the Wenatchee and the Methow. The contents of the plan follow guidelines for master plans as defined by the Northwest Power and Conservation Council (NPCC) (NPCC 2004).

1.1.1 Problem this Program Addresses

The proposed plan seeks to restore coho salmon to the Wenatchee and Methow river basins at biologically sustainable levels that will support harvest in most years. Challenges to coho reintroduction include:

1) the absence of locally adapted populations,

2) in-basin habitat degradation,

3) survival through the migration corridor, and

4) variability of ocean environmental conditions.

The proposed reintroduction program directly addresses the first two of the four challenges.

To overcome the absence of a locally adapted population, we build on the feasibility studies that have been conducted since 1996 and present a phased approach to reintroducing coho into the Wenatchee and Methow basins. In this plan, the initial broodstock development phases, begun during feasibility studies, seek to establish a local coho stock, originating from lower Columbia River hatchery stocks, which can return to mid-Columbia tributaries with increasing survival rates. (In 2006, 100% of the coho smolts released in both basins will be progeny of second-generation mid-Columbia broodstock). After broodstock development goals are met (see Section 4.3 and Chapter 5), the natural production phases move towards a locally adapted integrated hatchery program where ultimately the percent of natural-origin fish in the hatchery broodstock will exceed the percent of hatchery-origin fish on the spawning grounds (HSRG 2004). Through all the phases, the program proposes to work with other entities in the subbasins to implement habitat improvement and protection projects as identified in the site-specific Implementation Schedule developed for the Upper Columbia Salmon Recovery Board (UCSRB). This schedule of habitat projects will benefit coho as well as the listed species (spring chinook, steelhead, and bull trout) for which the plan was developed. The coho restoration program is designed to be terminated when a self-sustaining naturally reproducing population is established (natural-origin return escapement of more than 1,500 coho to each subbasin, with a terminal and mainstem harvest in most years). This goal is expected to be achieved after five generations of supplementation (by approximately 2026).

1.1.2 Mid-Columbia Coho History

Mid-Columbia coho salmon populations were decimated in the early 1900s 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, development, and fire management also contributed to destruction of salmon habitat.

Mullan (1983) estimated historical mid-Columbia River adult coho populations as follows:

- Wenatchee—6,000 - 7,000
- Methow—23,000 - 31,000
- Entiat—9,000-13,000
- Okanogan—Presence documented but no numbers specified

By the end of the 20th century, indigenous natural coho salmon no longer occupied the mid-Columbia river basins. Since Priest Rapids Dam 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).

For several reasons, self-sustaining coho populations were not 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:

- 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.
- 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 (CCPUD). 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. These species currently constitute the program at Turtle Rock. The last coho releases 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 unacclimated, 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.

- 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 that time, conditions and practices have changed 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, harvest and harvest management techniques are more capable of protecting upriver stocks, logging practice regulations provide increased environmental protection, mining has ended, and grazing practices have been improved. A few specific examples of projects designed to improve habitat conditions for fish in the target basins include:

Wenatchee Basin:

- improvements in fish passage at Tumwater and Dryden dams
- fish screens at Dryden Dam
- replacement of Chumstick Creek culverts

Methow Basin:

- improvements to the Methow Valley Irrigation District system
- restoration of salmonid habitat in Early Winters and Goat creeks

Similar improvements have been made on the mainstem Columbia.

Another significant change in regional conditions is that the ESA listings of several salmonid species that migrate through the lower Columbia River have curtailed coho fisheries that once over-harvested the mid-Columbia stocks of coho. These fisheries restrictions are likely to be in effect for a number of years.

Recent improvements in artificial production methodology will 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.

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

1.1.3 Local Adaptation

The lack of a locally adapted population may be one of the biggest challenges to coho reintroduction in mid-Columbia tributaries. The Wenatchee Subbasin Plan "Guiding Principle 11" states that reintroduction or supplementation programs should select an appropriate stock or locally adapt a donor stock where a local stock no longer exists (NPCC 2004a). The proposed project is designed to locally adapt a donor stock. While there is an increasing body of literature surrounding the genetic risks of supplementation programs (Busak and Currens 1995; Miller and

Kapuscinski 2003; Ford et al. unpublished manuscript), we have found very little research documenting naturalization or local adaptation of a domesticated hatchery stock.

The lower Columbia River coho stocks originally used during the feasibility phase (project #1996-040-00) are considered a non-local, domesticated hatchery stock. A domesticated hatchery stock is defined as a hatchery stock that has been perpetuated for numerous generations through artificial spawning of returning adult hatchery fish, juvenile rearing, and release (Berejikian and Ford 2004). A domesticated stock has evolved to become more fit in an artificial environment, at the expense of survival or reproductive success in the natural environment (Ford et al. unpublished manuscript).

Domestication is expressed as changes in qualitative traits. Three types of domestication selection have been recognized:

1) intentional or artificial domestication selection,

2) biased sampling during some stage of culture, and

3) unintentional selection (Busak and Currens 1995).

Intentional selection can be reduced by discontinuing selective practices (e.g., using only the early spawners). Control of domestication due to biased sampling depends upon the ability to incorporate random sampling into hatchery procedures.

Reduction of unintentional selection can be more difficult. Busak and Currens (1995) identify two means of reducing unintentional domestication selection.

a) Selection potentials can be decreased by minimizing the time fish are exposed to the hatchery environment; for example, only wild fish can be used as broodstock so that hatchery fish are regularly cycled through the natural environment (Busak and Currens 1995);

b) hatchery environments can be made more similar to wild environments (Maynard et al. 1995).

The proposed reintroduction program uses methods to reduce all three types of domestication selection, including those identified by Busak and Currens (1995).

Researchers have demonstrated reduced reproductive success of hatchery fish in natural environments (Miller and Kapuscinski 2003). For steelhead, success of naturally spawning hatchery returns in producing smolt offspring was reported to be 28% of that for wild spawners (Chilcote et al. 1986). Reisenbichler and McIntyre (1977) compared early survival of two-generation-old hatchery stock of steelhead with the wild stock from the same stream. Hatchery fish exhibited a statistically significant survival advantage over wild fish in the hatchery environment, but the situation was reversed in the natural environment. Swain and Riddell (1990) noted that hatchery juvenile coho salmon exhibited more agonistic behavior than wild juveniles. Berejikian and Ford (2004) reviewed 18 studies that directly estimated the relative fitness of hatchery and natural anadromous salmonids; based on this review, the authors concluded that domesticated steelhead, coho, and Atlantic salmon stocks will have low (<30%) lifetime relative fitness in the wild compared to native natural populations.

Without a natural population of coho in mid-Columbia tributaries, the opportunities to incorporate “wild, locally adapted” fish into the broodstock do not exist. To overcome this, we present a phased approach, where the initial broodstock development phases seek to develop a hatchery stock which can return to mid-Columbia tributaries with increasing survival rates. Next, the natural production phases move towards an integrated hatchery program where ultimately the percent of natural origin fish in the hatchery broodstock (pNOB) will exceed the percent of hatchery-origin fish on the spawning grounds (pHOS) (HSRG 2004).

The All H's Analyzer (AHA) was used to address the loss of fitness that occurs with many hatchery programs. The overarching principles of the proposed management strategy emphasize adherence to genetic, evolutionary and ecological principles, which will result in greater selection pressures from the natural environment than from the hatchery environment (Proportion of natural influence > 0.50) (Mobrand Biometrics).

We are aware of the need for caution when using the AHA or any other single model to generate specific objectives, numerical or otherwise, as described by the ISRP and ISAB (2005). However, project proponents have found minimal literature or empirical data to guide the transition from a non-local domesticated hatchery stock to a population locally adapted to the natural environment. The AHA model provides a framework from which the loss of fitness, or domestication, can be addressed in the form of a working hypothesis. We believe the proposed mid-Columbia coho reintroduction plan presents a unique opportunity to test some of the assumptions of the AHA model, as they pertain to domestication and local adaptation, in the absence of genetic risk[1] to a native coho population.

1.1.4 Habitat Degradation

Currently, many tributaries within the Wenatchee and Methow subbasins lack habitat of sufficient quantity and quality to sustain coho populations with a high enough level of productivity to overcome the reduced survival associated with migrating past 7-9 mainstem dams (EDT Analysis; Mobrand et al. 1997). Therefore, coordination with and support of ongoing habitat restoration efforts are an important component of a comprehensive coho reintroduction plan.

Within both the Wenatchee and Methow Subbasin Plans, coho are listed as a focal species (NPCC 2004a, NPCC 2004b). 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 for these areas (Wenatchee Subbasin Plan p. 71, Methow Subbasin Plan p. 79). Pages 178-179 of the Wenatchee Subbasin Plan describe the relationship of coho salmon to the current status of the habitat and conclude that "natural coho production in the Wenatchee sub-basin could increase if habitat problems within Nason, Icicle, Peshastin, Mission, and Chumstick creeks were improved. Preservation of quality areas in Chiwakum, Little Wenatchee, White and Chiwawa basins would ensure high quality areas remain intact."

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[1] Genetic risk is the probability of an event or activity having and adverse genetic consequence. Adverse consequences include 1) extinction, 2) loss of within population genetic diversity, 3) loss of among-population genetic diversity, and 4) domestication (Busak and Currens 1995).

1.2 Program Vision, Goals, and Guiding Principles

1.2.1 Vision

The following is the long-term vision for the Mid-Columbia Coho Restoration program.

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

1.2.2 Biological Objectives

Approaches to achieving restoration goals are described in terms of Biological Objectives.

Biological Objective 1: Develop locally adapted, naturally spawning coho stock in the Wenatchee and Methow river subbasins by 2026.

We propose to increase the fitness of reintroduced coho salmon by reducing domestication selection and emphasizing local adaptation. The program will use strict broodstock collection protocols which will incorporate natural origin fish in the broodstock and limit the proportion of hatchery origin adults on the spawning ground. The broodstock collection protocols are intended to manage the broodstock composition to increase the proportion of natural influence (PNI[2]) in the population with the goal of having a PNI value greater than 0.50; that is, the natural environment must have a greater influence on the population than the hatchery environment. Objective 1 will be considered successful when the following numeric goals have been achieved:

> *Goal 1. The 3-year mean escapement of natural origin returns in the Wenatchee (upstream of Tumwater Dam) and the Methow river subbasins exceeds 1,500 per subbasin.*
>
> This goal is designed to provide 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 results of the AHA calculations which predict a level of sustainability based upon Ecosystem Diagnosis and Treatment (EDT) inputs, estimated capacity, harvest rates, and hydro-system and marine survival.
>
> *Goal 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.*

Biological Objective 2: Evaluate the efficacy of coho reintroduction in Mid-Columbia tributaries.

We intend 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 is structured 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.

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[2] If pNOB is the percent natural origin fish in the hatchery broodstock and pHOS is the percent hatchery origin fish among natural spawners, then PNI= pNOB/(pNOB+pHOS).

Biological Objective 3: Increase the freshwater productivity of coho salmon in the Wenatchee and Methow subbasins.

Currently many tributaries within the Wenatchee and Methow subbasins lack habitat of sufficient quantity and quality to sustain coho populations productive enough to overcome the handicap of passing 7-9 mainstem dams. Therefore, we propose to coordinate and support ongoing and planned habitat restoration within the mid-Columbia as part of a comprehensive plan to restore naturally spawning coho salmon populations. The goal is, within 15 years, to achieve the target productivity values for each tributary that are derived from EDT analysis. Target values for Wenatchee and Methow tributaries are shown in Section 5.4.

1.2.3 Approaches to Achieving Restoration Goals

The proposed plan seeks to achieve the two restoration goals through the following actions, which are summarized in Chapter 4 and detailed in chapters 5 – 7:

- After initially releasing "domesticated" hatchery fish for reintroduction, the program seeks to increase the fitness of reintroduced coho salmon by reducing domestication selection and emphasizing local adaptation. The program would use strict broodstock protocols that maximize natural-origin adults in the hatchery program and would place a limit on the proportion of hatchery origin returns on the spawning grounds. The AHA model was used as a guide to address the fitness loss that commonly occurs with hatchery programs and that presumably occurred in the lower Columbia River hatchery source stock (see Section 5.4).
- Provide 50% of the cost of a staff member (the other half funded by Pacific Coastal Salmon Recovery Fund [PCSRF]) to identify, propose, solicit funds and implement habitat improvement projects which support habitat restoration in the Wenatchee and Methow rivers. Freshwater productivity of mid-Columbia coho will be improved by implementing habitat restoration projects in key tributaries as identified in the schedule developed for the UCSRB (Section 2.4.4) and by seeking restoration funds through the Habitat Conservation Plan tributary fund (HCP TF), Priest Rapids Settlement Agreement (PRSA), PCSRF, and the Salmon Recovery Funding Board (SRFB).
- Develop a harvest management plan to ensure that exploitation rates are based on survival and abundance forecasts, escapement goals, and are appropriate to changes in abundance caused, for example, by fluctuations in ocean conditions.

1.2.4 Guiding Principles and Mandates

In achieving the vision and restoration goals, the project is guided by the following principles and mandates:

- **Tribal restoration goals.** The Columbia River tribes recognize that fisheries are a basic and important natural resource, of vital concern to them, and that conservation of this resource depends on effective and progressive management. They further believe that by unity of action they can best accomplish these things, not only for the benefit of their own people but for all the people of the Pacific Northwest. The Columbia River treaty tribes believe *Wy-Kan-Ush-Mi Wa-Kish-Wit*, the tribal restoration plan, provides an adaptive management framework to restore the Columbia River salmon, simply stated: **put the fish back into the rivers**.

- **A holistic approach to salmon recovery.** This guideline incorporates the scientific principles of the Council's 2000 Fish and Wildlife Program (NPPC 2000). The program includes restoring extirpated species and collaboration with others to improve habitat. A restored ecosystem will benefit all species. Specifically, restoring coho salmon may provide much-needed nutrients for aquatic and terrestrial animals at the onset of winter when food sources may be scarce. Restored habitats should result in increased productivity for all salmonid species.

- **Northwest Power and Conservation Council principles, objectives and strategies for artificial production projects**. NPCC recommends artificial production under the proper conditions including:

  1) complementing habitat improvement by supplementing fish populations up to the sustainable carrying capacity with fish that are as similar as possible in genetics and behavior to wild native fish, and

  2) replacing lost salmon or steelhead populations.

  Further, the NPCC supports an "experimental adaptive management approach that includes an aggressive program to evaluate the risks and benefits and addresses scientific uncertainties." (NPPC 2000)

- **The principles, objectives, and processes defined in the Treaty of 1855 and *U.S. v. Oregon*.** In the Treaty of 1855, bands and tribes of the Yakama Nation reserved "[t]he exclusive right of taking fish in all the streams running through or bordering [their] reservation...and…taking fish at all usual and accustomed places…" The *United States versus Oregon* treaty fishing rights case affirmed that the 1855 treaty reserved for the tribes a fair share of the harvest, which was subsequently determined to be 50% of the harvestable portion of runs destined to pass the tribes' usual and accustomed fishing areas. The *U.S. v. Oregon* decision also established guidelines and procedures by which the tribes could function as self-regulating fishery co-managers together with the state and federal fishery agencies. The Yakama Nation views the *U.S. v. Oregon* process as the expression of its co-management authority and, therefore, the primary forum through which the tribe's management goals and priorities should be advanced.

- **The principles and process requirements of environmental laws, including the Endangered Species Act and National Environmental Policy Act.** Program proponents seek to meet coho restoration goals without harming natural or human resources. A key focus of the program is to minimize potential competitive impacts with sensitive species—Non-Target Taxa of Concern or NTTOC. These species are defined as spring chinook salmon, steelhead, and bull trout—species listed under the Endangered Species Act (ESA)—and sockeye salmon. The program would meet these principles by assuming a finite timeline for supplementation activities; emphasizing local adaptation that results in self-sustaining natural coho populations; and monitoring the size, abundance and distribution of sensitive species as they relate to coho reintroduction activities. Before site-specific decisions are made, future processes would thoroughly analyze the program's effects on species and resources of all kinds.

- **Visions and goals of the Wenatchee and Methow subbasin plans**. Coho are identified as a focal species in both subbasin plans. In the Wenatchee plan, Goal 3 is to "[r]estore, maintain, or enhance fish and wildlife populations to sustainable and harvestable levels, while protecting biological integrity and the genetic diversity of the species**."** (NPCC

2004a) In the Methow plan, "[t]he 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)

- **The need to minimize program costs while ensuring sufficient resources to meet program goals effectively**. Yakama Nation (YN) recognizes that many fish restoration projects throughout the region compete for limited funds. Therefore we present a time-limited plan that emphasizes the use of existing facilities to restore coho salmon while partnering with other programs, sharing resources with other agencies, and adapting the program in response to monitoring and evaluation.

1.3 Mid-Columbia Coho Reintroduction Project Documents

Since 1996, the Bonneville Power Administration (BPA) has been funding ongoing studies and artificial production of coho salmon (*Oncorhynchus kisutch)* in the Wenatchee and Methow river basins, in the state of Washington. The purpose was to determine the feasibility of reintroducing self-sustaining coho populations in the mid-Columbia region. The work is being conducted primarily by the YN, with significant assistance from other state, federal, and public utility participants.

1995 - 1997

This project was formally established by the Yakama Nation with the adoption of the Tribal Restoration Plan in 1995 (CRITFC 1995) by the four Columbia River treaty tribes (Nez Perce, Umatilla, Warm Springs, and Yakama).

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) (as documented in NPPC 1994). These high priority supplementation projects were forwarded with strong endorsements from both the *U.S. v. Oregon* Policy Committee and the National Marine Fisheries Service (NMFS).

The coho project was developed in two phases. Phase I was experimental, as it evaluated feasibility, ecological interaction, survival through the system and broodstock development. Phase II was to focus on production and restoration activities.

In the FY 1998 Annual Implementation Work Plan (AIWP), the Council recommended funding for completion of the environmental review of Phase I. Since 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).

1998

Spring: BPA determined that acclimation and release of coho smolts for research purposes at four sites in the Methow basin was categorically excluded from National Environmental Policy Act (NEPA) analysis.

Fall: A comprehensive research program was proposed (YIN 1998).

1999

April: BPA analyzed environmental impacts of the research project in the Mid-Columbia Coho Reintroduction Feasibility Project Final Environmental Assessment (EA) (USDOE/BPA 1999b). The EA analyzed impacts of research to determine the feasibility of reintroducing naturally reproducing coho into the Methow and Wenatchee river basins, from which they have been extirpated. The EA focused on the impacts of construction of coho acclimation facilities, of coho smolt releases, of monitoring their survival and interactions with other species, and of operation and modification of existing production facilities needed to conduct the research. Effects of that plan on species listed under the ESA also were analyzed in Biological Assessments (BAs) submitted to U.S. Fish and Wildlife Service (USFWS) and to NMFS.

***December*:** The project was further refined in the Hatchery and Genetics Management Plan (HGMP) (YN et al. 1999), required by NMFS in its Biological Opinion.

Annual report: Dunnigan, J. 1999. Feasibility and risks of coho reintroduction in mid-Columbia Tributaries: **1999 annual monitoring and evaluation report,** project No. 1996-040-000. Bonneville Power Administration, Portland, OR. [covers 1998 and 1999]

2000

July: A Partial Step 2 Review for NPPC was completed. The review was requested as part of the Fiscal Year 2000 Annual Implementation Work Plan that was triggered by YN's decision to switch the emphasis of this project from the Methow to the Wenatchee basin. It led to requirements that a future plan for the project would need to address (see Section 1.4.2 of the Master Plan).

Annual reports:

Murdoch, K.G. 2001. Mid-Columbia Coho Reintroduction Feasibility Project: **2000 Acclimation Report**. Prepared for: Bonneville Power Administration, Project # 1996-040-00. Portland, OR.

Murdoch, K.G., and J.L. Dunnigan. 2002. Feasibility and risks of coho reintroduction in mid-Columbia River tributaries: **2000 annual report**. *Prepared for:* Bonneville Power Administration, Project # 1996-040-00. Portland, OR.

2001

***April*:** BPA prepared a Supplement Analysis to evaluate additional research activities, temporary incubation and rearing facilities at the Two Rivers acclimation site, and potential additional acclimation sites not evaluated in the EA (USDOE/BPA 2001b).

***October*:** BPA prepared a Supplement Analysis to analyze the effects of using an existing building near Peshastin, Washington for a temporary site to incubate coho eggs for the program (USDOE/BPA 2001d).

Annual reports:

Murdoch, K.G. and C.M. Kamphaus. 2003. Mid-Columbia-Coho Reintroduction Feasibility Project: **2001 Annual Broodstock Development Report.** *Prepared for:* Bonneville Power Administration, Project # 1996-040-00. Portland, OR.

Murdoch, K.G, and M.L. Larue. 2002. Feasibility and risks of coho reintroduction in mid-Columbia River tributaries: **2001 annual report**. *Prepared for:* Bonneville Power Administration, Project # 1996-040-00. Portland, OR.

2002

***March*:** BPA categorically excluded the dredging of an existing pond behind Dam 5 at Leavenworth National Fish Hatchery (NFH) to improve its effectiveness as an acclimation site.

November: BPA prepared a Supplement Analysis to evaluate the effects of adding several new acclimation sites for the project (USDOE/BPA 2002).

- Leavenworth NFH: The project proposed use of and improvements to existing, unused Foster-Lucas ponds at Leavenworth NFH and construction of an improved water delivery system on hatchery grounds to partially replace the acclimation pond behind Dam 5, which would be unavailable after 2003.
- Nason Creek subbasin: The project proposed three new acclimation sites in the Nason Creek subbasin to help acclimate the remainder of the coho smolts programmed for the Wenatchee basin. The sites were:
    - Coulter Creek: Installation of an outlet pipe through a beaver dam, and seasonal installation and removal of nets across a beaver pond located on privately owned land, to allow acclimation and release of up to 100,000 coho smolts.
    - Whitepine Beaver Pond: Seasonal installation and removal of nets across a beaver pond on U.S. Forest Service (USFS) land, and clearing and graveling an overgrown logging road to provide vehicle access to a footpath, which would then allow access to the pond. From 50,000 to 100,000 smolts would be acclimated and released from this site. The site was never used.
    - Mahar Creek Pond (now called Rohlfing): Seasonal installation and removal of nets across an existing pond on privately owned land. From 50,000 to 100,000 smolts would be acclimated and released from this site.
- Little Wenatchee (Two Rivers): Within the previously evaluated area at an existing gravel pit (USDOE/BPA 1999b), the project proposed to use an existing discharge channel as a coho acclimation pond.
- Chumstick Creek: The project proposed a direct stream release of smolts, instead of acclimation as discussed in DOE/BPA 2001b.

December: The HGMP was updated, in consultation with project participants (YN et al. 2002).

Annual reports:

Kamphaus, C.M., and K.G. Murdoch. 2004. Mid-Columbia Coho Reintroduction Feasibility Study: **2002 Annual Broodstock Development Report**. *Prepared for:* Bonneville Power Administration, Project # 1996-040-00. Portland, OR.

Murdoch, K.G., C.M. Kamphaus, and S.A. Prevatte. 2004. Feasibility and risks of coho reintroduction in mid-Columbia tributaries: **2002 Annual Monitoring and Evaluation Report**. *Prepared for:* Bonneville Power Administration, Project # 1996-040-00. Portland, OR.

2003

July: BPA received concurrences from USFWS (letter dated July 31, 2003 from Mark G. Miller, Supervisor, Contral Washington Field Office) and NOAA Fisheries (letter dated June 23, 2003 from D. Robert Lohn, Regional Administrator) on expansion of the Mahar Creek acclimation pond and construction of the Two Rivers acclimation pond.

August: A Supplement Analysis was prepared to examine the impacts of expanding the Mahar Creek acclimation pond (USDOE/BPA 2003).

October: Final Biological Opinion covering the Mid-Columbia Coho Project (plus other upper Columbia artificial production projects) was issued. ESA Section 7 Consultation 1999/01883, issued October 22, 2003.

Annual reports:

Kamphaus, C.M. and K.G. Murdoch. 2005. Mid-Columbia Coho Reintroduction Feasibility Study: **2003 Annual Broodstock Development Report.** *Prepared for:* Bonneville Power Administration, Project # 1996-040-00. Portland, OR.

Murdoch, K.G., C.M. Kamphaus, and S.A. Prevatte. 2005. Mid-Columbia Coho Reintroduction Feasibility Study: **2003 Annual Monitoring and Evaluation Report**. *Prepared for:* Bonneville Power Administration, Project # 1996-040-00. Portland, OR.

2004

Annual reports:

Kamphaus, C.M. and K.G. Murdoch. *In Prep*. Mid-Columbia Coho Reintroduction Feasibility Study: **2004 Annual Broodstock Development Report.** *Prepared for:* Bonneville Power Administration, Project # 1996-040-00. Portland, OR.

Murdoch, K.G., C.M. Kamphaus, and S.A. Prevatte. *In Prep.* Mid-Columbia Coho Reintroduction Feasibility Study: **2004 Annual Monitoring and Evaluation Report.** *Prepared for:* Bonneville Power Administration, Project # 1996-040-00. Portland, OR.

2005

September: BPA categorically excluded minor modifications to the acclimation pond on the Rohlfing property (formerly called the Mahar Creek acclimation pond).

1.4 Consistency with Council's Requirements

1.4.1 Master Planning Guidelines

In accordance with Section 7.4B of the Fish and Wildlife Program (NPPC 1994), this master plan addresses Council master planning guidelines in the locations listed below.

Council Requirement 1

Address the relationship and consistencies of the proposed project to the eight scientific principles.

Principle 1. The abundance, productivity and diversity of organisms are integrally linked to the characteristics of their ecosystems.

See Sections: 1.1, 1.2, 1.5, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 4.1, 4.2, 4.3, 4.5, 5.3, 5.4, 6.2, 6.3, 7, Appendix A, B.1, B.2

Principle 2. Ecosystems are dynamic, resilient and develop over time.

See Sections: 1.1, 1.2, 1.5, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 4.1, 4.2, 4.3, 4.5, 5.3, 5.4, 7

Principle 3. Biological systems operate on various spatial and time scales that can be organized hierarchically.

See Sections 1.1, 1.5, 2.2, 2.4, 5.3, 5.4

Principle 4. Habitats develop, and are maintained, by physical and biological processes.

See Sections: 1.1, 1.2, 1.5, 2.1, 2.2, 2.3, 2.4, 4.1, 4.2, 4.3, 4.5, 5.3, 5.4, 6.2

Principle 5. Species play key roles in developing and maintaining ecological conditions.

Each species has one or more ecological functions that may be key to the development and See Sections: 1.1, 1.2, 1.5, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 4.1, 4.2, 4.3, 4.5, 5.3, 5.4

Principle 6. Biological diversity allows ecosystems to persist in the face of environmental variation.

See Sections: 1.1, 1.2, 1.5, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 4.1, 4.2, 4.3, 4.5, 5.3, 5.4

Principle 7. Ecological management is adaptive and experimental.

See Sections 1.2, 1.5, 3.2, 4.2, 4.3, 5.4, 6.2, 7

Principle 8. Ecosystem function, habitat structure and biological performance are affected by human actions.

Sections: 1.1, 1.2, 1.5, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 4.1, 4.2, 4.3, 4.5, 5.3, 5.4, 6.2, 6.3, 7, Appendix A, B.1, B.2

Council Requirement 2

Describe the link of the proposal to other projects and activities in the subbasin and the desired end state condition for the target subbasin.

Section 1.5 and 2.4.4.

Council Requirement 3

Define the biological objectives with measurable attributes that define progress, provide accountability and track changes through time associated with this project.

Section 1.2.2, Section 4.3.1, Chapter 5, Chapter 7.

Council Requirement 4

Define expected project benefits (e.g. preservation of biological diversity, fishery enhancement, water optimization, and habitat protection).

Section 1.2, 2.4.4, 4.3.6, 4.5.

Council Requirement 5

Describe the implementation strategies as they relate to the current conditions and restoration potential of the habitat for the target species and the life stage of interest.

Section 2.4, 4.3, Chapter 5.

Council Requirement 6

Address the relationship to the habitat strategies.

Section 1.2.2, 2.4, 4.3, 5.5.

Council Requirement 7

Ensure that cost-effective alternate measures are not overlooked and include descriptions of alternatives for resolving the resource problem, including a description of other management activities in the subbasin, province and basin.

Section 1.5, 2.4.4, 4.2, Chapter 6, B and C appendices.

Council Requirement 8

Provide the historical and current status of anadromous and resident fish and wildlife in the subbasin most relevant to the proposed project.

Section 2.2 and 2.3.

Council Requirement 9

Describe current and planned management of anadromous and resident fish and wildlife in the subbasin.

Section 1.5, 2.2, 2.3.

Council Requirement 10

Demonstrate consistency of the proposed project with NOAA Fisheries recovery plans and other fishery management and watershed plans.

Section 1.5, 2.4.4, 5.5.

Council Requirement 11

Describe the status of the comprehensive environmental assessment.

Section 1.3, 1.6.

Council Requirement 12

Describe the monitoring and evaluation plan.

Section 4.3.3, Chapter 7.

Council Requirement 13

Describe and provide specific items and cost estimates for 10 Fiscal Years for planning and design (i.e. conceptual, preliminary and final), construction, operation and maintenance and monitoring and evaluation.

Chapter 8, Appendix D.

Council Requirement 14

Address the relation and link to the Council's artificial production policies and strategies.

Section 4.3.2, 5.3, 5.4.

Council Requirement 15

Provide a completed Hatchery and Genetic Management Plan (HGMP) for the target population(s).

Appendix G.

Council Requirement 16

Describe the harvest plan.

Chapter 5, AHA calculations.

Council Requirement 17

Provide a conceptual design of the proposed facilities, including an assessment of the availability and utility of existing facilities.

Chapter 6 and Appendices B.1, B.2, C.1 – C.4.

1.4.2 Partial Step 2 Review

This section discusses where the Master Plan addresses the information needs identified in the Partial Step 2 review. As stated in the July 12, 2002 memorandum: "The results of Phase I will be used to address program areas pertaining to master planning as well as other aspects including National Environmental Policy Act documents. Before initiation of Phase II, this information will be used for a Step 2 review." (M. Fritsch, NPPC, memorandum to Council, July 12, 2000). The following four categories of information (in boldface type) were requested for the next Council review of the Mid-Columbia coho project. The location of this information in the Master Plan follows each category (in regular typeface).

1) Provide a specific statement of goals in terms of numbers of coho adults and/or of smolt to adult return rates that are expected to constitute success in reestablishment or at least to render unnecessary further hatchery plants or supplementation with artificially reared coho.

Section 1.2.2, Chapters 4 and 5.

2) Modify monitoring and evaluation procedures to clarify how time-limited objectives will be measured.

Chapter 7.

3) Discuss the possibility that further facilities may not be needed and the conditions that would enter into making that decision.

Chapter 6 and Appendices B.1, B.2, C.1 - C.4

4) Respond to the general and specific comments relating to:

- **harvest rates as limiting factors** (Chapter 5, AHA calculations, Section 7.1.10)
- **the monitoring and evaluation plan** (Chapter 7)
- **issues (i.e. ecological interactions, quality of rearing habitat and case studies of successes in similar endeavors).**
  - Ecological interactions: Sections 3.2, 7.2.
  - Quality of rearing habitat: Section 2.4, Chapter 5.
  - Case studies: Section 4.5

1.5 Relationship to Other Programs, Projects, and Plans in the Region

1.5.1 Treaty of 1855 and *U.S. v. Oregon*

In the Treaty of 1855, bands and tribes of the Yakama Nation reserved "[t]he exclusive right of taking fish in all the streams running through or bordering [their] reservation...and…taking fish at all usual and accustomed places…" "The treaty right to take fish in usual and accustomed places requires that fish runs pass such usual and accustomed places" (S. Jim and P. Rigdon, YN, letter to M. Eden, NPCC, August 25, 2005).

In the westward expansion of the United States during the 19th century, Congress required that federal representatives treat with and compensate native peoples who were then occupying the lands that were desired for inclusion in the Union. In the Treaty of 1855, 14 independent tribes and bands occupying roughly the central third of Washington State were confederated into the Yakama Nation. In exchange for ceding their ancestral lands to the United States so that they could lawfully be opened to settlement, tribal leaders secured in perpetuity certain rights and privileges that were considered necessary to preserve tribal culture and traditions. Among these reserved rights was the exclusive right to fish in rivers running through and bordering the new Yakama Reservation, and "in common with" residents of the territory at all "usual and accustomed" fishing areas. The Treaty of 1855 was ratified by Congress in 1859 and became recognized as "the supreme law of the land."

As increasing numbers of non-Indians began to develop agricultural, industrial, and fishery resources of the Columbia Basin, tribal fishers saw their Treaty-reserved fisheries steadily decline over the ensuing century. In 1968, several members of the Yakama Nation filed suit against the United States for failing to preserve and protect their access to fisheries reserved in the Treaty of 1855. The United States, on behalf of the Columbia River Treaty Tribes, filed suit against the State of Oregon for allowing non-treaty fisheries to harvest virtually all harvestable portions of Columbia River runs while restricting Treaty fisheries in order to meet escapement goals. The *United States versus Oregon* treaty fishing rights case affirmed that the 1855 treaty reserved for the tribes a fair share of the harvest, which was subsequently determined to be 50% of the harvestable portion of runs destined to pass the tribes' usual and accustomed fishing areas.

The *U.S. v. Oregon* decision also established guidelines and procedures by which the tribes could function as self-regulating fishery co-managers together with the state and federal fishery agencies. Under continuing Court oversight, a co-management process was created that provides for joint technical and policy review of management proposals by tribal, state, and federal parties to the lawsuit. This process is intended to ensure that Treaty and non-Treaty fishery regulations are consistent with harvest sharing principles and with rebuilding the upriver runs. The Yakama Nation views the *U.S. v. Oregon* process as the expression of its co-management authority and, therefore, the primary forum through which the tribe's management goals and priorities should be advanced.

The *U.S. v. Oregon* process is implemented through harvest and hatchery management plans that are jointly developed by the parties and become binding on them when adopted as Court orders. Harvest management plans are negotiated within the *U.S. v. Oregon* process and describe the management goals and guidelines that shape in-season harvest management. Hatchery management plans may be negotiated within the *U.S. v. Oregon* process or they may be brought into the process as plans jointly prepared by the relevant co-managers in a separate forum, such as a FERC hydro project licensing process. Once adopted into the *U.S. v. Oregon* management plan, these production plans become binding on the co-managers and cannot be unilaterally altered.

1.5.2 Columbia River Fish Management Plan *(U.S. v. Oregon)*

As stated in Section 1.5.1, *U.S. v. Oregon*, which remains under Court jurisdiction, upheld the treaty fishing rights of the Columbia River treaty tribes in a 1969 decision. In 1983, the court ordered the tribes, states and the federal government to develop a management plan, named the Columbia River Fish Management Plan (CRFMP). The purpose of the CRFMP is to protect, rebuild, and enhance upper Columbia fish runs while providing harvest for both Treaty Indian and non-Indian fisheries. Consistent with III.D.4 of the CRFMP, the All Species Review of the CRFMP (TAC 1997) states that the Parties continue to provide for coho production opportunity in natural areas of the upper Columbia compatible with natural production. "Possible sites include: Grande Ronde, Walla Walla, upper Yakima, Naches, and tributaries of the Clearwater, Wenatchee, Methow, and Entiat rivers."

> "Perhaps most significantly, the *US v. Oregon* framework provides the backdrop for the development and implementation of the Council's FWP [Fish and Wildlife Program]. Indeed, because the *US v. Oregon* process promotes exercise of the Yakama Nation's treaty rights, the Northwest Power Act ("the Act") requires that [the] FWP and implementing activities be consistent with *US v. Oregon* requirements. *See, 16 U.S.C. Sec. 839b(h)(6)."* (S. Jim and P. Rigdon, YN, letter to M. Eden, NPCC, August 25, 2005).

This proposed Master Plan would assist in meeting the Parties' (Yakama, Nez Perce, Umatilla and Warm Springs tribes; USFWS, NOAA, BIA, ODFW, WDFW, and IDFG) intent under the auspices of *U.S. v. Oregon*.

1.5.3 Mitchell Act

The Mitchell Act authorized the Secretary of Commerce to implement the construction of salmon hatcheries in Oregon, Washington, and Idaho as a means to mitigate for salmon production lost as a result of the construction of the federal Columbia River hydro-power system. Most of the Mitchell Act hatcheries were constructed in the lower Columbia River in the 1950s and 1960s. Only since 1988, under the jurisdiction of *U.S. v. Oregon,* have lower Columbia River Mitchell Act hatcheries been reprogrammed[3] to provide coho salmon smolts for release in upriver areas, including the Wenatchee and Methow basins. Smolts grown at these hatcheries, which are offspring of coho that returned to the mid-Columbia, provide the basis for reintroduction efforts in these two Columbia River basins. Up to 90% of the coho salmon proposed for release in this Master Plan will be reared in Mitchell Act facilities.

1.5.4 *Wy-Kan-Ush-Mi Wa-Kish-Wit*: Spirit of the Salmon Tribal Recovery Plan

This plan (CRITFC 1995) 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. *Wy-Kan-Ush-Mi Wa-Kish-Wit* provides the basic goal to restore the Columbia River salmon, which is, simply: **put the fish back into the rivers**. The proposed

[3] The word "reprogrammed" results from the fact that fish produced at a hatchery have a specific release program as part of their facility's management plan. Historically, most hatcheries, especially in the lower Columbia River released their juveniles on-station. The Tribes took the operating agencies to court (*U.S. v. Oregon*) to get the production "reprogrammed" and released above Zone 6 (Tribal fishing zone) so that the fish would be imprinted to locations above their fishery.

Master Plan meets the goals and objectives of the tribal restoration plan for coho restoration in the Wenatchee and Methow rivers.

1.5.5 Wenatchee and Methow Subbasin Plans

The proposed Mid-Columbia Coho Restoration Project 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 fish 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) BPA Project #1996-040-00 is the only project currently working toward these goals in mid-Columbia tributaries. The proposed master plan represents a strategy to re-establish coho runs in five generations of supplementation by emphasizing increased fitness through local adaptation and increased productivity through coordinated habitat improvement.

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. To highlight the issues, we have added emphasis within the quotations.

- ***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 clearly 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). Today coho reintroduction is identified as a priority in the *Wy-Kan-Ush-Mi Wa-Kish-Wit* document (Tribal Restoration Plan) and has been affirmed as a priority by the Northwest Power and Conservation Council."

"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."

"While the historic stock of coho salmon are considered extirpated in the Upper Columbia River, … [i]n cooperation with the WDFW and the USFWS, the Yakama Nation is currently leading coho salmon recovery efforts in the basin."

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, <u>reintroduction of coho to tributaries</u> 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.

Pages 79-80 Section 3.4.6 Fish Focal Species, Coho – Key Life History Strategies, Relationship to Habitat: This section provides detailed information from both the literature and YN's coho reintroduction program regarding Upper Columbia River coho life history strategies and relationship to the habitat.

*Page 81 Section 3.4.6 Fish Focal Species, Coho – Population Status: "*Coho salmon returning to the Methow Basin are primarily hatchery origin, but include an increasing naturally produced component as a result of ongoing reintroduction efforts."

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 81-83 Section 3.4.6 Fish Focal Species, Coho: These pages contain detailed descriptions of coho hatchery effects (history of coho programs and current programs), hydro-electric effects (GCFMP programs and Chelan and Douglas PUD HCP obligations to coho salmon), and harvest effects.

Pages 301-353 Section 5.5 Assessment Unit Summaries: Within 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. As a focal species in these Assessment Units, much of the recommended restoration strategies should improve habitat for coho. The geographic distribution of coho as a focal species within the Subbasin Plan is consistent with the proposed coho master 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." The inclusion of coho salmon as a 'focal species' in the Wenatchee Subbasin Plan clearly 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 26, Section 3.3.3 Guiding Principle-8: "Species diversity and the biotic community are a reflection of the ecosystem attributes. The co-evolved assemblage of species share requirements for similar ecosystem attributes and those attributes can be estimated by intensive study of **focal** or indicators species." Coho salmon are a focal species in the Wenatchee Subbasin Plan. They are part of the co-evolved assemblage of species. The only way to increase species diversity with co-evolved species is to restore those species which have become extirpated or limited on a geographic scale. The Subbasin Plan states that coho are a good indicator species for off-channel habitats.

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.**" We interpret this statement from the 10th guiding principle to directly apply 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 27, Section 3.3.3 Guiding Principle 11: "Reintroduction [coho] or supplementation [chinook and steelhead] programs for fish and wildlife should concentrate on specific environments within the basin, **selection of an appropriate stock for reintroduction to that environment or locally adapting a donor stock [coho] where a local stock no longer exists.**" This statement from the 11th guiding principle describes the strategies of the coho reintroduction program. YN's coho reintroduction program is the only program in the basin where a local stock is not available and is "developing a locally adapting donor stock." This guiding principle supports YN's reintroduction approach.

Page 28, Section 3.3.3 Guiding Principle 12: "At some point along the scale from intact population to former populations that have had entire metapopulations extirpated from the basin and adjacent basins, emphasis on recovery actions is better focused on rebuilding population structure than on habitat restoration**.** If the goal of cost-effective restoration is to be achieved, subbasin planners need to assess the optimal mix of habitat restoration and population structure restoration to achieve biological goals."

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: Within 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 71 Section 4.8.5 Coho (Oncorhynchus kisutch) – Rationale for Selection: "Coho salmon were once considered extinct in the mid-Columbia region, but have since been reintroduced. Recent re-introduction efforts have resulted in natural reproduction occurring in the basin. Mullan (1984) estimated the historical run size at 38,000 to 51,000 adults to the Wenatchee, Entiat, and Methow Rivers (Peven 2003). Recently the Yakama Nation has begun a substantial and concerted effort to reintroduce coho into the upper Columbia, using the Wenatchee and Methow subbasins during the feasibility phase of this work. **Coho salmon prefer and occupy different habitat types, selecting slower velocities and greater depths than the 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 for these areas."**

Page 178 Section 6.3.2 Aquatic/Fish Summary of Environmental/ Population Relationships of the Focal Species – Coho: Pages 178-179 describe the relationships of coho salmon (focal species) to the current status of the environment. Selection highlights are reported below:

> "Spawning areas for coho salmon in Nason Creek have been compromised by loss of riparian area and subsequent large wood recruitment, off channel habitats, channel stability, and general diversity…**Coho spawning habitat in the Little Wenatchee River remains in good condition.** Coho spawning also occurs in the Wenatchee River and Icicle Creek where increases in sediment deposition, channel confinement and higher flow rates have most likely reduced incubation success**. Largely unaltered coho spawning habitat exists in the Chiwawa and White Rivers."**
>
> "Natural coho production in the Wenatchee subbasin could increase if habitat problems within Nason, Icicle, Peshastin, Mission, and Chumstick creeks were improved. Preservation of quality habitat areas in Chiwakum, Little Wenatchee, White, and Chiwawa basins would ensure high quality areas remain intact."
>
> These conclusions within the subbasin plan indicate that YN's long-term plan is consistent with the findings in the Subbasin Plan in regards to tributaries containing coho habitat within the Wenatchee basin.

<u>*Page 305 Section 7.8.16 Summary of Near-term Opportunities by Focal Species – Coho Salmon:*</u> "**<u>Continued development of a locally adapted broodstock is essential to ensure future populations of naturally spawning coho salmon in the Wenatchee River.</u>** Increased habitat diversity (e.g., off channel habitat, increased structural diversity, etc) primarily in Nason Creek, Peshastin Creek, Mission Creek, and the lower Wenatchee River would increase the success of naturally spawning coho and increase productivity. Evaluation of migrational delays in Tumwater Canyon could improve extreme flow passage conditions for adults migrating to the upper Wenatchee subbasin."

This section clearly states that the continued coho broodstock development is not only consistent with the subbasin plan but "essential" for the restoration of coho salmon in the Wenatchee subbasin.

1.5.6 Yakima River Coho Restoration

The Yakima Coho restoration project is a component of the Yakima/Klickitat Fisheries Project (YKFP). The Yakama Nation is the lead agency in both Mid-Columbia and Yakima restoration projects. Both are high-priority NPCC projects, are in the Tribal Recovery Plan, are legally binding under *U.S. v. Oregon*, and have similar overall goals. Personnel from both projects meet as needed to review feasibility progress and results. Several studies in both projects have inter-basin application. For example, the predation studies of coho on sensitive species completed in both projects confirmed minimal interactions between coho and other salmonids. Both projects adaptively manage in response to results and peer review. Joint meetings of the two projects are held annually to coordinate objectives, production, research needs, and monitoring results.

1.5.7 Clearwater Basin Coho Restoration

This coho re-introduction project for the Clearwater Basin in Idaho is being implemented by the Nez Perce Tribe (NPT) and is funded by PCSRF. The NPT is a member of the Mid-Columbia Coho Technical Work Group (TWG). The data and analysis from their M&E plan is shared with this project and others at annual meetings of the TWG.

The Nez Perce Tribe's overall goal is to reintroduce and restore coho salmon to the Clearwater River subbasin at levels of abundance and productivity sufficient to support sustainable runs and annual harvest. Consistent with the Clearwater Subbasin Plan (EcoVista 2003), the Nez Perce Tribe envisions an annual escapement of 14,000 coho to the Clearwater River subbasin.

Uncertainties exist about whether an extirpated salmon species can be reintroduced and restored to healthy abundances 500 miles from the ocean, upstream of eight mainstem hydroelectric dams, using donor stock from the Lower Columbia River. Therefore, like the MCCRP, the NPT decided to develop the reintroduction program in two distinct phases.

- Phase I: Focus on establishing a localized Clearwater River coho salmon broodstock and meeting broodstock needs.
- Phase II: Focus on establishing naturally spawning populations of coho salmon in the Clearwater River Subbasin.

The number of adult coho passing Lower Granite Dam (LGD) has been increasing steadily since 1997 (<u>http://www.cbr.washington.edu/dart/dart.html</u>), suggesting that preliminary reintroduction efforts have successful at stimulating adult returns.

1.5.8 Mid-Columbia HCP Hatchery Compensation Plans

The proposed coho program is consistent with the mid-Columbia Habitat Conservation Plan's Hatchery Compensation Plan (HCP HC) for Rock Island, Rocky Reach and Wells Dams.[4] The Rock Island HCP HC will provide mitigation for coho salmon "following the development of a continuing coho hatchery program and/or the establishment of a naturally reproducing population of coho" (HCP 2002). Hatchery compensation under the Rocky Reach and Wells Dam HCPs will occur following the development of a continuing coho hatchery program, development of a long-term coho hatchery program, and/or the establishment of a threshold population of naturally reproducing coho in the Methow subbasin .

The Mid-Columbia Coho Reintroduction Feasibility Study (BPA 1996-040-000) has been closely coordinated with ongoing activities of HCP hatchery programs within the Wenatchee and Methow river basins. The proposed coho reintroduction plan will continue to build on this close coordination:

- The current feasibility study and the proposed coho master plan share trapping facilities with HCP steelhead hatchery programs, including trapping at Dryden Dam, Tumwater Dam, and Wells Dam. At each of these facilities, YN personnel and Washington Department of Fish and Wildlife (WDFW) operate the collection facilities together, reducing the personnel trapping needs for both programs.
- YN personnel have helped staff WDFW's smolt trap in the Wenatchee River near Monitor, to collect data during the spring smolt emigration.
- WDFW provides the YN with an annual population estimate for naturally produced coho.
- Hatchery coho are commonly used to evaluate the trap efficiency at the WDFW Monitor smolt trap and the WDFW/Douglas County PUD (DCPUD) smolt trap in the Methow River.
- The YN operates a smolt trap in Nason Creek, designed to collect data from emigrating naturally produced and hatchery produced coho. This trap also collects data on other migrating species that are under the umbrella of CCPUD's HCP monitoring programs and Grant County PUD.
- The proposed monitoring and evaluation plan is coordinated with the CCPUD and DCPUD HCP monitoring and evaluation plans through the sharing of resources and data collection.

1.5.9 Mid-Columbia HCP Tributary Conservation Plans

Under the Rock Island, Rocky Reach, and Wells Dam Habitat Conservation Plans (HCPs) Tributary Conservation Plans (TC), Chelan and Douglas County PUDs will fund habitat improvement projects for the protection and restoration of Plan Species' habitat within the Columbia River watershed, and the Okanogan, Methow, Entiat, and Wenatchee River watersheds. Coho salmon will be considered an HCP Species if criteria described above under ***HCP Hatchery Compensation*** are met. Habitat improvements in tributaries identified for coho restoration should result in increased productivity for coho salmon and all Plan species.

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[4] "Habitat Conservation Plan" is a federal term used in Federal Energy Regulatory Commission (FERC) settlements. Under an HCP, there are several sections: passage survival, habitat and water quality, tributary conservation (tributary fund is here), and hatchery compensation, among other sections.

1.5.10 Grant County PUD Settlement Agreement

Grant County PUD is currently in negotiations with the fisheries management agencies and tribes on finalizing a Settlement Agreement related to fish mitigation that would become a FERC license article associated with the re-licensing of Priest Rapids and Wanapum dams. Coho mitigation language within this Agreement mirrors the HCPs of the other Mid-Columbia PUDs. The draft Agreement states that if a coho hatchery program and/or a naturally reproducing population are established as defined by certain criteria, Grant PUD will provide mitigation to compensate for smolt losses at their two projects, thus providing another funding partner for the coho reintroduction and habitat restoration. This Agreement is in its final phase of negotiation.

1.5.11 Grand Coulee Fish Maintenance Project (GCFMP)

The USFWS operates the Leavenworth National Fish Hatchery Complex (Leavenworth NFH, Entiat NFH, Winthrop NFH). The complex was constructed by the U.S. Bureau of Reclamation (BOR) to replace fish losses that resulted from construction of Grand Coulee Dam. These programs were authorized as part of the Grand Coulee Fish Maintenance Project (GCFMP) on April 3, 1937, and re-authorized by the Mitchell Act (52 Stat. 345) on May 11, 1938. The Leavenworth NFH complex works closely in support of the current coho reintroduction feasibility study (BPA project #1996-040-00). The proposed Master Plan continues to share facilities and resources with all three federal hatcheries that comprise the Leavenworth NFH complex.

1.5.12 Integrated Status and Effectiveness Monitoring Program

The Integrated Status and Effectiveness Monitoring Program (ISEMP, BPA #2003-017-00) is a system-wide, multi-agency effort to implement a subbasin-scale pilot program to monitor status and trends of anadromous salmonids and their habitat in the Wenatchee, John Day, and Upper Salmon River basins; and to monitor the effectiveness of suites of habitat restoration projects in selected watersheds within the three target subbasins. This work builds on current status and trend monitoring programs. Several regional and local organizations are funding and implementing these programs. Much of the work proposed in the M&E plan is closely tied to activities under the ISEMP, including but not limited to smolt population estimates, smolt survival estimates, and species distribution. The ISEMP will continue to provide data to assist in the evaluation of coho reintroduction, and the coho reintroduction M&E project will also contribute to the ISEMP.

1.5.13 Pacific Coastal Salmon Recovery Fund

This fund was established by Congress in FY2000 to provide grants to the States and Tribes to assist state, local, and tribal salmon recovery efforts; it is administered by NOAA Fisheries (NMFS) through Columbia River Inter-Tribal Fish Commission (CRITFC). Projects funded under the PCSRF must be consistent with the Tribes' salmon restoration plan *Wy-Kan-Ush-Mi Wa-Kish-Wit*, and Congressional authorization. PCSRF funds salmon-related habitat restoration and conservation projects; salmon watershed restoration and coordination projects; salmon stock enhancement and supplementation projects; salmon–related research and data collection; and the maintenance and monitoring of projects completed with assistance from this fund, consistent with the overall goal for the PCSRF. Through this program, habitat improvement and protection projects have been funded in the Wenatchee and Methow basins. Past and future PCSRF projects will help improve and protect coho spawning and rearing habitat. Specific projects in the Wenatchee and Methow basins are as follows:

- *Wenatchee Basin Riparian Enhancement* - This purchase of riparian habitat adjacent to Peshastin Creek will add to habitat protection for coho and other species in this Wenatchee River tributary.
- *Nason Creek Wetlands Acquisition* – This is a YN land purchase that was completed to protect and enhance 26 acres of beaver dam wetlands complex and manage the site to provide for salmon passage to spawning areas and over-winter rearing habitat. These wetlands are located in an important reach of Nason Creek, at RM 7, that provides spawning and rearing habitat for ESA-listed spring chinook and steelhead along with coho and bull trout. The creek has been largely channelized and cut off from the floodplain by the transportation and power transmission corridor. Management of the beaver dams and water levels to provide for adult migration through the property at appropriate times would grant access to underutilized spawning habitat and provide critical over-winter rearing. **No beaver dams will be removed.** Alternative methods to allow upstream access will be used and could include notches, culverts, fish ladders, or weirs. The site also has potential to provide for acclimation of hatchery coho, steelhead, or spring chinook. The Mid-Columbia Coho Project currently releases smolts in an adjoining pond upstream of this property and may increase the number of coho acclimated and released from Nason Creek with the acquisition of this land.
- *Hancock Springs Restoration* - This YN habitat restoration project of a spring-fed tributary of the Methow River will provide off channel rearing for naturalize coho that are part of the re-introduction project.
- *Mid-Columbia Project Development Coordinator* - Employment of 1.0 FTE to focus on project proposal development, funding coordination and implementation for activities in the Upper Columbia (Wenatchee, Entiat, and Methow) region. The basic premise of this Coordinator position is that more successful proposals, benefiting the resource and maintaining a significant and sustained Yakama Nation presence in the Upper Columbia, will be developed if an individual is dedicated to this effort, rather than relying on intermittent and inconsistent efforts. Additionally, thoughtful organization or packaging of proposals will provide for a wider spectrum of funding sources. Allocation of position responsibilities is divided between Wenatchee, Entiat and Methow subbasins with an emphasis on the following priorities:
    1. Wenatchee - projects associated with the mainstem Channel Migration Zone study; Nason Creek coho acclimation and general salmonid spawning and rearing habitat; and White River habitat acquisition.
    2. Entiat - In-channel structures and riparian revegetation within the lower mainstem reaches; and habitat enhancements and acquisition in the upper Stillwaters area.
    3. Methow - Twisp River and Upper Methow coho acclimation sites; Twisp River habitat enhancement, floodplain acquisition, channel re-connection; Beaver Creek steelhead habitat enhancement and potential kelt reconditioning.

1.5.14 Salmon Recovery Funding Board

The goal of the state Salmon Recovery Funding Board (SRFB) is to fund the best salmon habitat projects in Washington State. "Best projects" are those that include local priorities and use the best available science. Eligible projects include restoration, acquisition, and assessment projects that will benefit salmon and the habitat and ecosystem functions on which they depend. Funding for the Board comes from state and federal sources. The SRFB relies on groups in individual watersheds to evaluate and rank proposed projects on an annual basis before it evaluates the proposals and makes funding decisions.

1.6 Decision Process and Schedule

Before this program can be fully implemented, several major steps need to be completed: produce facility designs and specifications; complete Council Step processes; and produce environmental analyses, including those required for NEPA, ESA, and various permitting statutes and regulations. See Chapter 8 for details.

Figure 1-2 shows how the various planning, regulatory, and review processes would fit together.

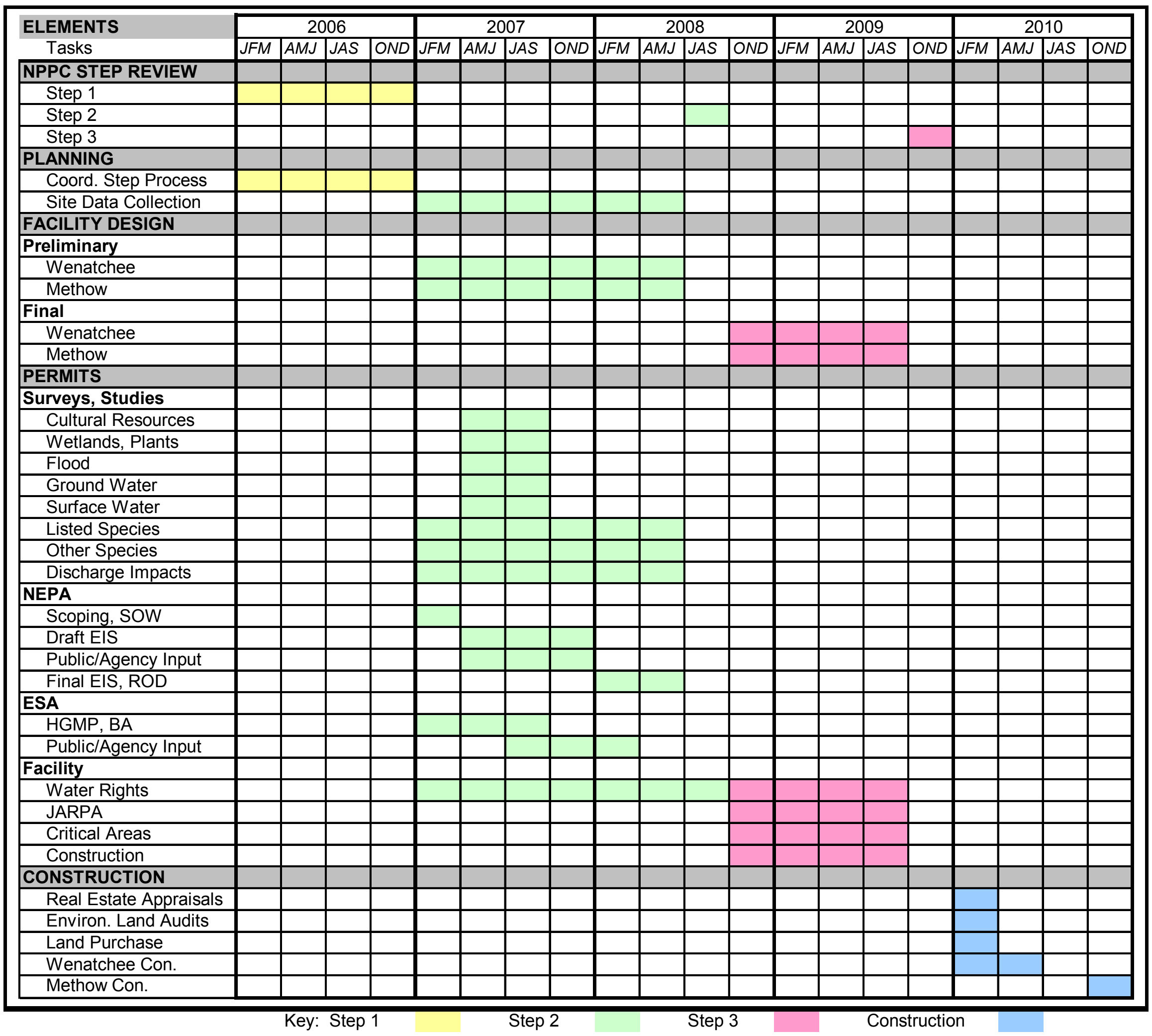

Figure 1-2. Project Schedule

1.7 Master Plan Development Team

The master plan was developed and written by:

- Tom Scribner – Yakama Nation, project manager.
- Keely Murdoch – Yakama Nation, lead project biologist.
- Cory Kamphaus – Yakama Nation, project biologist.
- Scott Prevatte – Yakama Nation, project biologist.
- Judy Woodward – Crossing Borders Communications, technical writer/editor.
- Greg Ferguson – Sea Springs Co, engineer/fish culturist.
- Nancy Weintraub – BPA, environmental specialist.

Subcontractors who have been important in the drafting of the plan include:

- Harry Senn – Fish Management Consultants, fish culturist.
- Dave Smith – C.P. Cramer, salmonid habitat ecologist.
- Jim Miller – GeoEngineers, geotechnical engineer.
- Doug Neely - International Statistical Training and Technical Institute, statistician.

Members of the Mid-Columbia Technical Work Group have contributed substantially to this master plan, as well as to reviews of the program throughout the years. They include:

- Laurie Weitkamp, Bill Waknitz, Kristine Peterson, Michelle McClure (NOAA Fisheries)
- Jeff Haymes (WDFW)
- Cameron Thomas (USFS)
- David Carie, Julie Collins (USFWS)
- Chris Fisher (Colville Tribe)
- Scott Everett (Nez Perce Tribe)
- Chuck Peven (CCPUD)
- Tom Kahler (DCPUD)
- Linda Hermeston (BPA)

In addition, the team listed below reviewed a draft of the master plan, with significant suggestions for improvements to the proposal.

Name	Affiliation	Area of Expertise
Dan Warren	D.J. Warren & Associates, Inc	Project Management, Budgeting, Cost Analysis, Compliance
Lars Mobrand	Mobrand-Jones&Stokes	Fisheries Science
Kevin Malone	Mobrand-Jones & Stokes	Fisheries Science
Bruce Watson	Mobrand-Jones & Stokes	Fisheries Science
John McGlenn	TetraTech/KCM, Inc.	Engineering
Mark Reiser	TetraTech/KCM, Inc.	Engineering
Nancy Bond Hemming	Nancy Bond Hemming	Technical Writing
Alison Squier	Ziji Creative Resources Inc.	Writing/editing, Compliance.

CHAPTER 2.
EXISTING ENVIRONMENT

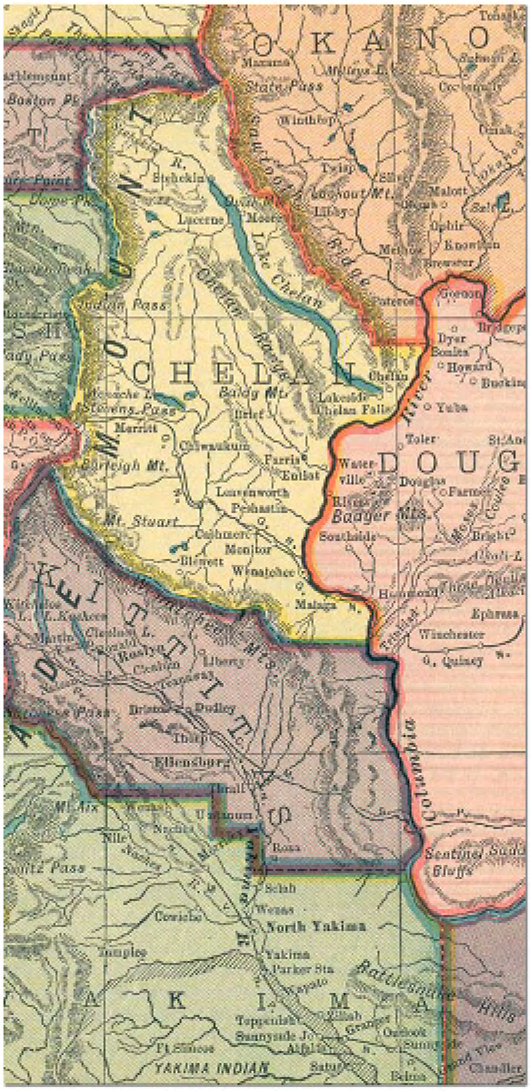

Photo from U.S. Digital Map Library

2.1 Description of the Subbasins

2.2 Status of Coho (Oncorhynchus kisutch) in the Subbasins

2.3 Status of Other Anadromous and Resident Fish in the Subbasins

2.4 Status of Habitat

Chapter 2. Existing Environment

2.1 Description of the Subbasins

The Wenatchee and Methow subbasins are part of the Columbia Cascade Ecological Province, which extends over an area of 14,333 square miles. The province, in north central Washington, encompasses the Columbia River from Wanapum Dam to the limit of anadromous fish passage at Chief Joseph Dam. Tributary subbasins are, for the most part, high-gradient streams that begin in the North Cascade Mountains and drain directly to the Columbia River. The province also includes a few smaller streams that drain smaller watersheds adjacent to the Columbia as well as a number of gulches that arise from the channeled scablands to the east (NPCC 2004a).

Besides the Wenatchee and Methow subbasins, the province includes the Entiat, Lake Chelan, Okanogan, and Upper Middle Mainstem Columbia River subbasins.

Construction of Grand Coulee Dam in 1934 blocked over 1,000 miles of habitat upstream of the Columbia Cascade Province in the upper Columbia River basin. Another 52 miles of habitat was blocked in 1961 by the completion of the Chief Joseph Dam. Six hydroelectric projects are downstream of this ecological province: Wanapum Dam and Priest Rapids Dam, and four federally owned projects—McNary Dam, John Day Dam, The Dalles Dam and Bonneville Dam (NPCC 2004a).

To offset the loss of anadromous salmonid production by the federally built projects, the federal government built and continues to operate the Leavenworth NFH in the Wenatchee subbasin, and later, the Entiat and Winthrop NFHs (ENFH, WNFH) in the Entiat and Methow subbasins, respectively. No federal mitigation facility was constructed in the Okanogan subbasin (NPCC 2004a).

With the construction of each of the privately owned mid-Columbia hydroelectric projects, additional production/hatchery facilities were developed in the Columbia Cascade Province. The recent Habitat Conservation Plan (HCP), initiated by Chelan and Douglas PUDs for ESA Section 10 consultation, identified the mitigation obligation of the PUDs (see Sections 1.5.8 and 1.5.9). The HCP also provides the groundwork for future changes in facility production goals and operations. Details of changes in hatchery production will be resolved over the next several years (NPCC 2004a).

In spite of past mitigation efforts, declining salmonid populations in the Columbia Cascade Province have resulted in ESA listings of spring chinook (Endangered, March 1999) and summer steelhead (Endangered, August 1997). Upper Columbia late-run chinook and Lake Wenatchee sockeye were also petitioned (March 1998) but were determined not warranted for listing. Recent years have shown improved salmonid runs to the province, consistent with findings throughout the Columbia basin (NPCC 2004a).

Native people traditionally lived, hunted, gathered and fished within the Columbia Cascade Province. The province includes land ceded by the Confederated Tribes and Bands of the Yakama Nation (Yakama Nation) under the Treaty of 1855 to the United States. Members of the

Yakama Nation and the Confederated Tribes of the Colville Reservation continue to exercise their hunting, gathering, and fishing rights within the province (NPCC 2004a).

2.1.1 Wenatchee Subbasin

The Wenatchee subbasin lies entirely within Chelan County (Figure 2-1). The subbasin comprises 9.3% of the Columbia Cascade Province and consists of approximately 854,000 acres (1,300 square miles). Approximately 81% of the subbasin is in federal (primarily US Forest Service [USFS]) and state ownership. The remaining 19% of the land is privately owned (NPCC 2004a).

The watershed originates in the Cascade Mountains, and includes the Alpine Lakes and Glacier Peak wilderness areas. The Wenatchee River enters the Columbia River at river mile (RM) 470. Five major tributaries—the Chiwawa, White, and Little Wenatchee rivers, and Nason and Icicle creeks—are the source of over 94% of the surface waters within the subbasin even though their drainage area represents only 58% of the total subbasin area (CCCD 1998 *in* NPCC 2004a).

Four major irrigation districts in the Wenatchee subbasin and two smaller irrigation groups have about 68% of the total issued water rights; other users are domestic (10%), commercial and industrial (8%), municipal (6%), fish hatcheries (3%) and all others (4%). Combined, these users have 420 cfs in water rights permits and certificates (357 cfs surface water, 63cfs ground water). The largest user is the Wenatchee Reclamation District, which serves over 9,000 users by diverting up to 200 cfs at Dryden Dam (NPCC 2004a).

Among subbasins in the upper Columbia region, the Wenatchee supports the greatest diversity of populations and overall abundance of salmonids. There are core populations of sockeye salmon, steelhead, bull trout and both spring and later-run chinook salmon in the upper Wenatchee subbasin that are relatively strong when compared to other populations in the Columbia basin (NPCC 2004a).

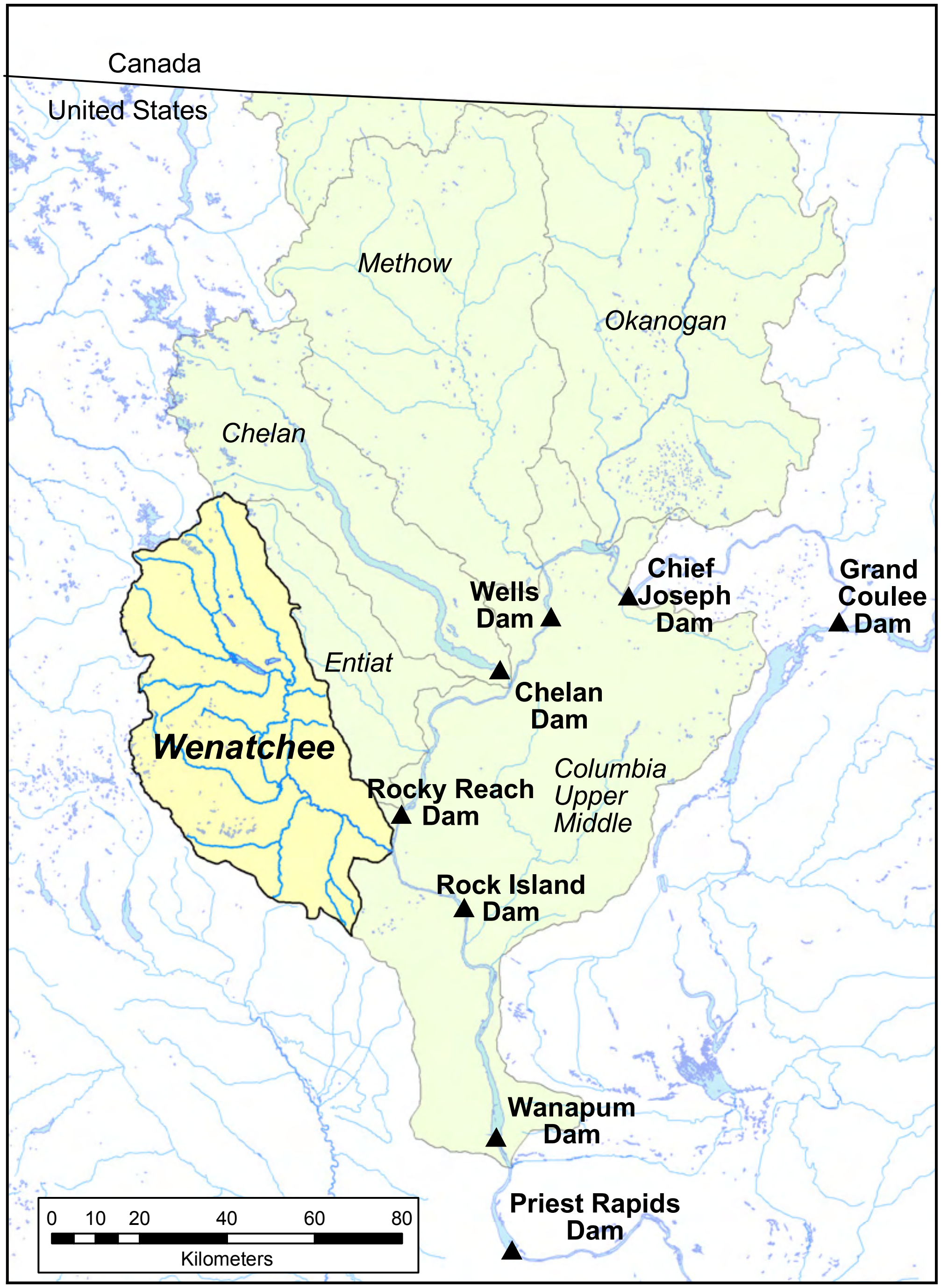

Figure 2-1. Wenatchee Subbasin in Relation to Upper Columbia River Dams and Subbasins

2.1.2 Methow Subbasin

The Methow subbasin lies entirely within Okanogan County (Figure 2-2). The subbasin comprises 12.7% of the Columbia Cascade Province and consists of 1,167,764 acres (1,825 square miles) (NPCC 2004b).

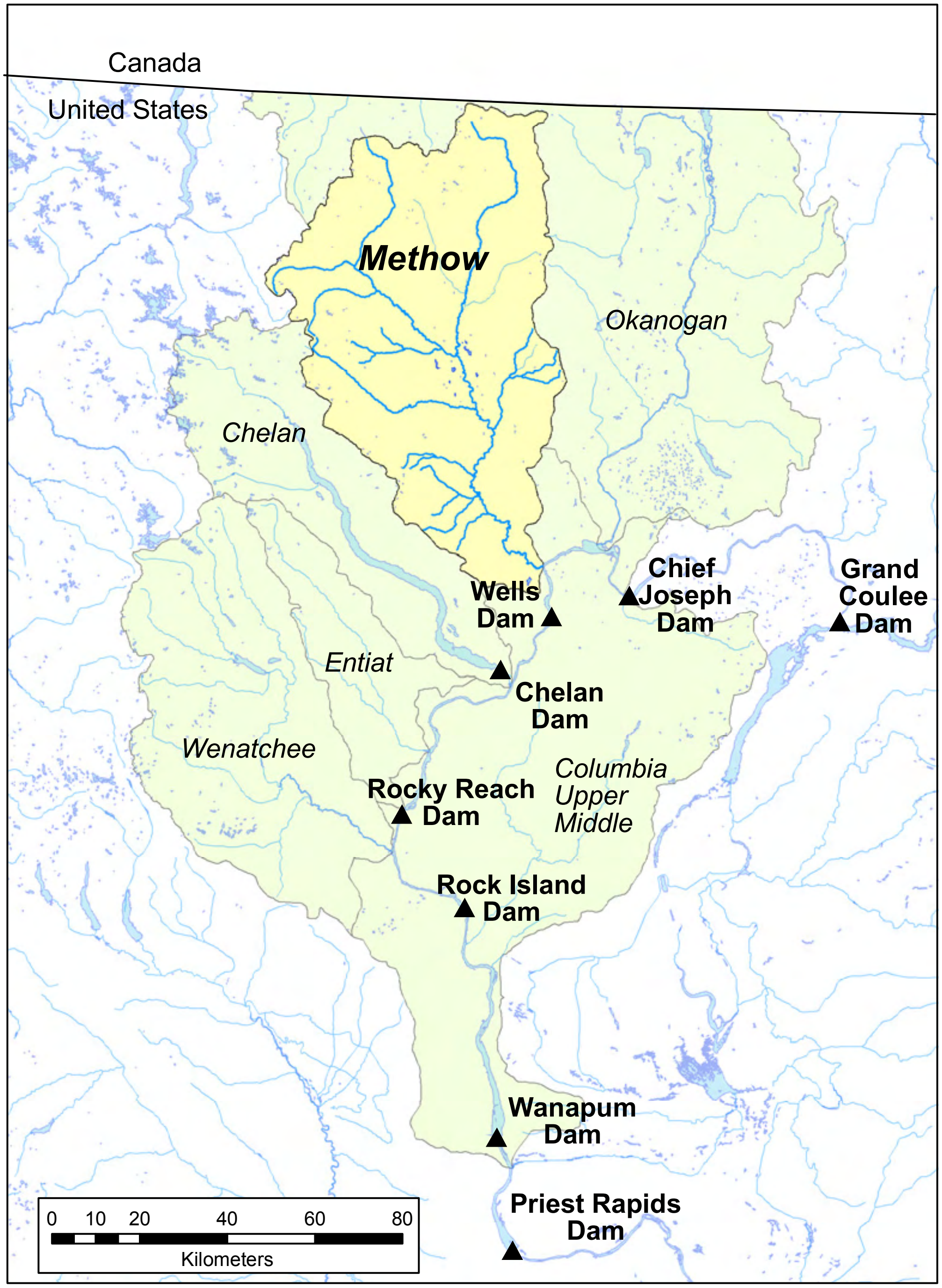

Figure 2-2. Methow Subbasin in Relation to Upper Columbia River Dams and Subbasins

The Methow River's confluence with the Columbia is at river mile 524 near Pateros, Washington. The Methow subbasin is characterized by large tracts of relatively pristine habitat contrasted with a growing human population. Less than 2% of the subbasin's land is irrigated. Six fish species and fourteen wildlife species are listed as Endangered, Threatened, or as Species of Concern (NPCC 2004b).

Logging, mining, orchards, farming, and grazing have played a substantial role in the Methow Valley for nearly a hundred years. Timber operations in the Methow watershed played an important role in the subbasin's economy through the 1800s. Activities related to timber harvest take place in the middle and upper reaches of the watershed (NPCC 2004b).

Unlined irrigation agricultural canals were introduced to the Methow subbasin in the 1800s as ranchers and farmers discovered that an irrigation system was required to supply consistent water for crops and livestock. The height of farming and ranching occurred in the Methow subbasin between 1940 and 1968 when 20,240 acres of land were irrigated from unlined surface diversions. Today, about 17,000 acres are under irrigation, and many of the subbasin farmers raise fresh fruit and vegetables (Methow Basin Watershed Plan, March 2004).

Farming and grazing are confined primarily to the lower and mid reaches of the subbasin. Orchards and small farms growing alfalfa and other irrigated crops constitute the majority of the subbasin's agricultural activities (NPCC 2004b).

Recreation, tourism, and related development play an increasing role in the area's economy. The Methow Valley offers an extensive range of tourism- and recreational-related opportunities (NPCC 2004b).

2.2 Status of Coho (*Oncorhynchus kisutch*) in the Subbasins

Chapman (1986) estimated that the peak run of coho entering the Columbia River in the 1880s was about 560,000 fish (NPCC 2004b). Mullan (1984) pointed out that most coho spawned in the lower Columbia River tributaries. Mullan (1984) estimated the historical coho run size at 6,000 – 7,000 adults to the Wenatchee basin and 23,000 – 31,000 to the Methow basin. Coho salmon were once considered extirpated in the mid-Columbia region. Recent re-introduction efforts have resulted in natural reproduction occurring in the some parts of the basins.

Population Characterization

Distribution

Historic. Coho salmon were once considered extirpated in the upper Columbia River (Fish and Hanavan 1948; Mullan 1984). Mullan (1984) estimated that upstream of the Yakima River, the Methow River and Spokane River historically produced the most coho, with lesser runs into the Wenatchee and Entiat. There are conflicting reports of whether the Okanogan subbasin historically produced coho (Craig and Suomela 1941; Vedan 2002).

Information regarding the historic distribution of coho salmon within the Wenatchee River basin is limited. Based on affidavits from long-time residents, Nason Creek was likely an important spawning area, and nearly all the smaller creeks had a run of coho salmon (Mullan 1984). The fall run of salmon in the Wenatchee River basin continued until about 1914-1915, after which it rapidly declined (Mullan 1984).

Washington Water Power blocked the Methow River at Pateros between 1915 and 1929 preventing all fish passage during those years and by the time it was removed, the Methow River run of coho was extinct. By the 1930s, the coho run into the mid- upper Columbia was virtually extirpated. Tributary dams on the Wenatchee, Entiat, and Methow rivers appeared to be more destructive to coho than either steelhead (where genetic “storage” presided in resident forms) or chinook (NPCC 2004b, p. 623).

Because the indigenous stock of coho salmon were extirpated in the upper Columbia River system, the Wenatchee and Methow subbasin coho are not addressed under the ESA or by WDFW’s 1994 Washington State Salmonid Stock Inventory (SASSI) (Peven 2003).

Current. Coho salmon 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 over-winter in small tributaries (Tripp and McCart 1983).

Since the YN’s program of coho reintroduction feasibility studies began, coho have been found to spawn in the mainstem Wenatchee River (Cashmere to Lake Wenatchee), Nason Creek, Beaver Creek, Icicle Creek, Peshastin Creek, Mission Creek, and possibly Chiwaukum Creek. 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 River and small tributaries such as Gold Creek.

Abundance

Historic. 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.

There were two previous attempts in the twentieth century to rebuild coho populations, although these two programs were not designed or intended to rebuild upriver runs—they were for harvest augmentation. Fish were not released in the natural production habitat areas in the watershed. Between the early 1940s and the mid 1970s, the USFWS raised and released coho as part of their mitigation responsibilities 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 may have occurred from these releases, the programs overall were not designed to reestablish naturally spawning populations. All coho releases under the CCPUD program (1971-1993) were made from the Turtle Rock Fish Hatchery, located in the middle of the Columbia River above Rocky Reach Dam. The release location likely contributed to the inability to produce a naturally spawning coho run. This reach of the Columbia River does not provide suitable coho spawning and rearing habitat.

Current. The Yakama Nation, as the lead agency, has implemented a feasibility study to evaluate coho reintroduction in mid-Columbia tributaries. Since the reintroduction of coho to the Wenatchee River in 1999, the abundance of adult returns has ranged between an estimated 350 to ~4,000 (Murdoch et al. 2004). Many of these fish are taken into the hatchery for broodstock development; the remainder have spawned 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 536 (Murdoch et al. 2004). Similar to the Wenatchee, many of the coho returning to the Methow River are either trapped for broodstock at Wells Dam or volunteer into Winthrop NFH. Spawning ground surveys are used to enumerate the numbers and distribution of naturally spawning coho in the Methow Subbasin.

Productivity

Historic. Historic production of coho salmon is difficult to determine, although it was most likely not as high as sockeye or late-run chinook in the Wenatchee (NPCC 2004a). Mullan (1984) estimated the historical coho run size to be 6,000 – 7,000 in the Wenatchee River and 23,000 – 31,000 in the Methow River. Historically, the Methow River produced more coho than chinook or steelhead (Craig and Suomela 1941 *in* NPCC 2004b).

Current. Current productivity is affected by loss or degradation of habitat in spawning and rearing areas, increased downstream mortality through the mainstem Columbia River, ocean conditions, and other abiotic factors (drought, etc.).

As described in the Wenatchee Subbasin Plan (NPCC 2004a), habitats in need of restoration within the Wenatchee basin include Nason, Icicle, Peshastin, Chumstick, and Mission Creeks. These areas lack habitat diversity, may have some passage obstructions, or have poor water quality (NPCC 2004a). Other areas within the Wenatchee subbasin proposed for coho reintroduction have good aquatic habitat and should be protected. The aquatic habitat in the Chiwawa River is in good condition with minimal development (NPCC 2004a). Development is constrained to the lower reach of the Chiwawa River. The White and Little Wenatchee rivers are among the healthiest watersheds in the Columbia Basin (NPCC 2004a).

In the Methow subbasin, habitat losses and associated loss of productivity have chiefly resulted from artificial and natural fish passage barriers, alteration and reduction of riparian habitat, loss of habitat connectivity, in-stream and floodplain habitat degradation, low flows and dewatering, and extreme water temperatures (NPCC 2004b). By improving habitat in known areas in need of restoration in both subbasins, it is reasonable to assume that production of coho would increase.

Diversity

Because hatchery stocks were used to reintroduce coho salmon (and to develop a local broodstock), spatial and life history diversity within the basin is likely lower than the historic populations of coho salmon. For restoration programs, where the population will be perpetuated from the original founders, collecting a minimum of 50 individuals for broodstock is commonly recommended in the conservation literature to prevent detrimental effects of inbreeding depression. As increased natural production occurs, incorporating naturally produced coho into the broodstock will maintain the effective population size and will encourage genetic diversity (Miller and Kapuscinski 2003). Increased habitat would most likely increase spatial and life history diversity for coho salmon in mid-Columbia tributaries.

Table 2-1. Wenatchee subbasin coho population characterization

	Distribution	Abundance	Productivity	Divsersity
Historic	High	Mod-high	Moderate	High
Current	Low	Low	Low	Low

Historical pictures of the native Methow coho indicate the fish were equal in size to the spring chinook (Mullan et al. 1992b).

Key Life History Strategies: Relationship to Habitat

Time of entry and spawning

Coho salmon enter the Wenatchee and Methow subbasins in early September through late November. Adults ascend the tributaries in the fall and spawn between mid-October and late December, although there is historical evidence of an earlier run of coho salmon (Mullan 1984).

Prespawning

Coho entering in September and October hold in larger pools prior to spawning; entering fish entering later may migrate quickly upstream to suitable spawning locations. The availability and number of deep pools and cover is important to offset potential pre-spawning mortality. Intact riparian habitat will increase the likelihood of instream cover, and normative channel geofluvial processes will increase the occurrence of deeper pools.

Redd characteristics

Clean gravel at the appropriate size and proper water depth and velocity are needed for redd building. Burner (1951) reported the range of depths for coho spawning to be between 8 and 51 cm. Coho spawn in velocities ranging from 0.30 to 0.75 m/s and may seek sites of groundwater seepage (Sandercock 1991).

Incubation and emergence

The length of time required for eggs to incubate in the gravel largely depends on temperature. Sandercock (1991) reported that the total heat requirement for coho incubation in the gravel (spawning to emergence) was 1,036 degree days over zero degrees C (±138 days). The percentage of eggs and alevins that survive to emergence depends on stream and streambed conditions. Fall and winter flooding, low flows, freezing of gravel, and heavy silt loads can significantly reduce survival. In the Wenatchee basin, fall flooding has a high frequency of occurrence. This may negatively affect incubation and emergence success, especially in years of extreme flow. Road building activities in the upper watersheds may also increase siltation, as well as grazing and mining activities. All three factors were once more prevalent than they are now in the basins, and the conditions have improved in most watersheds. Coho fry emerge from the gravel in April or May (K. Murdoch, personal communication).

Fry

Juvenile coho salmon generally distribute themselves downstream shortly after emergence and seek out suitable low gradient tributary and off channel habitats. They congregate in quiet backwaters, side channels, and shady small creeks with overhanging vegetation (Sandercock 1991).

Parr

Coho salmon prefer slower velocity rearing areas than chinook salmon or steelhead (Lister and Genoe 1970; Allee 1981; Taylor 1991a). Recent work completed by the Yakama Nation supports these findings (Murdoch et al. 2004). Juvenile coho tend to over-winter in riverine ponds and other off channel habitats. Over-winter survival is strongly correlated to the quantity of woody debris and habitat complexity (Quinn and Peterson 1996). Conservation of and restoration of high functioning habitat in natal tributaries along and restoration of riparian and geofluvial processes in or near known and potential parr rearing areas will have the highest likelihood of increasing parr survival.

Smolt

Naturally produced coho smolts in the Wenatchee and Methow subbasins emigrate between March and May (Murdoch et al. 2004).

2.3 Status of Other Anadromous and Resident Fish in the Subbasins

2.3.1 Steelhead

Background

Upper Columbia River tributaries were once productive wild summer steelhead systems, but the populations have declined significantly since the early 1900s. The intensive commercial fisheries in the late 1800s and industrial development of the Columbia River were largely responsible for the decline of the wild steelhead run (Mullan et al. 1992; Chapman et al. 1994b). Unlike chinook and sockeye salmon catches, steelhead harvest remained fairly constant from the early 1900s through 1940 at about 300,000 fish. Between 1938 and 1942, lower river commercial fisheries, including tribal fisheries within Zone 6, took about 70% of the run. Curtailing the commercial fisheries resulted in a resurgence of wild steelhead productivity in the upper Columbia River region, where the run size tripled (5,000 fish to 15,000 fish) between 1941-1954 (Mullan et al. 1992). Sale of steelhead by non-Indians was prohibited beginning in 1975. Subsequent to the dramatic increase, escapement has fluctuated widely. When the wild productivity declined again with completion of the Columbia River hydropower system, hatchery steelhead had replaced natural production in the run counts, masking the gravity of the change in wild fish production. Wild fish were subjected to, and suffered as a result of, mixed stock fisheries in the lower Columbia River directed at their abundant hatchery cohort. And, while the hatchery steelhead could sustain the relatively high harvest rates, their wild counterparts could not.

Hatchery fish made up an increasing fraction of the steelhead run after the 1960s, as wild runs were already depleted (Chapman et al. 1994b). Mullan et al. (1992) spawner-recruit analysis calculated the maximum sustainable yield (MSY) run size and escapement for steelhead at Rock Island Dam to be 16,000 - 19,000 and 4,000 – 7,000, respectively. When hatchery produced steelhead are combined with the naturally produced steelhead, no long-term declining trend is evident. However, naturally produced steelhead currently exist only at threshold levels.

ESA listing status

Upper Columbia River summer steelhead were listed as Endangered in August 1997 because the naturally spawning population was not replacing itself. Hatchery fish in the region, derived from local populations, were included in the listing because they are necessary to achieve recovery.

Current management strategy

Artificial production programs, using locally adapted summer steelhead were fully implemented by the late 1960s. External marking of all hatchery steelhead was implemented in 1987, allowing non-tribal fisheries to increase harvest rates on the component of the run that could sustain it, while providing more protection to the beleaguered wild component. Current artificial production programs focus releases into the Wenatchee, Methow and Okanogan systems, although the Entiat River received a portion of the hatchery steelhead up through 1998. Since the success of supplementation through artificial propagation remains equivocal, NMFS requested at least one stream in the region be treated as a reference stream, essentially eliminating all hatchery released steelhead. The Entiat River was chosen as the reference stream for the region because of the relatively small number of steelhead released annually (<50,000 fish), the limited public access in comparison to the other rivers, and the greater potential to account for changes in productivity based upon a more refined natural production area in the other systems.

Wild steelhead returning to the upper Columbia River region sustain themselves only at threshold population size today. The high hatchery return rate, genetic homogeneity of hatchery and wild steelhead (Chapman et al. 1994b), and maintenance of near MSY levels in most years suggest a truly wild fish does not exist. Rather, natural production sustains them, and without hatchery supplementation, the steelhead would suffer dire consequences.

All the artificial production programs operating in the region are intended to contribute to recovery of the naturally produced component as well as provide selective harvest opportunities.

Escapement objectives

The run size needed at Priest Rapids Dam to meet minimum escapement objectives for the tributary streams of the region totals 9,550 adults. The 9,550 fish run size is intended to provide a minimum of 2,500 natural spawners in the Wenatchee River, 2,500 natural spawners for the Methow River, and 600 natural spawners for the Okanogan River. Although the total run size is managed as a composite of hatchery and wild fish, because conservation and recovery of the Evolutionarily Significant Unit (ESU) is critical, embedded within the total run size is the requirement to achieve at least 1,300 wild (naturally produced) summer steelhead.

2.3.2 Spring Chinook

Background

The numbers of spring chinook that entered the Columbia River in the years immediately following the construction of Bonneville Dam (1938) averaged less than 102,000 (Chapman et al. 1995a). Numbers of spring chinook passing Rock Island Dam in the late 1930s and 1940s were likely depressed from years of over fishing. Runs increased in the 1950s, partly in response to reduced harvest rates. However, reduced harvest rates occurred concomitant with the hydropower development era, essentially reducing production of spring chinook from the upper Columbia. Spring chinook counting at Rock Island Dam (1933) began in 1935, and the numbers for the period 1935 – 1938 were less than 3,000 fish per year. Adult counts of spring chinook passing dams upstream of Priest Rapids Dam fluctuated extensively in the years following, but reached a peak of about 27,000 fish in the mid-1980s, a period of high ocean productivity. Escapements dropped precipitously in the six years following the peak, rose again in 1992 and 1993, but dropped to less than a few hundred in 1995 when ocean productivity dropped.

PUD-funded programs began comprehensive operation in the late 1980s and early 1990s. The focus of these programs was to increase the number of adult spring chinook spawning naturally by using locally adapted spring chinook, i.e., supplementation.

ESA listing status

Spring chinook from the upper Columbia River region was listed as Endangered under the ESA in March 1999. Three populations of spring chinook are recognized within the ESA listing; Methow, Entiat and Wenatchee. All three have established recovery levels, and collectively will need to meet or exceed these levels for the ESU to achieve recovery. In addition to the ESA listing of the natural origin spring chinook, hatchery origin spring chinook derived from local populations were included within the listing since they were deemed necessary to achieve recovery. Carson NFH-origin spring chinook continue to be reared at the Leavenworth and Entiat federal facilities. These fish are not included in the listing, and are therefore not subject to ESA management constraints.

Current management strategy

The WDFW operates several hatcheries and/or their satellite facilities above Priest Rapids Dam to produce spring chinook smolts for release into the Chiwawa, Chewuch, Methow and Twisp rivers. Commensurate with hydropower dam relicense requirements through the Federal Energy Regulatory Commission (FERC), the Wenatchee basin spring chinook smolt release number total is expected to increase, as well as expand to other tributaries, namely Nason Creek and the White River.

Current programs, as well as anticipated programs, reflect the origin of adults used for brood fish to produce the subsequent progeny. A supplementation strategy, using wild fish in the broodstock, is used with the goal of increasing the number of adults successful at spawning naturally.

Escapement objective

Spring chinook natural spawning escapement objectives for the principle tributaries to the upper Columbia River region include about 4,100 for the Wenatchee, 500 for the Entiat, and 2,000 for the Methow. These numbers are also consistent with carrying capacity or recovery requirements. In addition to the natural spawning escapement, artificial production requirements total almost 2,600 adults, including the federal facilities. Minimum run size necessary at Priest Rapids Dam to achieve the 9,200 fish natural escapement and brood stock goals is 16,000 spring chinook.

2.3.3 Upper Columbia Sockeye

Background

Sockeye in the Columbia River upstream from the confluence of the Snake River historically inhabited the lakes of the Yakima basin, Lake Wenatchee, lakes upstream and including Lake Osoyoos in the Okanogan basin, and the Arrow Lakes in British Columbia (headwaters to Columbia River). Construction of impassable dams, removal of water for irrigation, hydropower operations, and overfishing significantly altered the historic distribution of sockeye upstream of the Snake River, such that Lake Wenatchee and Lake Osoyoos retain the only current populations.

Since 1938, the percentage of sockeye destined for waters upstream of Rock Island Dam has been reported to vary from less than 1% (1941) to greater than 95% (1979) of the total that entered the Columbia River (Chapman et al. 1995b). Although in some years the escapement has been significantly altered by harvest in the lower Columbia River, i.e., in the mid-1980s, the percentage as a total of the run to the mouth of the Columbia River has grown steadily to generally exceed 90%. The percentage of adults returning to Lake Wenatchee and Lake Osoyoos has varied considerably from the total at Rock Island Dam. Historically, the Lake Wenatchee population outnumbered the Lake Osoyoos population. However, since the early 1960s and with the exception of 2002, the percentage of sockeye destined for Lake Osoyoos has been greater than the percentage destined for Lake Wenatchee. More recent counts have shown the Lake Osoyoos population to generally represent 60 – 75% of the count at Rock Island Dam. However, the percentage of adults observed on the spawning grounds has not comported well with the number of fish counted at different dams. Spawning ground surveys in both basins have often been able to account for only 50 – 70% of the dam counts. A variety of reasons could contribute to this disparity, including: 1) inflated dam counts due to a high rate of fallback, 2) inefficiencies of the spawning ground surveys as they relate to the ability to accurately account for total escapement, and 3) high pre-spawning mortality (conceivably a factor for the Lake Osoyoos population).

Historical artificial production programs were supported by the USFWS, but sockeye were not a dominant species cultured; by the 1960s, no artificial production of sockeye was occurring within the region. In 1990, the WDFW began operation of a small artificial production program (200,000 smolts) for sockeye from Lake Wenatchee as part of the Rock Island Settlement Agreement and now the new Mid-Columbia River Habitat Conservation Plan (HCP).

ESA listing status

Upper Columbia River sockeye are not currently listed under the federal ESA. The stock status for the Wenatchee population was rated as depressed by WDFW in 2002 because of short-term severe declines escapements in 1998 and 1999. The spawning escapement goal for this stock is 23,000 fish. Despite a significant improvement in the 2000 and 2001 returns, the stock has been at less than half the goal from 1994 to 1999.

Management strategy and escapement objectives

The natural and hatchery populations of sockeye originating from the Wenatchee and Okanogan basins are managed for natural spawning escapement goals of 23,000 fish over Tumwater Dam in the Wenatchee basin.

Recreational fisheries will be implemented when the run size exceeds (or is expected to exceed) 25,000 sockeye at Tumwater Dam. The Lake Wenatchee population is the only one that has an artificial production program associated with it. The current artificial production program of 200,000 smolts annually is support by CCPUD as part of the Mid-Columbia River HCP (formerly part of the Rock Island Settlement Agreement). This program is slated to change, and likely increase, consistent with the recently signed Mid-Columbia River HCP, which replaces the Rock Island Settlement Agreement.

2.3.4 Upper Columbia Summer/Fall Chinook

Summer/fall chinook are not considered NTTOC as it relates to coho restoration. The Upper Columbia River summer chinook aggregate population is healthy and not ESA listed. The population(s) was proposed for listing in the early 1990s, but a final determination by NOAA Fisheries concluded a listing was not warranted. Total spawner abundance has continued to increase from the low levels experienced in the early 1990s to the currently strong returns.

2.3.5 Bull Trout

Background

Bull trout (*Salvelinus confluentus*) are members of the char subgroup of the family Salmonidae. Bull trout range throughout the Columbia River and Snake River basins, extending east to headwater streams in Montana and Idaho, into Canada and in the Klamath River basin of south-central Oregon. Distribution of the population is scattered and patchy (USFWS 2005). Bull trout exhibit a number of life-history strategies. Stream resident bull trout complete their entire life cycle in the tributary streams where they spawn and rear. Most bull trout are migratory, spawning in tributary streams were juvenile fish typically rear for one to four years prior to migrating to either a larger river (fluvial) or lake (adfluvial), where they spend their adult life, returning to the tributary stream to spawn (Fraley and Shepard 1989).

For the purposes of recovery, the Upper Columbia Recovery Unit Team has identified three core areas, including the Wenatchee, Entiat, and Methow rivers. Within each core area many local populations may exist.

Within the Wenatchee Core Area, bull trout are dispersed throughout the basin with the strongest populations centered around Lake Wenatchee and the Chiwawa River (WDFW 1998). The Draft Recovery Plan (Chapter 22 - Upper Columbia Recovery Unit) identifies 6 migratory local populations within the Wenatchee River; these local populations include the Chiwawa River (including tributaries), White River, Little Wenatchee River (below the falls), Nason Creek (including Mill Creek), Chiwakum Creek and Peshastin Creek (including Ingalls Creek). Resident, fluvial, and adfluvial bull trout currently exist in the Wenatchee River Core Area (WDFW 1998). Resident bull trout occur in Icicle Creek above the barrier falls, and migratory bull trout are known to frequent the area below the falls. The Chiwawa River local population complex is the stronghold for bull trout in the upper Wenatchee (WDFW 1998). Adult bull trout 46 to 61 centimeters in length have been found throughout the river. Whether these migratory fish are fluvial (from the mainstem Chiwawa River, Wenatchee River, or Columbia River), adfluvial fish from Lake Wenatchee, or a combination is not known.

Within the Methow Core Area bull trout are known to occur in Gold Creek, Twisp River, Chewuch River, Wolf Creek, Early Winters Creek, Upper Methow River, Lost River, and Goat Creek. The WDFW classifies the status of bull trout in the Lost River as “healthy” but the remaining bull trout in the Methow River are classified as “unknown” (WDFW 1998). Within the Methow River adfluvial, fluvial and resident life history forms are present. The largest populations of migratory bull trout occur in the Twisp River, Wolf Creek, West Fork Methow River, and Lost River. The overall status and distribution of resident bull trout with in the Methow River is unknown (Draft Bull Trout Recovery Plan).

Overall, bull trout in the Wenatchee, Entiat, and Methow core areas persist at low abundance with the population in the Chiwawa River. Since 1999, estimates of spawning adults in the Chiwawa River have ranged between 246 and 462 (from the Draft Bull Trout Recovery Plan). Results from the 2001 redd surveys in the Wenatchee Core Area indicate that the annual spawning population is probably less than 1000 individuals and should be considered at risk of genetic drift. Seven of the local population in the Methow Core Area are mostly under 100 adults annually and are at risk of inbreeding depression. Based on available information, adult spawning abundance in the Methow Core Area is probably less than 1000 adults.

Reasons for decline of bull trout include historic and current land use actives. Some of the activities, especially water diversions, hydro power development, forestry and agriculture within core areas may have significantly reduced important fluvial populations (Draft Recovery Plan).

Declines in salmon species (including the extirpation of coho salmon) have decreased the forage base for bull trout. In addition to decreasing prey availability, the decline of salmon and steelhead reduced a historic energy source coming into the basin through the dying and recycling of nutrients from adult carcasses, eggs and juveniles.

ESA listing status

The USFWS issued a final rule listing the Columbia River and Klamath River populations of bull trout as a threatened species under the ESA on June 10, 1998 (63 FR 31647). The Upper Columbia Recovery Unit encompasses the geographic area from the Yakima River upstream to Chief Joseph Dam. The recovery unit includes the Enitat, Wenatchee, Methow, Chelan, and Okanogan basins, and the mainstem Columbia River.

Although proposed as Critical Habitat, the final rule, published on September 26, 2005 (USFWS 2005), excluded the all proposed critical habitat in the upper Columbia subbasin, including the Wenatchee and Methow rivers.

Current management strategy

The goal of the bull trout recovery plan is to ensure the long-term persistence and self-sustaining, complex, interacting populations of bull trout distributed across the native range of the species so that they can be delisted. To achieve this goal, the following objectives have been identified for bull trout in the Upper Columbia Recovery Unit (from the Draft Recovery Plan): 1) maintain the current distribution of bull trout and restore distribution in previously occupied areas within the Upper Columbia Recovery Unit, 2) maintain increasing trends in abundance of bull trout, 3) restore and maintain suitable habitat conditions for all bull trout life history stages and strategies, and 4) conserve genetic diversity and provide opportunities for genetic exchange.

Recovered abundance levels in the Upper Columbia Recovery Unit were determined by considering theoretical estimates of effective population size, historical census information and professional judgment of the recovery team.

Recovery criteria for bull trout in the upper Columbia Recovery Unit are as follows:

1) Distribution criteria will be met when bull trout are distributed among at least 16 local populations in the Upper Columbia Recovery Unit.
2) Abundance criteria will be met when the estimated abundance of adult bull trout among all local populations in the Upper Columbia Recovery Unit is between 6,322 to 10,426 fish.
3) Trend criteria will be met when adult bull trout exhibit a stable or increasing trend for at least two generations at or above the recovered abundance levels within the Wenatchee, Entiat and Methow core areas.
4) Connectivity criteria will be met when specific barriers to bull tout migration in the Upper Columbia Recovery Unit have been addressed.

2.4 Status of Habitat

Habitat in these basins has been evaluated and described using several methods. Section 2.4.1 summarizes habitat descriptions from the Wenatchee and Methow subbasin plans. Using these descriptions, Section 2.4.2 evaluates habitat using the NPCC habitat condition criteria (NPCC 2000). Section 2.4.3 presents the EDT analysis of the Wenatchee and Methow subbasins.

2.4.1 Habitat Descriptions from Subbasin Plans

2.4.1.1 Wenatchee Subbasin Habitat Description

The Wenatchee subbasin contains some of the most pristine habitat in the Columbia River Basin (NPCC 2004), while also experiencing considerable habitat degradation in some drainages. The subbasin is very diverse in elevation and environmental conditions. Quality Habitat Assessment (QHA) was used during the subbasin planning process to provide a structured qualitative approach to analyzing the relationship between the focal species and habitat conditions. For the assessment, the Wenatchee subbasin was divided into 11 Assessment Units that included the lower (mouth to Tumwater Canyon) and middle Wenatchee River (Tumwater Canyon to Lake Wenatchee) and tributaries: Mission Creek, Peshastin Creek, Chumstick Creek, Icicle Creek, Nason Creek, Chiwawa River, White River, Little Wenatchee River and Lake Wenatchee. The status of the habitat described below was summarized from the Wenatchee Subbasin Plan (NPCC 2004a).

Lower Wenatchee River

The lower portion of the Wenatchee River begins at RM 25.6 (below Tumwater Canyon) and flows southeasterly from the town of Leavenworth to the Columbia River. Settlement along the Wenatchee River began in 1890 with the construction of the Great Northern Railroad along the Wenatchee River. This was followed by floodplain development, irrigation diversion structures and bank armoring. Over a century of development has reduced in-stream large woody debris (LWD) and LWD recruitment, and reduced side channel/wetland habitat as well as the opportunity for development of side channel/wetland habitat. To varying degrees the altered riparian and channel conditions have also reduced pool frequency, increased bank erosion, possibly increased channel entrenchment and altered stream flows. Stream diversions and well withdrawal from shallow aquifers in the floodplain probably have the greatest influence on low stream flows. Channel confinement, channelization, and riparian and upland land use impacts probably have the greatest influence on peak flow timing and duration.

Middle Wenatchee Assessment Unit

The middle Wenatchee assessment unit includes the mainstem Wenatchee River from Tumwater Canyon (RM 25.6) to Lake Wenatchee (RM 54). Within Tumwater Canyon, the river character has been modified over time by railroad construction, dam construction, log drives, and highway construction. During railroad construction in the 1800s, the canyon bottom was narrowed and large boulders were removed, possibly resulting in channel degradation (Andonaegui 2001). Tumwater Dam at RM 31, built in the early 1900s, has altered channel bed grade and substrate content above and below the structure, creating Lake Jolanda. Log drives in the early 20th century removed LWD in the channel and blasted boulders from the channel to facilitate log drives. Within the Wenatchee River upstream of Tumwater Canyon, channel complexity and riparian condition has been altered over time from historic log drives and floodplain and streamside development. Results of these activities include reduced riparian and wetland connectivity, a loss of aquatic species connectivity through wetlands, reduced high flow refuge, reduced sinuosity and side channel development, increased bank erosion, reduced single pieces and complexes of LWD, reduced pool frequency, and a reduction in channel roughness. Anthropogenic factors affecting the upper Wenatchee subbasin include private home building and associated private land development; timber harvest on both private and federally owned lands, faming and associated land conversion, and the construction of state highways, county roads and logging roads.

Mission Creek

Mission Creek drains a 59,712 acre watershed located approximately 10 miles west of Wenatchee. Mission Creek flows 9.4 miles before emptying into the Wenatchee River (RM 10.4) at the town of Cashmere. Mission Creek is considered the most polluted water body in the Wenatchee River subbasin. Cumulative disruption of both stream channel and upland habitat throughout the watershed, except in the Devils Gulch reach of Mission Creek, has resulted in a declining population of salmonids since the mid 1880s (Rife 1999). Conditions that limit rearing habitat in the watershed include dewatering, low flows, and high in-stream temperatures (Andonaegui 2001). Diversion dams and culverts also create fish passage barriers that reduce access to spawning and rearing habitat. Floodplains have been separated from the stream channels and channels have been altered by forest roads, urban, agricultural and residential development. Channelized streams have eliminated or reduced woody riparian vegetation to a narrow band of mostly shrubs with some mature trees. Water quality in Mission Creek is poor. Mission Creek is on the WDOE 1998 303(d) list for temperature, low dissolved oxygen, high fecal coliform and pesticide counts. Water quantity in Mission Creek is also poor; the watershed is on the 303(d) list for low in-stream flows.

Peshastin Creek

Peshastin Creek originates near Swauk Pass and flows north, entering the Wenatchee River downstream of the town of Peshastin at RM 20. Ingalls Creek is the largest tributary to Peshastin Creek. The loss of channel sinuosity, floodplain function and riparian habitat (including off channel habitat) within the channel migration zone of Peshastin Creek has had the greatest effect on salmon production. Channel confinement resulting from the improvement of State Route 97 has reduced spawning habitat for salmon and steelhead and has also reduced juvenile rearing habitat for all salmonid species, especially over-wintering habitat. Floodplain and riparian habitat function have been reduced by residential and agricultural development, timber harvest and mining activity that has been active in various forms for over 100 years. Low LWD counts further reduce habitat quality. Peshastin Creek has been added to the current 303(d) list for exceeding temperature requirements and is considered “poor” by Forest Plan standards. Peshastin Creek is also included on the WDOE 1998 303(d) list for low in-stream flows.

Chumstick Creek

The Chumstick watershed is oriented in a north-south direction, with tributaries entering from the north and east. Chumstick Creek flows south into the Wenatchee River at RM 23.5, at the east end of the town of Leavenworth. Chumstick Creek once supported a population of summer steelhead, coho and possibly spring chinook salmon. Land development and use on both public and private land have created poor habitat conditions for most stream attributes. Railroad logging began in Chumstick valley in 1910 when the Lamb-Davis Timer company finished laying 26 miles of track from Leavenworth to Plain. In later years the track was removed and used as the base for Highway 207. Many degraded habitat attributes can be linked to channel confinement resulting from road density and construction, loss of floodplain connectivity and alteration of disturbance regimens. Additionally, in-stream flows are very low, upstream access is blocked by multiple stream crossing and impoundments, water quality is degraded, and high-fine sediments may limit spawning success and food production by macro-invertebrate communities. The Chumstick Creek drainage has bee identified as one of the more problematic watersheds in the Wenatchee subbasin relative to land-use impact and management issues. Even if fish passage is restored, degraded habitat quality and low flow conditions will continue to limit salmon production. Chumstick Creek is on the WDOE 303(d) list for dissolve oxygen, fecal coliform, pH, and low in-stream flow.

Icicle Creek

Icicle Creek originates high in the Cascade Mountains and is a 5th order stream. Icicle Creek drains a 214 square miles in North Central Washington. Icicle Creek flows east 31.8 RM before emptying into the Wenatchee River at RM 25.6 in the city of Leavenworth. From the USFS wilderness boundary to the headwaters, aquatic habitat closely resembles historic conditions. Floodplain connectivity and riparian habitat below the wilderness boundary have been altered through the construction of roads, campground development, timber harvests and private development. Habitat alteration increase dramatically below RM 2.8, primarily from streamside development and channel confinement. Bank stabilization, flood control, and loss of riparian habitat limits the streams ability to adjust to sediment, debris and high flows. This loss of function exacerbates bank destabilization in a naturally mobile stream section which in turn contributes additional sediment to the stream channel. Decreased in-channel complexity from the loss of LWD degrades channel conditions in the lower 2.8 miles (Andonaegui 2001). Leavenworth National Fish Hatchery (LNFH) structures block anadromous migration beginning at RM 2.8. The LNFH intake diversion dam is a fish passage barrier at low flows. The Icicle-Peshastin Irrigation District diversion dam at RM 5.7 may also hinder upstream fish passage at low flows (Mullan et al. 1992). Fish screens at the District and LNFH diversion do not meet current NMFS criteria and require updating. Changes in the historic channel's flow regime have caused sediment accumulation and vegetation encroachment. As a result, the historic stream channel has evolved from riverine to wetland. These issues are currently being addressed and are slated for construction in 2006. Once completed, the LNFH and the irrigation withdrawal will be in compliance with NOAA Fisheries and USFWS requirements under Section 7 of the ESA.

Nason Creek

The headwaters of Nason Creek lie in the eastern slopes of the Cascade Mountains. Nason Creek flows east out of Lake Valhalla (4,830 feet elevation) for approximately 21 miles and empties into the Wenatchee River at RM 53.6 just below Lake Wenatchee. Habitat in Nason Creek has been altered by human activities including railroad development, road building, channel straightening, timber harvest, and private development; the lower 15 miles of Nason Creek contain the most habitat features in poor condition. Due to a natural fish barrier, Gaynor Falls, this reach also contains all the anadromous salmonid spawning habitat and is a key corridor for connectivity of sub-watersheds. Low in-stream flows are common in August and September, a natural condition related to snow accumulation and snow melt patterns (Andonaegui 2001).

Little Wenatchee River

The Little Wenatchee River is a 4th order stream draining a 64,794-acre watershed. The Little Wenatchee River flows southwest for 25 miles and empties into Lake Wenatchee. The Little Wenatchee River is among the healthiest watersheds in the Columbia basin (NPCC 2004). Several moderate habitat concerns exist, however. Most of the concerns occur in and below areas of extensive timber harvest (Andonaegui 2001; USFS 1998). Most timber harvest in the Little Wenatchee River corridor has occurred from the mouth upstream to Cady Creek (RM 0.0-16.9) and in the Rainy Creek drainage. In these areas, the potential for LWD input has decreased. Moderate road densities of 2.4 mi/sq mile and harvest activities may also contribute to high stream temperatures by increasing runoff and decreasing water storage potential (Andonaegui 2001). During the 1970s, biologist were concerned that LWD complexes created fish passage barriers in the lower few miles of the river. They made several attempts to remove the complexes, although wood kept accumulating in the same locations (Andonaegui 2001; Mullan et al 1992; USFS 1998). A stream survey conducted in 2000 concluded that LWD levels below RM7.8 had good quantities of LWD present in the channel (Andonaeaui 2001). Pool frequency, depth and quality is considered good (Andonaegui 2001).

White River

The White River is a 5th order stream. The drainage encompasses 99,956 acres and originates in alpine glaciers and perennial snow fields. The White River flows south-southeast for the majority of its length (26.7 RM). Two large tributaries, Napeequa (RM 11.0) and Panther (RM 13.1) creeks, support anadromous salmonids. The White River drainage is among the healthiest in the Columbia basin (NPCC 2004). Several habitat concerns, however, exist (USFS 1998; Andonaegui 2001). The mainstem below the wilderness boundary has had some alteration; consequently, many habitat indicators are in only fair condition. The most altered are in the lower watershed below Panther Creek. Changes have resulted from floodplain development and impacts on riparian areas from historic cedar logging and roading. On private lands development of homes and vacation retreats is occurring (USFS 2004). The mainstem below White River Falls is a key spawning and migration corridor for anadromous salmon. The White River still maintains high quality, complex habitat with refuge and rearing habitat for multiple life stages and life histories. The watershed is well connected to adjacent high quality habitat in Lake Wenatchee and the Chiwawa River that provide refuge during disturbance events. The floodplain is in good condition.

Chiwawa River

The Chiwawa River originates from 5 glaciers on the southwestern slopes of the Entiat Mountains and flows southeasterly for 37 miles to its confluence with the Wenatchee River near the town of Plain. The Chiwawa River is a 5th order stream. Overall the Chiwawa watershed is in good condition. Development is minimal compared to most other watersheds in the Wenatchee subbasin and is constrained to the lower areas of the watershed. The lower Chiwawa River has several activities that can potentially influence watershed conditions, including high road density, road location, private land development, forest practices, and a water diversion. Road concerns occur mainly in the lower mainstem and Meadow Creek. In the upper watershed, there is no indication that frequency, size or intensity of natural disturbance events has changed other than alteration of the fire cycle through fire suppression. Channel conditions for much of the upper Chiwawa are presumed to be near historic conditions since floodplain connectivity remains intact and channel condition has had only minor alteration. In the lower Chiwawa River, log drives occurred until the mid-1930s. Although channel conditions have repaired considerably since that time, some evidence of in-channel degradation remains. Chiwawa wetlands and off-channel habitat in the watershed are in good condition (USFS 2003). The valley floor has an extensive network of ponds, beaver canals, side channels, abandoned oxbows and other wetlands. Abundance diversity, connectivity and quality of these wetlands is high.

2.4.1.2 Methow Subbasin Habitat Description

The Methow River basin is comprised mostly of large tracts of relatively pristine habitat. Topography varies from mountainous alpine terrain at elevations of 8,500 feet to gently sloping wide valleys down to an elevation of 800 feet. This diverse habitat supports well over 300 species of fish and wildlife (NPCC 2004b). The Methow Subbasin Plan (NPCC 2004b) reports that Methow basin habitat losses have resulted chiefly from artificial and natural fish passage barriers, alteration and reduction of riparian habitat, loss of habitat connectivity, in-stream and floodplain habitat degradation, low flows, and dewatering.

Lower Methow River

The lower Methow River includes the Methow mainstem and its tributaries from the town of Carlton to the mouth of the Methow River. Agriculture uses in this sub-watershed are primarily field crops and cattle at the upper end, with orchards along the lower end. This reach provides rearing habitat and acts as a migration corridor for all anadromous salmonids. Timber harvest, livestock grazing and high road densities characterize much of the Libby Creek drainage, with roads running parallel to every major stream. The lower 2.9 miles of Libby Creek has been channelized. Culverts and irrigation diversion structures impede salmonid passage on a number of tributaries. Upstream passage for salmonids is also limited by heavy beaver activity in some tributaries. Timber harvest, livestock grazing and elevated road densities also characterize Gold Creek. The lower 3.5 miles of Gold Creek have had riprap placed along the banks. Gold and Libby Creeks are characterized by low in-stream flows, and Gold Creek dewaters in a lower reach between RM 3 and RM 2 during some low-water years.

Middle Methow River

The middle Methow drainage includes the mainstem Methow from its confluence with the Chewuch River to the town of Carlton. County roads and state highways parallel both sides of the Methow River throughout this reach. Diking, conversion of riparian area to agriculture and residential uses and LWD removal along the mainstem Methow River have resulted in loss of side channel access, riparian vegetation, and overall habitat complexity. Much of the habitat within this area has not been adequately inventoried or assessed, and data gaps exist regarding the extent of habitat alterations. The Methow Valley Irrigation District diverts water to its east canal, about five miles north of the town of Twisp at RM 44.8.

Upper Methow River

The upper Methow River drainage includes the mainstem Methow from its headwaters to the Chewuch River (RM 50.1). Major tributaries in the drainage include Goat Creek, Wolf Creek, Hancock Creek, Little Boulder Creek, Dawn Creek, Gate Creek, Robinson Creek, Rattlesnake Creek and Trout Creek. Methow mainstem habitat between the Lost River confluence and Winthrop has been greatly affected by human activity. The river has a low gradient throughout this reach, and a number of dikes block assess to valuable side-channel spawning and rearing habitat. The floodplain is constrained by those dikes as well as by rip-rapping and bank stabilization measures. Riparian habitat has been converted to agricultural use, and more recently and increasingly, to residential use along the mainstem between the Early Winters confluence and the Mazama bridge, which in some areas has resulted in bank erosion. Historic timber harvest activities, fire, livestock grazing, and construction of logging roads throughout the lower reaches of the Goat Creek and Wolf Creek drainages have also resulted in large sediment loads in the Methow River. Improvement in grazing practices in this sub-watershed and in other areas of the basin has helped reduce the current impact of livestock grazing. The amount of sediment delivered to creeks and streams from natural occurrences has not been quantified relative to the amount of sediment contributed through human use.

Twisp River

The Twisp River flows into the Methow at the town of Twisp. A substantial portion of the Twisp river sub-watershed lies within designated wilderness and is in nearly pristine condition. Most human activity and related habitat changes within the drainage have taken place in the lower 15 miles of the Twisp River. Reduced levels of LWD, road placement, diking, bank hardening, and conversion of riparian areas to agriculture and residential uses have altered habitat conditions in this area, resulting in the loss of channel complexity and floodplain function. There are seven irrigation diversions on the Twisp River. The Twisp River from Buttermilk Creek to the mouth has been diked and rip-rapped in places, resulting in a highly simplified channel and disconnected side channels and associated wetlands. Levels of LWD recruitment potential in the lower Twisp River are below normal.

Beaver Creek

Beaver Creek drains into the Methow River five miles downstream from the town of Twisp. Previously, anadromous salmonids have had limited access to Beaver Creed due to its many obstructions. Most of these diversions have been removed or are in the process of being modified for passage. Road density in the Beaver Creek drainage is the highest in the Methow subbasin. Extensive timber harvest has occurred in the Beaver Creek drainage since the 1960s, resulting in heavy sediment loading, slop destabilization, and reduction in recruitment potential for LWD (USFS 2000a). Limited grazing activity has also contributed to stream sediment delivery in this Beaver Creek. In low-water years, Beaver Creek goes dry in the fall, except in the uppermost reaches and in the lowest 0.3 mile, which maintain flows via irrigation return.

Chewuch River

The Chewuch River enters the Methow at the town of Winthrop. The majority of the human impact has occurred in the lower half of the drainage, with the upper 50% remaining generally undisturbed. Five ditches divert water within the Chewuch sub-watershed, and two roads parallel segments of the Chewuch. Low flows in late summer through winter reduce quantity of rearing habitat in the lower Chewuch River. High water temperatures in the lower river may at times cause a migration barrier. Extensive riprap for flood control associated with residential development has also occurred in the lower eight miles of the Chewuch as well as along several tributaries. The drainage's upper reaches are characterized by harsh winters and icing.

Early Winters Creek

Early Winters Creek enters the Methow about 3.5 miles upstream from the town of Mazama. The majority of the watershed is in relatively pristine condition. Human impacts are primarily restricted to the lower two miles of Early Winters Creek, including its alluvial fan. The lower half-mile has been rip-rapped and diked to keep the channel in a stable location in order to accommodate Highway 20 and to protect private property. Levels of LWD in the first two miles are low, and pool quality and quantity is poor. Severe low flows persist in the lower 1.4 miles of the creek. Low base flows are naturally occurring during the winter months; however, low flows during the late summer and early fall may be exacerbated by two irrigation diversion (USFS 1998b). In 2000 and 2001 the USFS completed a restoration project on this reach of the creek. The restoration included an increase of LWD, pools and quality habitat. The Early Winters Ditch on Early Winters Creek is currently meeting NMFS and USFWS target flow of 35 cfs for spring chinook and bull trout, and the irrigation district is using wells that are not in continuity with groundwater and surface water to meet the remainder of its irrigation needs. Fine sediment and chemical runoff from state Route 20 may negatively affect water quality.

Wolf Creek

Wolf Creek, a Methow River tributary, drains the Methow about 3 miles above the town of Winthrop. Approximately 80% of the drainage is designated wilderness with very good habitat conditions. The Forest Service manages the remainder of the drainage for multiple uses with exception of the last 1.5 miles, which is privately owned. Impacts from timber harvest and roads are limited primarily to the Little Wolf Creek drainage. Introduction of woody debris and pool formation projects were completed in 2000 along the lower 0.5 mile of the creek.

Goat Creek

Goat Creek drains into the Methow from the north about a mile downstream from the town of Mazama. Portions of the upper third of the Goat Creek drainage have been heavily grazed. The lower two-thirds of the drainage have been logged, roaded and grazed (USFS 1995). The Goat Creek drainage has over 150 miles of roads—more than 4 miles of road per square mile—with almost all of those located in the lower half of the drainage. Sediment from roads and slope failures is carried by Goat Creek to salmon spawning areas in the Methow River. Livestock have also damaged or suppressed re-growth of riparian vegetation in some tributaries. Goat Creek exhibits elevated water temperatures, low flows, and/or dewatering in August and September (USFWS 1998).

Lost River

The Lost River empties into the Methow River from the north at RM 73.0, roughly six miles above Early Winters confluence. About 95% of the drainage lies within the Pasayten Wilderness. Human impact in the drainage is largely restricted to the river's lower mile. Within the channel migration zone of the first mile, the construction of road and dikes associated with home development has constrained the channel and floodplain function and potentially reducing pool quality and quantity as well as side channel habitat. Some riparian habitat in the lower mile has been converted to residential development and pasture land. Residential construction on the alluvial fan my lead to a constrained channel in the future. LWD has been removed from the lower mile of the river for flood control and firewood gathering; however, the potential for LWD recruitment is thought to be at natural levels. Lower stream flows are a natural condition throughout the Lost River drainage, but water temperatures remain cold.

2.4.2 Description of Wenatchee and Methow Subbasin Habitats Based on NPCC Habitat Condition Criteria

Based on the habitat descriptions provided by the Wenatchee and Methow River Subbasin Plans (NPCC 2004a and NPCC 2004b), we rated each assessment unit, or watershed within the subbasins, using the criteria for conditions described by the NPCC (NPPC 2000).

The NPCC presents restoration strategies, including artificial production strategies, based on the current condition and the restoration potential of habitat for the species and life stages of interest (NPPC 2000). Generally, for intact habitat where a target population is largely intact, "the biological objective for that habitat will be to preserve the habitat and restore the population of the target species up to the sustainable capacity of the habitat." The NPCC recommends artificial production under the proper conditions, including 1) complementing habitat improvements by supplementing with native fish populations up to the sustainable carrying capacity and 2) replacing lost salmon or steelhead populations (NPPC 2000). Restoration of salmon populations is recommended when a species is experiencing low to no natural production, or as is the case for mid-and upper Columbia River coho, where the natural population has been eliminated. Artificial production for the purpose of restoration is recommended only when the habitat is in good condition or in the process of being restored (NPPC 2000). Within the Wenatchee and Methow basins, the tributaries proposed for coho reintroduction include both "intact" and "restorable" habitat conditions and meet the criteria for implementing an artificial production program for the purpose of restoration. Table 2-2 shows habitat condition for the two subbasins using the NPCC criteria.

Table 2-2. Wenatchee and Methow subbasin habitat conditions

Subbasin	Assessment Unit	Habitat Condition	Description
Wenatchee	Lower Wenatchee River	Compromised	Ecological function or habitat structure substantially diminished
	Mission Creek	Compromised	Ecological function or habitat structure substantially diminished
	Peshastin Creek	Compromised	Ecological function or habitat structure substantially diminished
	Chumstick Creek	Compromised	Ecological function or habitat structure substantially diminished
	Middle Wenatchee River	Restorable	Potentially restorable to intact status through conventional techniques and approaches
	Icicle Creek	Restorable	Potentially restorable to intact status through conventional techniques and approaches
	Nason Creek	Restorable	Potentially restorable to intact status through conventional techniques and approaches
	Little Wenatchee River	Intact	Ecological functions and habitat structure largely intact
	White River	Intact	Ecological function and habitat structure largely intact
	Chiwawa River	Intact	Ecological function and habitat structure largely intact
Methow	Lower Methow River	Compromised	Ecological function or habitat structure substantially diminished
	Middle Methow River	Compromised	Ecological function or habitat structure substantially diminished
	Upper Methow River	Restorable	Potentially restorable to intact status through conventional techniques and approaches
	Twisp River	Intact	Ecological function and habitat structure largely intact
	Beaver Creek	Compromised	Ecological function or habitat structure substantially diminished
	Chewuch River	Restorable/ Intact	Potentially restorable to intact status through conventional techniques and approaches
	Early Winters Creek	Intact	Ecological function and habitat structure largely intact
	Wolf Creek	Intact	Ecological function and habitat structure largely intact
	Goat Creek	Restorable	Potentially restorable to intact status through conventional techniques and approaches
	Lost River	Intact	Ecological function and habitat structure largely intact

2.4.3 Description of Wenatchee and Methow Subbasin Habitats Based on Ecosystem Diagnosis and Treatment Method

Coho habitat within the Wenatchee and Methow subbasins was assessed using the Ecosystem Diagnosis and Treatment (EDT) method. EDT is an analytical model which relates habitat features and biological performance to support conservation and recovery planning for salmonids (Lichatowich et al. 1995; Lestelle et al. 2004). EDT incorporates information from empirical observation, local experts, and other models and analyses.

The Information Structure and associated data categories are defined at three levels of organization. Together, these can be thought of as an information pyramid in which each level builds on information from the lower level (Figure 2-3). As we move up through the three levels, we take an increasingly organism-centered view of the ecosystem. Levels 1 and 2 together characterize the environment, or ecosystem, providing the characterization of the environment needed to analyze biological performance for a species. The Level 3 category characterizes the same environment from the perspective of "the focal species" (Mobrand et al. 1997)—in this case, coho salmon. This category describes the biological performance in relation to the state of the ecosystem described by the Level 2 ecological attributes.

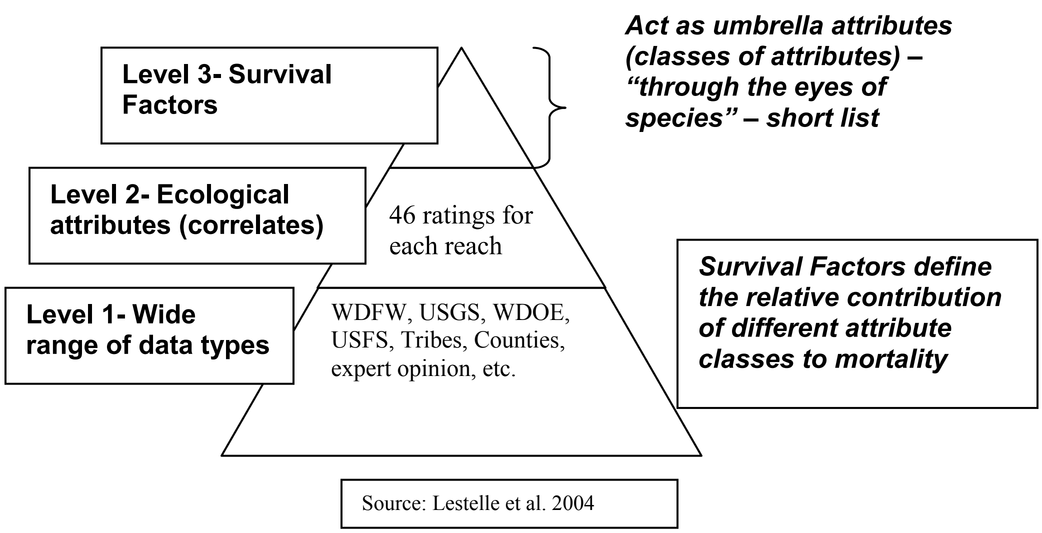

Figure 2-3. Data and Information Pyramid

2.4.3.1 Wenatchee Subbasin EDT Diagnosis for Coho Salmon

The Wenatchee subbasin was divided into 119 stream reaches and 23 obstructions. A stream reach was a segment of river in which environmental, anthropogenic, and biological attributes were relatively constant. The stream reaches were grouped into 19 larger geographic areas or assessment units (AU). A habitat work group consisting of biologists from WDFW, USFWS, USFS, Yakama Nation, Chelan County, and several environmental consulting firms, rated the habitat attributes for the stream reaches within the Wenatchee basin. The work group drew upon published and unpublished data and information. More detail on the processes and habitat ratings can be found in the Draft Upper Columbia Salmon Recovery Plan (UCSRB 2005).

Priority Assessment Units

Based on the average rank and the sum of the **protection benefits** across three performance measures—diversity index, productivity, and abundance—the top assessment units for habitat protection benefits to coho salmon are the Chiwawa River, White River, and Upper Wenatchee River (Chiwakum Creek to Lake Wenatchee). This means that coho in the basin will benefit most from protecting the existing attributes of these three assessment units. Other highly ranking assessment units for coho in the protection category include Tumwater Canyon, Lower Nason Creek (mouth to Gaynor Falls), and the Little Wenatchee River.

Based on the average rank sum of **restoration benefits** across the three performance measures—diversity index, productivity, and abundance—the assessment units which ranked highest in restoration benefits for coho salmon are Lower Nason Creek, Upper Wenatchee River, and the White River. This means that the greatest increases in coho abundance, productivity, and life history diversity would occur if the degraded habitat in these streams was restored. The inclusion of the upper Wenatchee River as a top restoration priority was somewhat unexpected but consistent with the EDT results for spring chinook in the Wenatchee basin. The Chiwawa and White rivers ranked relatively high in restoration benefits to coho productivity, even though they are thought to be in relatively pristine conditions. We conclude that, in this pristine habitat, there are still a few small problems which, if fixed, would substantially increase productivity (C. Baldwin, WDFW, pers comm.). The Chiwawa and White rivers also ranked highest in protection benefits to coho productivity.

Figure 2-4 and Table 2-3 summarize the relative importance of geographic areas for protection and restoration measures.

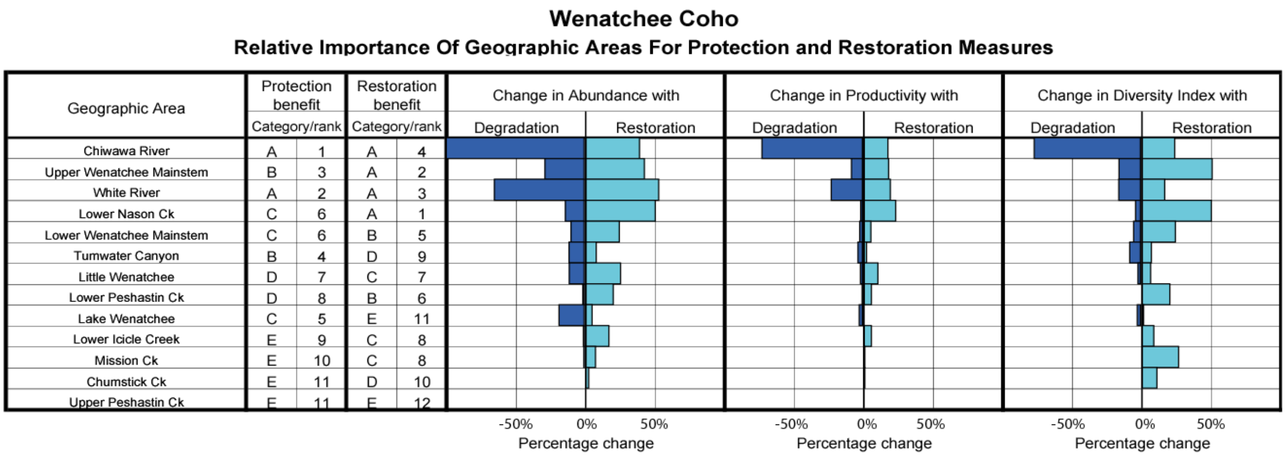

Figure 2-4. EDT Model Output for the Assessment Unit Summary for Wenatchee Coho Salmon

Note: The restoration and degradation potential is the percent change in each of the performance measures (abundance, productivity, diversity) that would take place if all environmental attributes in that assessment unit were either restored or degraded.

Figure 2-4 illustrates which assessment units will be the most important to re-establishing a naturally reproducing coho population. For example, the figure shows that the White River ranks high for coho for protection: its existing habitat qualities make the White the second most valuable river for coho of those evaluated in the Wenatchee subbasin. The figure also shows that, if the attributes of that river are degraded, then coho abundance would be reduced by over 60% (assuming coho occupied that river); and if all the attributes currently at risk were restored, that coho abundance could be increased by 50%. The reaches that ranked highest in protection and restoration values also provided the highest predicted coho productivity (Table 2-3).

Table 2-3. Wenatchee basin coho adult productivity values predicted by EDT

Location	White R	Chi-wawa R	Little Wenat-chee R	Wenat-chee R	Nason Ck	Icicle Ck	Pesh-astin Ck	Beaver Ck	Chum-stick Ck	Mission Ck
EDT Predicted Productivity Values	1.6	1.5	1.5	1.3	1.1	<1	<1	<1	<1	<1

Note: Productivity values less than 1 are unlikely to establish naturally reproducing populations.

Stream Reach Analysis

Reach and life stage-specific limiting factors are shown in Figure 2-5. Habitat diversity, obstructions, sediment load, and key habitat quality were primary limiting factors in one or more assessment units (Figure 2-5). Other limiting attributes of lesser importance included channel stability, competition with hatchery fish, flow, and food. The Chiwawa River, White River, Upper Wenatchee River and Lower Nason Creek have no primary limiting factors for coho (Figure 2-5). Primary limiting factors are those attributes ranking “high” in restoration priority. Primary limiting factors were found in Chumstick Creek (obstructions and key habitat quality), Little Wenatchee River (sediment load), Lower Icicle Creek (habitat diversity, obstructions, and sediment load), Lower Peshastin Creek (obstructions), Lower Mainstem Wenatchee (habitat diversity), Mission Creek (obstructions, sediment load, and key habitat quality), Tumwater Canyon (habitat diversity), and Upper Peshastin Creek (habitat diversity). Assessment units with the fewest limiting attributes will likely be important reaches for coho reintroduction.

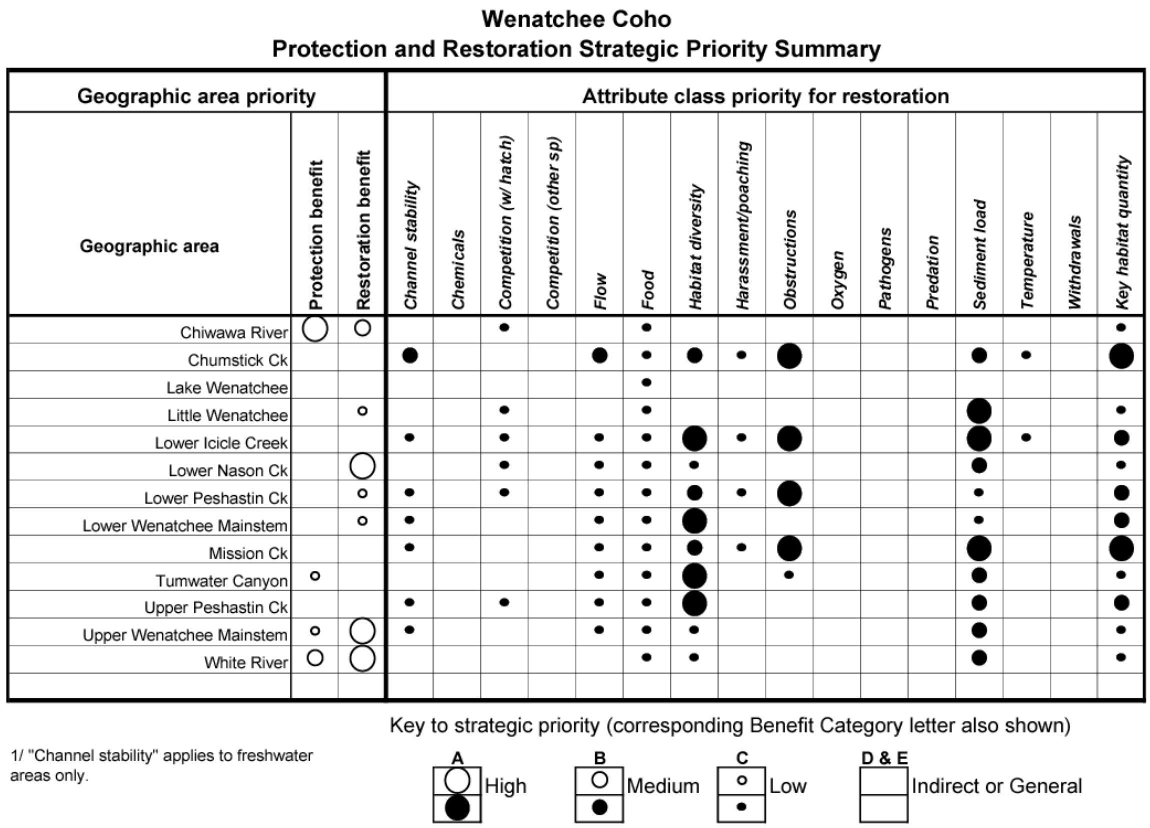

Figure 2-5. EDT Strategic Priority Summary for Wenatchee Basin Coho Salmon

Note: Prioritized attributes in need of restoration are shown for each assessment unit.

2.4.3.2. *Methow Subbasin EDT Diagnosis*

Coho habitat within the Methow subbasin was also assessed using the EDT method. The Methow subbasin was divided into 148 stream reaches; the reaches were grouped into 13 assessment units (AUs). A stream reach was a segment of river in which environmental, anthropogenic, and biological attributes were relatively constant. A technical workgroup rated habitat attributes for the stream reaches within the Methow subbasin. The work group drew upon published and unpublished data and information. More detail on the processes and habitat ratings can be found in the Methow Subbasin Plan (NPCC 2004b).

Priority Assessment Units

Based on the average rank and the sum of the protection benefit across three performance measures (as identified in the Wenatchee Diagnosis), the assessment units that ranked highest for habitat protection benefits to coho are the Upper Methow River (Rkm 119.8 – 134.6, including the Lost River and Early Winters Creek), the Upper Twisp River (Rkm 27.8 – 49.9), and the Middle Methow River (Rkm 53.1 – 94.3). The highest ranking assessment units in terms of protection benefits will likely be essential to coho restoration in the Methow basin. Other high ranking assessment units include Upper Middle Methow (Rkm 94.3 - 119.8), Lower Twisp River (Rkm 0.0 – 27.8), and Upper Chewuch River (Rkm 18.1 – 56.0). Assessment units that ranked highest for restoration benefits to coho salmon are Middle Methow River, Upper Chewuch River, and Lower Chewuch River (Rkm 0.0 to 18.1). A summary of relative importance to coho of geographic areas for protection and restoration measures is shown in Figure 2-6.

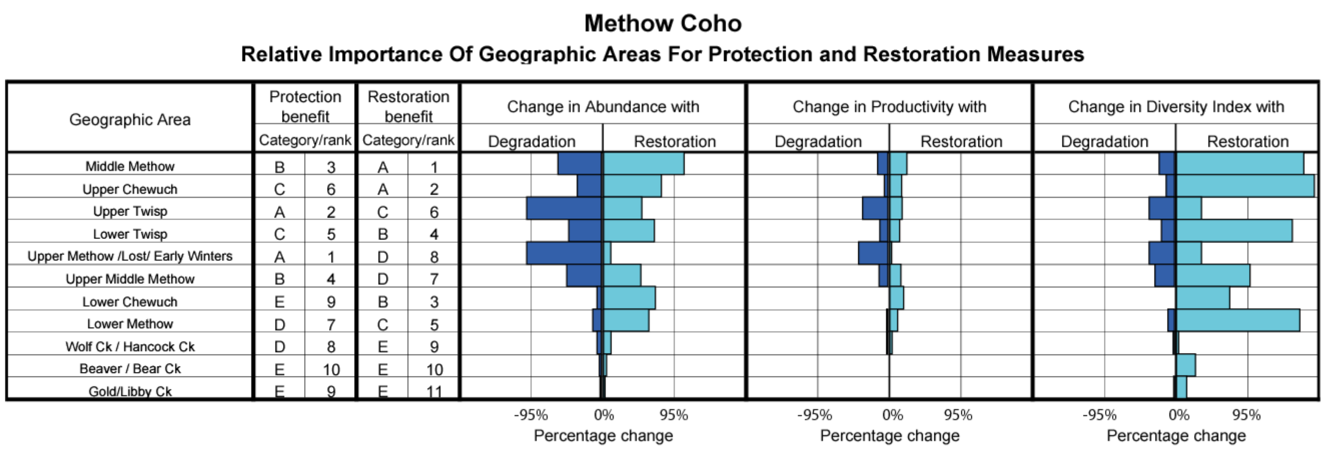

Figure 2-6. EDT Model Output for the Assessment Unit Summary for Methow Coho Salmon

Note: The restoration and degradation potential is the percent change in each of the performance measures (abundance, productivity, diversity) that would take place if all environmental attributes in that assessment unit were either restored or degraded.

As described in the Wenatchee Diagnosis, the reaches that ranked highest in protection and restoration values also provided the highest predicted coho productivity (Table 2-4).

Table 2-4. Methow basin coho adult productivity values predicted by EDT

Location	Lost River	Twisp River	Methow River	Early Winters Creek	Chewuch Creek	Wolf Creek	Beaver Creek	Gold Creek
EDT Predicted Productivity Values	1.4	1.3	1.2	1.2	1.1	<1	<1	<1

Note: Productivity values less than 1 are unlikely to establish naturally reproducing populations.

Stream Reach Analysis

Reach and life stage specific limiting factors are shown in Figure 2-7. Habitat diversity was a primary limiting factors in five assessment units (Figure 2-7). Other limiting attributes of lesser importance included channel stability, competition with hatchery fish, flow, food, harassment/poaching, predation, sediment load, and key habitat quality. The Lower and Upper Chewuch River, Lower and Upper Twisp River, Upper-Middle Methow River, and Upper Methow/Lost/Early Winters Assessment Units have no primary limiting factors for coho (Figure 2-7). Primary limiting factors are those attributes ranking "high" in restoration priority. Primary limiting factors were found in Beaver Creek, Gold and Libby Creeks, Lower Methow River, Middle Methow River, Wolf Creek and Hancock Creek. Assessment units with the fewest limiting attributes will likely be important reaches for coho reintroduction.

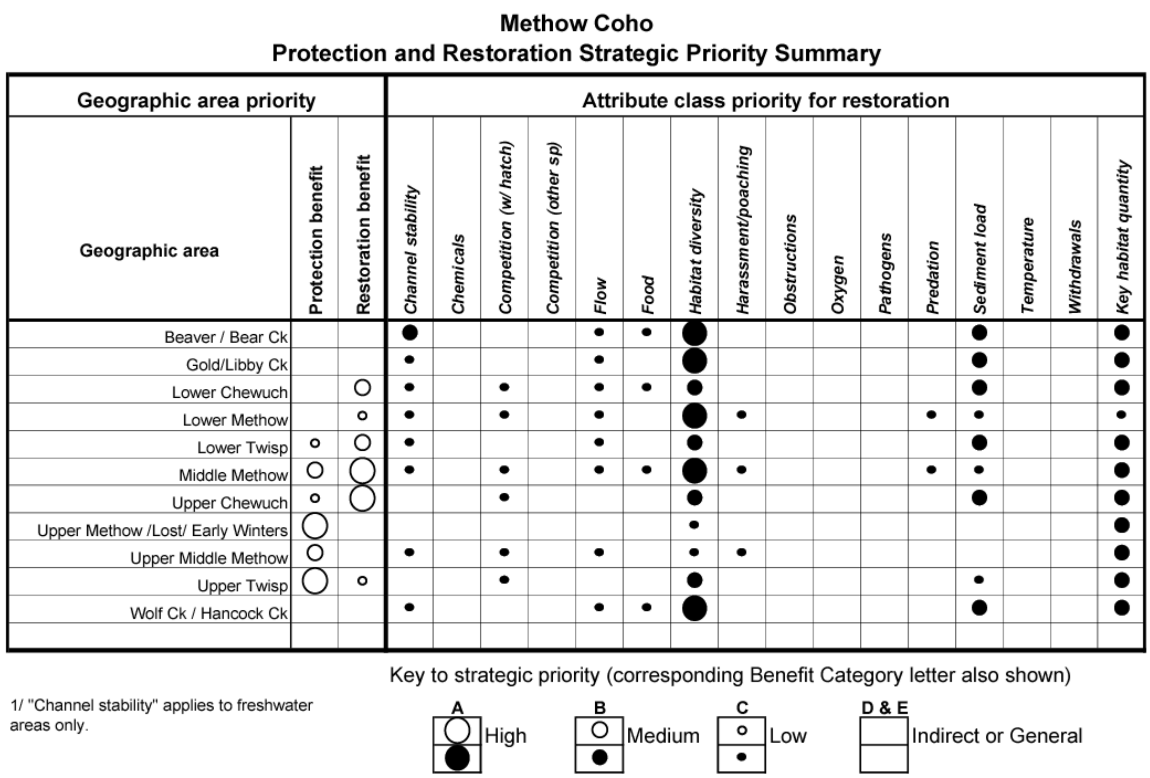

Figure 2-7. EDT Strategic Priority Summary for Methow Basin Coho Salmon

Note: Prioritized attributes in need of restoration are shown for each assessment unit.

2.4.4 Planned Habitat Restoration Projects

Over the past two years, the UCSRB has been actively involved in the development of the Upper Columbia Salmon Recovery Plan. The primary focus of this effort is on spring chinook, summer steelhead and bull trout. The EDT methodology was applied to spring chinook and steelhead as the primary means to identify key limiting factors and specific stream reaches within both the Methow and Wenatchee subbasins. A comparison of results for the EDT runs for coho salmon, chinook salmon and summer steelhead indicate a strong correlation of limiting factors affecting these three species. This is not a surprising result since channel simplification resulting in lost key habitat (primarily pools), lost habitat structure/diversity, impeded floodplain function, and disassociation of side channels is evident throughout many important reaches within these two subbasins. Habitat actions addressing these factors will provide substantial benefits to all anadromous fish species at various times of the year and life histories.

As a result of the EDT analysis and identification of the key limiting factors, the UCSRB directed technical staff, representing USFWS, WDFW, USFS, Yakama Nation, Colville Tribes, and all interested stakeholders (including Chelan County Conservation District, Bureau of Reclamation and other entities) to develop a site-specific Implementation Schedule. The Implementation Schedule groups protection actions into discrete categories by assessment unit (watershed):

1) water quality,

2) flows/hydrology,

3) riparian/floodplain condition,

4) in-channel habitat conditions,

5) habitat quality,

6) habitat access, and

7) ecological relationships.

Where specific limiting factors have been identified within these categories, site-specific actions and, to the degree practicable, site-specific locations have been described. Additionally, these actions have been sequenced over time, specifically 0-3 years, 3-6 years, 6-10 years and > ten years intervals. In all cases, protection and restoration activities described in the Implementation Schedule are considered by the technical staff to be feasible and appropriate such that this list represents a realistic—even conser-vative—estimate of future actions.

From a technical perspective, the primary purpose of the Implementation Schedule is to allow resource managers to evaluate the effectiveness of proposed actions using the EDT model. Using this model (and in association with the All H Analyzer), resource managers will provide defensible estimates of future habitat changes and will provide useful information in understanding population responses to these changes. Additionally, utilization of this Schedule will better coordinate restoration actions and is intended to provide greater assurance that actions will take place in a timely manner.

It is assumed that adequate funding is available to implement all actions identified in this Schedule and that this Schedule is a reasonable reflection of future restoration actions. This assumption is founded in the fact that both Wenatchee and Methow subbasins will be receiving directed mitigation funds from not only the BPA Fish and Wildlife Program, but also the Habitat Conservation Plans for Chelan and Douglas PUDs as well as from future relicensing mitigation from Grant PUD. Upon the establishment of the coho program as a long-term (20-25 years) restoration action, additional funding will be available from the Mid-Columbia PUDs as a part of their anticipated mitigation and production obligations. Additionally, the Washington State Salmon Recovery Fund Board (SRFB) has traditionally provided several million dollars per year to the Columbia Cascade Province specifically for salmonid restoration. Other funding sources are EPA, USFWS and tribal Pacific Coast Salmon Recovery Funds which will also play an important role in implementing habitat restoration actions associated with this schedule.

A general summary of the Implementation Schedule is provided below. It is important to note that Tables 2-5 and 2-6 are only summaries and many other actions are anticipated throughout both subbasins. It is the intent of these tables to capture only the key habitat actions in key watersheds. The Salmon Recovery Plan, of which the Implementation Schedule is a part, will remain in draft form until the federal Recovery review and evaluation process is completed, anticipated by December 2006.

Table 2-5. Summary of key actions in the Wenatchee subbasin and estimated time frames for initiation and completion

Wenatchee Subbasin		
Primary Assessment Unit	**Key Actions**	**Estimated Timeframe (Beginning in 2007)**
Lower Wenatchee River	Side channel reconnection and off-channel habitat restoration. Approximately 20 sites identified in mainstem, of which 4-6 have been identified as highest priority.	High priority sites implemented within the next 10 years progressing as appropriate based upon monitoring conclusions. Other sites developed if feasible and needed.
	Riparian re-vegetation associated with side-channel and off-channel habitat and other areas currently degraded.	Activity would be ongoing and as opportunities arise. Objective to return 75% of riparian to normative condition.
Upper Wenatchee River	Culvert replacement in key tributary streams.	All passage issues resolved by year 6 after initiation of Implementation Plan
	Provide mainstem habitat diversity using large wood complexes.	Survey and engineer work evaluation complete in Year 3, initial implementation and monitoring complete in year 6 and proceed with additional structures as appropriate through year 10. Estimated 15 – 20 structures.
	Riparian plantings in degraded areas	Initiate as soon as possible; estimated 500 lineal feet per year over 10-year period.
Peshastin Creek	Culvert replacement in key tributary streams, three sites identified.	All passage issues resolved by year 6. Mainstem passage above Peshastin Irrigation Canal recently completed.
	Increase habitat diversity with large rock and/or wood structures.	Implement 2-4 structures within next three years and based upon monitoring continue implementation of expected 20 – 30 additional structures by Year 10.
	Development of side-channel habitat in lower mainstem as identified in Channel Migration Zone study. Evaluation of additional side channel habitat in lower mainstem.	Evaluation and implementation estimated between years 6-10, or thereafter.
Lower Icicle Creek	Increase irrigation delivery and use efficiency to increase low summer flows.	Evaluation period estimated to begin in years 0-3. Implementation uncertain at this time.
	Stream bank restoration and associated riparian plantings to reduce sediment yield and increase habitat diversity.	Evaluation of overall need and strategy and initial implementation anticipated prior to year 6. Estimated to continue 500 lineal stream bank implementation to restore all stream banks where feasible.
	Obstructions removal from LNFH to boulder field at RM 8.	Progress in ongoing and expected to be completed prior to year 6.

Primary Assessment Unit	Key Actions	Estimated Timeframe (Beginning in 2007)
Lower Nason Creek	System-wide approach to restore channel function, diversity and side channel habitat. Focus on lower 12 miles of mainstem.	Bureau of Reclamation has initiated system-wide evaluation with regards to channel morphology and condition. Nason Creek noted as primary focus of habitat restoration in Wenatchee Subbasin. Evaluation completed in Year 3 and implementation schedule will be developed at that time.
	Passage to Coulter, Roaring, Mill, and Roaring creeks	Evaluation of desired action expected prior to year 3, full implementation expected prior to year 6.
	Nutrient enhancement through analog and/or hatchery carcasses.	Evaluation and implementation/monitoring design prior to year 3.
White River	Nutrient enhancement through analog and/or hatchery carcasses.	Evaluation and implementation/monitoring design prior to year 3.
	Improvement of habitat diversity through conservation easements and modest enhancement where appropriate. Watershed approach to restore side channel/off channel function	Acquisition of easements on-going and anticipated to continue through the next 10 years.
Chiwawa River	Riparian and side/off channel enhancements and protection of key habitat through increased management actions associated with recreation use and road management on USFS lands.	Implementation of these activities is ongoing and anticipated to be largely competed prior to year 10.
	Nutrient enhancement through analog and/or hatchery carcasses.	Evaluation and implementation/monitoring design prior to year 3.

Table 2-6. Summary of key actions in the Methow subbasin and estimated time frames for initiation and completion

Methow Subbasin		
Primary Assessment Unit	**Key Actions**	**Estimated Timeframe (Beginning 2007)**
Lower Methow	From Winthrop to Twisp, and at a few locations downstream of Twisp and upstream of historic town site of Silver, reestablish natural off channel storage capacity areas by reconnecting side channels, wetlands, beaver ponds.	BOR is currently evaluating these areas for future project implementation. Design and engineering is anticipated prior to year 3 and implementation of actions is scheduled for years 3-6.
	Re-establishment of floodplain function and riparian vegetation / cottonwood forests to enhance habitat quality and improve water temperatures. Areas currently being identified through BOR evaluation.	Same as above. Re vegetation expected to be ongoing through year 10 of this Implementation Schedule.
	Habitat protection in areas with intact functioning systems.	Action is ongoing and relatively aggressive through local land trusts.
Upper Middle and Upper Methow	Improve and protect existing intact and functioning riparian and floodplain habitat within Early Winters and near Lost River airport through establishment of flood channels and side channels where appropriate and acquisition of land or conservation easements.	System wide assessment is needed, time frame anticipated in years 0-3
	Reduce sediment through USFS road maintenance and management plan.	Assess and design in years 3-6 and implement as appropriate thereafter.
Upper/Lower Twisp	Enhancement of water quality through improvements in irrigation efficiency and instream flow and enhancement of riparian vegetation.	Assessment is ongoing and specific timelines are not available at this time. Associated with BOR watershed evaluation. Implementation expected prior to year 10.
	Removal or modification of levees or dikes as appropriate. Four possible locations identified on USFS locations.	Assessment scheduled for years 0-3. Implementation Schedule is not yet defined. Associated with BOR watershed evaluation. Implementation expected prior to year 10.
	Fence wetland and riparian areas on USFS lands to allow recovery from grazing and promote beaver re-colonization.	Design and implement within years 0-3.
	Acquisition through purchase or conservation easements to protect and enhance side and off channel structure, diversity and riparian function.	Ongoing.

Primary Assessment Unit	Key Actions	Estimated Timeframe (Beginning 2007)
Upper/Lower Chewuch	Improve water quantity / storage and habitat complexity on all tributaries and mainstem through re-establishment of beaver colonies.	Initiate in year 0-3 and maintain active program to promote action.
	Improve riparian habitat through livestock enclosures within four identified sub-watersheds.	Design and implement within years 0-3.
	Improve sediment levels through road management on USFS system.	NEPA and associated planning initiated in years 0-3 with implementation of priority actions beginning in year 4-6.
	Eradication or control of brook trout within the system.	Evaluate options and plan development in years 0-3 and implement as appropriate.

Chapter 3.
Summary of Feasibility Study Results and Resolution of Critical Uncertainties

3.1 Benefits to Coho

3.2 Risks to Other Species

Chapter 3. Summary of Feasibility Study Results and Resolution of Critical Uncertainties

Studies to determine the feasibility of reintroducing coho into mid-Columbia basins began in 1996. In response to a National Marine Fisheries Service Biological Opinion (NMFS 1999), a Hatchery and Genetics Management Plan (HGMP) was prepared in 1999 which outlined goals, objectives, and study plans. As studies progressed, project participants and the Mid-Columbia TWG[5] refined the study objectives, which are outlined in a revised version of the HGMP (YN et al. 2002). 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.

Project performance indicators were developed to measure success at achieving the goals (Section 1.10 of the 2002 HGMP). Indicators were divided into those that measured benefits to coho and those that measured risks to other species.

Benefits to coho

- Trends in survival of hatchery coho as measured by PIT tags (smolt-to-smolt), and by counts at dams/facilities and CWTs (smolt-to-adult).
- Spatial distribution of returning adults in potential natural spawning areas as identified from radio telemetry, foot/boat redd surveys, and weirs.
- Reproductive success (initial evaluations only) of naturally reproducing coho using redd counts and smolt production estimates.
- Changes made by out-of-basin stock, using genetic monitoring of neutral allelic frequencies; and phenotypic traits such as fecundity, body morphometry, maturation timing, and straying and homing to acclimation sites.

Risks to other listed species

- Predation on other species (spring chinook and sockeye fry) by program hatchery fish as indicated by stomach content analyses.
- Residualism studies as determined through snorkel surveys.
- Superimposition of spring chinook redds by spawning coho as measured by superimposition studies and spawning ground surveys.
- Competition for food and habitat during freshwater rearing of naturally produced coho juveniles as measured through micro-habitat use and growth evaluations, in habitat with and without coho.

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[5] Current TWG members include Bonneville Power Administration, Confederated Tribes of the Colville Indian Reservation, Nez Perce Tribe, NOAA Fisheries, U.S. Fish and Wildlife Service, Northwest Power and Conservation Council, U.S. Forest Service, Chelan and Douglas County Public Utility Districts.

- Predation by naturally produced coho on spring chinook fry through trapping and stomach analysis.

This chapter is only a summary of feasibility study results—full details are provided in the cited documents.

3.1 Benefits to Coho

Feasibility Goal 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.

To test whether this goal could be met, researchers used as performance indicators coho survival at various stages, the spatial distribution of returning adults, and to a limited degree, reproductive success. Genetic changes had been proposed as a performance indicator in the HGMP, but genetic studies were not funded. Study results are described in sections 3.1.1 and 3.1.2. Two generations of broodstock development have occurred to date. Lower Columbia River coho stocks are no longer released in the Wenatchee River.

3.1.1 Coho survival

The Mid-Columbia Coho Reintroduction Feasibility Study began in 1996 with acclimated releases of reprogrammed lower Columbia River stocks in the Methow River. In 1999 the focus of the feasibility study shifted to the Wenatchee River basin due to low smolt-to-adult survival rates (SARs) and a lack of suitable broodstock collection facilities in the Methow River. Acclimated coho releases in the Wenatchee basin began with coho pre-smolts reprogrammed from lower Columbia River facilities; since then, the feasibility program has transitioned to 100% local brood collected in both basins. Second generation mid-Columbia brood coho are currently being reared at Winthrop NFH, Cascade FH, and Willard NFH (Table 3-1).

Evidence that this approach is working comes from data collected during the feasibility phases of the mid-Columbia and Yakima River coho reintroduction programs. An important measure of the effect of local adaptation is smolt-to-adult return rate. Figure 3-1 from Corps of Engineers' smolt and adult data at McNary Dam indicates that this rate is increasing rapidly for all coho programs above this dam (mid-Columbia, Umatilla River and Yakima River).

Table 3-1. Broodstock collected and smolts produced

Brood Year	Release Year	Basin	Brood Source	Adult Return Year	Broodstock Collected	Mid-Columbia Smolts Produced
1996	1998	Methow	LCR	1999	150*	143,000
1997	1999	Wenatchee	LCR	2000	919	585,000
1998	2000	Wenatchee	LCR	2001	1219	738,900
		Methow	LCR	2001	334	162,800
1999	2001	Wenatchee	LCR & MCR	2002	213	133,000
		Methow	LCR	2002	52	22,000
2000	2002	Wenatchee	MCR & LCR	2003	1706	1,064,000
		Methow	LCR	2003	208	65,000
2001	2003	Wenatchee	MCR	2004	1450	1,468,000
		Methow	LCR	2004	118	45,000
2002	2004	Wenatchee	MCR & LCR	2005	1406	1,382,900
		Methow	LCR	2005	345	246,958
2003	2005	Wenatchee	MCR	2006	N/A	N/A
		Methow	MCR & LCR	2006	N/A	N/A
2004	2006**	Wenatchee	MCR**	2007	N/A	N/A
		Methow	MCR**	2007	N/A	N/A

* Indicates number spawned and not total number of broodstock collected.
** 100% second generation mid-Columbia brood origin smolts will be released in both basins in 2006.

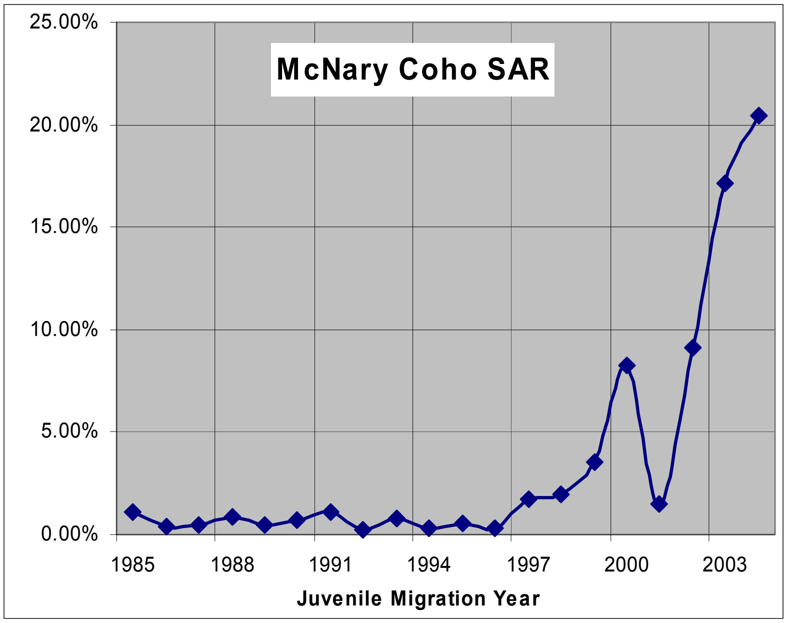

Figure 3-1. Coho SARs at McNary Dam

(calculated from juvenile passage indices and adult counts)

Figure 3-2 shows SARs for coho returns to the Wenatchee and Methow rivers. During 2001 and 2002, SARS in the Wenatchee and Methow basins were similar; both were SARs for reprogrammed lower Columbia River stocks. During 2003 and 2004, first-generation mid-Columbia brood coho returned to the Wenatchee River; reprogrammed lower Columbia brood returned to the Methow. It should be noted that the 2002 low adult return rate is a direct result of the drought year of 2001, which resulted in poor smolt migratory conditions and extremely high smolt-to-smolt mortality rates.

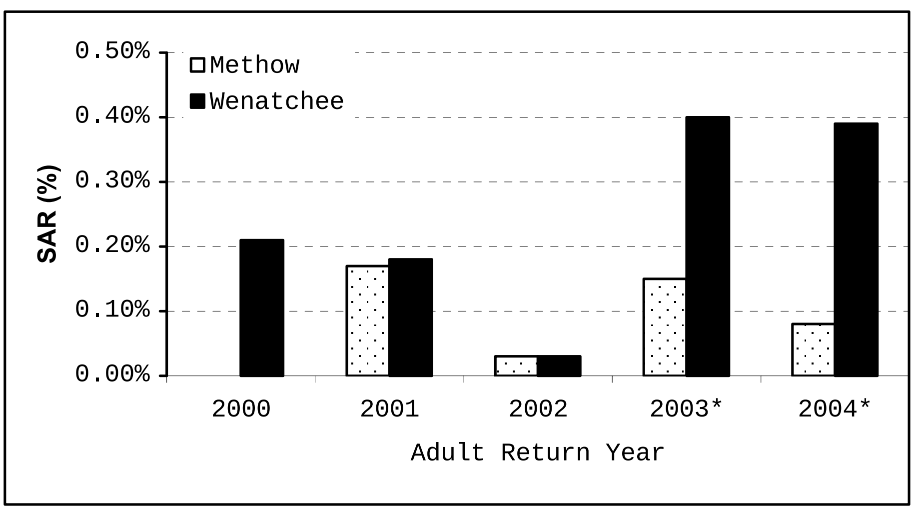

Figure 3-2. Smolt-to-Adult Survival Rates for Hatchery Coho in the Methow and Wenatchee Rivers

*During 2003 and 2004, first-generation mid-Columbia brood coho returned to the Wenatchee River; all other returns represent reprogrammed lower Columbia River stocks.

In 2002 (BY 2000) and 2003 (BY 2001), we released differentially coded-wire-tagged lower Columbia brood (LCR) and first generation mid-Columbia brood (MCR) from Dam 5 on Icicle Creek, to determine if a survival advantage can be observed with one generation of broodstock development. Both groups were reared at lower Columbia facilities and were acclimated in the same pond, for the same duration of time. Figure 3-3 shows that SARs for BY 2000 and BY 2001 were higher for mid-Columbia brood (0.53% and 0.56%;) than for lower Columbia brood (0.31% and 0.45). In both years, results of a z-test for differences in proportions indicated that mid-Columbia brood survive at statistically higher rates than reprogrammed lower Columbia brood coho.

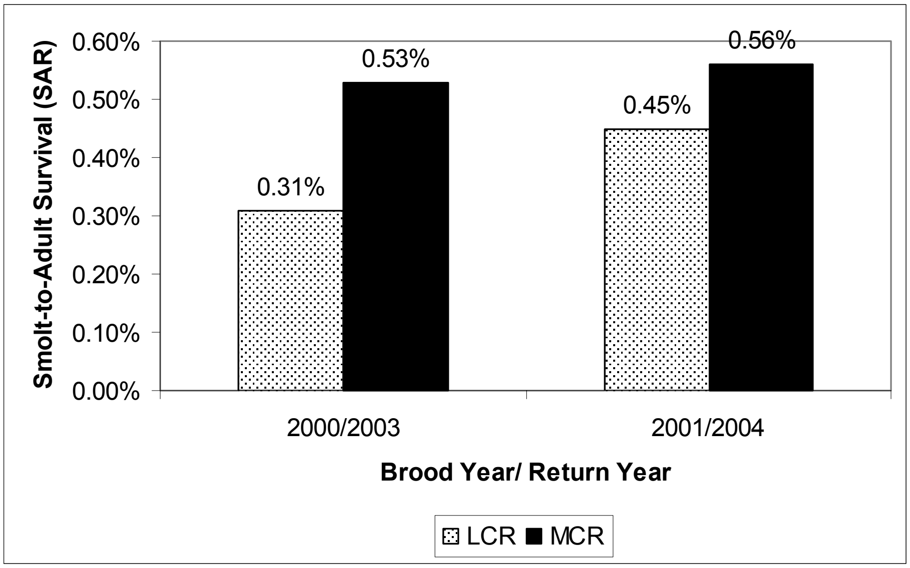

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Figure 3-3. SARs for Reprogrammed LCR Brood and First-generation MCR Brood Reared at Lower Columbia Facilities

The feasibility phase demonstrated that a local broodstock can be developed from lower river stocks. It appears that a survival advantage can be achieved with one generation of selection. Our proposal uses methods that are expected to encourage a continuation of the selection process, eventually resulting in a locally adapted population (Chapters 4 and 5). We expect to continue to see increases in survival as local adaptation progresses.

3.1.2 Spatial distribution of returning adults

During the feasibility phase, extensive spawning ground surveys and radio-telemetry studies documented spawning escapement and distribution. In 2000, 2001, and 2002, spawning ground surveys focused on the Wenatchee River basin; they expanded to include the Methow basin in 2003 and 2004. Figure 3-4 shows the number and distribution of redds in the Wenatchee River.

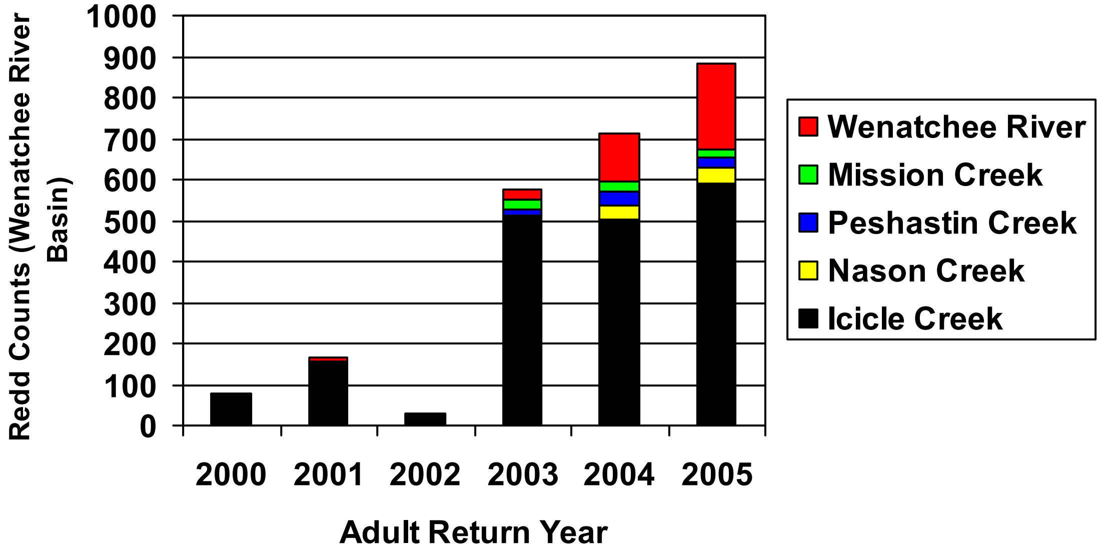

Figure 3-4. Number and Distribution of Coho Redds in Wenatchee Basin, 2000 – 2005

With data collected from a WDFW-operated rotary smolt trap on the Wenatchee River, we estimated the population size of naturally produced coho smolts emigrating from the Wenatchee River and calculated an egg-to-emigrant survival rate (Table 3-2). This egg-to-emigrant survival rate can be viewed as a maximum rate, because unidentified coho redds cannot be accounted for in this estimate. The egg-to-emigrant survival rates observed for naturally produced coho comport well with those observed for spring chinook in the basin. The egg-to-emigrant survival rate for spring chinook in the Chiwawa River has ranged from 4.7% to 18.1% over the last ten years (Miller 2003). Table 3-2 demonstrates that observed redds are producing smolts and the smolts are returning as adults.

Table 3-2. Natural coho production in the Wenatchee river, Brood Years 2000-2004

Brood Year	Redds	Natural Smolt Estimate[1]	Egg-to-Emigrant Survival [2]	Smolt-to-Adult Survival
2000	77	17,054	8.20%	0.37%[3]
2001	165	36,678	8.65%	0.40%[2]
2002	28	5,826	9.80%	N/A
2003	625	N/A	N/A	N/A
2004	714	N/A	N/A	N/A

[1] Natural coho smolt production estimate provided by T. Miller (WDFW unpublished data).

[2] Egg-to-emigrant survival should be viewed as a maximum due to the possibility of unidentified and uncounted coho redds.

[3] Smolt-to-adult survival rate based on scale analysis by J. Sneva (WDFW).

3.2 Risks to Other Species

Feasibility Goal 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.

As planned in the HGMP (YN et al. 2002), critical uncertainties regarding species interactions were investigated. The issues identified in the HGMP are as follows:

1) rate of predation by hatchery coho on spring chinook fry,

2) rate of predation by hatchery coho on sockeye fry,

3) superimposition of spring chinook redds by spawning coho,

4) rates of residualism, and

5) competition for space and food during freshwater rearing of naturally produced coho juveniles as measured through micro-habitat use and growth evaluations.

The HGMP also identified the need for additional studies of interactions between naturally produced coho and listed and sensitive species, if sufficient numbers of naturally produced coho allowed a meaningful study to be conducted.

The studies summarized below answered a number of the critical uncertainties identified in the feasibility phase. However the question of predation rates by *naturally* produced coho on spring chinook fry remains. We will answer this question during the NPIP as part of the proposed M&E plan (see Chapter 7).

With the completion of many species interaction evaluations and most critical uncertainties answered, the monitoring and evaluation plan (Chapter 7) is designed to coordinate the coho reintroduction effort with other ongoing programs, such as the Chelan and Douglas PUD HCP Hatchery Compensation M&E Plan and the Integrated Status and Effectiveness Monitoring Program (BPA Project # 2003-017-00), to monitor the status of listed and endangered species. Much of the data previously or currently being collected by this program, or that is currently proposed by other programs, can be used to help detect negative effects, if any, of coho reintroduction.

3.2.1 Predation by Hatchery Coho on Other Species

Predation by hatchery coho on spring chinook fry

During the feasibility phase, the YN completed three predation evaluations in the During the feasibility phase, the YN completed three predation evaluations in the Wenatchee Basin and two predation evaluations in the Yakima River. Methods for all five studies were similar and are detailed in Dunnigan (1999), Murdoch and Dunnigan (2002), Murdoch and LaRue (2002), Murdoch et al. (2005). Hatchery coho smolts released from acclimation sites were recaptured at a smolt trap downstream. The distance downstream varied in each tributary and depended upon the location of the acclimation site and distribution of chinook redds and fry. The protocols specified that all fish be removed from the live box hourly. The frequent removal of coho from the trap was intended to minimize predation within the live box. The target sample size of coho in each study (approximately 1,000) was collected from throughout the run and retained for stomach content analysis. We estimated the incidence of predation, gastric evacuation rate, and residence time; these factors allowed us to estimate the total number of prey items consumed.

Murdoch and Dunnigan 2000. In 2000 we completed a study to measure predation on summer chinook fry by hatchery coho smolts volitionally released into the Icicle River and recaptured at a rotary smolt trap operated by WDFW on the Wenatchee River (RM 7.1) (Murdoch and Dunnigan 2002). The total migration distance from release to recapture was 21.3 miles and included some of the highest densities of chinook redds and subsequent fry emergence in the Wenatchee River. We observed an incidence of predation of 0.006 (95%CI 0.0016-0.0154). We estimated the total number of summer chinook fry consumed based on the gastric evacuation rate of 30.2 hours and a residence time of 16.5 days. Because the release was volitional, we had no way of accurately calculating residence time in the Wenatchee River. We used the day the volitional release began to the date of mean catch at the trap. Because it took approximately three weeks for all the fish to leave the pond, we believe the model over-estimates the total number of fish consumed due to the known overestimate in residence time. We estimated the total number of summer chinook fry consumed to be 134,125 or 1.31% (95% CI 0.36% to 3.35%) of the total summer chinook fry population. This rate of predation is higher than studies of predation by hatchery coho on spring chinook fry, presumably because of the greater abundance and availability of summer chinook fry. Similar studies have shown that the rate of predation is higher with greater abundance and densities of prey (Hawkins and Tipping 1999; Hawkins 2002).

Murdoch and LaRue 2002. In 2001, YN completed a study to measure predation on spring chinook fry in Nason Creek (Murdoch and LaRue 2002). We volitionally released coho smolts from the Butcher Creek acclimation pond (RM 8.1 on Nason Creek) and recaptured the smolts in a rotary smolt trap located at RM 0.8 on Nason Creek. We observed an incidence of predation of 0.0018 (95%CI 0.0002-0.0066). We estimated the total number of summer chinook fry consumed based on the gastric evacuation rate of 40.5 hours and a residence time of 15.8 days. As during the 2000 evaluation, we used the date the volitional release began and mean catch at the trap to estimate residence time. This method likely resulted in an over-estimate of residence time, because it typically takes approximately three weeks for most of the fish to leave the pond. We estimated the total number of spring chinook fry consumed to be 2,436 or 0.96% (95% CI 0.12% to 3.5%) of the total spring chinook fry population in Nason Creek.

Murdoch et al. 2005. In 2003, YN repeated the 2001 predation evaluation in Nason Creek. We added PIT tag detectors to the outlet of the Butcher Creek pond and scanned all recaptures at the trap for the presence of PIT tags. This allowed us to calculate the actual residence time for hatchery coho in Nason Creek and to produce an accurate estimate of the total number of fish consumed. We observed an incidence of predation of 0.0028 (95%CI 0.0006-0.0082). We estimated the total number of spring chinook fry consumed based on the gastric evacuation rate of 40.5 hours and a residence time of 1.7 days. The estimated number of spring chinook fry consumed was 1009 or 0.14% (95% CI 0.03% to 0.4%) of the total spring chinook fry population in Nason Creek. The 2003 predation evaluation probably produced the most accurate results due to our ability to measure residence time with PIT tags. Predation evaluations in the Yakima River have produced similar results (Dunnigan 1999).

Predation/Interactions: hatchery coho and sockeye fry

During 2001, 2002, and 2003 we investigated the distribution of sockeye fry in Lake Wenatchee and the migration timing and patterns of coho smolts migrating through the lake to determine if hatchery coho have the opportunity to encounter and prey upon sockeye smolts (Murdoch and

LaRue 2002; Murdoch et al. 2004; Murdoch et al. 2005). We used radio-telemetry to track the migration of coho smolts through the lake and hydroacoustics, tow netting, and snorkeling to determine the distributions and diel movements of sockeye fry within the lake.

We found that upon entering Lake Wenatchee, sockeye fry rapidly assume a pelagic existence. The results of the hydroacoustics and tow netting indicated that during the day sockeye fry were primarily found below 45 meters. At night the fry moved towards the surface and shoreward. Coho appeared to migrate primarily through littoral areas. The sockeye fry entered the pelagic zone of the lake shortly after emergence and assumed daily vertical migrations typical in other sockeye rearing lakes. Based on the results of the 2002 and 2003 evaluations (Murdoch et. al. 2004; Murdoch et. al. 2005) we believe that the predation risk for sockeye salmon fry by hatchery coho smolts is low. Because of the diel vertical movements of the fry, the greatest opportunity for hatchery coho to encounter a sockeye fry is at night when coho feeding ceases (Sandercock 1998). Crepuscular periods may present limited opportunity for predation.

To verify our conclusion, we initiated a predation evaluation in 2003. Hatchery coho smolts were released from the Two Rivers Acclimation Site on the Little Wenatchee River (RM 1.5), migrated through Lake Wenatchee and were recaptured and retained for stomach analysis in a smolt trap located approximately 0.5 RM downstream from Lake Wenatchee. No coho collected for stomach content analysis contained fish remains (Incidence of Predation = 0.0), although samples sizes were much lower than desired (72 samples collected) due to low trap efficiency (<0.5%), rendering the results inconclusive.

3.2.2 Superimposition by Coho on Spring Chinook Redds

In 2001 we initiated a study to evaluate superimposition of spring chinook redds by spawning coho. For this study, we triangulated the precise location of spring chinook redds in Nason Creek, to ensure that chinook redds could be located a month or more later while coho were spawning. We triangulated the locations of 50 spring chinook redds in two study reaches. For each identified coho redd, any chinook redds nearby were relocated, and the percentage of superimposition, if any, was visually estimated. 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, we have relied on CCPUD or WDFW to flag chinook redds with a location description on the flagging; we then followed our previous procedure to identify coho superimposition. We have observed no redd superimposition in Nason Creek. 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 (edges vs. pool tail outs) for spawning.

3.2.3 Rates of Residualism

In 2000 and 2001 we completed comprehensive and systematic snorkel surveys to determine rates of residualism in hatchery coho. In 2000 we completed three surveys of Icicle Creek; each survey sampled approximately 20% of the available habitat. During the first survey (July 5) we observed 4 residual coho (expands to 20 when the sample rate is accounted for). During the second survey (July 24) we observed no residual coho. During the final survey (August 3) we observed one residual coho (expands to 5). We completed two surveys in Nason Creek. Each survey sampled approximately 20% of the available habitat. We found no residual coho during either survey. We repeated the surveys in 2001. In 2001 we sampled 20% of the available habitat in Icicle Creek and observed 2 residual coho (expands to 10). We sampled approximately 28% of the available habitat in Nason Creek and found no residual coho. Snorkel surveys were also conducted in the Methow River with similar results.

Due to the low estimates of hatchery coho residuals, it is unlikely that the residuals were ecologically capable of negatively impacting any species present unless the environment was at or exceeding the natural carrying capacity.

3.2.4 F2 Interactions

Competition for food and habitat

The YN completed two replicate studies to examine microhabitat use by juvenile coho, chinook, and steelhead (Murdoch et al. 2004; Murdoch et al. 2005). The purpose of these studies was to investigate habitat use and growth of spring chinook, steelhead and coho salmon in Nason Creek, Washington, with the specific objective to determine the potential for naturally produced juvenile coho salmon to negatively impact spring chinook salmon and steelhead parr through competition for space and food. Due to the low numbers of naturally produced coho in Nason Creek during the feasibility phase of the reintroduction effort, we out-planted approximately 33,000 hatchery coho fingerlings in Nason Creek for the competition evaluations. While the scatter-planted coho salmon are of hatchery origin, they served as a surrogate for naturally produced coho, providing valuable information regarding interactions between juvenile coho, chinook and steelhead. Scatter-planting densities were based on the estimated carrying capacity and temporary coho escapement limits (memo from Tim Tynan, NMFS-SFD and Laurie Weitkamp-NWFSC, June 29, 2001). The estimate was provided by Tom Cooney (NMFS-UCR TRT). The study designs were reviewed and approved by the mid-Columbia coho TWG. During the course of both studies we collected data on distribution, macrohabitat preference, microhabitat use in control and treatment reaches, and growth of age-0 spring chinook salmon, age-0 coho salmon, and yearling steelhead. During the studies, we collected micro-habitat data on 4,968 juvenile chinook, 729 juvenile coho, and 254 juvenile steelhead.

We found that coho, chinook, and steelhead select different microhabitats. Coho did not appear to displace chinook or steelhead from preferred microhabitats (there was no difference in microhabitat use by chinook and steelhead prior to, and after, coho scatter-planting) (Murdoch et al. 2004; Murdoch et al. 2005). The presence of coho in the treatment reaches did not affect the growth or condition factor of chinook or steelhead. The extensive data collected during both years lends convincing evidence that the reintroduction of juvenile coho, at accepted densities, is unlikely to negatively affect chinook or steelhead through competition for space and food. The microhabitat selection results we observed are consistent with other studies and have been well supported in the literature (Hartman 1965; Lister and Genoe 1970; Allee 1981; Glova 1987;

Bisson et al. 1988; Spaulding et al. 1989; Murphy et al. 1989; Bugert and Bjornn 1991; Taylor 1991a; Mullan et al. 1992; Nickelson et al. 1992; Beecher et al. 2002; Hicks and Hall 2003; Riley et al. 2004).

Predation by naturally reared coho on spring chinook fry

During July 2002, approximately 33,000 coho parr were scatter-planted in Nason Creek between RK 3.0 and 13.0. Details on scatter-plant location and numbers can be found in Murdoch et al. 2004. The scatter-planted coho over-wintering in Nason Creek were recaptured in the rotary smolt trap described in Section 3.2.1. Trap operation began the second week of March and continued until mid-June. The scatter-planted coho were identified by an adipose clip and verified in the lab through coded wire tag (CWT) recovery. During the predation evaluation, all naturally reared coho and naturally produced coho were retained for stomach content analysis. In lieu of a measured residence time, an estimated "predation window" was used in the expansion equations described in Murdoch et al. 2005. The predation window was calculated as the time between mean chinook fry emergence, as measured by tracking temperature units and verified by catch at the trap, and mean passage of scatter-planted coho at the trap.

During the study, 37 naturally reared coho smolts were captured in the rotary smolt trap (mean FL = 108.9 mm; standard deviation = 13.9). All were retained for stomach content analysis. Of the 37 coho, one had consumed a fish, which was not positively identified as a spring chinook fry (Murdoch et al. 2005). We analyzed the data as a "worst case scenario" by assuming that the prey fish collected were confirmed as spring chinook.

Results of the stomach content analysis indicate that naturally reared coho fed primarily on insects. Of all the naturally reared coho samples collected during the study (n=37), 28 (75.7%) contained insects. Five (13.5%) of the samples were empty, 5 (13.5%) contained plant material, 1 (2.7%) contained fish, and 2 (5.4%) were unidentifiable (likely detritus or other digested fish food).

After expanding the incidence of predation by the "window of predation," estimated gastric evacuation rate, and the estimated number of naturally reared coho in the river during the study, we estimated the total number of spring chinook fry consumed to be 1,265 or 0.17% of the spring chinook fry population in Nason Creek.

The small sample size of naturally reared coho may not have resulted in an accurate estimate of the incidence of predation. Results of a z-test for differences in proportions indicate no significant difference in the incidence of predation between naturally reared and hatchery coho (p=0.31). Reasons the rate of predation could be higher for naturally produced coho than for hatchery coho include increased residence time (increased opportunity to consume spring chinook fry), and dietary differences as a result of natural rearing. Because naturally produced coho are smaller than hatchery coho, their ability to consume a spring chinook fry may be size-limited. An accurate measure of predation by naturally produced coho smolts on newly emerged spring chinook fry may not be possible until more natural coho are produced in tributaries containing spring chinook.

Chapter 4.
Overview of Proposed Program and Alternatives

Chapter 4. Overview of Proposed Program and Alternatives

4.1 Introduction

Feasibility study results, as summarized in Chapter 3, demonstrate that coho can be successfully reintroduced into mid-Columbia basins.

For the following reasons, the YN proposes to continue and expand the reintroduction program over the long term.

- Coho are returning to the Wenatchee and Methow basins and reproducing naturally in the Wenatchee River, Icicle Creek, and the Methow River.
- We have demonstrated that it is possible to develop a local broodstock from Lower Columbia River stocks. The program no longer relies on transfers of Lower Columbia River coho to the Wenatchee River. In 2005, the entire smolt release in the Wenatchee basin consisted of second-generation mid-Columbia brood. In 2006, only second-generation mid-Columbia brood coho will be released in both the Methow and Wenatchee basins.
- Studies have shown little or no risk of adverse ecological interactions between hatchery-produced coho and listed and sensitive species in these basins.
- Reintroducing coho meets restoration goals as laid out in the Columbia River Anadromous Fish Tribal Fish Restoration Plan, *Wy-Kan-Ush-Mi Wa-Kish-Wit* (CRITFC 1995).
- Agreements under *U.S. v. Oregon* entitle YN to releases of 1.5 million coho in mid-Columbia basins. YN and WDFW believe that establishing self-sustaining and naturally reproducing populations of a locally adapted stock is more ecologically sound and more likely to allow the program eventually to be terminated than if fish are produced under a traditional harvest augmentation program.

The resource co-mangers, YN and WDFW, have established a goal of reintroducing naturally reproducing coho in Wenatchee and Methow tributaries. While questions remain, the co-managers believe the feasibility studies demonstrate that they are questions of *how best* to achieve the goal of reintroducing a naturally reproducing, locally adapted coho population, rather than *whether* it can be done. (YN/WDFW letter to NPCC, 8/16/04).

4.2 Issues/Alternatives Considered in Program Development

In this section, we present the background for how and why the proposal was developed.

4.2.1 Alternatives Considered

As the feasibility studies neared their conclusion and began showing encouraging results, program managers considered how to proceed. Initially, overall program options appeared to fall into three broad categories:

1) Take no further action to restore coho
2) Continue feasibility studies
3) Pursue approval and funding for a traditional (non-experimental) supplementation-style program.

The option to **take no further action** is not a reasonable alternative, given the successes to date. In addition, it is not a cost-effective or ecologically sound use of *U.S. v. Oregon* fish, nor does it effectively meet tribal restoration goals, goals in the recently completed subbasin plans, or a variety of policy guidance from the last several years that endorses re-establishment of coho in mid-Columbia tributaries. While some natural reproduction is taking place in the Wenatchee and Methow basins, it is too limited to ensure self-sustaining populations in those areas. Simply planting un-acclimated fish in those basins without continuing to develop a locally adapted broodstock would be spending limited funds and resources on producing fish that experience has shown survive at lower rates than locally adapted fish. Concerns about the effect of naturally reproducing coho on listed species in the basins would not be addressed without a monitoring program in place.

The option to **continue feasibility studies** is not necessary or cost-effective because feasibility questions have been answered—coho will survive to return to mid-Columbia basins, a locally adapted broodstock is being developed, and risks to other species from hatchery fish have been shown to be low.

To date, the template for a **traditional supplementation program** can best be described as establishing some production goal (rarely habitat-based), designing and constructing facilities to achieve that goal, followed with monitoring and evaluation activities to determine if the goal was achieved. The long-term facility/program footprint would be established and permanent prior to any results from monitoring and evaluation that could significantly alter or terminate part or all of a program.

Initially, YN considered proposing a traditional supplementation program in three basins—in the Wenatchee and the Methow, as well as in the Entiat (which was part of the long-term vision from the outset). However, co-managers and members of the TWG raised several concerns, including:

- the costs of a program to reintroduce a non-listed species when the regional focus seems to be on restoring listed fish.
- the concern that effects of naturally reproducing coho on listed species had not been effectively studied because adequate numbers of such coho were not yet available to allow a statistically meaningful study;

- the desire of resource managers, to maintain the Entiat as a reference basin by not introducing additional species at this time.

4.2.2 Rationale for Proposed Program

To balance the concerns raised by WDFW and the TWG with the encouraging results from the feasibility studies and the long-standing policy goals related to coho, the original plan was modified.

- The current proposal differs from the traditional approach in that it allows for potential program changes as a result of monitoring and evaluation. The basic concept is to initially minimize the impact of the facility footprint (see Sections 4.3.2 and Chapter 6), and to evaluate what does or does not work in achieving project goals by using or modifying existing facilities in the early program phases. This approach allows evaluation and adaptive management, which in turn enables new facility development to proceed in a cost-effective manner.
- The proposal calls for studies of effects of naturally reproducing coho on listed species, when numbers of naturally produced coho are sufficient to undertake such studies (Sections 4.3.3 and 7.2). They would be preceded by baseline monitoring of listed and sensitive species, to allow proponents to determine whether the status of sensitive species changes as coho numbers increase.
- The proposal includes contingency plans for considering a change in direction, focus, or specific activities of the program based on monitoring results at several key stages (Section 4.3.5).
- With limited resources for the program and the limited natural production potential in the Entiat, at this point the program will focus on the subbasins with more habitat potential—the Wenatchee and Methow.
- The proposed program terminates when restoration goals are met.

The proposal attempts to balance political, practical, and ecological concerns. The Yakama Nation has a treaty right, under the Treaty of 1855, to take fish in usual and accustomed places. This means that fish runs must pass those usual and accustomed places; coho do not now pass such places in the mid-Columbia in harvestable numbers. Because the *U.S. v. Oregon* process promotes exercise of the Yakama Nation's treaty rights, the Northwest Power Act requires the Council's Fish and Wildlife Program and implementing activities to be consistent with *U.S. v. Oregon* requirements (16 U.S.C. Sec. 839b(h)(6). The Columbia River Fish Management Plan, which implements *U.S. v. Oregon* directives, allocates a certain number of coho to mid-Columbia basins. The Yakama Nation believes that developing these fish into naturally reproducing populations is a more ecologically sound and ultimately cost-effective method of attempting to restore treaty rights related to coho, and will, in the long-term, result in more significant opportunities for both tribal and non-tribal harvest, than simply dumping them into mid-Columbia tributaries will ever achieve. Despite the money spent on previous traditional coho hatchery programs in the basins, little or no harvest occurred in mid-Columbia tributaries that were usual and accustomed fishing places for Yakamas. The Tribal Restoration Plan has included a goal of restoring coho populations since 1995. Furthermore, the recent Methow and Wenatchee subbasin plans both name coho as focal species.

At the same time, Yakama Nation and WDFW recognize the importance of ensuring other species are not adversely affected. Spring chinook, for example, are extremely important culturally to the YN, as they are to other tribes and to non-tribal fishers. The YN has no desire to reintroduce coho at the expense of spring chinook, steelhead, or other fish species. Yet, in practical terms, continuing feasibility studies for many more years, without making larger-scale attempts to increase numbers of coho in mid-Columbia tributaries, simply adds costs to the region's efforts to restore coho with no benefit in terms of harvest or ecological diversity. In addition, the small-scale studies of interactions done so far demonstrated that effects (either beneficial or adverse) are unlikely to be observed until a significant number of juvenile and adult coho are introduced into the regional ecosystem.

The extensive monitoring program proposed (see Section 4.3.3 for a summary and Chapter 7 for details) is necessary in order to:

1) help proponents to respond to potential species interactions;

2) determine if or when goals of each phase have been achieved;

3) guide any necessary adaptations in program management or direction;

4) provide scientific documentation of the results of this innovative program.

The expense of the monitoring program is offset by the relatively low capital costs achieved by focusing on use of existing facilities for the first two phases of the program; and by proposing primarily low-cost new facilities in later phases, if warranted.

4.3 Proposed Program

4.3.1 Phased Approach

The proposed coho reintroduction plan builds on the existing Mid-Columbia Coho Reintroduction Feasibility Study. It is designed to achieve coho restoration goals in mid-Columbia tributaries as identified in the Tribal Restoration Plan (*Wy-Kan-Ush-Mi Wa-Kish-Wit*) and in the Wenatchee and Methow subbasin plans. We present a phased approach which incorporates the development of a mid-Columbia hatchery broodstock, naturalization through local adaptation to tributaries in the Wenatchee and Methow subbasins, and habitat restoration that benefits coho reintroduction as well as ESA-listed spring chinook, steelhead and bull trout.

The conceptual restoration plan for coho salmon in the Wenatchee and Methow subbasins includes five distinct phases. The program is designed to be discontinued after five generations of supplementation unless it can be clearly demonstrated that continued supplementation is needed to prevent extirpation from once again occurring.

- **Habitat Improvement Phase (HIP)** is expected to last 10-15 years and seeks to coordinate and implement the habitat improvement schedule developed for the UCSRB. Results of this schedule are expected to improve productivity and capacity of coho salmon, spring chinook salmon, bull trout, and steelhead.
- **Broodstock Development Phase 1 (BDP1)** is designed to develop a mid-Columbia broodstock from lower Columbia River coho, so that they become increasingly adapted to the longer migration to mid-Columbia tributaries. BDP1 focuses on eliminating reliance on lower Columbia stocks and transitioning to a local broodstock. This phase

has been completed in the Wenatchee subbasin. During FY 2007-2009 the Methow subbasin will operate in this phase. The expected duration of BDP1 in the Methow is three years.

- **Broodstock Development Phase 2 (BDP2)** is designed to encourage local adaptation of the broodstock by moving broodstock capture sites further upstream where stamina and run-timing constraints of lower Columbia brood coho may be reaching their limits (Murdoch et al. 2004). During FY2007-2010 the Wenatchee subbasin will operate in this phase. The expected duration of BDP2 is four years for the Wenatchee subbasin and three years for the Methow.
- **Natural Production Phases** focus on decreasing domestication selection and increasing fitness in the natural environment. Hatchery coho will be introduced to habitat areas predicted by EDT to be the most successful for coho. Also, hatchery and natural broodstock compositions will be managed to increase the proportion of natural influence (PNI[6]) in the population, with the goal of having a PNI value 0.5—that is, the natural environment must have a greater influence on the population than the hatchery environment. The natural production phases are described below:
    - **Natural Production Implementation Phase (NPIP)** represents initial releases into most habitat areas and will proceed for one generation. The NPIP seeks to begin the local adaptation[7] process by releasing enough hatchery fish in the natural environment to result in a spawning aggregate in each tributary, of sufficient size that natural selection can act upon the population and enough first generation natural origin adults will begin to return so that they can be incorporated into the broodstock as the Natural Production phases continue. The Wenatchee and Methow subbasins are expected to begin this phase in FY2011 and FY2012 respectively. The duration of this phase will be one generation (3 years).
    - **Natural Production Support Phase (Support Phase)** will emphasize further local adaptation and naturalization. We will do this through an initial 30% reduction in release numbers, with a goal to increase the proportion of natural origin fish in the broodstock (pNOB) to 35% and to limit the proportion of hatchery origin fish (pHOS) on the spawning grounds to 75%. As we reach this initial goal, we will continue to reduce the hatchery program size, increase the pNOB and decrease the pHOS to the point that we are able to reach a PNI value greater than 0.50 (pNOB = 80%, pHOS < 65%). A PNI > 0.5 is predicted to result in increased natural fitness and associate survival rates for the population (L. Mobrand pers. comm.). The Wenatchee and Methow subbasins are expect to begin this phase in FY2014 and FY2015, respectively. The expected duration of the Support Phase is four generations (12 years).

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[6] If pNOB is the percent natural-origin fish in the hatchery broodstock and pHOS is the percent hatchery origin fish among natural spawners, then PNI= pNOB/(pNOB+pHOS).

[7] We use the term "local adaptation" to refer to the process of naturalization: addressing the loss of fitness that occurs with hatchery stocks by emphasizing selection in the natural environment so that the population becomes adapted to habitats within each subbasin and ultimately achieves PNI > 0.5. "Local adaptation" is distinguished from "broodstock development" which 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.

Key goals and management strategies for the five phases in each subbasin are summarized in Tables 4-1 and 4-2.

Table 4-1. Wenatchee subbasin program summary

	BDP1	BDP2	Natural Production Implementation	Natural Production Support	Fully Restored Population
Management Goal	-Eliminate transfers of Lower Columbia River Brood. -Broodstock collection = 1,312 (25% past Tumwater)	-"Fine tune" broodstock so that returning coho can reach key habitat within the subbasins. -Broodstock collection = 1,312 (50% past Tumwater).	-Initiate natural production in key habitat areas. -NOR 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 LNFH.	-Release 50% of smolts above Tumwater Dam, 50% in Icicle Creek. -Broodstock collected at 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 matrix schedule for harvest and broodstock management. pNOB = 10% pHOS = 90%	-Further local adaptation process and reduce domestication selection. -Convert to integrated hatchery program and move towards PNI >0.5. -Implement matrix schedule for harvest and broodstock management. pNOB = 80% pHOS = 60%	-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.
Coordinated Habitat Projects	-UCSRB habitat initiative schedule is begun through HCP, SRFB, BPA, PCSRF funds.	-Continue UCRSB habitat initiative schedule through HCP, SRFB, BPA, PCSRF funds.	-Continue UCSRB habitat initiative schedule through HCP, SRFB, BPA, PCSRF funds. -Hydro-system survival is improved.	-UCSRB habitat initiative schedule is fully implemented.	-USSRB habitat initiative schedule is fully implemented. -Hydro-system survival specified in the BiOP is achieved.

Table 4-2. Methow subbasin program summary

	BDP1	BDP2	Natural Production Implementation	Natural Production Support	Fully Restored Population
Management Goal	-Eliminate transfers of Lower Columbia River Brood. -Broodstock collection = 656.	-Encourage broodstock adaptation so that returning coho can reach key habitat within the subbasins. -Broodstock collection = 1,312 .	-Initiate natural production in key habitat areas. -NOR Escapement >600.	-Develop locally adapted, fully integrated stock. -NOR Escapement >900.	Self-sustaining naturally reproducing population is established. -NOR Escapement >1500. -Terminal and mainstem harvest in most years.
Management Strategy	-Primary release site(s) at WNFH and Wells FH. -Primary broodstock collection site is Wells Dam	-Primary release site(s) at WNFH and Wells FH. -Primary collection site(s) at WNFH 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 = 10% pHOS = 90%	-Further the local adaptation process and reduce domestication selection. -Convert to integrated hatchery program and move towards PNI >0.5. -Implement matrix schedule for harvest and broodstock management. pNOB = 80% pHOS = 60%	-Harvest according the matrix schedule. -Implement hatchery supplementation as needed to prevent extirpation and achieve harvest goals, subject to condition that PNI>0.5.
Coordinated Habitat Projects	-UCRSB habitat initiative schedule is begun through HCP, SRFB, BPA, PCSRF funds	-UCRSB habitat initiative schedule is continued through HCP, SRFB, BPA, PCSRF funds	- UCRSB habitat initiative schedule is continued through HCP, SRFB, BPA, PCSRF funds. Hydro-system survival is improved.	-UCRSB habitat initiative schedule is fully implemented.	USRSB habitat initiative schedule is fully implemented. Hydro-system survival specified in the BiOP is achieved.

Table 4-3 shows release plan numbers for each phase in both the Wenatchee and Methow subbasins.

Table 4-3. Proposed smolt release numbers
(smolts released/1,000,000)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Wenatchee																					
Broodstock Dev																					
Phase I																					
Phase II	1.00	1.00	1.00	1.00	1.00																
Natural Production																					
Implementation						1.16	1.16	1.16													
Support Phase I									0.81	0.81	0.81	0.81	0.81	0.81							
Support Phase II															0.40	0.40	0.40	0.40	0.40	0.40	
Methow																					
Broodstock Dev																					
Phase I	0.50	0.50	0.50																		
Phase II				0.50	0.50	0.50															
Natural Production																					
Implementation							1.00	1.00	1.00												
Support Phase I										0.70	0.70	0.70	0.70	0.70	0.70						
Support Phase II																0.35	0.35	0.35	0.35	0.35	0.35
TOTAL	1.50	1.50	1.50	1.50	1.50	1.66	2.16	2.16	1.81	1.51	1.51	1.51	1.51	1.51	1.10	0.75	0.75	0.75	0.75	0.75	0.35

4.3.2 Proposed Facilities – Overview

A progressive approach to the design of the MCCRP has been taken. Input from experienced Yakama Nation biologists, reviews of the recent scientific literature, and discussions with regional experts have been used to assemble a program that is and will continue to make use of the latest salmon reintroduction methodology. Important publications include Hatchery Reform: Principles and Recommendations of the Hatchery Scientific Review Group (Mobrand et al. 2004). Many of the conclusions reached by the HSRG about the future of hatcheries and how they should be operated are being implemented by the MCCRP. These include using hatcheries as part of an "integrated strategy" to meet harvest and conservation goals, operating hatcheries "with consideration of the potential for genetic and ecological interactions with natural stocks," and developing plans with well defined goals and informed feedback.

The project design and operation are also consistent with features of "landscape hatcheries" as described by Williams et al. (2003). MCCRP practices that conform to the recommended principles of ecosystem-based hatchery programs are the capture of locally returning brood that are genetically representative of the local stock; production of fish using wild characteristics as a guideline; rearing on natural water temperatures at low densities; system flexibility (responsiveness to the principles of adaptive management); decentralized, small-scale release sites; and the monitoring and evaluation of results.

Broodstock Development Phases

Fish produced for the broodstock development phases would be captured at existing adult traps, produced from existing hatcheries, and released from acclimation sites that do not require new rearing unit construction. However, modifications to these existing facilities may be necessary in order to meet project goals (see Chapter 6).

Figure 4-1 shows the existing sites of major fish culture activities.

- Broodstock capture:

  Wenatchee subbasin: traps on the Wenatchee River will include Leavenworth NFH, and Tumwater and Dryden Dams.

  Methow subbasin: trapping facilities will include Wells FH, Winthrop NFH, and Wells Dam east/west ladders.
- Broodstock holding and early incubation: Entiat and Winthrop NFHs.
- Rearing to pre-smolt size: Cascade FH, Willard and Winthrop NFHs.
- Acclimation:

  Wenatchee: Rohlfing, Coulter, Butcher, and Beaver ponds and the Leavenworth NFH on Icicle Creek.

  Methow: Winthrop and Wells hatcheries.

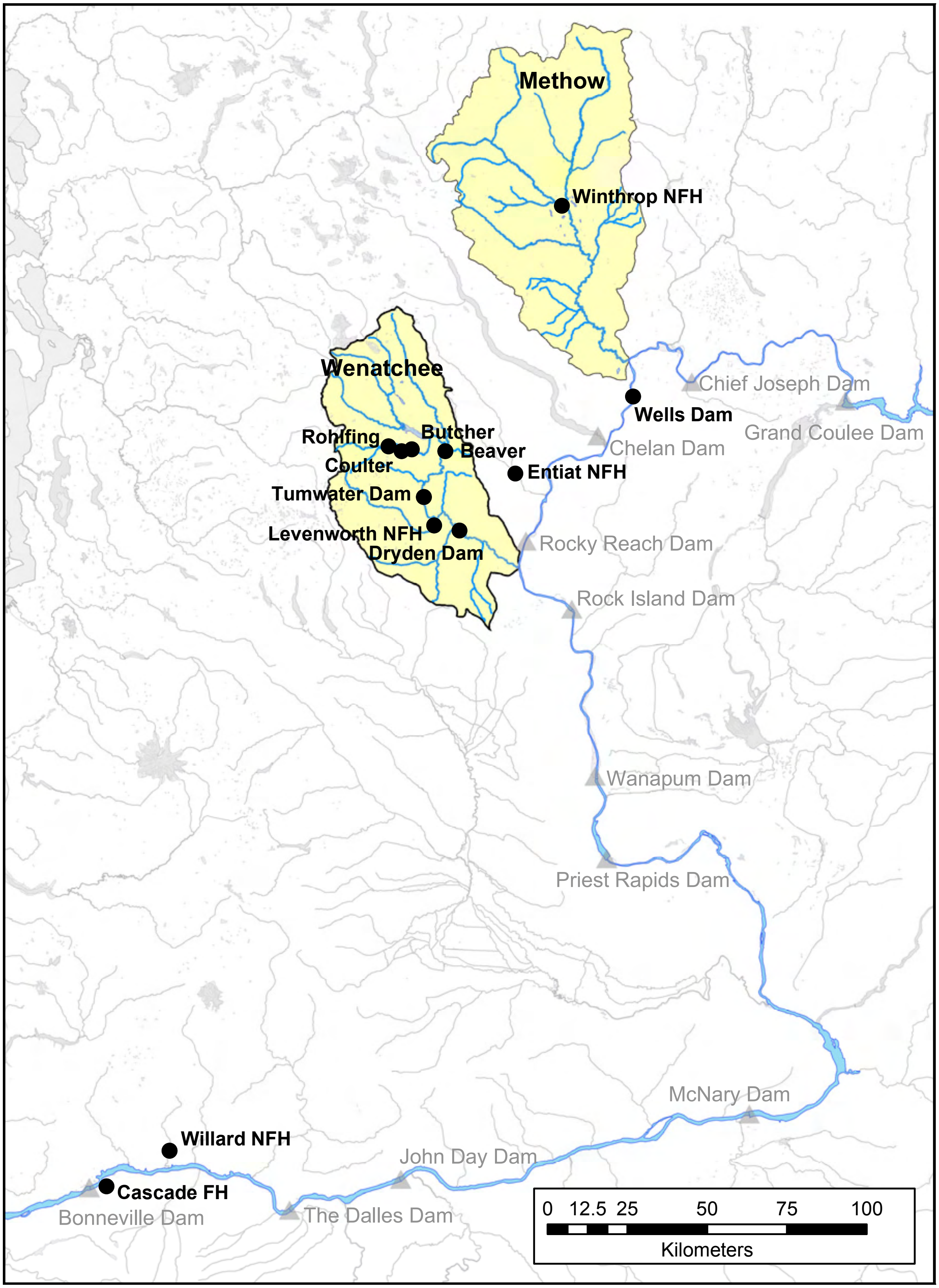


Figure 4-1. Sites of Fish Culture Activities and Existing Facilities

Natural Production Implementation Phases

Beginning with the NPIP, the plan proposes to continue rearing most program fish at existing hatcheries, with constructed habitats in the Methow producing 15% of the total. Acclimation is planned to occur in a combination of existing and new sites. The release sites target EDT-predicted coho spawning and rearing habitat. The multi-function sites in the Methow basin would be used as both rearing and release sites. One conventional acclimation site is planned on the White River in the Wenatchee watershed. The remainder of the sites are existing pools and small, constructed ponds. Table 4-4 summarizes those facilities and Figures 4-2 and 4-3 show their locations. Chapter 6 and the C Appendices describe the facilities in more detail.

Table 4-4. Proposed program facilities, existing and new

Facility Type	Wenatchee Subbasin Facilities		Methow Subbasin Facilities	
	Site	Status	Site	Status
Brood capture (primary sites)	Dryden	Existing	Wells Dam	Existing
	Tumwater	Existing	Winthrop NFH	Existing
	Tributary weirs	Existing and new	Tributary weirs	Existing
			Foghorn	Existing
Rearing	Cascade	Existing	Cascade	Existing
	Willard	Existing	Winthrop	Existing
Multi-Function	Dryden[1]	New	Eightmile[2]	New
			Heath Ranch[2]	New
Acclimation	Icicle/**LNFH**	Existing	Methow/**Winthrop**	Existing
	Nason/**Coulter/Roaring**	Existing	Chewuch/**Ramsey**	Existing
	Nason/**Rohlfing**	Existing	Twisp/**Poorman**	Existing
	Beaver**/Beaver**	Existing	Twisp/**Lincoln**	New
	White**/Tall Timber**	New	Wolf/**Biddle**	Existing
	Chiwawa/**Clear**	Existing	Methow/**Hancock**	Existing
	Chiwawa**Chikamin/Minnow**	New	Methow/**Goat Wall**	New
	Chiwawa/**Chiwawa**	New		
	Little Wen**./Two Rivers**	Existing		

[1]Dryden is an adult holding and incubation facility only.

[2]Eightmile and Heath Ranch are multi-function sites where both rearing and acclimation occur.

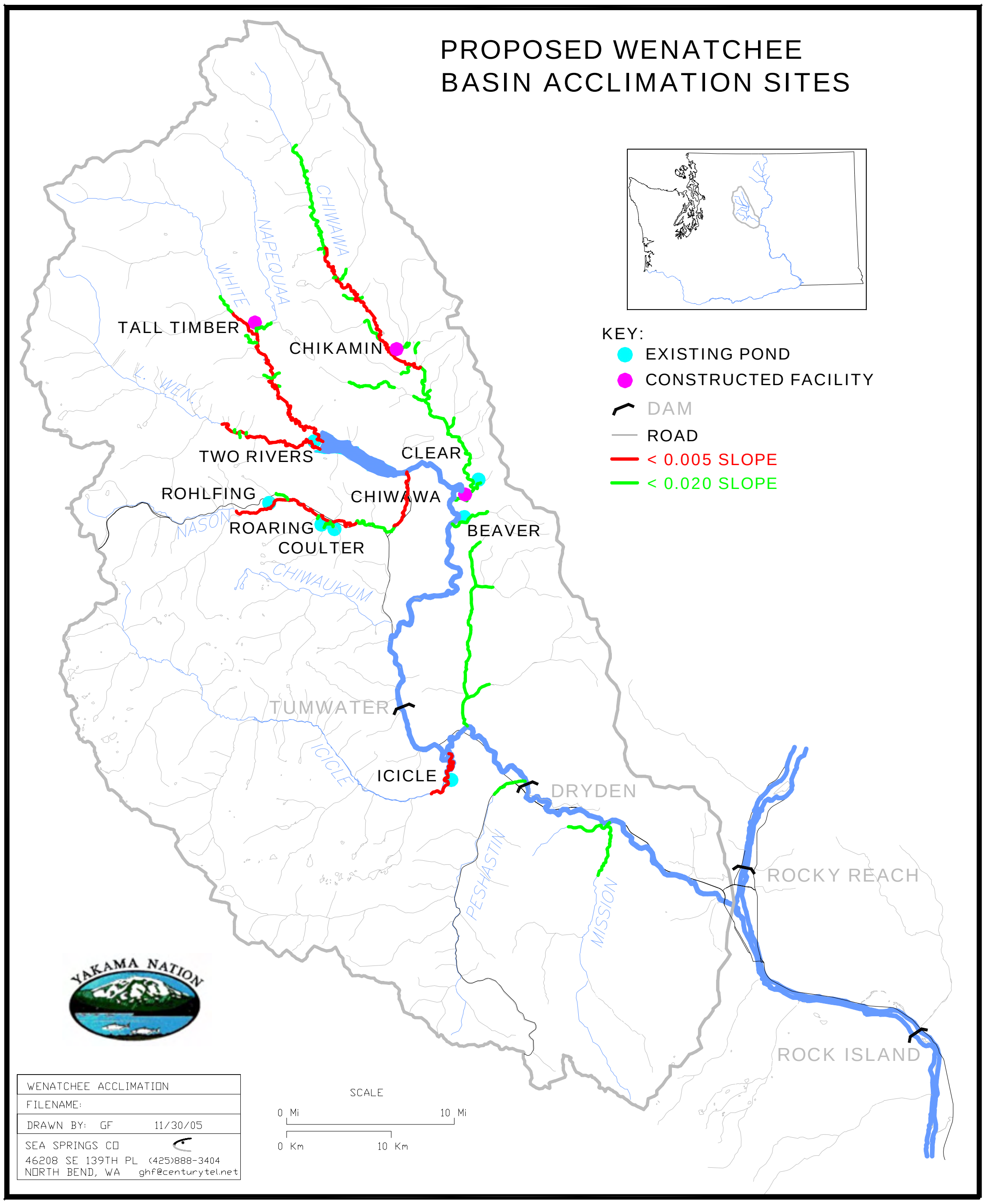


Figure 4-2. Wenatchee Subbasin Proposed Acclimation Sites

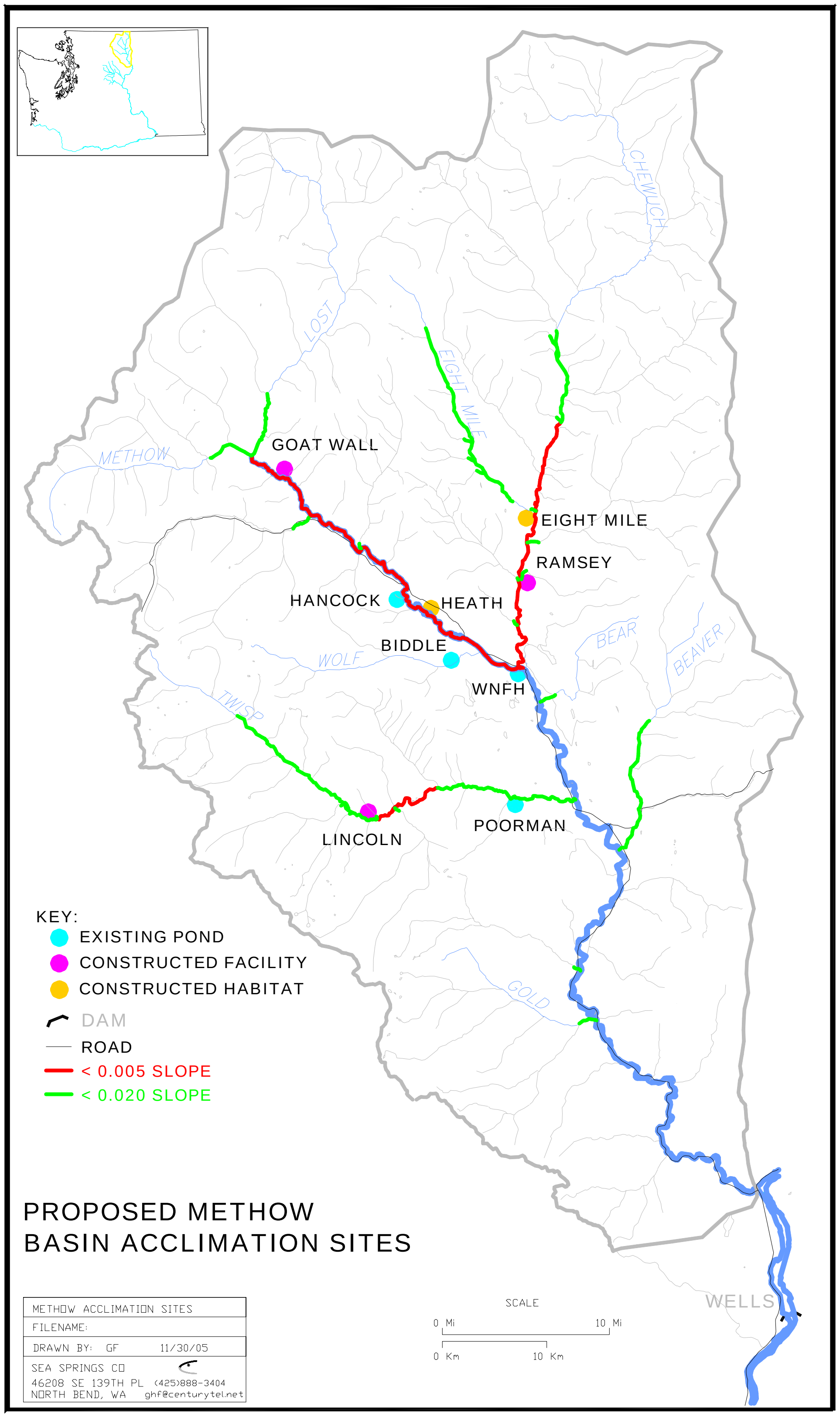
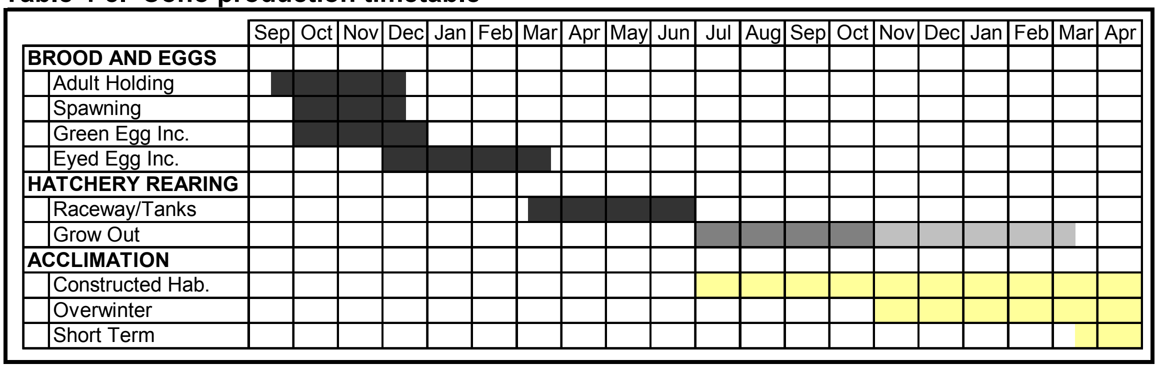


Figure 4-3. Methow Subbasin Proposed Acclimation Sites

The scheduling of program fish culture activities is shown in Table 4-5. The timing of egg and fish transfer 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 egg incubation occurs at or near these holding facilities. Eyed eggs are moved to hatcheries in mid-winter for final incubation and early rearing. After marking at the end of June, some of the hatchery production can be moved to constructed habitats (Section 6.2.3) or to hatchery grow-out ponds. In early to late winter, pre-smolts are moved to the remaining final acclimation/release sites.

Table 4-5. Coho production timetable



4.3.3 Summary of Proposed 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 returning fish; when the program in each basin can move into a new phase; whether supplementation will be appropriate; and whether naturally produced coho are adversely affecting listed and sensitive species. Table 4-6 summarizes the M&E plan; details are provided in Chapter 7.

Table 4-6. Summary of M&E activities

M&E Activity	Indicator	Strategy	Restoration Phases	Coordination 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 (BPA project #2003-017-00); CCPUD/ DCPUD HCP 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: Integrated Status & Effectiveness Monitoring Program (BPA project #2003-017-00); CCPUD/ DCPUD HCP Hatchery Programs
Egg-to-emigrant survival	Project Performance	Smolt trapping Redd counts CWT	BDP1, BDP2, NPIP, NPSP[2]	Yes: Integrated Status & Effectiveness Monitoring Program (BPA project #2003-017-00); CCPUD/ DCPUD HCP Hatchery Programs

M&E Activity	Indicator	Strategy	Restoration Phases	Coordination with other 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
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 Electro-fishing	BDP1, BDP2, NPIP, NPSP[3]	Yes: Integrated Status & Effective-ness Monitoring Program (BPA project #2003-017-00); CCPUD/ DCPUD HCP Hatchery Programs
NTTOC – Abundance and survival	Species Interactions / Status of NTTOC	Smolt trapping Underwater observation Electro-fishing	BDP1, BDP2, NPIP, NPSP[3]	Yes: Integrated Status & Effective-ness Monitoring Program (BPA project #2003-017-00); CCPUD/ DCPUD HCP Hatchery Programs
NTTOC – Distribution	Species Interactions / Status of NTTOC	Redd counts Underwater observation Electro-fishing	BDP1, BDP2, NPIP, NPSP[3]	Yes: Integrated Status & Effective-ness Monitoring Program (BPA project #2003-017-00); CCPUD/ DCPUD HCP Hatchery Programs
Competition	Species Interactions / Mechanisms of Interaction	Underwater observation Enclosures Size and growth	NPIP	No

M&E Activity	Indicator	Strategy	Restoration Phases	Coordination with other programs
Predation by naturally produced coho on spring chinook fry	Species Interactions / Mechanisms of Interaction	Smolt trapping Emergence and emigration timing	NPIP	Yes: Integrated Status & Effective-ness Monitoring Program (BPA project #2003-017-00); CCPUD/ DCPUD HCP Hatchery Programs
Morphometrics and life history traits	Genetic Adaptability	Adult trapping Redd counts Carcass recovery Smolt trapping CWT	BDP1, BDP2, NPIP, NPSP	Yes: Integrated Status & Effect-iveness Monitoring Program (BPA project #2003-017-00); CCPUD/ DCPUD HCP Hatchery Programs
Genetic monitoring	Genetic Adaptability	Genetic sampling CWT	BDP1, BDP2, NPIP, NPSP	No
Contemporaneous sperm cryo-preservation	Genetic Adaptability	Cryo-preserva-tion and use of previously preserved milt	BDP1, BDP2, NPIP, NPSP[4]	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.

[3] Baseline NTTOC monitoring during BDP1 & BDP2, effect monitoring during NPIP &NPSP.

[4] Milt for cryo-preservation will be collected during BDP1 (initially, milt was collected during feasibility), stored throughout BDP2 and used for evaluation during NPIP or NPSP.

4.3.4 Program Cost Summary

This section summarizes estimated costs for all the program elements; Chapter 8 provides the details. Costs are based on a fish release plan that is expected to last until 2026, as shown in Table 4-7.

Table 4-7. Program schedule

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Wenatchee																					
Broodstock Dev																					
Natural Production																					
Methow																					
Broodstock Dev																					
Natural Production																					

Estimates of the capital and operating costs cover the project's lifetime. Capital cost estimates are shown in Table 4-8 and include program planning; preliminary and final designs; project-level (such as NEPA and ESA) evaluations; facility development permits; land purchase; construction; and capital equipment. To minimize capital costs, the proposed facility plan for the Mid-Columbia Coho Restoration project makes extensive use of existing facilities—brood capture, rearing, and acclimation—in the region.

Table 4-8. Total MCCRP capital costs

Planning and Design	$1,040,975
Permits	$875,355
Capital Equipment	$1,280,130
Multi-Function Facilities	$3,473,294
Acclimation Facilities	$3,252,439
TOTAL	**$9,922,193**

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 will change over time. Expenses during years when release numbers and operating costs are at their maximum are estimated to be:

Table 4-9. Peak annual operating expenses (2012)

Operation and Maintenance	$2,250,710
Monitoring and Evaluation	$1,298,425
Tagging	$653,417
General and Administrative	$428,620
SUBTOTAL	**$4,631,172**
Cost Share	$1,179,800
TOTAL	**$3,451,372**

The proposed program currently shares rearing costs with National Oceanic and Atmospheric Administration (NOAA) through the Mitchell Act and monitoring and evaluation costs with WDFW and the region's Public Utility Districts (PUDs). Additional funding support may be available in the future through these agencies and others in the region.

4.3.5 Contingency Plans and Decision Processes

1. **If BDP1 goals are not achieved within 3 generations:**
    a. Evaluate cause for failure to meet BDP1 goals. Possible causes include but are not limited to: poor trap efficiency, lower than expected SARs (due to migratory or ocean conditions), and lower than expected egg-to-smolt survival (in hatchery).
    b. Determine if the cause of failure to achieve goals can be ameliorated.
    c. Implement course of action and re-evaluate after one generation. If course of action appears successful, continue until BDP1 goals are achieved or for two generations.
    d. If no corrective action can be made and the cause is determined to be the result of out-of-basin effects, repeat BDP1.
    e. If no corrective action can be made and the cause is not the result of out-of-basin effects, consider a harvest augmentation program.
2. **If BDP2 goals are not achieved within 4 generations:**
    a. Evaluate the cause for failure to achieve BDP2 goals. Possible causes include, but are not limited to: poor trap efficiency, lower than expected SARs (due to migratory or ocean conditions), lower than expected egg-to-smolt survival (in hatchery), the local adaptation process does not proceed as quickly as expected, or we made incorrect assumptions regarding coho habitat and life history in mid-Columbia tributaries.
    b. Determine if the cause of failure to meet goals can be ameliorated.

c. Implement course of action. If the local broodstock is not adapting as quickly as expected, the course of action may include repeating BDP1.

d. If no corrective action can be made and the cause is determined to be due to out-of-basin effects, repeat BDP2.

e. If no corrective action can be made and the cause is not the result of out-of-basin effects, consider a harvest augmentation program.

3. Natural Production Phases Adaptive Management Process:

The natural production phases are designed to result in a fully integrated program, while decreasing domestication selection and increasing local adaptation in both the broodstock and the natural spawning population. To achieve this, we used the AHA model to address the loss of fitness associated with hatchery programs for five generations of broodstock management. The natural production phases are not measured against a success/failure scenario; rather, they represent an evaluation and decision process—an adaptive management process.

a. After one generation of the Natural Production Implementation Phase, release numbers will be reduced by 30%. The purpose of the Natural Production Implementation Phase is to cycle sufficient coho eggs through the natural environment to begin the local adaptation and naturalization process.

b. For the Support Phase, release numbers initially will be reduced by 30% (from Implementation Phase release numbers), with an initial target of 35% pNOB and 75% pHOS. (Note: AHA does not predict that pHOS objectives will be met until release numbers are further reduced.) If initial pNOB targets are not met within two generations, the program will be closely evaluated and adjusted depending upon the reason initial targets have not been reached. Possible reasons include but are not limited to 1) inadequate trapping facilities or protocols; or 2) lower than expected productivity, migratory survival, or marine survival.

    i. If we determine that sufficient natural-origin brood are returning to the basin but we are unable to incorporate sufficient numbers into the broodstock, primary trap locations, operation schedules, or trap modifications may be required.

    ii. If insufficient numbers of natural-origin coho are returning to the basin, then either productivity, migratory or marine survival are lower than expected and modeled. If the cause is lower than expected productivity, habitat improvements may need to better target key areas for coho production, the habitat improvement schedule may need to be accelerated, or the coho are not adapting as quickly as expected. Under these scenarios we will continue with the current release and broodstock capture strategy or consider reducing release numbers to aid in reaching initial pNOB targets and accelerate the local adaptation process.

    iii. After initial pNOB targets have been achieved for one generation (3 years) and the habitat improvement schedule is proceeding as anticipated, release numbers will be reduced by 50%, the pNOB target will be increased to 80% and the pHOS target will become 60%. A similar decision process will be repeated as described in "i" above. When final pNOB targets have consistently been achieved for one generation, the local adaptation process should have progressed sufficiently that the proposed BPA-funded program could be discontinued.

iv. Supplementation may be required in some years, and local adaptation could be protected by releasing moderate numbers of coho smolts to hedge against catastrophic events. All populations have lows and highs. In the low years, supplementation might be needed as an insurance policy against a second extirpation. Alternatively, a small supplementation program may be needed at the end of the proposed 20-year program (5 generations after beginning the NP phases). For example, 150,000 coho smolts could be produced at LNFH for a number of years (maybe 10) until we are sure the naturally spawning populations can survive for the long term. In both cases, the fish would come from the naturally spawning population, and in both cases, the program could be funded under the PUDs' compensation program, not by BPA.

4.3.6 Why the Program is Expected to Succeed

The basic premise of the Mid-Columbia Coho Restoration Program is that non-local, domesticated hatchery stocks can be used to develop self-sustaining, naturally reproducing populations in targeted watersheds**.** Results to date have demonstrated that the concept is viable if properly implemented (Murdoch et al. 2004). The program presents a unique opportunity to develop methods for, and measure rates of, the conversion of hatchery stocks into naturally reproductive and viable populations in new habitats. The AHA model would be used to address the loss of fitness common with hatchery programs by reducing domestication selection and emphasizing local adaptation. This new line of research complements the past two decades of fishery genetics research, which has emphasized the risks of artificial propagation to natural populations, by exploring the potential for using abundant hatchery genetic resources to restore extirpated or demographically vulnerable populations. This is particularly important as regional fishery managers and funding entities consider the role of artificial propagation in the recovery of ESA-listed and non-listed populations and extirpated salmonids.

Previous efforts to transplant salmon populations to new environments show varying outcomes. There are many examples of unsuccessful attempts to develop new populations from both hatchery and natural transplants. Quinn (2005) discusses examples which include serious efforts to introduce: 1) an even-year pink run in Puget Sound, 2) chinook in Chile, 3) pink salmon on the East Coast, and 4) sockeye in Upper Adams Lake, B.C. He discusses these failures as examples of "the importance of local adaptation to fitness."

Further evidence of the role of local adaptation comes from a coho study done at Big Creek Hatchery in Oregon. Unfertilized eggs and milt were brought to this hatchery from many hatchery locations and reared to smolt size for release. It was found that the distance between the release site and the river of origin had a large impact on survival rates (Reisenbichler 1988). Coho from within the same drainage showed similar and higher survival rates than those moved large distances.

A number of successful introductions demonstrate the potential effectiveness of transplanting donor stocks over long distances to develop new salmonid populations. Examples of successful transplants of anadromous fishes outside the species' range include:

- Pink, coho, chinook salmon, and steelhead are now self-sustaining in all of the five Great Lakes as a result of hatchery plants in 1956 (Quinn 2005).
- Anadromous populations of chinook salmon were established in New Zealand from releases to a single river system (the Waitaki) between 1901 and 1907 (McDowall 1994). Spawning chinook were noted in the Hakataramea River within a few years and within 10 years had distributed to other large glacier-fed rivers on the east coast of the South Island where spawning presently occurs (Kinnison et al. 2001). Due to local adaptation, the New Zealand chinook populations now phenotypically differ in morphometric and reproductive traits (Kinnison et al. 1998a, 1998b; Kinnison et al. 2001).
- Sockeye transplanted from Baker Lake (Washington) established a self-sustaining population in Lake Washington and Lake Sammamish after the indigenous population was extirpated by the construction of the Montlake Cut in 1917.
- Construction of a dam near the mouth of the Methow in 1915 extirpated the native spring chinook stock. The Winthrop NFH helped re-establish the run with chinook captured from the trap at Rock Island Dam after removal of the dam (Brannon et al. 2004).

These successes were probably a result of the transplanted populations having enough of the adaptive traits needed to be viable within the introduced environment. Evaluation of these successes demonstrates that:

1) introduced hatchery stocks have the capacity to quickly adapt to local conditions (Quinn 2005; Brannon et al. 2004; Hendry 2001), and

2) much remains to be learned about the critical elements of successful reintroductions.

The most relevant past attempts at coho reintroduction are in the mid-Columbia region. Mullan (1984) states that despite hatchery releases at Leavenworth, Entiat, and Winthrop National Fish Hatcheries from 1942 to 1975, "there is no evidence to indicate development of a self-sustaining population of coho salmon above threshold levels recorded in the 1930s." The failure to re-establish natural coho runs through these hatchery releases was "to have been primarily related to necessary reliance, because of severe depletion of upper river stock, upon short-run, late-spawning lower river stocks lacking genetic suitability."

In earlier attempts at coho restoration, there were few aquacultural or genetic protocols to prepare the stock for local habitat conditions. The mid-Columbia coho program is expected to succeed for the following reasons:

This program emphasizes accelerating local adaptation of donor stocks.

- The phased approach described in Chapter 4 moves broodstock capture and smolt release locations upstream as adaptive criteria, such as tissue lipid levels, skin color, run timing, maturation timing and condition factor increase in the returning adults. Naturalization is encouraged as an evolutionary process.

- Natural-origin fish will be preferentially selected for broodstock to maximize local adaptation and minimize further domestication. The target proportion of natural-origin fish in the broodstock increases and release numbers decrease as the program progresses.
- Improved fish culture techniques (rearing at low densities, acclimation in natural conditions, improved feed, following natural growth profiles) have been shown to increase adult return rates and provide a higher likelihood that enough adults will return to satisfy local broodstock development needs. The higher adult return rates also expand the genetic pool from which local, heritable traits will develop.
- Acclimation and release locations are proposed in areas that have high-quality coho habitat.
- Coordinated efforts to improve habitat conditions for coho salmon and other salmonids should result in increased productivity and survival of naturally produced fish.

This program is taking advantage of improved post-release survival conditions.

- Tributary outmigration survival has increased due to improvements in irrigation screening systems.
- Mainstem Columbia hydro project operations now include water management and smolt protection systems that improve smolt survival.
- Mainstem predation control is provided by programs such as the northern pikeminnow sportfish reward program.
- When the draft Upper Columbia Recovery Plan (UCSRB 2005) for listed salmonids is adopted and implemented, measures to improve survival will benefit coho as well.
- HCP required survival criteria and tributary habitat improvements will be implemented.
- Evidence that this approach is working comes from data collected during the feasibility phases of the mid-Columbia and Yakima River coho reintroduction programs. An important measure of the effect of local adaptation is smolt-to-adult return rate. The results presented in Section 3.1 show that this rate is increasing rapidly for all coho programs above McNary Dam (mid-Columbia, Umatilla River and Yakima River) after implementation of the fish culture techniques described above.

4.4 Program Risks

Program risks generally fall into three categories:

1) species interaction risks,

2) facility development risks, and

3) operations risks.

During feasibility studies, the program studied interaction risks extensively. Results are summarized in Chapter 3. While we believe the proposed program poses little risk to other species, we recognize that some uncertainty remains and have proposed studies in the monitoring and evaluation plan to determine changes in status to other fish species and whether the change is caused by coho reintroduction (see Section 7.2). Interaction risks also will be reviewed during

NEPA and ESA analyses that will be done as part of the Step 2 process, but previous NEPA and ESA analyses for this project have shown little impact or have resulted in modifications to the program to accommodate concerns.

Risks of developing the proposed new facilities have not been comprehensively assessed, although preliminary issues and potential problems have been identified. The potential exists for impacts to natural resources such as wetlands, floodplains, non-aquatic listed and sensitive species, water quality and quantity, and to property owners and nearby residents. Chapter 6 describes preliminary development risks for each proposed new site. The detailed evaluation of site development impacts will be done during the NEPA evaluation that is part of the Step 2 process. Development risks are reduced by selecting alternative sites for each proposed facility component.

Operations risks include effects on listed and sensitive species of smolt and adult trapping, electro-shocking, and other M&E activities. Effects of any proposed changes in operation of existing traps, or locations of M&E activities, will be evaluated in NEPA and ESA analyses and will be subject to conditions set during those processes. Operational risks are reduced by considering potential impacts during site location selection and facility design.

4.5 Program Benefits

Coho reintroduction is an important part of a regional, integrated, ecological recovery strategy. Cultural, socio-economic, and ecological benefits are expected to result from the return of this species to areas where it once occurred in abundance.

Salmon are a part of the spiritual and cultural identity of the four Columbia River treaty tribes. They also play an important role in the economic well being of tribal members. Recovery of coho salmon to the Yakama Nation's "usual and accustomed" fishing places helps support regional tribal objectives.

The commercial value of Columbia Basin tribal, commercial, and recreational fisheries is estimated by the IAEB (2005) as contributing "about $142 million total personal income annually to communities on the West Coast." Coho salmon returning to Mid-Columbia watersheds will add to this value.

Marine nutrients deposited in the form of coho carcasses will improve stream rearing conditions for other species (Quinn 2005), including those that are ESA-listed. Juvenile steelhead, for example, congregate in areas where salmon carcasses are deposited and they show a dramatic increase in condition factor (Bilby et al. 1998). Coho salmon may be a particularly important link in nutrient cycling processes. Coho salmon spawn high in the watershed at the onset of winter, delivering nutrients to the uppermost reaches where all species downstream will benefit (Vannote et al. 1980). During winter, reduced primary production may limit the standing crop of invertebrates. The addition of carcasses at the onset of winter may provide an increased food base (Pearsons and Hopley 1999) and improve over-winter survival for all species. The Wenatchee Subbasin Plan (page 27) 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).

The presence of both naturally produced and hatchery coho may increase prey densities, potentially reducing losses of ESA-listed species from predation. Coho eggs, fry, and smolts (natural and hatchery) will increase the availability of prey, providing increased food supply for aquatic species including steelhead and bull trout (Pearsons and Hopley 1999). Loss of prey likely has contributed to the decline in bull trout populations (Ratliff et al. 1996).

Ecological benefits of coho restoration could extend beyond the aquatic community to other ESA-listed species, including the bald eagle and grizzly bear. Salmon are an important feed resource for these species. Bald eagles, over-wintering in the Wenatchee River, have been observed feeding on coho carcasses on Icicle Creek (C. Kamphaus, YN, pers. comm.). Riparian vegetation will also benefit from the nutrients derived from coho carcasses (Quinn 2005; Cederholm et al. 1999). For these reasons, salmon are recognized as a "keystone" species in vertebrate communities (Quinn 2005, Cederholm et al. 1999, Willson and Halupka 1995).

Other listed fish species will indirectly benefit from the presence of this missing native species. The justification for developing regional habitat conservation measures protecting all fish species will be strengthened. For example, restoring hydraulic functionality to currently isolated side channels will be an important habitat improvement for coho. Parts of these side channel habitats may also be used by spring chinook, steelhead, and bull trout.

Project purchase of riparian land for acclimation and constructed habitat will protect critical habitat for all species. Constructed habitat will benefit all species as a natural rearing environment after the termination of this project.

The opportunity to study the local adaptation process in detail is a significant benefit to regional fish managers and researchers. There is very little literature available that evaluates the time or techniques required to develop locally adapted stocks or the traits that would define naturalization. The MCCRP will collect information on phenotypic traits such as migration timing, spawn timing, adult size, adult sex ratios, fecundity rates, and tissue lipid concentration as a measure of stored energy reserves (Section 7.3). Together with genotype measurements, these traits will be compared with those in the originating hatchery stock to track the rate and direction of adaptation to natural habitats in the mid-Columbia tributaries. Juvenile and adult survival rates will be documented and compared with other stocks and species considered to be locally-adapted natural stocks. This line of investigation will have system-wide application by providing the region with important new information regarding the role of hatcheries and hatchery stocks in restoring salmonid populations to natural habitats in the Columbia Basin.

In the words of the Endangered Species Act (1973):

> "various species of fish, wildlife, and plants in the United States have been rendered extinct as a consequence of economic growth and development untempered by adequate concern and conservation;…these species of fish, wildlife, and plants are of aesthetic, ecological, educational, historical, recreational, and scientific value to the Nation and its people."

Chapter 5.
Program Details

Chapter 5. Biological Program Details

5.1 Broodstock Development Phase 1

5.1.1 Wenatchee

This phase has been completed in the Wenatchee subbasin. For FY2007-2009, the project will proceed to the second phase.

5.1.2 Methow

During FY2007-2008 we expect to implement BDP1 in the Methow subbasin. During BDP1, we plan to release 500,000 smolts annually from the Methow River Basin. Source fish for initial release would be a combination of adult returns from the current releases of 250,000-300,000 smolts, Wenatchee River coho returns in excess of Wenatchee River broodstock development goals, and reprogrammed lower Columbia River coho, if necessary. During BDP1, 250,000-350,000 acclimated coho smolts would be released from the Winthrop NFH (WNFH). The remaining 150,000-250,000 smolts would be released from acclimation site(s) at Wells Dam Hatchery, or on the Methow, Twisp and /or Chewuch rivers.

Both Methow and Wenatchee returns will be used to comprise the entire mid-Columbia program, with each basin supplementing the other in years of basin-specific shortfalls. Should broodstock shortfalls occur in the future in *both* basins, the program will rely on coho returns to other above-McNary Dam locations to supplement its production needs. The intent is *not* to use lower river hatchery populations for future broodstock. In 2005, the YN developed a contingency plan with the Umatilla Tribe and ODFW to use adult coho returns to the Umatilla River if there were shortfalls in the mid-Columbia. This plan was not needed when the run to the Wenatchee and Methow was sufficient to meet full production needs in 2005, but can be used in future years if necessary.

During BDP1, Wells Dam would be the primary broodstock collection site, with supplemental trapping at the WNFH, the Chewuch/Twisp weirs, and possibly Wells FH. BDP1 will be considered successful when a mean trappable adult return of 632 coho adults (annual broodstock collection goal) in one 3-year period within 9 years is reached at Methow basin trapping facilities (Wells Dam, WNFH, and Chewuch/Twisp weirs). Successful completion of BDP1 will trigger the implementation of BDP2.

5.2 Broodstock Development Phase 2

5.2.1 Wenatchee

During BDP2 (FY2007-2010), we propose to release one million smolts annually from the Wenatchee River basin. Approximately 500,000 would be released above Tumwater Dam in Nason Creek, Chiwawa River, and Beaver Creek. The remaining 500,000 coho smolts would continue to be released from Icicle Creek to ensure that broodstock collection goals are met while transitioning to upper basin collection sites.

We would primarily trap broodstock at Tumwater Dam, with additional trapping at Nason Creek (a semi-permanent weir is at the 30% design phase under the umbrella of the Grant County PUD production program), Chiwawa River Weir, Dryden Dam and/or Icicle Creek. An emphasis on the use of upstream trapping sites will allow selection for coho which are able to navigate Tumwater Canyon and return to tributaries of the upper Wenatchee River. Coho smolts released from upper basin tributaries and Icicle Creek would be differentiated by the use of body tags (a CWT placed in the adipose fin). Body tagging will allow researchers to either pass or capture adult coho at Dryden Dam.

Broodstock Development Phase 2 will be successfully completed when we have a mean adult return to Wenatchee River traps of 1,312 adult coho for one 3-year period within 9 years, with a minimum of 50% of the broodstock collected at Tumwater Dam or other upper basin trapping sites. The requirement of 50% of broodstock collected at Tumwater Dam is based on the distribution of juvenile releases (50% above Tumwater Dam and 50% below Tumwater Dam). If we collect 50% of our broodstock at Tumwater Dam (or other upstream trapping sites) when 50% of the juveniles are released in upstream areas, it is assumed that we will be able to trap 100% of our broodstock from upstream returning stocks during the Natural Production Implementation Phase. Successful completion of BDP2 will trigger the start of the Natural Production Phases.

5.2.2 Methow

BDP2 is expected to begin in FY2009 and continue through FY2011. During BDP2, we propose to release 500,000 smolts annual from the Methow River basin. During BDP2, 250,000-350,000 acclimated coho smolts would be released from the Winthrop NFH. The remaining 150,000-250,000 smolts would be released from acclimation site(s) on the Methow, Twisp and /or Chewuch rivers.

During BDP2, broodstock collection efforts would shift emphasis to upstream trapping sites, to select coho which are able to return to the WNFH and to coho spawning habitat. Winthrop NFH and the Chewuch/Twisp weirs will become the focal broodstock trapping locations. During BDP2, release sites and numbers would remain the same as during BDP1. We expect a gradual transition to 100% collection in upstream locations. During this transition, we would continue to trap as needed at Wells Dam to ensure that broodstock goals are met.

BDP2 will be considered successful when a mean of 656 adult coho (broodstock collection goal for BDP2) are trapped at upstream trapping sites (WNFH and Chewuch Weir) for one 3-year period, with 1,312 adult coho (broodstock collection goal for Natural Production Implementation Phase) trappable at Wells Dam. Completion of BDP2 will trigger the Natural Production Phases.

5.3 Natural Production Phases

The natural production phases are anticipated to begin in FY2011 (Wenatchee subbasin). At the conclusion of BDP2 we expect to have hatchery broodstock which can successfully migrate back to the Wenatchee and Methow rivers. However, we recognize that the Wenatchee and Methow stocks will remain domesticated until they are locally adapted[8] to habitats in the natural environment. The Natural Production Phases described below represent the proposed transition from a domesticated hatchery program to locally adapted naturally reproducing populations in the Wenatchee and Methow subbasins.

We view the habitat initiatives and schedule described in Section 2.4.4 as a key component to successful restoration of the naturally reproducing coho populations. With the combination of habitat improvements, which should result in increased productivity, and a supplementation program designed to maximize local adaptation while reducing domestication selection, the program is designed to have reached its self-sustaining goals and be terminated after five generations of supplementation.

5.3.1 Natural Production Implementation Phase

We expect to begin the Implementation Phase in FY 2011 in the Wenatchee and in FY 2012 in the Methow. The Implementation Phase is designed to begin the local adaptation and naturalization process by reintroducing coho in areas predicted by EDT to have the greatest chance of success: the Chiwawa River, White River, Little Wenatchee River, Upper Wenatchee River, and Nason Creek in the Wenatchee subbasin; and in the mid- and upper reaches of the Methow River, the Chewuch River, and the Twisp River in the Methow subbasin. The Implementation Phase seeks to initiate the local adaptation and naturalization process by releasing enough hatchery fish in the natural environment to result in a spawning aggregate in each tributary of sufficient size that natural selection can act upon the population; and with an adequate number of first-generation natural-origin adults to incorporate into the broodstock as the Natural Production phases continue (Tables 5-1 and 5-2). The Implementation Phase will last for one generation (three years).

During NPIP in the Wenatchee subbasin, broodstock capture will continue to focus on upper basin sites listed in BDP2. Wherever facilities exist, broodstock will be collected within the tributary of release. Facility operations and trap duration continue from BDP2; additional trapping sites include the Chiwawa and White River adult weirs, though the latter has yet to be built by Grant PUD for the White River spring chinook recovery program.

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[8] We use the term "local adaptation" to refer to the process of naturalization: addressing the loss fitness that occurs with hatchery stocks by emphasizing selection in the natural environment so that the population becomes adapted to habitats within each subbasin and ultimately achieves PNI > 0.5. "Local adaptation" is distinguished from "broodstock development" which selects for coho which can return to the Wenatchee and Methow rivers but does not address loss of fitness and adaptation to the natural environment.

Table 5-1. Proposed release numbers and locations for the Natural Production phases in the Wenatchee subbasin

Location	**Implementation Phase** Release Number (one generation only)	**Support Phase (I)** Initial Release Number (est. three generations)	**Support Phase (F)** Final Release Number (PNI >0.5; est. two generations)	**Long-Term (PFC)** Periodic Supplementation may be needed to avoid extirpation again**.**
Chiwawa River	440,000	308,000	154,000	0
White River	210,000	147,000	73,500	0
Nason Creek	210,000	147,000	73,500	0
Little Wenatchee River	120,000	84,000	42,000	0
Upper Wenatchee River	100,000	70,000	35,000	0
Icicle Creek	75,000	50,000	25,000	100,000 (3 generations until we have shown the population can persist without continued supplementation)
Total	**1,155,000**	**806,000**	**403,000**	**100,000**

Table 5-2. Proposed release numbers and locations for the Natural Production phases in the Methow subbasin

Location	**Implementation Phase** Release Number (one generation only)	**Support Phase (I)** Initial Release Number (Est. 3 generations)	**Support Phase (F)** Final Release Number (PNI >0.5; Est. 2 generations)	**Long-Term (PFC)** Periodic supplementation may be needed to avoid extirpation again
Mid & Upper Methow	350,000	245,000	122,500	100k release may be retained at WNFH for 3 generations until it can be shown that the population will persist without supplementation.
Chewuch River	325,000	227,500	113,750	0
Twisp River	275,000	192,500	96,250	0
Wolf Creek	50,000	35,000	17,500	0
Total	**1,000,000**	**700,000**	**350,000**	**100,000**

The release numbers proposed for the Implementation Phase are generally based upon the predicted number of hatchery fish needed to initially seed the habitat. We used two methods to estimate the capacity of naturally produced smolts in the Wenatchee and Methow basins: 1) the smolt production model described by Zillges (1977) and 2) Ecosystem Diagnosis and Treatment (EDT) (Mobrand et. al. 1997).

The Zillges (1977) method is a smolt production model which has been used for Puget Sound and Washington coastal systems when actual data are not available (Seiler et al. 2004). The method described by Zillges (1977) uses stream length in larger tributaries, and stream area (length x width) in smaller tributaries to estimate coho smolt production. Bradford et al. (1997) found that coho salmon smolt abundance was primarily correlated with stream length, and that stream length was the most appropriate general measure of coho production. The number of smolts produced per unit of stream length was constant and independent of stream size (Bradford et al. 1997). Other variables such as discharge, stream gradient, and valley slope were not correlated with coho smolt production (Bradford et al. 1997). However, Bradford et al. (1997) cautioned that models which predict coho smolt production based on stream length, such as Zillges (1977), are suitable at the regional or watershed level, but the precision of a prediction for a single stream may be poor. Because different factors may be important in different streams at different times, there are no general predictive models that will yield precise estimates of coho smolt production potential (Bradford et al. 1997).

We also used EDT (Mobrand et al. 1997) to provide an estimate of juvenile and adult capacity in the Wenatchee and Methow rivers. In some cases, such as in the Little Wenatchee and the White River, the two estimates were almost identical, lending confidence to the estimates in these tributaries. In other cases, such as Icicle Creek and Nason Creek, the EDT estimates appeared unrealistically low, based on data collected to date, and the Zillges (1977) method appeared unrealistically high. In cases with a discrepancy between the estimates, we used the mid-point between the two values to estimate capacity.

The capacity values were used as upper limits for the program. To minimize potential species interactions, the actual release numbers will result in seeding levels below the estimated capacity, but are predicted to result in an adequate spawning escapement for which natural selection will begin the local adaptation process.

After three years (one coho generation) of Implementation Phase releases, we propose to reduce the release numbers by 30% as we enter the Natural Production Support Phase.

5.3.2 Natural Production Support Phase

This phase will begin following the Implementation Phase (FY 2014 in the Wenatchee subbasin) and will be terminated after four generations (12 years) in 2026 unless it can be demonstrated that continued natural production support and local adaptation is still required to reach project goals. After termination of the program, periodic hatchery supplementation may be needed to prevent a second extirpation and to achieve harvest goals. To address the fitness loss commonly associated with hatchery programs, the Support Phase uses the fitness computations in the AHA model to guide program management, with the goal of reducing domestication selection and increasing local adaptation. The support phase will result in a fully integrated population which receives greater selective pressures from the natural environment than from the hatchery environment (PNI > 0.5), and eventually achieves a self-sustaining population.

Initial release numbers will be reduced 30% from Implementation Phase release numbers. The initial proportion of natural origin fish in the broodstock (pNOB) will be greater than or equal to 35%. When this initial goal is met (pNOB > 35%) we will continue to reduce the size of the supplementation program while increasing the pNOB (up to 80%) and limiting the proportion of hatchery fish on the spawning grounds (pHOS; 65%) until we have reached a PNI value of 0.50 or greater.

During NPSP in the Wenatchee, broodstock capture will continue to focus on upper basin collection from sites listed in BDP2 and NPIP. The majority of broodstock collection will occur at tributary facilities (Nason Creek, White River, and Chiwawa River). Implementation success within multiple streams and watersheds will drive collection numbers during the NPSP. Short-falls in collection goals will result in utilizing Tumwater Dam and lower basin sites (Dryden Dam, Icicle side channel, and LNFH). Annual broodstock protocols will address collection numbers and bi-weekly quotas.

In the Methow, broodstock collection will continue in the same locations as in NPIP.

5.4 AHA Calculations

AHA computations for each release tributary depict the transition from a domesticated hatchery stock to a fully integrated supplementation program, and finally to a self- sustaining, naturally reproducing population. The computations assume the habitat improvement schedule developed for the UCSRB (Section 2.4.4) will occur and that habitat capacity and associated productivity will increase to their target values. A summary of the AHA calculations for each targeted tributary for coho restoration is in Tables 5-3 – 5-10 for the Wenatchee subbasin and in Tables 5-11 – 5-16 for the Methow subbasin.

We are aware of the need for caution when using the AHA or any other single model to generate specific objectives, numerical or otherwise, as described by the ISRP and ISAB (2005). However, project proponents have found minimal literature or empirical data to guide the transition from a non-local domesticated hatchery stock to a population locally adapted to the natural environment. The AHA model provides a framework from which the loss of fitness, or domestication, can be addressed in the form of a working hypothesis. We believe the proposed mid-Columbia coho reintroduction plan presents a unique opportunity to test some of the assumptions of the AHA model, as they pertain to domestication and local adaptation, in the absence of genetic risk[9] to a native coho population.

5.4.1 Wenatchee Subbasin AHA Calculations

Table 5-3. Natural production phase goals and expected results (based on AHA calculations) for the Chiwawa River

Natural Production Phase	Prod*	Adult Capacity	NPIP Smolt Release Number	pNOB Goal	pHOS Goal	pNOB Realized	pHOS Realized	PNI	Avg. Predicted HOR	Avg. Predicted NOR	Avg. NOR Escape-ment	Avg. Total Escape-ment
Implementation	1.52	1435	440,000	10%	90%	11%	81%	0.12	1656	304	251	1327
Support (I)	1.52	1435	308,000	35%	75%	35%	77%	0.31	1293	376	246	1086
Support (F)	1.75	1435	154,000	80%	65%	80%	60%	0.58	610	541	392	971
Recovered (PFC)	2.10	1500	None	N/A	N/A	N/A	N/A	1.0	0	449	449	449

* Initial productivity rates based on are based upon current conditions as predicted by EDT. Increased productivity is predicted to result from habitat improvement

[9] Genetic risk is the probability of an event or activity having and adverse genetic consequence. Adverse consequences include 1) extinction, 2) loss of within population genetic diversity, 3) loss of among-population genetic diversity, and 4) domestication (Busak and Currens 1995).

Table 5-4. Harvest rates used in projecting the results for Chiwawa River natural production phases

Natural Production Phase	Natural Origin Returns (NOR)			Hatchery Origin Return (HOR)			Total Harvest	
	Mixed Stock	Mainstem	Terminal	Mixed Stock	Mainstem	Terminal	NOR/HOR	Count
Implementation	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	315
Support (I)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	261
Support (F)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	170
Recovered (PFC)	0.10	0.10	0.05	N/A	N/A	N/A	0.23/0.00	134

Table 5-5. Natural production phase goals and expected results (based on AHA calculations) for the White River

Natural Production Phase	Prod.*	Adult Capacity	NPIP Smolt Release Number	pNOB Goal	pHOS Goal	pNOB Realized	pHOS Realized	PNI	Avg. Predicted HOR	Avg. Predicted NOR	Avg. NOR Escape-ment	Avg. Total Escape-ment
Implementation	1.63	717	210,000	10%	90%	11%	78%	0.12	783	165	140	648
Support (I)	1.63	717	157,000	35%	75%	35%	73%	0.32	614	210	148	547
Support (F)	1.75	717	73,500	80%	65%	80%	57%	0.59	293	279	208	669
Recovered (PFC)	2.20	1077	None	N/A	N/A	N/A	N/A	1.0	0	363	363	363

* Initial productivity rates based on are based upon current conditions as predicted by EDT. Increased productivity is predicted to result from habitat improvement

Table 5-6. Harvest rates used it projecting the results for White River natural production phases

Natural Production Phase	Natural Origin Returns (NOR)			Hatchery Origin Return (HOR)			Total Harvest	
	Mixed Stock	Mainstem	Terminal	Mixed Stock	Mainstem	Terminal	NOR/HOR	Count
Implementation	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	151
Support (I)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	127
Support (F)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	83
Recovered (PFC)	0.10	0.10	0.05	N/A	N/A	N/A	0.23/0.00	109

Table 5-7. Natural production phase goals and expected results (based on AHA calculations) for Nason Creek

Natural Production Phase	Prod.*	Adult Capacity	NPIP Smolt Release Number	pNOB Goal	pHOS Goal	pNOB Realized	pHOS Realized	PNI	Avg. Predicted HOR	Avg. Predicted NOR	Avg. NOR Escape-ment	Avg. Total Escape-ment
Implementation	1.13	709	210,000	10%	90%	11%	84%	0.11	790	121	96	609
Support (I)	1.13	709	147,000	35%	75%	35%	83%	0.29	609	140	79	473
Support (F)	1.50	709	73,500	80%	65%	80%	64%	0.51	291	228	157	434
Recovered (PFC)	2.10	900	None	N/A	N/A	N/A	N/A	1.0	0	281	281	281

* Initial productivity rates are based upon current conditions as predicted by EDT. Increased productivity is predicted to result from habitat improvement

Table 5-8. Harvest rates used in projecting the results for Nason Creek natural production phases

Natural Production Phase	Natural Origin Returns (NOR)			Hatchery Origin Return (HOR)			Total Harvest	
	Mixed Stock	Mainstem	Terminal	Mixed Stock	Mainstem	Terminal	NOR/HOR	Count
Implementation	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	147
Support (I)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	118
Support (F)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	78
Recovered (PFC)	0.10	0.10	0.05	N/A	N/A	N/A	0.23/0.00	84

Table 5-9. Natural production phase goals and expected results (based on AHA calculations) for the Little Wenatchee River

Natural Production Phase	Prod.*	Adult Capacity	NPIP Smolt Release Number	pNOB Goal	pHOS Goal	pNOB Realized	pHOS Realized	PNI	Avg. Predicted HOR	Avg. Predicted NOR	Avg. NOR Escape-ment	Avg. Total Escape-ment
Implementation	1.50	447	120,000	10%	90%	11%	80%	0.12	455	90	75	370
Support (I)	1.50	717	84,000	35%	75%	35%	75%	0.32	354	112	76	306
Support (F)	1.65	717	42,000	80%	65%	80%	56%	0.57	167	164	123	282
Recovered (PFC)	2.10	1077	None	N/A	N/A	N/A	N/A	1.0	0	254	254	254

* Initial productivity rates based on are based upon current conditions as predicted by EDT. Increased productivity is predicted to result from habitat improvement.

Table 5-10. Harvest rates used in projecting the results for Little Wenatchee River natural production phases

Natural Production Phase	Natural Origin Returns (NOR)			Hatchery Origin Return (HOR)			Total Harvest	
	Mixed Stock	Mainstem	Terminal	Mixed Stock	Mainstem	Terminal	HOR/NOR	Count
Implementation	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	87
Support (I)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	72
Support (F)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	48
Recovered (PFC)	0.10	0.10	0.05	N/A	N/A	N/A	0.23/0.00	59

5.4.2 Methow Subbasin AHA Calculations

Table 5-11. Natural production phase goals and expected results (based on AHA calculations) for the mid and upper Methow River

Natural Production Phase	Prod*	Est. Adult Capacity	NPIP Smolt Release Number	pNOB Goal	pHOS Goal	pNOB Realized	pHOS Realized	PNI	Avg. Predicted HOR	Avg. Predicted NOR	Avg. NOR Escape-ment	Avg. Total Escape-ment
Implementation	1.19	1836	350,000	10%	90%	11%	81%	0.12	1339	244	202	1073
Support (I)	1.19	1836	245,000	35%	75%	35%	80%	0.31	1018	304	201	862
Support (F)	1.35	1836	122,500	80%	60%	80%	57%	0.58	481	461	343	803
Recovered (PFC)	1.69	2000	None	N/A	N/A	N/A	N/A	1.0	0	374	374	374

* Initial productivity rates based on are based upon current conditions as predicted by EDT. Increased productivity is predicted to result from habitat improvement.

Table 5-12. Harvest rates used in projecting results for mid-and upper Methow River natural production phases

Natural Production Phase	Natural Origin Returns (NOR)			Hatchery Origin Return (HOR)			Total Harvest	
	Mixed Stock	Mainstem	Terminal	Mixed Stock	Mainstem	Terminal	NOR/HOR	Count
Implementation	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	254
Support (I)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	206
Support (F)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	138
Recovered (PFC)	0.10	0.10	0.05	N/A	N/A	N/A	0.23/0.00	112

Table 5-13. Natural production phase goals and expected results (based on AHA calculations) for the Chewuch River

Natural Production Phase	Prod.*	Adult Capacity	NPIP Smolt Release Number	pNOB Goal	pHOS Goal	pNOB Realized	pHOS Realized	PNI	Avg. Predicted HOR	Avg. Predicted NOR	Avg. NOR Escape-ment	Avg. Total Escape-ment
Implementation	1.10	1415	325,000	10%	90%	11%	83%	0.11	1223	196	157	952
Support (I)	1.10	1415	227,500	35%	75%	35%	82%	0.30	944	232	137	750
Support (F)	1.45	1415	113,750	80%	6%	80%	59%	0.58	451	399	289	705
Recovered (PFC)	1.79	2000	None	N/A	N/A	N/A	N/A	1.0	0	456	459	456

* Initial productivity rates based on are based upon current conditions as predicted by EDT. Increased productivity is predicted to result from habitat improvement

Table 5-14. Harvest rates used to project results for Chewuch River natural production phases

Natural Production Phase	Natural Origin Returns (NOR)			Hatchery Origin Return (HOR)			Total Harvest	
	Mixed Stock	Mainstem	Terminal	Mixed Stock	Mainstem	Terminal	NOR/HOR	Count
Implementation	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	229
Support (I)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	186
Support (F)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	125
Recovered (PFC)	0.10	0.10	0.05	N/A	N/A	N/A	0.23/0.00	83

Table 5-15. Natural production phase goals and expected results (based on AHA calculations for Twisp River

Natural Production Phase	Prod.*	Adult Capacity	NPIP Smolt Release Number	pNOB Goal	pHOS Goal	pNOB Realized	pHOS Realized	PNI	Avg. Predicted HOR	Avg. Predicted NOR	Avg. NOR Escape-ment	Avg. Total Escape-ment
Implementation	1.32	926	275,000	10%	90%	11%	82%	0.12	1027	176	143	810
Support (I)	1.32	926	192,500	35%	75%	35%	80%	0.30	803	215	134	655
Support (F)	1.45	926	95,250	80%	60%	80%	65%	0.55	349	277	184	533
Recovered (PFC)	1.64	1000	None	N/A	N/A	N/A	N/A	1.0	0	193	193	193

* Initial productivity rates based on are based upon current conditions as predicted by EDT. Increased productivity is predicted to result from habitat improvement

Table 5-16. Harvest rates used to project results for Twisp River natural production phases

Natural Production Phase	Natural Origin Returns (NOR)			Hatchery Origin Return (HOR)			Total Harvest	
	Mixed Stock	Mainstem	Terminal	Mixed Stock	Mainstem	Terminal	NOR/HOR	Count
Implementation	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	194
Support (I)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	160
Support (F)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	99
Recovered (PFC)	0.10	0.10	0.05	N/A	N/A	N/A	0.23/0.00	58

It should be noted that wherever possible, we will seek to emphasize local adaptation which will include tributary-specific adaptation. However, we are not proposing to build additional weirs or capture facilities. We will promote local adaptation to the extent possible within the limitation of existing facilities and technology. This plan assumes that weirs currently proposed for chinook salmon on Nason and the White River would also be available for coho capture. In the Methow, the only tributary adult capture weir currently in operation is on the Twisp River, funded by Douglas County PUD (DCPUD) and operated by WDFW. Feasibility work is under way by DCPUD to build another tributary weir on the Chewuch River and possibly the upper Methow River mainstem at Foghorn Dam.

During the Natural Production phases, we recognize that abundance of adult returns may vary greatly from year to year. For this reason we have developed schedules for the disposition of returning adult coho within each Natural Production phase. These schedules are shown in Tables 5-17 – 5-19 for the Wenatchee and Tables 5-20 – 5-22 for the Methow. The grey shaded areas of these tables indicate that the success criteria for each of the Natural Production phases are being met. Successful implementation of the habitat initiative schedule developed for the UCSRB (Section 2.4.4) will increase the proportion of time the population will remain in the shaded "goal range" and reduce dependence upon hatchery supplementation.

Table 5-17. Management schedule for the disposition of adult returns to the Wenatchee subbasin during the Natural Production Implementation Phase

Natural Origin Returns		Hatchery Origin Returns: ≥100	500	1000	1500	2000	4000	5000
≥100	HOR	$70_B, 30_S, 0_H$	$350_B, 150_S, 0_H$	$700_B, 300_S, 0_H$	$1050_B, 450_S, 0_H$	$1274_B, 726_S, 0_H$	$1274_B, 2726_S, 0_H$	$1274_B, 3726_S, 0_H$
	NOR	$70_B, 30_S, 0_H$	$70_B, 30_S, 0_H$	$70_B, 30_S, 0_H$	$70_B, 30_S, 0_H$	$70_B, 30_S, 0_H$	$70_B, 30_S, 0_H$	$70_B, 30_S, 0_H$
500	HOR	$70_B, 30_S, 0_H$	$350_B, 150_S, 0_H$	$700_B, 300_S, 0_H$	$1050_B, 450_S, 0_H$	$1210_B, 790_S, 0_H$	$1210_B, 2790_S, 0_H$	$1210_B, 3534_S, 256_H$
	NOR	$350_B, 150_S, 0_H$	$350_B, 150_S, 0_H$	$350_B, 150_S, 0_H$	$294_B, 206_S, 0_H$	$134_B, 366_S, 0_H$	$134_B, 366_S, 0_H$	$134_B, 366_S, 0_H$
1000	HOR	$70_B, 30_S, 0_H$	$350_B, 150_S, 0_H$	$700_B, 300_S, 0_H$	$1050_B, 450_S, 0_H$	$1210_B, 790_S, 0_H$	$1210_B, 2790_S, 0_H$	$1210_B, 3034_S, 756_H$
	NOR	$700_B, 300_S, 0_H$	$700_B, 300_S, 0_H$	$644_B, 356_S, 0_H$	$294_B, 706_S, 0_H$	$134_B, 866_S, 0_H$	$134_B, 866_S, 0_H$	$134_B, 866_S, 0_H$
1500	HOR	$70_B, 30_S, 0_H$	$350_B, 150_S, 0_H$	$700_B, 300_S, 0_H$	$1050_B, 450_S, 0_H$	$1210_B, 790_S, 0_H$	$1210_B, 2534_S, 256_H$	$1210_B, 2534_S, 1256_H$
	NOR	$1050_B, 450_S, 0_H$	$994_B, 506_S, 0_H$	$644_B, 856_S, 0_H$	$294_B, 1206_S, 0_H$	$134_B, 1366_S, 0_H$	$134_B, 1366_S, 0_H$	$134_B, 1366_S, 0_H$
2000	HOR	$70_B, 30_S, 0_H$	$350_B, 150_S, 0_H$	$700_B, 300_S, 0_H$	$1050_B, 450_S, 0_H$	$1210_B, 790_S, 0_H$	$1210_B, 2034_S, 756_H$	$1210_B, 2034_S, 1756_H$
	NOR	$1274_B, 726_S, 0_H$	$994_B, 1006_S, 0_H$	$644_B, 1356_S, 0_H$	$294_B, 1706_S, 0_H$	$134_B, 1866_S, 0_H$	$134_B, 1866_S, 0_H$	$134_B, 1866_S, 0_H$
4000	HOR	$70_B, 30_S, 0_H$	$350_B, 150_S, 0_H$	$700_B, 300_S, 0_H$	$1050_B, 194_S, 156_H$	$1210_B, 34_S, 756_H$	$1210_B, 34_S, 2756_H$	$1210_B, 34_S, 3756_H$
	NOR	$1274_B, 2726_S, 0_H$	$994_B, 3006_S, 0_H$	$644_B, 3356_S, 0_H$	$294_B, 3706_S, 0_H$	$134_B, 3866_S, 0_H$	$134_B, 3866_S, 0_H$	$134_B, 3866_S, 0_H$
5000	HOR	$70_B, 30_S, 0_H$	$244_B, 0_S, 256_H$	$244_B, 0_S, 756_H$	$244_B, 0_S, 1256_H$	$244_B, 0_S, 1756_H$	$244_B, 0_S, 3756_H$	$244_B, 0_S, 4756_H$
	NOR	$1274_B, 3726_S, 0_H$	$1100_B, 3900_S, 0_H$	$1100_B, 3900_S, 0_H$	$1100_B, 3900_S, 0_H$	$1100_B, 3900_S, 0_H$	$1100_B, 3900_S, 0_H$	$1100_B, 3900_S, 0_H$

B=broodstock, S= spawning escapement, H=terminal harvest.

Grey shaded cells indicate that objectives for the Implementation Phase are being met. Implementation Phase Objectives: B=1344 (10% NOR, 90%HOR), no restrictions on pHOS. Assumptions include an adult capacity of 3900.

Table 5-18. Management schedule for the disposition of adult returns to the Wenatchee subbasin during the Natural Production Support Phase (Initial)

Natural Origin Returns		Hatchery Origin Returns: ≥100	500	1000	1500	2000	4000	5000
≥100	HOR	$70_B, 30_S, 0_H$	$350_B, 150_S, 0_H$	$700_B, 300_S, 0_H$	$831_B, 669_S, 0_H$	$831_B, 1169_S, 0_H$	$831_B, 3169_S, 0_H$	$831_B, 3830_S, 339_H$
	NOR	$70_B, 30_S, 0_H$	$70_B, 30_S, 0_H$	$70_B, 30_S, 0_H$	$70_B, 30_S, 0_H$	$70_B, 30_S, 0_H$	$70_B, 30_S, 0_H$	$70_B, 30_S, 0_H$
500	HOR	$70_B, 30_S, 0_H$	$350_B, 150_S, 0_H$	$586_B, 414_S, 0_H$	$586_B, 914_S, 0_H$	$586_B, 1414_S, 0_H$	$586_B, 3414_S, 0_H$	$586_B, 3715_S, 699_H$
	NOR	$350_B, 150_S, 0_H$	$350_B, 150_S, 0_H$	$315_B, 185_S, 0_H$	$315_B, 185_S, 0_H$	$315_B, 185_S, 0_H$	$315_B, 185_S, 0_H$	$315_B, 185_S, 0_H$
1000	HOR	$70_B, 30_S, 0_H$	$350_B, 150_S, 0_H$	$586_B, 414_S, 0_H$	$586_B, 914_S, 0_H$	$586_B, 1414_S, 0_H$	$586_B, 3215_S, 199_H$	$586_B, 3215_S, 1199_H$
	NOR	$700_B, 300_S, 0_H$	$551_B, 449_S, 0_H$	$315_B, 685_S, 0_H$	$315_B, 685_S, 0_H$	$315_B, 685_S, 0_H$	$315_B, 685_S, 0_H$	$315_B, 685_S, 0_H$
1500	HOR	$70_B, 30_S, 0_H$	$350_B, 150_S, 0_H$	$586_B, 414_S, 0_H$	$586_B, 914_S, 0_H$	$586_B, 1414_S, 0_H$	$586_B, 2715_S, 699_H$	$586_B, 2715_S, 1699_H$
	NOR	$831_B, 669_S, 0_H$	$551_B, 949_S, 0_H$	$315_B, 1185_S, 0_H$	$315_B, 1185_S, 0_H$	$315_B, 1185_S, 0_H$	$315_B, 1185_S, 0_H$	$315_B, 1185_S, 0_H$
2000	HOR	$70_B, 30_S, 0_H$	$350_B, 150_S, 0_H$	$586_B, 414_S, 0_H$	$586_B, 914_S, 0_H$	$586_B, 1414_S, 0_H$	$586_B, 2215_S, 2801_H$	$586_B, 2215_S, 2199_H$
	NOR	$831_B, 1169_S, 0_H$	$551_B, 1449_S, 0_H$	$315_B, 1685_S, 0_H$	$315_B, 1685_S, 0_H$	$315_B, 1685_S, 0_H$	$315_B, 1685_S, 0_H$	$315_B, 1685_S, 0_H$
4000	HOR	$70_B, 30_S, 0_H$	$350_B, 150_S, 0_H$	$586_B, 414_S, 0_H$	$586_B, 215_S, 699_H$	$586_B, 215_S, 1199_H$	$586_B, 215_S, 3199_H$	$586_B, 215_S, 4199_H$
	NOR	$831_B, 3169_S, 0_H$	$551_B, 3449_S, 0_H$	$315_B, 3685_S, 0_H$	$315_B, 3685_S, 0_H$	$315_B, 3685_S, 0_H$	$315_B, 3685_S, 0_H$	$315_B, 3685_S, 0_H$
5000	HOR	$0_B, 0_S, 100_H$	$0_B, 0_S, 500_H$	$0_B, 0_S, 1000_H$	$0_B, 0_S, 1500_H$	$0_B, 0_S, 2000_H$	$0_B, 0_S, 4000_H$	$0_B, 0_S, 5000_H$
	NOR	$901_B, 3900_S, 199_H$	$901_B, 3900_S, 199_H$	$901_B, 3900_S, 199_H$	$901_B, 3900_S, 199_H$	$901_B, 3900_S, 199_H$	$901_B, 3900_S, 199_H$	$901_B, 3900_S, 199_H$

B=broodstock, S= spawning escapement, H=terminal harvest.

Grey shaded cells indicate that objectives for the Initial Support Phase are being met. Initial Support Phase Objectives: Broodstock = 901 (35% NOR, 65%HOR), pHOS = 75%. Assumptions include an adult capacity of 3900.

Table 5-19. Management schedule for the disposition of adult returns to the Wenatchee subbasin during the Natural Production Support Phase (Final)

Hatchery Origin Returns

Natural Origin Returns		≥100	500	1000	1500	2000	4000	5000
≥100	HOR	70_B, 30_S, 0_H	350_B, 150_S, 0_H	376_B, 624_S, 0_H	376_B, 1124_S, 0_H	376_B, 1624_S, 0_H	376_B, 2797_S, 827_H	376_B, 2797_S, 1827_H
	NOR	70_B, 30_S, 0_H	70_B, 30_S, 0_H	70_B, 30_S, 0_H	70_B, 30_S, 0_H	70_B, 30_S, 0_H	70_B, 30_S, 0_H	70_B, 30_S, 0_H
500	HOR	70_B, 30_S, 0_H	96_B, 404_S, 0_H	96_B, 904_S, 0_H	96_B, 1404_S, 0_H	96_B, 1904_S, 0_H	96_B, 3750_S, 154_H	96_B, 3750_S, 1154_H
	NOR	350_B, 150_S, 0_H	350_B, 150_S, 0_H	350_B, 150_S, 0_H	350_B, 150_S, 0_H	350_B, 150_S, 0_H	350_B, 150_S, 0_H	350_B, 150_S, 0_H
1000	HOR	70_B, 30_S, 0_H	90_B, 410_S, 0_H	90_B, 910_S, 0_H	90_B, 1410_S, 0_H	90_B, 1910_S, 0_H	90_B, 3256_S, 654_H	90_B, 3256_S, 1654_H
	NOR	376_B, 624_S, 0_H	356_B, 644_S, 0_H	356_B, 644_S, 0_H	356_B, 644_S, 0_H	356_B, 644_S, 0_H	356_B, 644_S, 0_H	356_B, 644_S, 0_H
1500	HOR	70_B, 30_S, 0_H	90_B, 410_S, 0_H	90_B, 910_S, 0_H	90_B, 1410_S, 0_H	90_B, 1910_S, 0_H	90_B, 2756_S, 1154_H	90_B, 2756_S, 2154_H
	NOR	376_B, 1124_S, 0_H	356_B, 1144_S, 0_H	356_B, 1144_S, 0_H	356_B, 1144_S, 0_H	356_B, 1144_S, 0_H	356_B, 1144_S, 0_H	356_B, 1144_S, 0_H
2000	HOR	70_B, 30_S, 0_H	90_B, 410_S, 0_H	90_B, 910_S, 0_H	90_B, 1410_S, 0_H	90_B, 1910_S, 0_H	90_B, 2346_S, 1564_H	90_B, 2346_S, 2564_H
	NOR	376_B, 1624_S, 0_H	356_B, 1554_S, 0_H	356_B, 1554_S, 0_H	356_B, 1554_S, 0_H	356_B, 1554_S, 0_H	356_B, 1554_S, 0_H	356_B, 1554_S, 0_H
4000	HOR	70_B, 30_S, 0_H	90_B, 256_S, 154_H	90_B, 256_S, 654H	90_B, 256_S, 1154_H	90_B, 256_S, 1654_H	90_B, 256_S, 3654_H	90_B, 256_S, 4654_H
	NOR	376_B, 3624_S, 0_H	356_B, 3644_S, 0_H	356_B, 3644_S, 0_H	356_B, 3644_S, 0_H	356_B, 3644_S, 0_H	356_B, 3644_S, 0_H	356_B, 3644_S, 0_H
5000	HOR	0_B, 0_S, 100_H	0_B, 0_S, 500_H	0_B, 0_S, 1000_H	0_B, 0_S, 1500_H	0_B, 0_S, 2000_H	0_B, 0_S, 4000_H	0_B, 0_S, 5000_H
	NOR	446_B, 3900_S, 854_H	446_B, 3900_S, 854_H	446_B, 3900_S, 854_H	446_B, 3900_S, 854_H	446_B, 3900_S, 854_H	446_B, 3900_S, 854_H	446_B, 3900_S, 854_H

B=broodstock, S= spawning escapement, H=terminal harvest.

Grey shaded cells indicate that objectives for the Final Support Phase are being met. Final Support Phase Objectives: Broodstock = 446 (80% NOR, 20%HOR), pHOS = 60%. Assumptions include an adult capacity of 3900.

Table 5-20. Management schedule for the disposition of adult returns to the Methow subbasin during the Natural Production Implementation Phase

Natural Origin Returns		≥100	500	1000	1500	2000	4000	5000
≥100	HOR	70_B, 30_S, 0_H	350_B, 150_S, 0_H	700_B, 300_S, 0_H	1050_B, 450_S, 0_H	1141_B, 859_S, 0_H	1141_B, 2860_S, 0_H	1141_B, 3859_S, 0_H
	NOR	70_B, 30_S, 0_H	70_B, 30_S, 0_H	70_B, 30_S, 0_H	70_B, 30_S, 0_H	70_B, 30_S, 0_H	70_B, 30_S, 0_H	70_B, 30_S, 0_H
500	HOR	70_B, 30_S, 0_H	350_B, 150_S, 0_H	700_B, 300_S, 0_H	1050_B, 450_S, 0_H	1087_B, 913_S, 0_H	1087_B, 2913_S, 0_H	1087_B, 3524_S, 389_H
	NOR	350_B, 150_S, 0_H	350_B, 150_S, 0_H	350_B, 150_S, 0_H	161_B, 339_S, 0_H	124_B, 376_S, 0_H	124_B, 376_S, 0_H	124_B, 376_S, 0_H
1000	HOR	70_B, 30_S, 0_H	350_B, 150_S, 0_H	700_B, 300_S, 0_H	1050_B, 450_S, 0_H	1087_B, 913_S, 0_H	1087_B, 2913_S, 0_H	1087_B, 3024_S, 889_H
	NOR	700_B, 300_S, 0_H	700_B, 300_S, 0_H	511_B, 489_S, 0_H	161_B, 839_S, 0_H	124_B, 876_S, 0_H	124_B, 876_S, 0_H	124_B, 876_S, 0_H
1500	HOR	70_B, 30_S, 0_H	350_B, 150_S, 0_H	700_B, 300_S, 0_H	1050_B, 450_S, 0_H	1087_B, 913_S, 0_H	1087_B, 2524_S, 389_H	1087_B, 2524_S, 1389_H
	NOR	1050_B, 450_S, 0_H	861_B, 639_S, 0_H	511_B, 989_S, 0_H	161_B, 1339_S, 0_H	124_B, 1376_S, 0_H	124_B, 1376_S, 0_H	124_B, 1376_S, 0_H
2000	HOR	70_B, 30_S, 0_H	350_B, 150_S, 0_H	700_B, 300_S, 0_H	1050_B, 450_S, 0_H	1087_B, 913_S, 0_H	1087_B, 2024_S, 889_H	1087_B, 2024_S, 1889_H
	NOR	1141_B, 859_S, 0_H	861_B, 1139_S, 0_H	511_B, 1489_S, 0_H	161_B, 1839_S, 0_H	124_B, 1876_S, 0_H	124_B, 1876_S, 0_H	124_B, 1876_S, 0_H
4000	HOR	70_B, 30_S, 0_H	350_B, 150_S, 0_H	700_B, 300_S, 0_H	1050_B, 61_S, 389_H	1087_B, 24_S, 889_H	1087_B, 24_S, 2889_H	1087_B, 24_S, 3889_H
	NOR	1141_B, 2859_S, 0_H	861_B, 3139_S, 0_H	511_B, 3489_S, 0_H	161_B, 3839_S, 0_H	124_B, 3876_S, 0_H	124_B, 3876_S, 0_H	124_B, 3876_S, 0_H
5000	HOR	70_B, 30_S, 0_H	21_B, 0_S, 479_H	21_B, 0_S, 979_H	21_B, 0_S, 1479_H	21_B, 0_S, 1979_H	21_B, 0_S, 3979_H	21_B, 0_S, 4979_H
	NOR	1141_B, 8859_S, 0_H	1100_B, 3900_S, 0_H	1100_B, 3900_S, 0_H	1100_B, 3900_S, 0_H	1100_B, 3900_S, 0_H	1100_B, 3900_S, 0_H	1100_B, 3900_S, 0_H

B=broodstock, S= spawning escapement, H=terminal harvest.

Grey shaded cells indicate that objectives for the Implementation Phase are being met. Implementation Phase Objectives: B=1211 (10% NOR, 90%HOR), no restrictions on pHOS. Assumptions include an adult capacity of 3900.

Table 5-21. Management schedule for the disposition of adult returns to the Methow subbasin during the Natural Production Support Phase (Initial)

Natural Origin Returns		Hatchery Origin Returns: ≥100	500	1000	1500	2000	4000	5000
≥100	HOR	$70_B, 30_S, 0_H$	$350_B, 150_S, 0_H$	$700_B, 300_S, 0_H$	$778_B, 722_S, 0_H$	$778_B, 1222_S, 0_H$	$778_B, 3222_S, 0_H$	$778_B, 3870_S, 352_H$
	NOR	$70_B, 30_S, 0_H$	$70_B, 30_S, 0_H$	$70_B, 30_S, 0_H$	$70_B, 30_S, 0_H$	$70_B, 30_S, 0_H$	$70_B, 30_S, 0_H$	$70_B, 30_S, 0_H$
500	HOR	$70_B, 30_S, 0_H$	$350_B, 150_S, 0_H$	$551_B, 449_S, 0_H$	$551_B, 949_S, 0_H$	$551_B, 1449_S, 0_H$	$551_B, 3449_S, 0_H$	$551_B, 3697_S, 752_H$
	NOR	$350_B, 150_S, 0_H$	$350_B, 150_S, 0_H$	$297_B, 203_S, 0_H$	$297_B, 203_S, 0_H$	$297_B, 203_S, 0_H$	$297_B, 203_S, 0_H$	$297_B, 203_S, 0_H$
1000	HOR	$70_B, 30_S, 0_H$	$350_B, 150_S, 0_H$	$551_B, 449_S, 0_H$	$551_B, 949_S, 0_H$	$551_B, 1449_S, 0_H$	$551_B, 3197_S, 252_H$	$551_B, 3197_S, 1252_H$
	NOR	$700_B, 300_S, 0_H$	$498_B, 502_S, 0_H$	$297_B, 703_S, 0_H$	$297_B, 703_S, 0_H$	$297_B, 703_S, 0_H$	$297_B, 703_S, 0_H$	$297_B, 703_S, 0_H$
1500	HOR	$70_B, 30_S, 0_H$	$350_B, 150_S, 0_H$	$551_B, 449_S, 0_H$	$551_B, 949_S, 0_H$	$551_B, 1449_S, 0_H$	$551_B, 2697_S, 752_H$	$551_B, 2697_S, 1752_H$
	NOR	$778_B, 722_S, 0_H$	$498_B, 1002_S, 0_H$	$297_B, 1203_S, 0_H$	$297_B, 1203_S, 0_H$	$297_B, 1203_S, 0_H$	$297_B, 1203_S, 0_H$	$297_B, 1203_S, 0_H$
2000	HOR	$70_B, 30_S, 0_H$	$350_B, 150_S, 0_H$	$551_B, 449_S, 0_H$	$551_B, 949_S, 0_H$	$551_B, 1449_S, 0_H$	$551_B, 2197_S, 1252_H$	$551_B, 2197_S, 2252_H$
	NOR	$778_B, 1222_S, 0_H$	$498_B, 1502_S, 0_H$	$297_B, 1703_S, 0_H$	$297_B, 1703_S, 0_H$	$297_B, 1703_S, 0_H$	$297_B, 1703_S, 0_H$	$297_B, 1703_S, 0_H$
4000	HOR	$70_B, 30_S, 0_H$	$350_B, 150_S, 0_H$	$551_B, 197_S, 252_H$	$551_B, 197_S, 752_H$	$551_B, 197_S, 1252_H$	$551_B, 197_S, 3252_H$	$551_B, 197_S, 4252_H$
	NOR	$778_B, 3222_S, 0_H$	$498_B, 3502_S, 0_H$	$297_B, 3703_S, 0_H$	$297_B, 3703_S, 0_H$	$297_B, 3703_S, 0_H$	$297_B, 3703_S, 0_H$	$297_B, 3703_S, 0_H$
5000	HOR	$0_B, 0_S, 100_H$	$848_B, 3900_S, 252_H$	$848_B, 3900_S, 252_H$	$848_B, 3900_S, 252_H$	$848_B, 3900_S, 252_H$	$848_B, 3900_S, 252_H$	$848_B, 3900_S, 252_H$
	NOR	$848_B, 3900_S, 252_H$	$848_B, 3900_S, 252_H$	$848_B, 3900_S, 252_H$	$848_B, 3900_S, 252_H$	$848_B, 3900_S, 252_H$	$848_B, 3900_S, 252_H$	$848_B, 3900_S, 252_H$

B=broodstock, S= spawning escapement, H=terminal harvest.

Grey shaded cells indicate that objectives for the Initial Support Phase are being met. Initial Support Phase Objectives: Broodstock = 848 (35% NOR, 65%HOR), pHOS = 75%. Assumptions include an adult capacity of 3900.

Table 5-22. Management schedule for the disposition of adult returns to the Methow subbasin during the Natural Production Support Phase (Final)

Natural Origin Returns		≥100	500	1000	1500	2000	4000	5000
≥100	HOR	70_B, 30_S, 0_H	350_B, 150_S, 0_H	354_B, 646_S, 0_H	354_B, 1146_S, 0_H	354_B, 1646_S, 0_H	354_B, 3646_S, 0_H	354_B, 3870_S, 776_H
	NOR	70_B, 30_S, 0_H	70_B, 30_S, 0_H	70_B, 30_S, 0_H	70_B, 30_S, 0_H	70_B, 30_S, 0_H	70_B, 30_S, 0_H	70_B, 30_S, 0_H
500	HOR	70_B, 30_S, 0_H	85_B, 415_S, 0_H	85_B, 915_S, 0_H	85_B, 1415_S, 0_H	85_B, 1915_S, 0_H	85_B, 3739_S, 176_H	85_B, 3739_S, 1176_H
	NOR	350_B, 150_S, 0_H	339_B, 161_S, 0_H	339_B, 161_S, 0_H	339_B, 161_S, 0_H	339_B, 161_S, 0_H	339_B, 161_S, 0_H	339_B, 161_S, 0_H
1000	HOR	70_B, 30_S, 0_H	85_B, 915_S, 0_H	85_B, 915_S, 0_H	85_B, 1415_S, 0_H	85_B, 1915_S, 0_H	85_B, 3239_S, 676_H	85_B, 3239_S, 1676_H
	NOR	354_B, 626_S, 0_H	339_B, 661_S, 0_H	339_B, 661_S, 0_H	339_B, 661_S, 0_H	339_B, 661_S, 0_H	339_B, 661_S, 0_H	339_B, 661_S, 0_H
1500	HOR	70_B, 30_S, 0_H	85_B, 915_S, 0_H	85_B, 915_S, 0_H	85_B, 1415_S, 0_H	85_B, 1915_S, 0_H	85_B, 2739_S, 1176_H	85_B, 2739_S, 2176_H
	NOR	354_B,1126_S, 0_H	339_B, 1161_S, 0_H	339_B, 1161_S, 0_H	339_B, 1161_S, 0_H	339_B, 1161_S, 0_H	339_B, 1161_S, 0_H	339_B, 1161_S, 0_H
2000	HOR	70_B, 30_S, 0_H	85_B, 915_S, 0_H	85_B, 915_S, 0_H	85_B, 1415_S, 0_H	85_B, 1915_S, 0_H	85_B, 2239_S, 1676_H	85_B, 2239_S, 2676_H
	NOR	354_B,1626_S, 0_H	339_B,1661_S, 0_H	339_B,1661_S, 0_H	339_B,1661_S, 0_H	339_B,1661_S, 0_H	339_B,1661_S, 0_H	339_B,1661_S, 0_H
4000	HOR	70_B, 30_S, 0_H	85_B, 231_S, 184_H	85_B, 239_S, 676H	85_B, 239_S, 1176_H	85_B, 239_S, 1676_H	85_B, 239_S, 3676_H	85B, 239S, 4676H
	NOR	354_B,3626_S, 0_H	339_B,3661_S, 0_H	339_B,3661_S, 0_H	339_B,3661_S, 0_H	339_B,3661_S, 0_H	339_B,3661_S, 0_H	339_B,3661_S, 0_H
5000	HOR	0_B, 0_S, 100_H	0_B, 0_S, 500_H	0_B, 0_S, 1000_H	0_B, 0_S, 1500_H	0_B, 0_S, 2000_H	0_B, 0_S, 4000_H	0_B, 0_S, 5000_H
	NOR	424_B, 3900_S, 676_H	424_B, 3900_S, 676_H	424_B, 3900_S, 676_H	424_B, 3900_S, 676_H	424_B, 3900_S, 676_H	424_B, 3900_S, 676_H	424_B, 3900_S, 676_H

B=broodstock, S= spawning escapement, H=terminal harvest.

Grey shaded cells indicate that objectives for the Initial Support Phase are being met. Initial Support Phase Objectives: Broodstock = 424 (80% NOR, 20%HOR), pHOS = 60. Assumptions include an adult capacity of 3900.

5.5 Habitat Improvement Phase

The Habitat Improvement Phase (HIP) of the proposed Mid-Columbia Coho Restoration Program is expected to last 10-15 years and seeks to coordinate and implement the habitat improvement schedule developed for the UCSRB. Results of this schedule are expected to improve productivity and capacity of coho salmon, spring chinook salmon, bull trout, and steelhead. We propose that the MCCRP provide 50% of the cost of a staff member (the other half funded by Pacific Coastal Salmon Recovery Fund [PCSRF]) to identify, propose, solicit funds and implement the UCSRB program in the Wenatchee and Methow rivers. See Section 2.4.4.

Funding for coho habitat improvements is expected to be closely associated with ongoing activities within the Upper Columbia Province. The UCSRB is expected to submit a Salmon Recovery Plan to NOAA Fisheries early in 2006. Included in this plan is a list of limiting factors identified for each watershed (approximately HUC 5 scale). Associated with this planning effort, the Upper Columbia Regional Technical Team[10] has developed a Draft Implementation Schedule that describes site-specific habitat protection, restoration and enhancement actions (and a sequence for the implementation of actions) that would address these limiting factors and benefit all salmonid populations throughout the Province (Tables 2-5 and 2-6, Section 2.4.4). Additional public involvement and modeling (with both EDT and AHA) is needed before a final Implementation Schedule is adopted by the Board and submitted as an integral part of the Salmon Recovery Plan. Future modeling and evaluation is expected not only for coho salmon, but for spring chinook, steelhead and bull trout as well.

The Yakama Nation is working closely with other tribal, state, federal and local governments to coordinate funding needs identified in this Upper Columbia Implementation Schedule. It is anticipated this schedule will substantially drive funding decisions associated with tributary mitigation described in the ESA Section 10 Habitat Conservation Plans for both Chelan and Douglas County PUDs, as well as ESA Section 7 mitigation and future re-licensing obligations by Grant County PUD. Yakama Nation fisheries staff fully expect these funds will serve as significant cost-share contributions to the NPCC Fish and Wildlife Program as well as the State Salmon Recovery Funding Board (SRFB) annual allocations. Additionally, the Yakama Nation currently receives approximately $400,000 annually through the Pacific Coast Salmon Recovery Funds (PCSRF). Included in the 2006 PCSRF allocation is a full-time position for a Habitat Project Development and Coordination specialist who will work through the Yakama Nation Coho Program office in Wenatchee, Washington, focusing on activities specifically in the Columbia Cascade Province. Clearly, many other funding sources are currently being used to improve salmonid habitat conditions in the Province, and these sources are also being considered by the RTT and Board in the development of the Implementation Schedule.

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[10] The Regional Technical Team is a body of professional fisheries and hydrologic scientists and resource managers that provide technical input to the Upper Columbia Salmon Recovery Board for habitat project development and regional monitoring.

Chapter 6.
Proposed Facilities

Chapter 6. Proposed Facilities

The Mid-Columbia Restoration Plan continues the reintroduction of coho salmon in the Wenatchee and Methow subbasins through the artificial production and acclimation/release of the progeny of locally captured broodstock. Hatchery rearing is proposed mainly due to the high egg to pre-smolt survival rates that result from their controlled environments. Acclimation is proposed to provide smolts with a gradual introduction to the wild and to imprint them on areas that have suitable habitat.

6.1 Broodstock Capture Facilities

All proposed broodstock capture facilities already exist or are being planned for development by other agencies. Trap operations might need to change to meet broodstock collection goals for the proposed coho program; effects of operational changes on listed and sensitive species would be evaluated during NEPA and ESA processes.

6.1.1 Wenatchee Subbasin

Dryden Dam

Dryden Dam collection facility is located at RK 28.2 on the Wenatchee River. This facility is owned and maintained by CCPUD. Both WDFW and YN collect steelhead, summer chinook and coho broodstock from Dryden Dam. This site has been instrumental for coho broodstock collection since the inception of the program. There are two trapping facilities within the Dryden Dam structure: left bank and right bank.

The left bank collection facility is located on the northern shore of the river and operates passively. An impassable concrete wall parallels the entrance to the trap. This prevents fish from migrating past the trap. As the fish enter, a series of ladders provide passage upstream. A V-trap weir allows passage into the holding area. The left bank trap is checked once a day, while operating, to provide brood collection and/or upstream passage of adult fish.

Dryden right bank is located directly across from the left bank facility and is also a passive trap. A small concrete apron spans across approximately half the Wenatchee River. An expandable/retractable, water-filled bladder is positioned atop the apron to provide blockage for migrating fish. Fish move through the right bank facility and into a holding area via a V-trap weir. Daily checks are made to allow for passage or collection of fish as long as the trap is operational. On the last trapping day of the week, both facilities are made passive to provide upstream movement on non-trapping days. Collection efficiencies at these locations depend on Wenatchee River flows. Higher flows result in reduced trapping efficiencies because of an accessible, migratory portion located in the middle portion of the dam.

Tumwater Dam

Tumwater Dam is located at RK 49.4 on the Wenatchee River. This facility is owned and maintained by CCPUD. YN and WDFW are co-operators of this facility. Tumwater Dam can be actively or passively operated, depending on fish numbers and available personnel.

Passive trapping allows migrating fish to move through a series of pools and enter a holding facility. Once in the holding facility, a denil fish ladder leads fish to a chute where they are shunted into another holding facility. A hopper hauls fish out of the holding area where they are sorted, identified, and either kept for broodstock purposes or passed. This passive operation allows for minimal personnel. YN and/or WDFW will check the trap at least once a day.

Active operation follows the same procedures except that once fish move up the denil, a sampler is present to identify and decide which holding tank to send the fish into. During large salmon runs, it is necessary to actively trap Tumwater Dam so as not to overload the hopper/holding area. For non-trapping days, Tumwater Dam is opened for passage and a video monitoring system will record all migrating fish species.

In the Wenatchee subbasin, BDP1 is completed. During BDP2, Tumwater Dam trapping would occur up to 7 days a week, 16 hours a day from September through the middle of December, which is an increase from current practice (3 days a week, 16 hours a day). When YN is responsible for trap operations, Tumwater Dam will operate passively unless numbers warrant active trapping. During trap operations, YN personnel will check the trap at least once a day.

Leavenworth National Fish Hatchery

Leavenworth NFH volunteer ladder will be used for broodstock collection on Icicle Creek when available. This collection facility is owned and operated by USFWS. The hatchery ladder is located at RK 4.5 on the left bank shore directly below the hatchery pool. Broodstock enter here and migrate through a series of ladders until they enter one of two hatchery adult holding ponds. Fish enter the adult ponds through V-trap weirs, one located on each pond. However in most years the fish ladder and ponds are not available for broodstock collection, due to use for juvenile rearing. The LNFH volunteer ladder would operate 7 days a week, 24 hours a day beginning September through the middle of December.

Icicle Side Channel Trap(s)

Icicle Creek side channel collection would potentially occur at the Dam 5 structure and/or the headgate (Structure 2) located at the uppermost part of the side channel, at Leavenworth NFH. Trap design, weir configurations, and operations are in the initial phases of development but have not been finalized. If operations allow passive trapping, we would trap up to 7 days a week, 24 hours a day from September to the middle of December. Active and passive trapping schedule would need to be coordinated between all parties involved in Icicle Creek passage restoration.

Chiwawa Adult Weir Trap

The Chiwawa weir is located adjacent to the Chiwawa Acclimation Facility on the Chiwawa River (RK 2.0). This tributary trap will be important for future collection needs as coho releases are proposed for this basin. This weir spans the entire width of the river. The position of the weir is angled slightly to move migrating fish towards the right-bank shore. A holding facility is located on the right bank.

Chiwawa River adult weir trap would operate up to 7 days a week, 24 hours a day. The Chiwawa River trap would be operated passively with coho volunteering into the holding area. YN personnel will check the trap a minimum of once a day. Multiple checks per day would be warranted if large numbers of coho return to the Chiwawa in any given year. Trapping would begin in September and run through the middle of December.

Nason Creek Adult Weir Trap

The Nason Creek adult weir trap is a proposed, semi-permanent design that will be located on the lower kilometer of Nason Creek. The Nason Creek adult weir is being proposed/funded by Grant County PUD as a part of their mitigation obligations and would be operated by the YN. The trap is scheduled for operation by spring 2008. Early season trap operations will depend on WDFW scheduled needs for their supplementation programs. Preferred operations would be 7 days a week, 16 hours a day for active trapping from September to the middle of December. Annual broodstock protocols will provide specifics for bi-weekly collection goals and proportions collected from all the facilities. These protocols will be available by June 1 of every year.

White River Adult Weir Trap

The White River adult weir is another proposed, temporary trap that will be located somewhere in the lower two kilometers of the river. Exact weir location and operation is unknown at this time, but the trap may be operational by the NPIP. This weir will also be funded by Grant County PUD and would be operated by WDFW and YN. The design is for an actively operated weir for broodstock collection purposes.

6.1.2 Methow Subbasin

Wells Dam

Wells Dam is located at RK 829.6 on the Columbia River. This facility has been used by the MCCRP for broodstock collection due to difficulties of fulfilling broodstock goals within the Methow River subbasin. Unlike the Wenatchee River Basin, the Methow River does not have a lower basin trapping facility and must rely on a Columbia River mainstem location.

Wells Dam will be the primary collection facility during the BDP1. Wells Dam trap operations will be 7 days a week, up to 16 hours a day. Trapping duration will be from mid-September through mid-December. During BDP2, Wells collection will be modified to ensure that broodstock collection goals are met while allowing sufficient migration past the facility so that returning coho can be trapped at upstream locations. The proportion of Wells coho incorporated into the broodstock will depend on in-basin efforts. During the natural production phases, Wells Dam will continue to operate from September to the middle of December; the number of trapping days per week will be adjusted as necessary.

There are two trapping facilities at Wells Dam, the East and West fish ladders. All facilities are owned and maintained by DCPUD; the traps are operated by WDFW and YN. Both traps are positioned on exiting fish ladders. Fish ascend the west ladder and negotiate a chute where they are either shunted into a holding area at the Wells FH, or returned to the ladder. The fish that are shunted into the hatchery holding area are sorted at least once a week, depending on numbers in the holding pond. Fish using the east ladder trap ascend a series of pools to the trap. Fish negotiate a denil then pass down a chute where they are shunted to a holding container or returned to the ladder. Fish collected in the container are then placed in a transport truck for delivery to WNFH for holding. On non-trapping days, the trapping weirs are opened for fish passage.

Winthrop National Fish Hatchery

Winthrop NFH is located at RK 80.6 and is owned and operated by the USFWS. Fish volunteer into the hatchery's adult ponds through Spring Creek, a tributary to the Methow River. Coho collected at WNFH are held until spawning.

Supplemental trapping will occur at the WNFH volunteer ladder during BDP1 and BDP2. WNFH collections consist of coho volunteers into the hatchery adult holding ponds. Trap operation will be 7 days a week, 24 hours a day, mid-September to mid-December. During the natural production phases WNFH's volunteer ladder will be used only if additional hatchery fish are needed to ensure that broodstock collection goals are met.

Twisp River Adult Weir Trap

This adult weir trap is located at RK 6.4 on the Twisp River. This tributary trap will be important for providing additional broodstock within the basin.

Beginning with BDP2, trap operations will be 7 days a week, 16 hours a day beginning September to mid-December. Bi-weekly quotas will be provided in annual broodstock protocol documents by June 1. Shortfalls at this and other weir trap locations will require collection at Wells Dam.

The Twisp River weir is currently operated by WDFW. This floating weir is owned and maintained by DCPUD.

Chewuch River Adult Weir Trap

The Chewuch River weir trap is a proposed trap funded by DCPUD. It is currently undergoing feasibility evaluations. This facility would be operated by WDFW and YN.

Foghorn Dam

Foghorn Dam is a rock structure dam just above the Methow Valley Spring Chinook Supplementation Hatchery on the Methow mainstem 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, then this location may be used for adult coho trapping.

6.2 Rearing Facilities

6.2.1 Rearing System and Site Alternatives

During the **broodstock development** phases, the mid-Columbia coho program proposes to use existing facilities for rearing. To help meet the objectives of the **natural production** phases, multiple alternatives for the rearing component of the project were evaluated. Guidelines were developed to select the basic types of systems and specific sites that would support the natural production phase rearing plan. See Appendix B.1.

The rearing environment in which fish are cultured is critical to meeting project goals. The availability of the correct amount and quality of reliable water supplies and the capability of sites to include effective rearing units are important requirements. Other siting guidelines involve construction and operating costs, the environmental impacts of construction and operation, the flexibility to meet changing needs, and operational considerations.

The different basic types of fish rearing system options evaluated were:

- Existing public hatcheries
- A new, large, central hatchery
- Several small rearing facilities located in the watersheds
- A central hatchery using constructed, natural habitat
- Extended rearing at acclimation sites
- Constructed habitat
- Combinations of the above.

Specific sites that could be used in these systems include existing Yakama Nation, USFWS, and Mitchell Act-funded hatcheries; existing acclimation sites with long-term rearing capability; and locations that require new development and construction.

These production systems and sites were compared and from them, a rearing plan proposed. It places heavy emphasis on using existing hatcheries due to cost considerations. Those hatcheries are Cascade Fish Hatchery and Willard National Fish Hatchery on the lower Columbia River and Winthrop National Fish Hatchery in the Methow subbasin. A new, small facility with only adult holding and incubation capabilities is proposed for the Wenatchee subbasin. Fry-to-smolt production in constructed habitats is proposed for a portion of the Methow releases. Summary descriptions of these facilities are in Sections 6.2.1 – 6.2.3, with details, including site drawings and additional photographs, in Appendices C.1 and C.2.

6.2.2 Lower Columbia River Rearing Facilities

Cascade Fish Hatchery

The mid-Columbia coho program proposes to produce pre-smolts from Cascade Fish Hatchery for the life of the program. The hatchery is operated by the Oregon Department of Fish and Wildlife (ODFW) on Eagle Creek, near Bonneville Dam. The numbers of fish destined for each subbasin change throughout the life of the program and are shown in Tables 6-1 and 6-2.

Cascade Fish Hatchery 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 (information from IHOT 1996):

- Adult holding: 1 concrete adult holding pond - 22,500 cubic feet
- Incubation: Vertical stack incubators
- Raceways: 30 concrete raceways 16 feet by 78 feet by 2.5 feet deep; 3,120 cubic feet each.

The 2005 production goals were 700,000 coho for the mid-Columbia coho program, 1,000,000 coho for the Confederated Tribes of the Umatilla Nation, and 600,000 coho for the Clatsop Economic Development Commission. Water is supplied by gravity from Eagle Creek. The total water right is 20,200 gpm (45 cfs) with an actual average water usage of about 7,117 gpm (16 cfs). Typical Eagle Creek water temperatures 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 produce smolts that survive to adulthood in increased numbers (see Appendix A).

Fish will need to be trucked up to 250 miles to the upstream acclimation/release sites on the White, Chiwawa, and Little Wenatchee rivers and Nason Creek.

The 2005 Mid-Columbia coho program reared 700,000 pre-smolts in 8 raceways, or 87,500 fish per rearing unit. Fish sizes for the March transport dates average 20/lb (4,375 lbs/raceway), resulting in volume densities in the raceways of 1.4 lbs per cft, typical for raceway culture but, due to space limitations, considerably higher than the MCCRP target value for new pond-based hatcheries (0.3 lbs per cubic foot).

Willard National Fish Hatchery

The mid-Columbia coho program proposes to produce pre-smolts from Willard NFH for the Wenatchee subbasin. The numbers of fish produced for the program changes throughout the life of the program and are shown in Table 6-1.

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. It operates on surface water and has full rearing capability, with the following facilities (information from IHOT 1997):

- 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.
- 24 full stacks of vertical tray incubators (384 trays).

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 2005, the hatchery reared 600,000 coho for the mid-Columbia program.

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 a problem in the past but is being controlled with improved fish culture techniques. Fish will need to be trucked up to 250 miles to the upstream release sites on the on the White, Chiwawa, and Little Wenatchee rivers and Nason Creek.

The concrete raceways are narrow and shallow, which may have a negative impact on smolt quality (see Appendix A). The overhead covers are installed close to the water surface, providing effective shade. The general condition of the hatchery is good. A recent intake rebuild has improved water supply reliability.

6.2.3 Wenatchee Subbasin Rearing Facilities

For the duration of the program, project proponents propose to continue to rear coho at the existing Willard National Fish Hatchery and Cascade Fish Hatchery on the lower Columbia River (see Section 6.2.1), as shown in Table 6-1. However, due to the distance of these hatcheries from the Wenatchee subbasin, adult holding and early incubation will need to occur at other locations. Currently, Entiat NFH is being used for these functions; however, Entiat NFH is being considered for a programmatic change which would preclude continued use by the MCCRP during the fall.

Table 6-1. Wenatchee rearing locations and numbers

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
EXISTING HATCHERIES																					
Cascade	0.45	0.45	0.45	0.45	0.45	0.45	0.25	0.25	0.25	0.46	0.46	0.46	0.46	0.46	0.40	0.41	0.41	0.41	0.41	0.41	0.00
Willard	0.55	0.55	0.55	0.55	0.55	0.71	0.91	0.91	0.56	0.35	0.35	0.35	0.35	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	**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**	**0.00**

Adult Holding and Incubation Facility

A new, small adult holding and early incubation facility is proposed on the Wenatchee River. This facility would provide a centrally located site for handling the valuable local broodstock and incubation of eggs to the eyed stage.

The preferred location for this facility is near Dryden Dam at the mouth of Peshastin Creek. Ground water supplies would be developed to supply adult holding raceways and incubators. The site is in a location that would allow the development of rearing capacity with a surface water intake in the future, if required.

A site on the Chiwawa River immediately adjacent to the existing CCPUD Chiwawa Acclimation Pond is an alternative to Dryden. Dryden is the preferred option, however, because development risks, particularly land ownership, are somewhat lower than for Chiwawa. The Chiwawa site is discussed in detail in Appendix C.1.

Facility Requirements

- Site functions: The Dryden facility would perform limited 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 they would be moved to the two lower river facilities, Cascade FH and Willard NFH, for hatching and early rearing.
- Production numbers: 1,300 adults and 1,300,000 eyed eggs.
- Development timing: Current plans call for hatchery construction to start during the second quarter of 2008, testing to occur in 2009, and operation to begin in 2010.

Site Information

- Location, elevation: Near the mouth of Peshastin Creek; in T24N, R18E, SW ¼ of S22 in Chelan County; adjacent to Dryden Dam; elevation 980 feet.
- Tributary of: The Wenatchee at river mile 18.
- Ownership: The 8.5-acre Washington State Department of Transportation (WSDOT) property (Figure 6-1) is lot number 241822745006, zoned Commercial Agricultural Lands (AC). The 15.5-acre Willow Springs Orchards property (Figure 6-1) is lot number 241822745055, zoned Rural Residential /Resource (RR2.5).
- Geotechnical conditions: Soils are likely AASHTO classifications A-1 to A-2.
- Critical areas designation: Unknown.
- Flood designation: Zone X500 (between 100 and 500 year floods). The proposed site sits on a bench that is 20 to 40 feet above the Peshastin Creek delta. Construction in this area will allow the hatchery to sit above the 100-year flood elevation without placing fill in the floodplain.
- Current land use: The proposed hatchery site is an orchard; the proposed infiltration gallery area is used by WSDOT for storage of highway sand.
- Access: Plowed, paved roads.
- Utilities: 3-phase power is available at the nearby Dryden right bank ladder facility; telephone lines at the road could be brought into the facility.
- Trucking distances: Approximately 40 miles from the upstream acclimation sites on the White, Chiwawa, and Little Wenatchee rivers and Nason Creek.

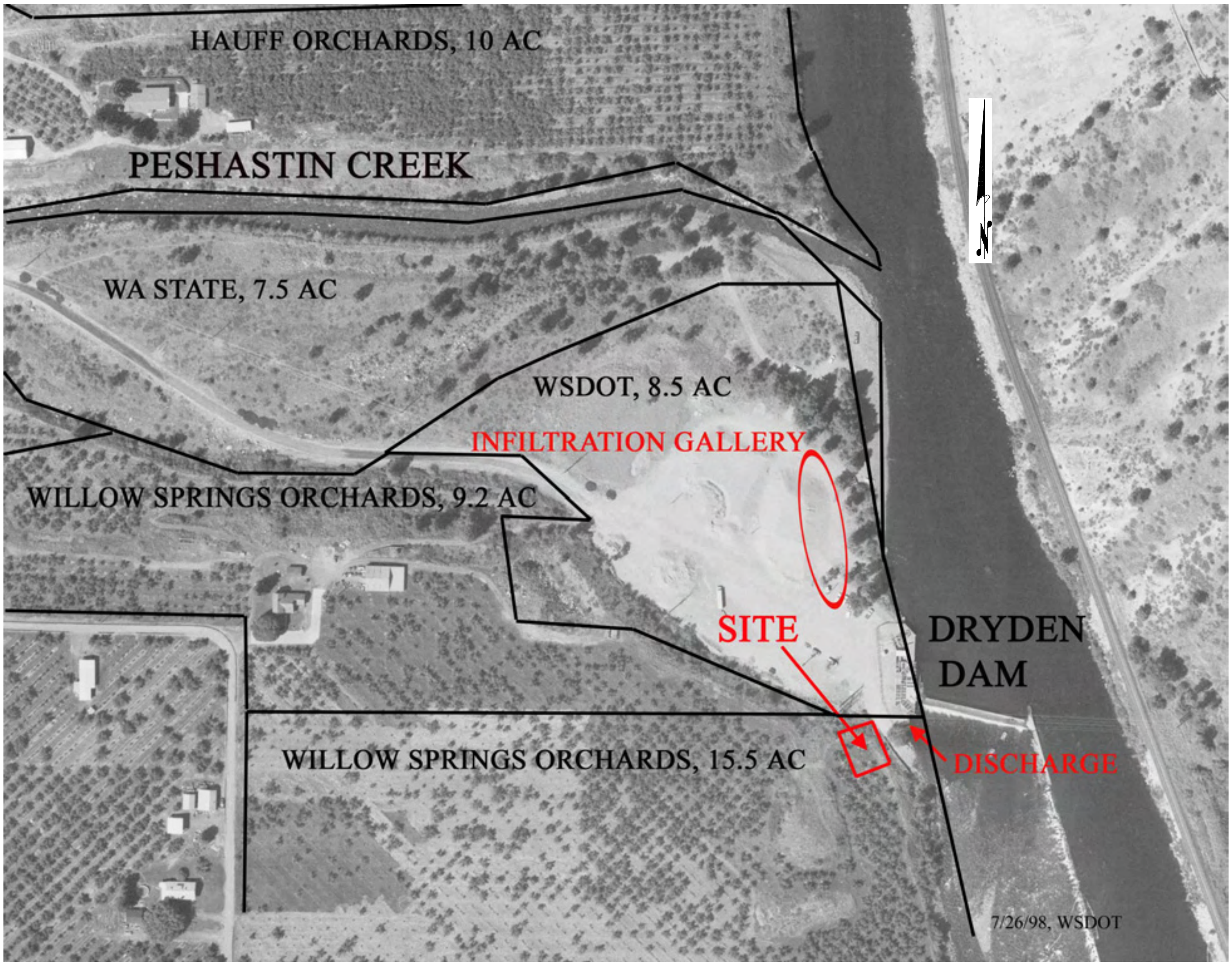

Figure 6-1. Site of Proposed Dryden Adult Holding and Incubation Facility

Water Supply

- Groundwater availability: The geology of the site suggests productive groundwater conditions. Historic gravel deposition at the Peshastin alluvial fan may have left thick layers of clean gravel.
- Groundwater withdrawal. An infiltration gallery is proposed, although deeper well water may also be available.
- Flood levels: The area where an infiltration gallery is proposed is within the 100-year flood boundaries; the facility site is above it.
- Groundwater temperature: Unknown, likely close to the average annual air temperature in the area, 48° F at Dryden (data from the Western Regional Climate Center).

Proposed Design

Site plans are shown in Appendix C.1. The following summarizes design characteristics.

- Water supply: Water from the infiltration gallery would be piped to the facility site, then run through a packed column to put it into gas equilibrium with air.
- Adult holding: 3 concrete raceways (the 2 required plus a back-up), will be available for holding adults. Multiple divisions in the raceways will allow fish at different levels of development to be held separately.
- Incubation: 10 vertical stack incubators will be capable of incubating 1,300,000 coho eggs.
- Water discharge: Return of water to the Wenatchee is proposed at the Dryden right bank ladder entrance to improve attraction for returning fish.
- Predator control, cover: The site will be fenced and an overhead net system will be installed.
- Waste treatment: Adults will not be fed so raceway discharge will not be treated. Incubation effluent will require formalin removal, which would be done in the facility building.
- Facility size: The proposed layout requires 19,000 square feet (0.4 acres) of land.

Environmental Issues

- Listed species: Bull trout, steelhead, and spring chinook migrate through the Wenatchee River but would not be adversely affected by the facility. The water intakes from the Wenatchee and Peshastin Creek would meet NMFS screening and design criteria for listed fish (NMFS 2004).
- Floodplains: The facility structures will be outside the 100-year floodplain and the infiltration gallery will be below grade, resulting in no net impact to flood storage capacity.
- Water rights: Due to the presence of a large number of wells in the area and the potential large hatchery withdrawals, well operation may affect surrounding property owners. An infiltration gallery would have less impact on deeper aquifers because it draws water from a surface aquifer that is recharged by surface water. Hydrologic impacts on flow in Peshastin Creek are possible and will need to be evaluated.
- Other fish operations: Other fish operations upstream of the proposed site will not likely impact operation of this coho facility. The only fish facility in the vicinity is Chelan PUD's Dryden Summer Chinook Acclimation Pond, which is located across the Wenatchee River (left bank) and downstream a half mile. However, the water intake for this acclimation pond is upriver of the proposed Dryden site, and the summer chinook acclimation facility is not used during the months the proposed facility would be used, so discharge from the proposed facility would not impact the PUD acclimation pond.

Development Risks

- Groundwater availability: Lack of groundwater would prevent development of the site; however, geologic conditions (see above) are favorable for groundwater development.
- Water quality: Use of agricultural chemicals in nearby farmland could adversely affect water quality at the proposed facility.

- Other permits: Because the required environmental processes would not be completed until later phases of the decision-making process, risks exist of not being able to obtain some of these required permits. Risks include local property owner opposition. Farmers may be threatened by fish restoration projects in general if they believe that their irrigation water rights will be reduced because of minimum instream flow requirements for fish.
- Land availability: Negotiations with the private land owners for use of the hatchery property, with Chelan PUD for construction near the Dryden ladder, and with WSDOT for use of land for infiltration gallery construction would not be conducted until later phases of the decision-making process; therefore, availability of these properties is not yet known.

6.2.4 Methow Subbasin

In the Methow subbasin, the program proposes to rear coho at the existing Cascade and Winthrop hatcheries and at two constructed habitats. The total reared per year at the hatcheries for Methow release is shown in Table 6-2. Detailed plans are described in Appendix C.2.

Table 6-2. Methow rearing locations and numbers

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
EXISTING HATCHERIES																					
Cascade	0.25	0.25	0.25	0.25	0.25	0.25	0.45	0.45	0.45	0.24	0.24	0.24	0.24	0.24	0.24	0.00	0.00	0.00	0.00	0.00	0.00
Winthrop	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
CONSTRUCTED HABITATS																					
Eightmile							0.20	0.20	0.20	0.14	0.14	0.14	0.14	0.14	0.14	0.07	0.07	0.07	0.07	0.07	0.07
Heath Ranch							0.10	0.10	0.10	0.07	0.07	0.07	0.07	0.07	0.07	0.04	0.04	0.04	0.04	0.04	0.04
TOTAL	**0.50**	**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**

Constructed Habitats

The basic principles of the constructed habitats are described in Appendix B.1 Rearing Facilities Alternatives and in the literature (Smith et al. 2004). They consist of pools, runs, riffles, alcoves, and ponds (see Figure 6-2) and include woody debris and overhead cover. Constructed habitat is a rearing environment that mimics natural conditions.

The program proposes to use Winthrop NFH to hold all adults that return to Methow constructed habitats, to incubate their eggs and rear them to fingerling size. Fingerlings are moved to the habitats after tagging in June. They are reared in the habitats to smolt size and released in April. Migrations out of the habitat will be prevented until fish are fully smolted. Exit fish screens will be maintained throughout the 10-month production cycle. These habitats function as both rearing and acclimation/release sites.

Predation control will be an important feature of the habitats. Fences will be used where possible and heavy tree cover will limit access by birds with long landing flight paths such as mergansers. Other bird predation will be controlled by deterrence through human presence, a technique that has been used effectively at sites currently operated by the MCCRP as well as at federal and state hatcheries.

Natural foods (aquatic insects and macro-invertebrates) will be produced in the habitats, but the mass is not expected to be enough to meet nutritional demands. Therefore, supplemental hatchery fish food will be provided.

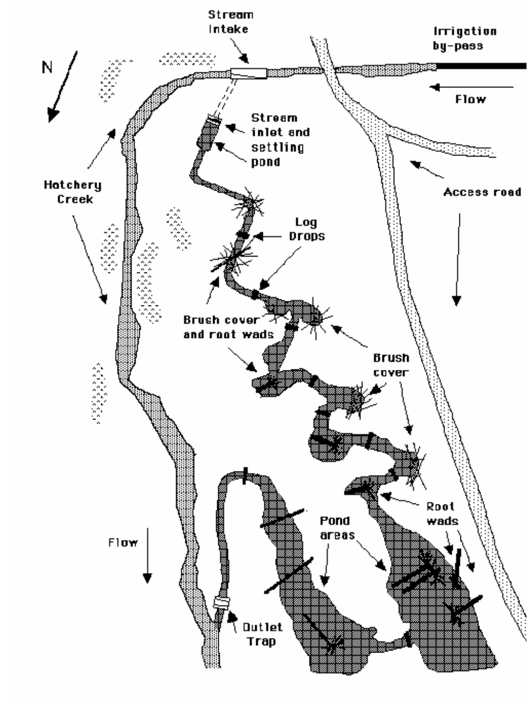

Figure 6-2. Typical Constructed Habitat

(from Smith et al. 2004)

Eightmile Constructed Habitat

A potential constructed habitat site has been identified near the mouth of Eightmile Creek, a tributary of the Chewuch River, on USFS property at Eightmile Ranch (Figure 6-3). A combination of surface water from Eightmile Creek and well water is proposed for the water supply.

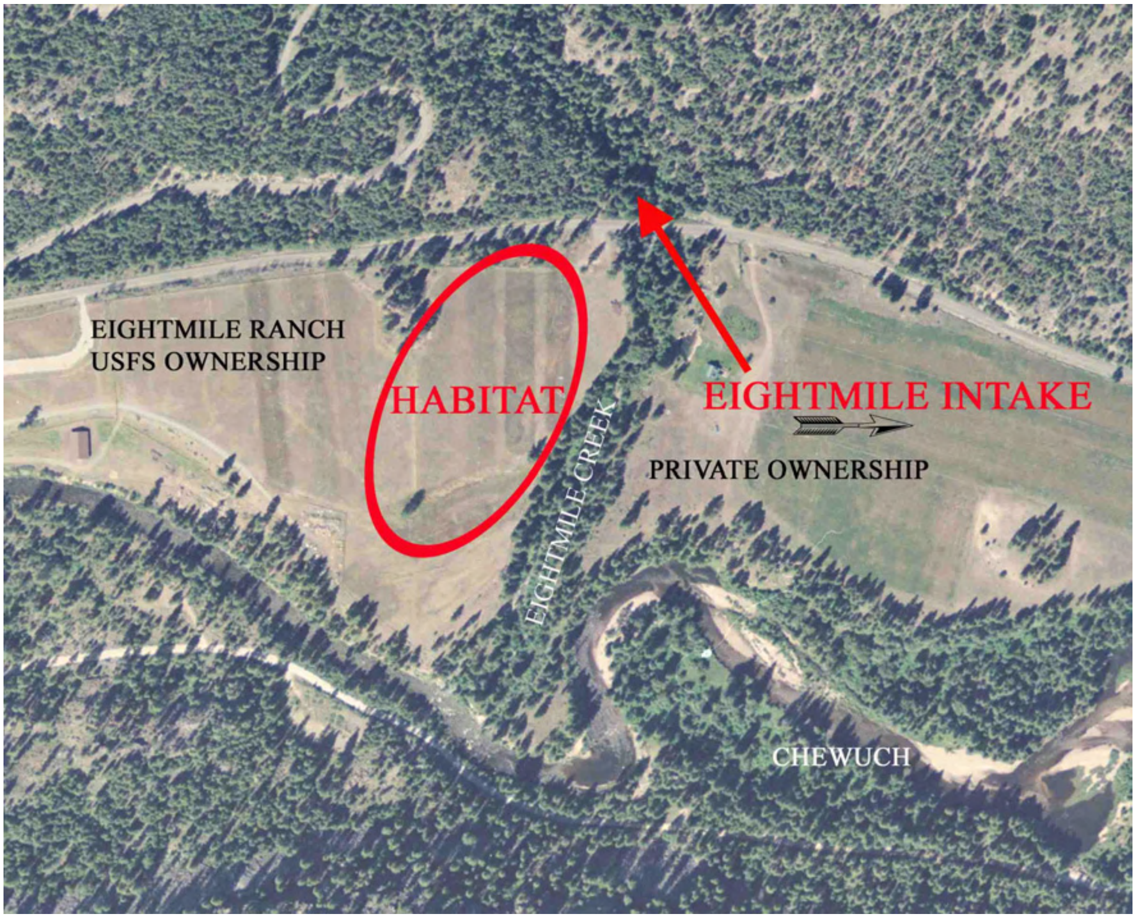

Figure 6-3. Eightmile Constructed Habitat Location

Facility Requirements

- Fish numbers: 200,000 are proposed.
- Water and space programming: Space requirements have been developed through experience with a test site on the Dungeness River (Smith et al. 2004). Minimum water flow rates are determined using standard hatchery procedures (Piper et al. 1982). Higher water flows may be used to provide additional hydraulic complexity. Appendix C.2 details water and space needs at assumed water temperatures.
- Land requirement: Assuming that the water surface area takes up 33% of the site, 15 acres of land are required.
- Development timing: Current plans call for releases to begin as early as 2010. Construction and testing would then need to be completed by the summer of 2009.

Site Information

- Location, elevation: Near the mouth of Eightmile Creek; in T36N, R21E, SE ¼ of S23 in Okanogan County; elevation 2,100 feet.
- Tributary of: The Chewuch at river mile 11.
- Ownership: USFS. .
- Geotechnical conditions: Site development is not limited by physical terrain characteristics. Soils are likely AASHTO classifications A-1 to A-2.
- Zoning: None.
- Shoreline designation: None.
- Comprehensive plan designation: USFS.
- Flood designation: Out of flood hazard zones.
- Wetlands designation: none
- Current land use: Pasture.
- Access: Plowed, paved roads.
- Expansion capability: Land may be available for expansion.

Water Supplies

- Surface water flow: The site has two potential surface water sources, an abandoned irrigation intake on Eightmile Creek and existing wells on the Eightmile Ranch. The proposed peak withdrawal of 6.5 cfs in September would result in about half the flow being removed from the creek between the intake and discharge location (see Appendix C2. Table 2).
- Surface water temperature: Data is not available but will be collected.
- Surface water quality: Excellent due to the undeveloped nature of the watershed.
- Icing potential: High for Eightmile Creek; groundwater pumped to the intake will reduce icing problems.
- Flood levels: Above flood elevations.
- Groundwater availability: The USFS has developed a well field on the Eightmile Ranch property for irrigation. Two new production wells were constructed and one existing well was reconditioned in 2002. Pump test results show potential yields of up to a total of 875 gpm. The availability of part of this capacity for operation of the constructed habitat has not yet been discussed or evaluated with stakeholders (USFS, Washington Dept. of Ecology, and irrigators). One new well is proposed for the location that will be dedicated to the habitat operation and potentially to mitigate impacts of surface water withdrawal.
- Groundwater temperature: Unknown but will be determined in the future.

Proposed Design

- The habitat will require approximately 10 acres of water surface area in a variety of sizes and shapes.
- Construction will involve balancing cut and fill. Material excavated to form the water environments will be used to construct the surrounding land areas. No fill will be removed from the site.
- Surface water for the habitat will be withdrawn from the abandoned irrigation intake upstream of the road culvert (see details in Appendix C.2). To reduce the impact of this withdrawal from Eightmile Creek, water will be pumped from the discharge of the habitat up to a point close the intake during low flow periods.
- Ground water from the existing and new wells will be used in the winter to add water supply security and to reduce icing conditions on the intake. It will also be used in the summer to reduce discharge water temperatures.
- Tree, brush, and grass plantings will provide shade and stabilize habitat shorelines. Large, woody debris will be hauled to the site and strategically placed throughout the system.
- The discharge channel will be constructed with log sills to allow passage of adults into spawning areas below the habitat.
- Outlet structures will prevent premature downstream movement and will include fish counters to enumerate migration.

Environmental Issues

- Listed species: The area is potential wolf, lynx, grizzly bear, bald eagle, spotted owl, Nelsons checker-mallow, and Ute ladies'-tresses habitat. Bull trout, steelhead, and spring chinook exist in the Chewuch River. Steelhead and bull trout use the lower section of Eightmile Creek.
- Water rights: Withdrawal of surface water from a section of Eightmile Creek has potential impacts on migration conditions for area fish. Passage improvements in Eightmile Creek may be necessary to mitigate for changed flow conditions. This could entail strategically placing or rearranging boulders and woody debris and adding rock filled gabions to establish reliable flows for passage.
- Water temperature: Increasing the retention time of Eightmile Creek water by holding it in a constructed habitat will increase water temperatures in the summer. However, groundwater from wells will be added to the habitat to reduce temperature impacts.

Development Risks

- Water rights: Obtaining the rights to withdraw water from Eightmile Creek and changing the period of use of the groundwater may be issues.
- Land availability: Negotiations with the USFS for use of the property have not been conducted. The development of a constructed habitat would reduce the pasture land available for Eightmile Ranch.

- Local opposition: The reintroduction of coho into the Methow and construction of a habitat at Eightmile may be opposed by local citizens for a variety of reasons, which will be addressed during NEPA scoping and document reviews.

Heath Ranch Constructed Habitat

A potential constructed habitat site has been identified on the Heath Ranch, with a very small portion of the continuous waterway at the southern boundary of Big Valley Ranch, in the Methow watershed. Existing spring water is the proposed water source. Much of the habitat currently exists and is planned to be used by this project.

Facility Requirements

- Fish numbers: A 100,000 smolt release is proposed for this site.
- Water and space programming: Space requirements have been developed through experience with a test site on the Dungeness River (Smith et al. 2004). Minimum water flow rates are determined using standard hatchery procedures (Piper et al. 1982). Higher water flows may be used to provide additional hydraulic complexity. Appendix C.2 details water and space needs at assumed water temperatures.
- Development timing: Current plans call for releases to begin as early as 2013. Construction and testing would then need to be completed by the summer of 2012.

Site Information

- Location, elevation: T35N, R21E, SE ¼ of S30 in Okanogan County; elevation 1,800 feet.
- Tributary of: The Methow at river mile 54.
- Ownership: Big Valley Ranch – WDFW; Heath Ranch – private.
- Zoning: Rural Residential.
- Shoreline designation: Rural Development.
- Comprehensive plan designation: Big Valley Ranch – state land; Heath Ranch – agricultural.
- Wetlands designation: Palustrine in the National Wetlands Inventory.
- Current land use: Wildlife management, recreation.
- Access: Plowed, paved road (Hwy 20) to within 1,000 feet of the site, gravel road access road.
- Expansion capability: Land may be available for expansion.
- Trucking distances: None.

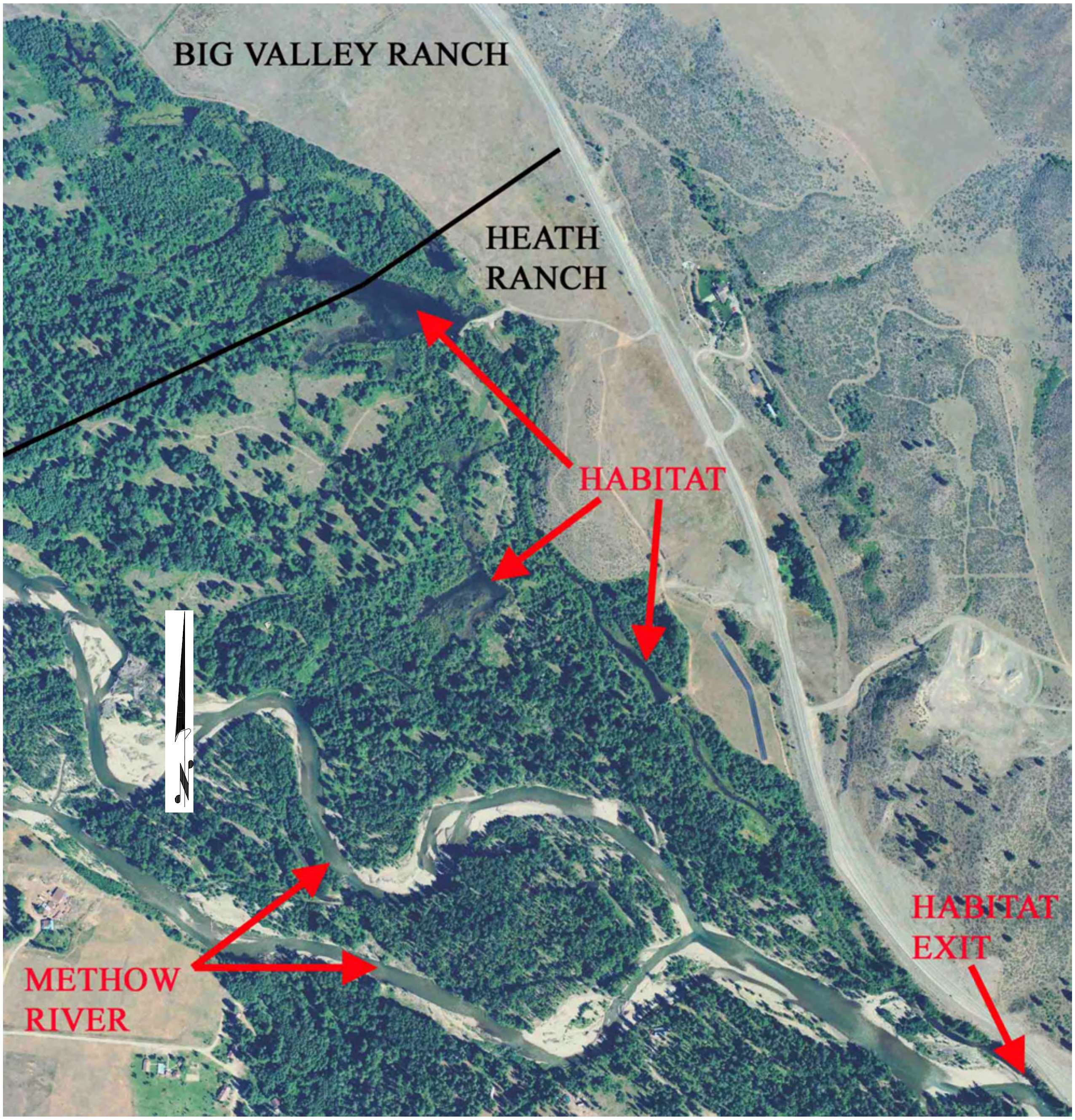

Figure 6-4. Heath Ranch Constructed Habitat Location

Water Supplies

- Water flow: Flows have not been measured but will be in the future.
- Water temperature: Data not available but will be collected in the future.
- Surface water quality: Likely excellent.
- Icing potential: Low.
- Flood levels: The site is within the 100-year flood elevation boundary.

Proposed Design

- Spring water flows through the series of ponds and wetlands. Additional water supply development is not planned.
- The spring channel is 1.5 miles long. To have the required 200,000 square feet of water surface area, the spring channel needs to average over 3 feet in width, which is the case. A detailed survey will allow a more precise estimate of surface area. Some minor construction may be planned to improve habitat conditions. Access to the habitat by migratory fish may not be possible now (Bob Jateff, WDFW biologist, personal communication, 2005), so barriers may need to be removed.
- Fencing may not be possible on the Big Valley section of the habitat due to WDFW wildlife management preferences (open range). Though optimal, fencing is not necessary for meeting the site's objectives for producing quality coho smolts. Other predation reduction options could include human presence for extended periods of time and/or using only the portion of the habitat that is on Heath property where fencing may be allowed.
- A downstream fish barrier would be constructed to prevent early migration of coho out of the system. The barrier will also include fish counting systems.

Environmental Issues

- The area is potential wolf, lynx, grizzly bear, bald eagle, spotted owl, Nelsons checker-mallow, and Ute ladies'-tresses habitat. Bull trout, steelhead, and spring chinook exist in the Methow River. Listed and other fish species currently do not have access to this off channel habitat. This project would link it to the river, making the habitat accessible when channel outlet traps and intake screens are removed after release of the coho smolts. Some non-target species may residualize until the next brood year of coho is introduced, but this could benefit those fish by increasing prey density and by providing supplemental feed.
- Impacts to wildlife on the Big Valley Ranch from site operation must be minimized. Disturbances from construction and/or operation will need to be controlled to meet wildlife management objectives.

Development Risks

- Land availability: Negotiations with the WDFW and the private land owners for use of the property have not been conducted.
- Local opposition: The reintroduction of coho into the Methow may be opposed by local citizens for a variety of reasons.

Winthrop National Fish Hatchery

The proposed plan calls for the continued production of 250,000 pre-smolts from the Winthrop NFH. Starting with Broodstock Development Phase 2 (BDP2), only part of this production will continue to be released on station. The removal of fish prior to reaching full smolt size will reduce hatchery loadings.

Plans also call for Winthrop NFH to hold all captured Methow broodstock. With minor modifications of less than $5,000 to the water delivery system, adult holding area, and incubation system, this facility will hold the 1,300 adults (600 gpm and 5,000 cft of adult holding water volume), and incubate up to the eyed stage, the 1,300,000 eggs that this plan requires.

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 U.S. Fish and Wildlife Service.

The following information is from Integrated Hatchery Operations Team (IHOT) 1998 and the 2002 HGMP (YN et al. 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 total capacity). Water use ranges from 8,528 to 27,686 gpm, with the Methow River providing the majority of the flow. Rearing systems include:

Adult Holding Ponds: 2 concrete ponds at 25,000 cft each that are not currently being used.

Incubation: 150 iso buckets and 150 vertical stack trays.

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 cft each (design flow of 300 gpm).

Raceways: 7 at 100 feet x 12 feet x 1.8 feet — 2,200 cft each (design flow of 350 gpm).

Foster-Lucas Ponds: 7 at 2,750 cft each (design flow of 350 gpm).

6.3 Acclimation Facilities

The primary objective of the acclimation plan is to produce quality smolts that return as adults in high numbers to habitat areas that will support natural production. The impact of acclimation systems on overall adult survival rates; return rates to natural production areas; capital and operating costs; flexibility to adapt to changing release numbers, locations, and methods; and site development considerations helped determine the program design. Guidelines based on these elements were used to evaluate both general types of acclimation system alternatives and specific sites that comprise those systems.

To develop the conceptual design proposed in this master plan, multiple alternatives for the acclimation component of the project were evaluated; the alternatives and a proposed plan are described in detail in Appendix B.2.

Acclimation options evaluated in Appendix B.2 are:

- Length of acclimation period.
- Number of release locations.
- Location of sites within watershed.
- Type of water supplies.
- Design of acclimation rearing systems.

A comparison of these options based on the selection guidelines demonstrates that a program based on multiple, low density, natural ponds fed by gravity flow surface water is the most cost effective system that meets program objectives. The proposed program emphasizes these sites while also including other designs dictated by practical, watershed-dependant considerations.

The proposed acclimation system has one or more release sites in each of the tributary streams that are targeted for reintroduction. A total of 18 release sites are proposed in the Wenatchee and Methow watersheds. Eleven of these sites exist now and do not require significant amounts of construction (6 of the 11 are currently being used by the MCCRP). Of the remaining 7 sitess that require construction, 2 will be used for rearing as well as acclimation and release.

The proposed acclimation plan is based on an innovative system of multiple low-cost, natural sites located near coho habitat. Although this technique is not in widespread use, it has been well tested during the feasibility phase of the Mid-Columbia and Yakima coho projects.

This acclimation system is expected to produce high adult return rates, spread fish into appropriate habitat, and have low overall project costs. It will also have the flexibility to adapt to planned and unplanned changes in program release protocols.

6.3.2 Wenatchee Subbasin

Smolts are proposed to be released from a total of 9 locations in the Wenatchee watershed. Six of these sites currently exist and 3 require substantial amounts of construction. Most of the proposed acclimation sites in the Wenatchee subbasin have been used in the past by the MCCRP. Figure 6-6 shows the locations of the sites that form the proposed plan for the Wenatchee. Conceptual designs and photographs of the sites are shown in Appendix C.3.

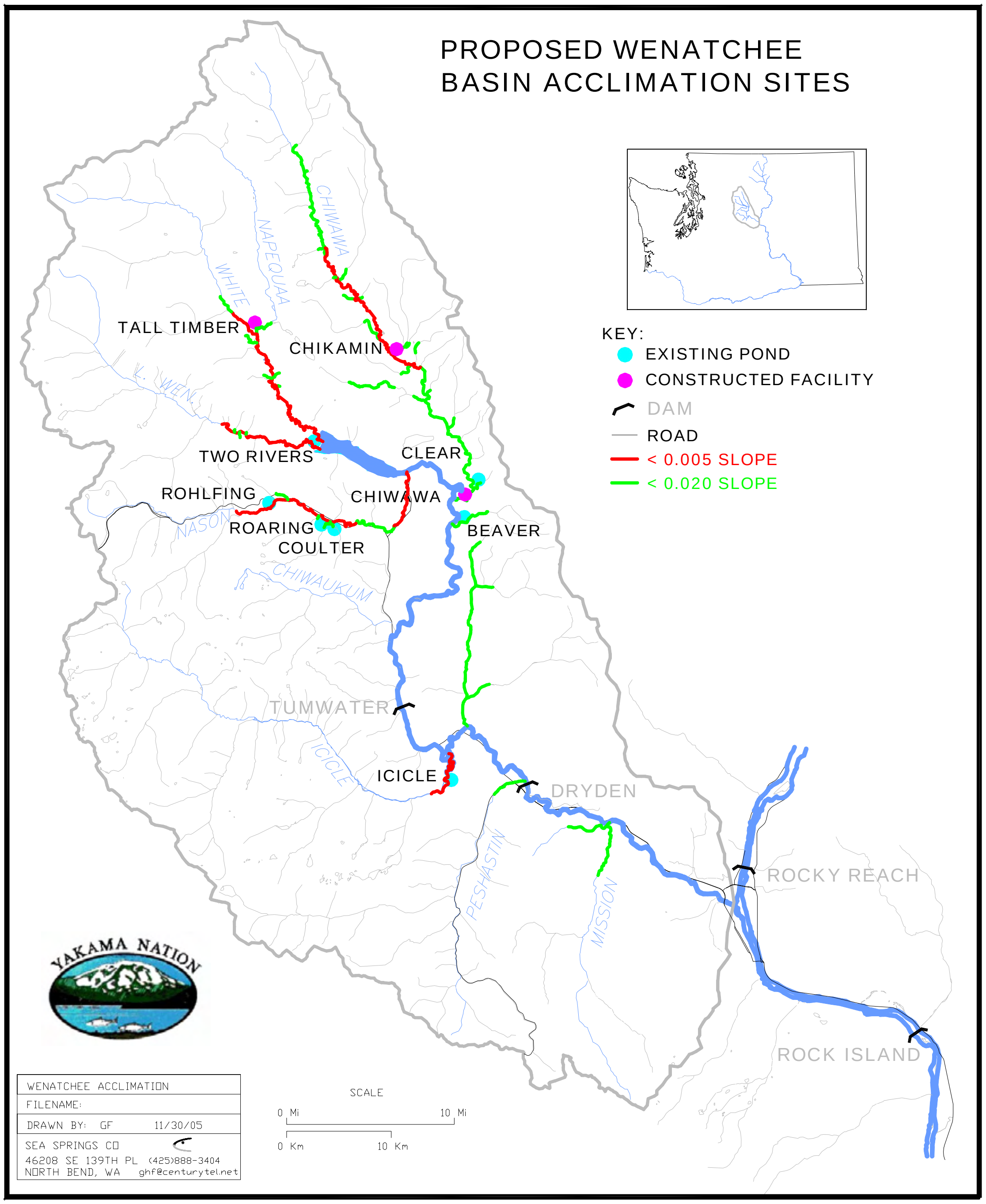

Figure 6-5. Proposed Wenatchee Subbasin Acclimation Sites

Many factors can result in a preferred location not being available for use. In all the watersheds, alternatives to the proposed sites discussed below have been identified and are listed in Appendix B.2.

Site descriptions

General information

Information about the location of the sites, their purpose, their type, their accessibility, and the presence of utilities is summarized in Table 6-3. In the location section, the tributary column lists the stream into which the acclimation ponds drain. River miles and elevation give a rough indication of the migratory difficulty for each proposed site.

The purpose section of the table provides some information about the proximity to habitat and about the main purpose of the site. Some locations function to release smolts so that returning adults are imprinted on spawning habitat located near the release site, some sites are used mainly for broodstock development (with adults returning to downstream locations), and some sites are intended to distribute adults widely within the targeted stream. The slope data (for the approximately one mile of stream below the release point) is a rough approximation of the quality of nearby habitat. Slopes less than 0.5% have been identified on watershed maps as approximating low-gradient habitat.

The site type section indicates whether ponds currently exist or must be constructed and the type of facility proposed. The site type section also lists whether the locations have reasonable potential for over-winter acclimation. In all of the following tables, the sites in red typeface require significant amounts of construction. This includes the construction of ponds and pumped water supply systems at Tall Timber, ponds and a gravity water intake at Chikamin, and construction of both ponds at Chiwawa.

Table 6-3. Wenatchee acclimation site general information

	LOCATION							PURPOSE				SITE TYPE					OTHER	
	MAIN TRIBUTARY	RIVER MI. TO MOUTH OF WEN.	TOWNSHIP	RANGE	SECTION	1/4 SECTION	ELEVATION	LOCAL SPAWNING	BROOD DEVELOPMENT	WIDE ADULT DISTRIBUTION	DOWNSTREAM SLOPE (%)	WINTER USE	EXISTING NATURAL POND	EXISTING MANMADE POND	CONSTRUCTED POND	CONSTRUCTED FACILITY	PLOWED ACCESS	UTILITIES
Rohlfing	Nason	68	26	16	5	NE	2,240			✓	0.29	✓		✓			✓	✓
Coulter/Roaring	Nason	64	26	16	11	SE	2,170	✓			0.32		✓				✓	✓
Tall Timber	White	70	28	16	18	SW	1,930			✓	0.21	✓				✓	✓	✓
Beaver	Wenatchee	47	26	17	12	NE	1,900	✓	✓		1.33			✓			✓	
Chikamin	Chikamin	62	28	17	21	SW	2,400	✓			0.12				✓			
Clear	Chiwawa	50	27	18	31	NE	2,000			✓	0.85	✓		✓			✓	✓
Chiwawa	Chiwawa	48	27	17	36	SE	1,860			✓	0.90	✓				✓	✓	✓
Two Rivers	L. Wen.	60	27	16	21	SW	1,880			✓	0.16	✓		✓			✓	✓

Water and Space

Minimum water requirements were calculated based on a flow density of 6 pounds of fish per gallon/minute of flow, with an average release size of 18 fish per pound (see Appendix A Fish Culture Guidelines, for more detail and references). This is an average minimum value based on approximate spring-time water temperatures and assumes saturated inflow; however, rflow rates should be higher to provide a safety margin; the amount of margin depends on the reliability of the water supply at each site. Space requirements were calculated using 0.3 pounds of fish per cubic foot of water at sites with 24 hour security and 0.1 lbs/cft at all other sites. The land requirement assumes that the water surface covers half of the site.

Table 6-4 describes the water source and provides some flow data. These are preliminary measurements; more flow data will be collected. In general, locations that have either gravity or pumped ground water supplies are capable of operating through the winter. Sites with intakes require a high degree of security.

Table 6-4. Wenatchee acclimation site water and space requirements

	REQUIREMENTS									WATER SUPPLY							SPACE
	PROPOSED RELEASE NUMBER	CURRENT CAPACITY	WATER NEEDED (CFS)	REARING SPACE RQRT (CFT)	WATER SURFACE RQRT (ACRES)	Number of Ponds	POND LENGTH	POND WIDTH	LAND SURFACE RQRT (ACRES)	WATER SOURCE	APRIL FLOW (CFS)	GRAVITY, GROUND	GRAVITY, SURFACE	INTAKE REQUIRED	PUMPED, GROUND	PUMPED SURFACE	CURRENT POND SIZE (CFT)
Rohlfing	105,000	105,000	2.2	19,000	0.1					Unnamed			✓		✓		36,000
Coulter/Roaring	105,000	200,000	2.2	19,000	0.1					Coulter			✓				32,400
Tall Timber	210,000		4.3	39,000	0.3	2.0	139.6	46.5	0.6	Napeequa				✓		✓	
Beaver	100,000	75,000	2.1	19,000	0.1					Beaver	2.0		✓	✓			25,120
Chikamin	100,000		2.1	19,000	0.1	1.0	137.8	45.9	0.3	Minnow	30.0		✓	✓			
Clear	170,000	170,000	3.5	31,000	0.2					Clear	2.0	✓					NA
Chiwawa	170,000		3.5	31,000	0.2	2.0	124.5	41.5	0.5	Chiwawa	Large					✓	
Two Rivers	120,000	120,000	2.5	22,000	0.2					Lake	1.3				✓	✓	30,000

Environmental Conditions

Table 6-5 shows land use designations, ESA-listed fish species that might be near the sites, and other potential development risks for proposed Wenatchee basin sites. These and other impacts will be evaluated in more detail during permit and decision processes, including the NEPA analysis.

Chelan County zoning designations are defined as follows: 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 recreational; and FC, commercial forest. Flood designations have the following meanings: X500 is between the 100-year and 500-year flood elevations; A is within the 100-year floodplain and possibly in a floodway; and X is out of the floodplain.

Check marks under the species listed in the Environmental Impacts column indicate that they are likely to be present near the intake or pond. The main impacts to listed fish are barriers or intakes which impede migration around or through acclimation sites. Site designs aim to minimize these impacts.

Development risks list some of the major issues that may prevent construction and/or operation of the sites and affect the facility development process. They include: local opposition during construction permit application; low flow volumes; water rights issues; waste discharge addressed through the NPDES process; the availability (lease, purchase, or use agreement) of land and access. A check mark in these columns means that preliminary analysis indicates the issue might be a problem at that site.

Table 6-5. Wenatchee acclimation site environmental conditions

	LAND USE				ENV. IMPACTS				DEV. RISKS					
	ZONING	FLOOD DESIGNATION	LAND USE	OWNERSHIP	MINIMAL FISH IMPACTS	BULL TROUT LIKELY	STEELHEAD LIKELY	SPRING CHINOOK LIKELY	LOCAL OPPOSITION	FLOW QUANTITIES	WATER RIGHTS	DISCHARGE IMPACTS	LAND OWNERSHIP	ACCESS
Rohlfing	RR5	X	Rural residential	Private		✓	✓			✓		✓		
Coulter/Roaring	RR5	X	Rural residential	Private		✓	✓					✓		
Tall Timber	RR20	X	Guest ranch	Private	✓				✓		✓		✓	
Beaver	RR5	X	Guest ranch	Private			✓			✓		✓		
Chikamin	FC	X	Private forestry	Private		✓	✓	✓		✓		✓	✓	✓
Clear	RRR	X	Private campground	Private	✓					✓		✓	✓	
Chiwawa	RR20		Acclimation	Public	✓						✓		✓	
Two Rivers	RR20	A	Gravel mine	Private	✓								✓	

Additional Site Information

Water effluent treatment systems that are separate from acclimation ponds are not planned. Relatively small numbers of fish will be held at low densities in large ponds. The minimum retention time for water flowing through the pond will be 2.5 hours and in most cases will be several times longer than this. Fish wastes 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. Most acclimation ponds developed for other species in the region do not include off-line effluent treatment systems.

Avian and mammalian predation is a major consideration for remote acclimation sites. At some locations, chain link fences and overhead bird netting will be installed. At other sites, electric fences and overhead wires could be used. 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 and will be employed at locations where no structures are possible.

Many of the ponds at proposed sites could become inundated during floods, which can occur in the spring during coho acclimation/migration periods. For that reason, the program will not prevent the unplanned release of fish due to flooding.

Existing Sites

- *Rohlfing*. This site is currently being used by the MCCRP. The recent addition of a well will allow it to be used for over-winter acclimation. Low flows in this intermittent stream that supplies surface water limit the number of fish that can be acclimated. Installation of fencing has been approved by the landowner to reduce predation. The site is located near the upstream end of accessible habitat on Nason Creek.
- *Coulter/Roaring*. These sites are very close together and will be managed as one. Coulter is a beaver pond that is currently being used by the MCCRP. The Roaring wetland complex (much of which is owned by Yakama Nation) has several large beaver ponds that can be used for acclimation. Fish released from Coulter pond will migrate through the Roaring wetland complex to reach Nason Creek. Steelhead are known to migrate through the complex and to spawn in Roaring Creek. Net enclosures for coho in the beaver ponds would allow the free passage of other species through the system. These sites will introduce smolts into one of the important habitat areas of Nason Creek.
- *Beaver*. This site is currently being used by the MCCRP. The pond has an existing intake that allows free passage of migrants throughout Beaver Creek while coho are acclimating. Bird predation is limited to some extent by the surrounding tree cover, but otters are present. Beaver Creek has similar habitat attributes as many streams used by coastal coho salmon; however, to date it has seen limited spawning activity. Use may be limited by obstructions to migration including culverts and an irrigation diversion. Improvements to migration will be addressed during the habitat improvement phase of the proposed reintroduction program.
- *Clear*. This pond is on property owned by a private campground. Owners have been approached in the past about coho acclimation and have been receptive. The large pond volume and secure water supply will allow large numbers of fish to be acclimated through the winter. An acclimation site on Clear Creek would introduce smolts into the lower Chiwawa, downstream of low-gradient, high-quality habitat.
- *Two Rivers*. This site previously has been used by the MCCRP. Water was pumped from a lake formed by a gravel mine operation to an existing pond. Gravel excavation through the winter and spring creates relatively high turbidity in the lake. To minimize sediment discharge, water was returned to the lake rather than to the Little Wenatchee River. The site introduces coho into the lower section of the Little Wenatchee.

New Facilities

- *Tall Timber*. There are no accessible, existing ponds on the White that can be used for acclimation and few tributary streams that would allow gravity fed ponds to be constructed. For this reason, a conventional pumped water acclimation site is proposed. The proposed location is in the upper part of the low-gradient section of the White River. Plans are to drill a well and to construct a surface water intake and two ponds. Groundwater from the well will be spread over the river water intake to reduce icing impacts and allow use of the site through the winter. Predation control will include fences and overhead nets. The operation of a pumped surface water intake will require effective alarm systems and 24-hour security. Recent attempts to build a spring chinook acclimation facility on the site have been met with public opposition. We believe the coho project may be more acceptable because the purpose is reintroduction rather than supplementation of an existing population, and because the proposed facility will be temporary.

- *Chikamin*. An existing pond on private property exists where Minnow Creek enters the Chikamin, a tributary of the Chiwawa. The pond is likely important habitat for other species and is not large enough to segregate with net enclosures. As a result, an off-channel pond is proposed for construction near the mouth of Minnow Creek, on land to be purchased. Water from a gravity flow intake on Chikamin would feed the ponds. The Chikamin itself, and the low-gradient section of the Chiwawa where it enters, are likely high-quality coho habitat.
- *Chiwawa*. Construction of an earthen pond adjacent to the Chiwawa Spring Chinook Acclimation Facility is proposed. Second-use water from the facility would supply the coho pond. No new water systems are constructed, and it is assumed that land would not need to be purchased. Over-winter operation, good site security and predation control will be possible. The site reintroduces smolts into the lower section of the Chiwawa.

6.3.3 Methow Subbasin

Smolts are proposed to be released from a total of nine locations in the Methow watershed (Figure 6-6). Three of these are also rearing sites: the Winthrop NFH; the Eightmile constructed habitat; and the Heath constructed habitat. These sites are described in detail in Section 6.2 Rearing Facilities. Of the remaining six, five have existing ponds that can be used. Two of the six sites require substantial amounts of construction. Alternatives to the proposed sites are listed in Appendix B.2.

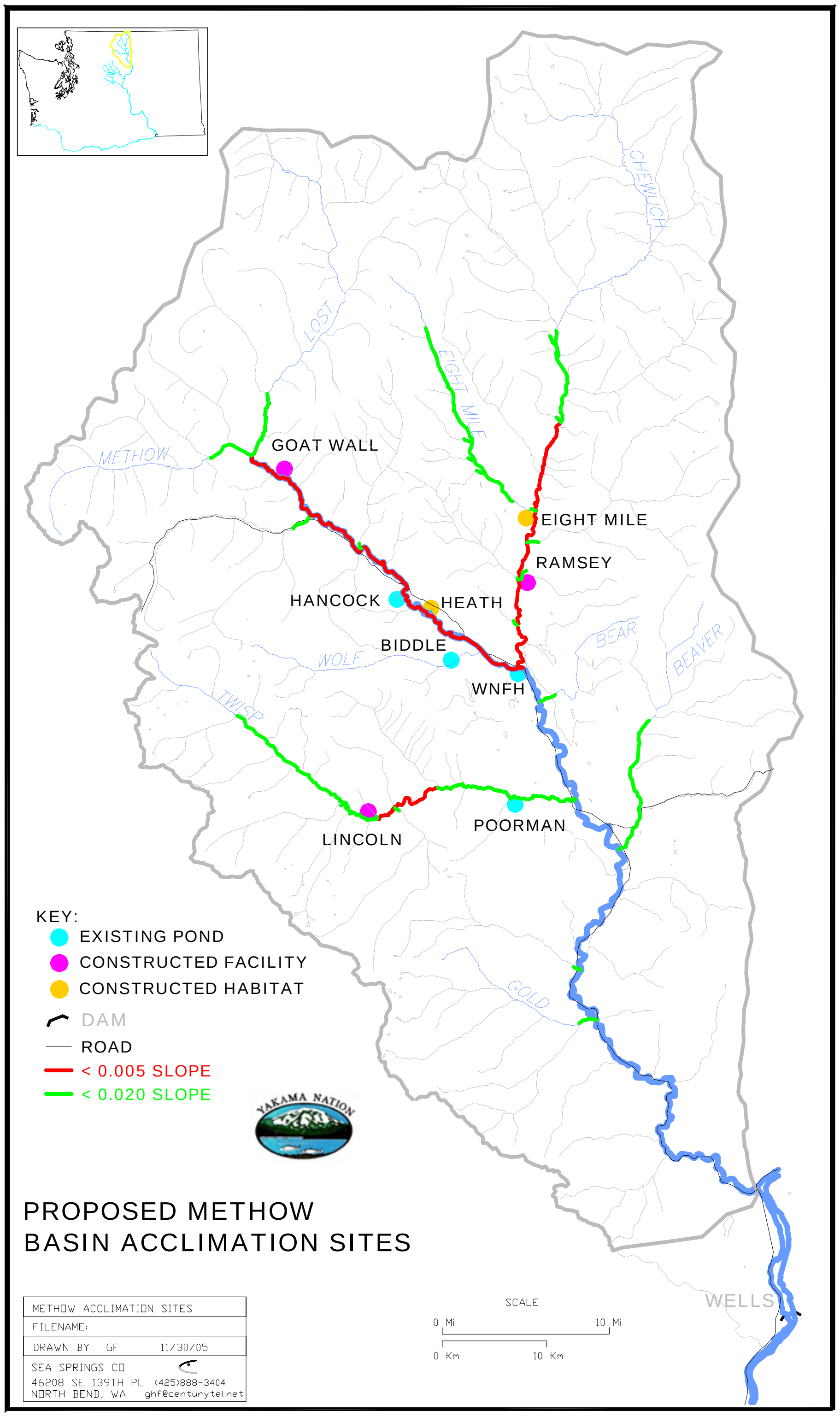

Figure 6-6. Proposed Methow Subbasin Acclimation Sites

Site Descriptions

General Information

Information about the location of the sites, their purpose, their type, their accessibility, and the presence of utilities is summarized in Table 6-6. The categories in the table are the same as for Table 6-3. In all the following tables, the sites in red typeface require significant amounts of construction, including construction of ponds and water supply systems at Lincoln and construction of both ponds and water systems at Goat Wall.

Table 6-6. Methow acclimation site general information

	LOCATION						PURPOSE				SITE TYPE					OTHER	
	MAIN TRIBUTARY	RM TO MOUTH OF METHOW	TOWNSHIP	RANGE	SECTION	ELEVATION	LOCAL SPAWNING	BROOD DEVELOPMENT	WIDE ADULT DISTRIBUTION	DOWNSTREAM SLOPE (%)	WINTER USE	EXISTING NATURAL POND	EXISTING MANMADE POND	CONSTRUCTED POND	CONSTRUCTED HABITAT	PLOWED ACCESS	UTILITIES
Ramsey	Chewuck	57	35	21	11	1930			✓	0.57			✓			✓	✓
Poorman	Twisp	44	33	21	10	1730			✓	0.67	✓		✓			✓	✓
Lincoln	Twisp	56	33	20	16	2310	✓		✓	0.57	✓	✓				✓	✓
Biddle	Wolf	54	35	21	32	1920	✓	✓		2.40			✓			✓	✓
Hancock	Methow	59	35	20	15	1920	✓		✓	0.49	✓	✓				✓	
Goat Wall	Methow	68	34	17	7	2258	✓		✓	2.25	✓	✓				✓	

Water and Space

Water and space requirements were calculated as described for the Wenatchee sites. Table 6-7 summarizes them.

Table 6-7. Methow acclimation site water and space requirements

	REQUIREMENTS									WATER SUPPLY							SPACE
	PROPOSED RELEASE NUMBER	CURRENT CAPACITY	WATER NEEDED (CFS)	REARING SPACE RQRT (CFT)	WATER SURFACE RQRT (ACRES)	Number of Ponds	POND LENGTH	POND WIDTH	LAND SURFACE RQRT (ACRES)	WATER SOURCE	APRIL FLOW	GRAVITY, GROUND	GRAVITY, SURFACE	INTAKE REQUIRED	PUMPED, GROUND	PUMPED SURFACE	EXISTING POND SIZE (CFT)
Ramsey	125,000	185,000	2.6	23,000	0.2					Ramsey			✓				
Poorman	137,500	100,000	2.8	25,000	0.2					Ground		✓					
Lincoln	137,500		2.8	25,000	0.2					Twisp	Large		✓	✓		✓	36,000
Biddle	50,000	75,000	1.0	9,000	0.1					Wolf	2		✓	✓			10,000
Hancock	100,000	200,000	2.1	19,000	0.1					Springs	9	✓					
Goat Wall	50,000		1.0	9,000	0.1	1.0	94.9	31.6	0.1	Springs	Large	✓		✓		✓	

Environmental Conditions

Table 6-8 shows land use designations, ESA-listed fish species that might be near the sites, and other potential development risks for proposed Methow basin sites. These and other impacts will be evaluated in more detail during permit and decision processes, including the NEPA analysis.

Okanogan County zoning designations are defined as follows: RR, rural residential; VF, valley floor; MD, Methow review district. Riverine wetlands are associated with adjacent river systems and paulstrine are associated with small streams and marshes.

Check marks under the species listed in the Impacts column indicate that they are likely to be present near the intake or pond. The main impact to listed fish are barriers or intakes which impede migration around or through acclimation sites. Sites are designed to minimize these impacts, wherever possible.

The Development Risks section list some of the major issues that may prevent construction and/or operation of the sites and affect the facility development process. They include local opposition during construction permit application; low flow volumes; water rights issues; waste discharge addressed through the NPDES process; the availability (lease, purchase, or use agreement) of land; and access. A check mark in these columns signifies problematic issues identified during the preliminary analysis.

Table 6-8. Methow acclimation site environmental conditions

	LAND USE						ENV. IMPACTS				DEV. RISKS					
	ZONING	WETLAND DESIGNATION	FLOOD DESIGNATION	COMPREHENSIVE PLAN LAND USE	LAND USE	OWNERSHIP	MINIMAL FISH IMPACTS	BULL TROUT LIKELY	STEELHEAD LIKELY	SPRING CHINOOK LIKELY	LOCAL OPPOSITION	FLOW QUANTITIES	WATER RIGHTS	DISCHARGE IMPACTS	LAND OWNERSHIP	ACCESS
Ramsey	VF	Paulstrine	100 Yr	Ag	Rural residential	Private		✓	✓	✓	✓			✓	✓	
Poorman	VF	Paulstrine	100 Yr	Ag	Rural residential	Private	✓				✓			✓	✓	
Lincoln	VF	Riverine	100 Yr	None	Rural residential	Private		✓	✓	✓		✓	✓	✓		
Biddle	RR	None	None	Ag	Rural residential	Private	✓							✓		
Hancock	RR	Paulstrine	None	State	Pasture	Private		✓	✓	✓	✓			✓	✓	
Goat Wall	RR	Paulstrine	98 Yr	None	Rural residential	Private		✓	✓	✓	✓	✓	✓	✓	✓	

Additional Site Information

As in the Wenatchee, water effluent treatment systems that are separate from acclimation ponds are not planned. Predation deterrence techniques would be similar to those described for the Wenatchee. Site-specific details are described below.

Existing Sites

- *Ramsey*. This large pond on private land is fed by Ramsey Creek water. The site is located in the middle of the low-gradient section of the Chewuch.
- *Poorman*. Large ponds are fed by spring water. Although parts freeze over, the site is likely to be functional in winter. This site will introduce smolts into the lower Twisp.
- *Hancock*. Recent Yakama Nation restoration projects have replaced a road culvert, improved fencing, added woody debris, and improved flow conditions in the spring channel. It is now much more accessible to salmonids and has habitat that should be very attractive to spawning coho. Fry that migrate out of the spring can rear in the Methow mainstem. Net enclosures in the existing ponds would allow the site to be used by other species during coho acclimation.
- *Biddle*. This site has been used in the past by the MCCRP. It has an intake and off-line pond. The intake needs to be improved to minimize impacts to other salmonids in Wolf Creek.

New Facilities

- *Lincoln*. Ponds currently exist on the Lincoln property. The ponds are adjacent to the Twisp River. An unscreened culvert provides river water to the ponds. The culvert elevation allows water flow only at moderate to high discharge. A new intake that meets NMFS/WDFW screen criteria is required. Development of a pumped groundwater supply will provide water supply security and will allow winter operation. Existing vegetation will make placement of predator control fences difficult, but overhead nets can limit bird problems. This site puts coho into the upper portion of the low-gradient section of the Twisp.
- *Goat Wall*. A series of small ponds on private property are fed by springs at the base of Goat Wall. The ponds are valuable habitat for several species of plants, fish, and other wildlife and are not large enough to acclimate coho. As a result, it is proposed that a portion of the spring water be diverted into constructed ponds and that a new well be built to supplement the spring water. Adults produced from Goat Wall releases must migrate through a reach of the Methow River that frequently dewaters in late summer or early fall. However, releases from this site may encourage coho, when flow conditions allow, to return to the upper Methow above the dewatered area where quality coho habitat exists. Adult coho frequently migrate upstream during fall freshets which would provide passage in most years.

Chapter 7.
Monitoring and Evaluation Plan

Chapter 7. Monitoring and Evaluation Plan

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.

7.1 Project Performance Indicators

7.1.1 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-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-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. Knowledge of how rearing and environmental conditions affect smolt survival allows researchers to adaptively manage the reintroduction effort to maximize survival. Smolt-smolt survival indices will be used to parse out that portion of mortality that is occurring during emigration.

Restoration Phases: BDP1, BDP2, NPIP. Smolt-smolt survival rates will be measured during NPSP if smolt-to-adult rates are not meeting program goals and further investigation into survival is warranted.

Methods: Groups of juvenile coho, ranging in size from 3,500 to 8,000, 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 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 2004.

7.1.2 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 2004) or predator and mortality observations (Kamphaus and Murdoch 2005).

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 2004. 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 2005).

7.1.3 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 based on size and the amount of growth in the pond, and on a pre-release examination of external features such as fins and eyes; of internal organs including kidney and liver; 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 2005.

7.1.4 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) 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 NPSP, 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, Mahar Pond). 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.

7.1.5 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 (I) Phase – H_o: pHOS ≤ 75%
- Support (F) Phase – H_o: pHOS ≤ 60%

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 25mm (Quinn 2005). Radio-telemetry techniques may be used, particularly during the natural production phases, to identify previously unknown coho spawning locations, 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.

7.1.6 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 (i.e., 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.

7.1.7 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 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.

7.1.8 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 $_{\text{smolt-adult}}$ is the estimated smolt-to-adult survival rates; Adults and Jacks $_{\textbf{broodyear } X}$ is the number of adult coho to return from broodyear X; Smolts $_{\textbf{broodyear } X}$ 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. Knowledge of how smolt-to-adult survival indices correlated with rearing and environmental conditions will allow researchers to adaptively manage the reintroduction effort to maximize survival. The SAR 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 river coho salmon 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 $_{\text{Support Phase}}$

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 Wenatchee River smolt trap (RM 7.1), 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.

7.1.9 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:

$$P_{adult} = S2/S1$$

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: $P_{\text{Broodstock Development Phases}} \geq P_{\text{Implementation Phase}} \geq P_{\text{Support Phase}}$

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.**

7.1.10 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 fishers. 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.

7.2 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 (i.e., 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 NPSP, but may continue longer pending results.

7.2.1 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**). This NTTOC monitoring plan is consistent with current and proposed plans to monitor species interactions in the Wenatchee and Yakima basins (Busak et al. 1997; Hubble et al. 2004; Murdoch and Peven 2005).

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 all 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.

7.2.1.1 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 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.

Currently 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 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. The 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).

7.2.1.2 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. During the natural production phases, the rotational release schedule of the NPIP will provide a means to compare size, abundance, and distribution of NTOCC in coho release tributaries with those same factors in tributaries without coho releases. 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 references 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 effect change.

From tributaries with smolt trapping programs in the Wenatchee basin (Nason Creek, Chiwawa River, Peshastin Creek), the Methow River (Twisp River, Mainstem Methow), and the Entiat River, we will determine whether the catch at the trap can be used to measure size and growth. 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). The Chiwawa River trap is operated by WDFW and the Peshastin Creek trap is operated by the USFWS. A smolt trap in the White River is currently proposed by WDFW. In the Methow River, the Twisp and Methow rivers traps are both operated by WDFW. The USFWS operates a rotary smolt trap in the Entiat River (reference populations).

Up to four index sites of 200 meters in length will be established in each tributary with current or future proposed coho releases and in the Entiat River. Index sites will be selected for their accessibility, proximity to spawning areas, and habitat availability. Within these index sites, we will collect a sample of up to 50 chinook and 50 steelhead with a backpack electro-fisher. Sample sizes may be adjusted following power analysis of actual data. We will sample three times per year (March, July/August, November) and compare the size and condition of the electro-fishing sample to the catch at the trap for the same time period. We will test the null hypothesis that juvenile chinook and steelhead captured in the smolt trap are the same size as juvenile chinook and steelhead captured with a backpack electro-fisher. If we find no statistical difference in size and condition of fish collected with a backpack electro-fisher and fish collected with the smolt trap, then data collected from the smolt trap will be used to monitor size and growth of NTTOC. If the size of the fish from the two sample methods is not the same, then size and condition sampling will proceed using the same methods as tributaries without smolt traps (see next paragraph). Size and growth will also be calculated for juvenile coho.

From tributaries without a current smolt trapping program, the Little Wenatchee River, and the Chewuch River, we will collect a sample of juvenile chinook and steelhead from up to four index sites (as described in the above paragraph), three times per year (March, July/August, November). The sample sizes will be determined by the abundance of NTTOC and juvenile coho. Sampling will be conducted using a backpack electro-fisher. This device temporarily immobilizes juvenile salmonids with varying levels of direct current (DC), dependant on water conductivity. Our ability to detect a difference in growth will be determined with power analysis and sample sizes, or methods will be adjusted if statistical power is too low. Collected fish will be anesthetized in a solution of MS-222 measured to the nearest millimeter and weighted to the nearest .01 gram. Sampled fish will be allowed to fully recover before release.

In order to avoid duplication of efforts, this portion of the monitoring plan will be closely coordinated and integrated with ongoing evaluations in the Wenatchee and Methow basins, including but not limited to Integrated Basin Wide Monitoring (BPA project #2003-017-000), and M&E activities associated with supplementation projects funded by the mid-Columbia PUDs.

7.2.1.3 Abundance and Survival

Objective: To measure the abundance and corresponding survival rates for NTTOC in target tributaries.

Rationale: See **Section 7.2.1.2**. 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 effect change.

Current on-going smolt trapping programs in Nason Creek, Chiwawa River, White River, Peshastin Creek, Wenatchee River, Twisp River and Methow River will form the basis for the NTTOC abundance and survival estimates. Similar traps on the Chewuch River and Little Wenatchee are 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 to ongoing and proposed smolt trapping programs described above, up to four index sites of 200 meters in length will be established in each tributary with current or future proposed coho releases; the same index sites will be used for growth monitoring. Within these index sites, we will estimate rearing densities three times annually (March, July/August, November). Rearing densities will be estimated through underwater observation. We will evaluate the baseline relationship between egg-seeding level, rearing densities, and egg-to-emigrant survival for NTTOC before and after coho reintroduction.

***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 7.2.1.2, to determine if the coho reintroduction efforts are causing the observed change or if other factors may be involved.

Methods: 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 Integrated Status and Monitoring Program, and M&E activities funded by the mid-Columbia PUDs.

7.2.1.4 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 effect 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 monitoring of up to four index sites in each tributary and results of the Integrated Status & Effectiveness Monitoring Program (BPA Project No. 2003-017-00). The same index sites identified for size structure and abundance and survival monitoring will be used to evaluate distribution. The index sites will be sampled three times annually through snorkel or electro-fishing techniques described in the sections on size and abundance monitoring.

7.2.2 Mechanism of Interaction

7.2.2.1 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. Through studies in aquaria or enclosures, statistical power is more easily achieved 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.

7.2.2.2 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.

7.3 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. There are likely to be some changes in the life history characteristics of the introduced broodstock due to multiple factors including 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)[11] 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?

7.3.1 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 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 morphometics 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.

7.3.2 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.

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[11] SNP – Single nucleotide polymorphism; an alteration of one base in the genome of an organism (e.g., A⇔G or C⇔T).

***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 included 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[12] 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 for coho salmon reintroduction efforts.

3) Over time, as the broodstock development process 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.

[12] Haplotype – The composite genotype of multiple loci that can provide a "fingerprint" for various lineages, populations, or individuals.

7.3.3 Contemporaneous Sperm Cryopreservation

Objective: To determine the biological significance of changes in phenotypic or genetic traits.

***Rationale*:** Neither neutral genetic data nor phenotypic differentiation can be used exclusively as a direct measure of local adaptation. Therefore we propose to directly measure the accumulation of locally useful traits using contemporaneous milt cryopreservation. In 2002 and 2003 we cryo-preserved milt from 50 males. These males represent returns of Lower Columbia River (LCR) brood and first generation Mid-Columbia River (MCR) brood coho. After a period of 5 to 10 coho salmon generations, the cryopreserved milt will be used to directly measure any observed survival benefits of the local adaptation process.

Hypothesis:

- H_o: Survival $_{\text{source stock cross}} \geq$ Survival $_{\text{first generation cross}} \geq$ Survival $_{\text{second generation cross}} \geq$ Survival $_{\text{locally adapted stock}}$

***Restoration Phases*:** Milt cryopreservation during BDP1; experimental crosses during the natural production phases.

***Methods*:** In 2006 we will also collect milt from second generation returns. After a period of 5 to 10 coho salmon generations (15 to 30 years, depending on the rate of observed phenotypic differentiation), a number of mid-Columbia female coho salmon will be collected and their eggs will be subdivided and fertilized to create the following crosses

1) source stock x mid Columbia female;

2) first generation x mid-Columbia female;

3) second generation x mid-Columbia female; and

4) mid-Columbia male x mid-Columbia female.

If natural selection has resulted in a survival advantage (i.e., local adaptation), we would expect cross one to have the lowest survival, cross four to have the highest survival, and crosses two and three to be intermediate.

Power analysis will be used to determine the required number of matings to achieve adequate statistical power. Resulting progeny will be differentially marked to allow identification of returning adults. We would compare a suite of life history characters, which would include run timing, maturation timing, fecundity, egg size, length at age, sex ratio and perhaps body morphometrics and neutral quantitative traits that are highly heritable. We will also evaluate genetic differences between groups using allelic frequencies. A combination of neutral and adaptive SNP loci will be the primary markers.

Chapter 8.
Cost Estimates and Schedules

8.1 Introduction

8.2 Schedules

8.3 Capital Costs

8.4 Operating Costs

8.5 Total Program Cost Schedule

Chapter 8. Cost Estimates and Schedules

8.1 Introduction

This chapter presents project schedules and estimated costs for all the program elements. Timetables for fish releases, facility development, and the monitoring and evaluation plan are based on program objectives described in Chapters 4 and 5.

The capital and operating costs of the proposed coho reintroduction program are for the period 2006 – 2026. The estimating procedures used are detailed in the Appendices. The methods used produce an accuracy higher than +/- 35% to 50%, the level suggested in the 3 Step review process description (NPPC 2001).

Operating cost estimates also have a high degree of accuracy. They are based on the actual costs of operating the feasibility phase of the MCCRP. The cost structure of all the elements of operation are well defined through these current project budgets and are adjusted to predict future costs.

Estimated expense totals are shown in the following tables both with and without cost sharing amounts. Project support currently being provided (detailed in the following sections) is expected to continue in future years and is shown in red typeface in the tables. In addition, there may be other funding contributions that are not listed. For example, land purchase funds for sites that have high value as habitat may be supplemented by resource agencies and groups. When this program receives the authority and funding from NPCC and BPA to continue its operation, the Grant, Chelan and Douglas County PUDs are obligated to support the coho reintroduction program as part of their Hatchery Compensation Plan (HCP) mitigation responsibility, resulting in additional cost-sharing.

8.2 Schedules

While the proposed reintroduction plan maximizes use of existing facilities (trapping, spawning, incubation, rearing, and acclimation), development of the project requires that several evaluation processes be conducted, that designs be completed and that permits be obtained for new facilities. These new facilities include a small adult holding and incubation site in the Wenatchee subbasin, two constructed habitats for rearing in the Methow subbasin, and five acclimation sites that involve varying degrees of construction in both basins (see Chapter 6).

Design, permitting and construction activities are scheduled to meet program requirements. New facilities are not required in the broodstock development phases. Natural production phases start in 2011 in the Wenatchee and 2012 in the Methow. New facilities will need to be operational by these dates.

The general schedule shown in Table 8-1 displays how each of the program facility development elements are structured within the NPCC step review process. Facility construction can begin after the Step 3 review in 2009, allowing facilities to be in use by the required dates.

Table 8-1. Planning, design, permit, and construction schedule

	2006				2007				2008				2009				2010			
	JFM	AMJ	JAS	OND	JFM	AMJ	JAS	OND	JFM	AMJ	JAS	OND	JFM	AMJ	JAS	OND	JFM	AMJ	JAS	OND
NPPC STEP REVIEW																				
	Step 1	Step 1	Step 1	Step 1							Step 2					step 3				
PLANNING																				
	Step 1	Step 1	Step 1	Step 1	Step 2	Step 2	Step 2	Step 2	Step 2	Step 2		step 3	step 3	step 3	step 3					
DESIGN																				
					Step 2	Step 2	Step 2	Step 2	Step 2	Step 2		step 3	step 3	step 3	step 3					
PERMITS																				
NEPA					Step 2	Step 2	Step 2	Step 2	Step 2	Step 2		step 3	step 3	step 3	step 3					
ESA					Step 2	Step 2	Step 2	Step 2	Step 2	Step 2		step 3	step 3	step 3	step 3					
Facility					Step 2	Step 2	Step 2	Step 2	Step 2	Step 2	Step 2	step 3	step 3	step 3	step 3					
CONSTRUCTION																				
Wenatchee																	■	■		
Methow																			■	■

Key: Step 1 | Step 2 | step 3

8.2.1 Smolt Release

The smolt release schedule, shown in Table 4-3 (Chapter 4), guides timing of the facility development tasks and the calculation of program capital and operating costs.

8.2.2 Facility Development

Development of the project requires that several evaluation processes be conducted, that designs be completed, and that permits be obtained for new facilities. Table 8-2 shows the planned schedule for each of the facility development elements and the tasks that support the completion of those elements. The tasks are described in more detail in Chapter IV.A.1 of Appendix D.

This is an aggressive schedule that assumes that Step 1 review of the Master Plan will be completed by the end of December 2006; that the NEPA and ESA permit process are completed in 18 months from completion of the Step 1 review; that the Step 2 review process takes 3 months; and that the Step 3 review can be completed in the third quarter of 2009. To meet this timetable, it is expected that fast-track planning and design procedures will be used. For example, facility permitting time periods can be shortened by submitting water rights applications prior to preliminary designs being completed, and land purchase can be expedited by conducting preliminary discussions with land owners at proposed facility locations prior to a Step 3 decision.

Table 8-2. Detailed schedule for planning, design and construction

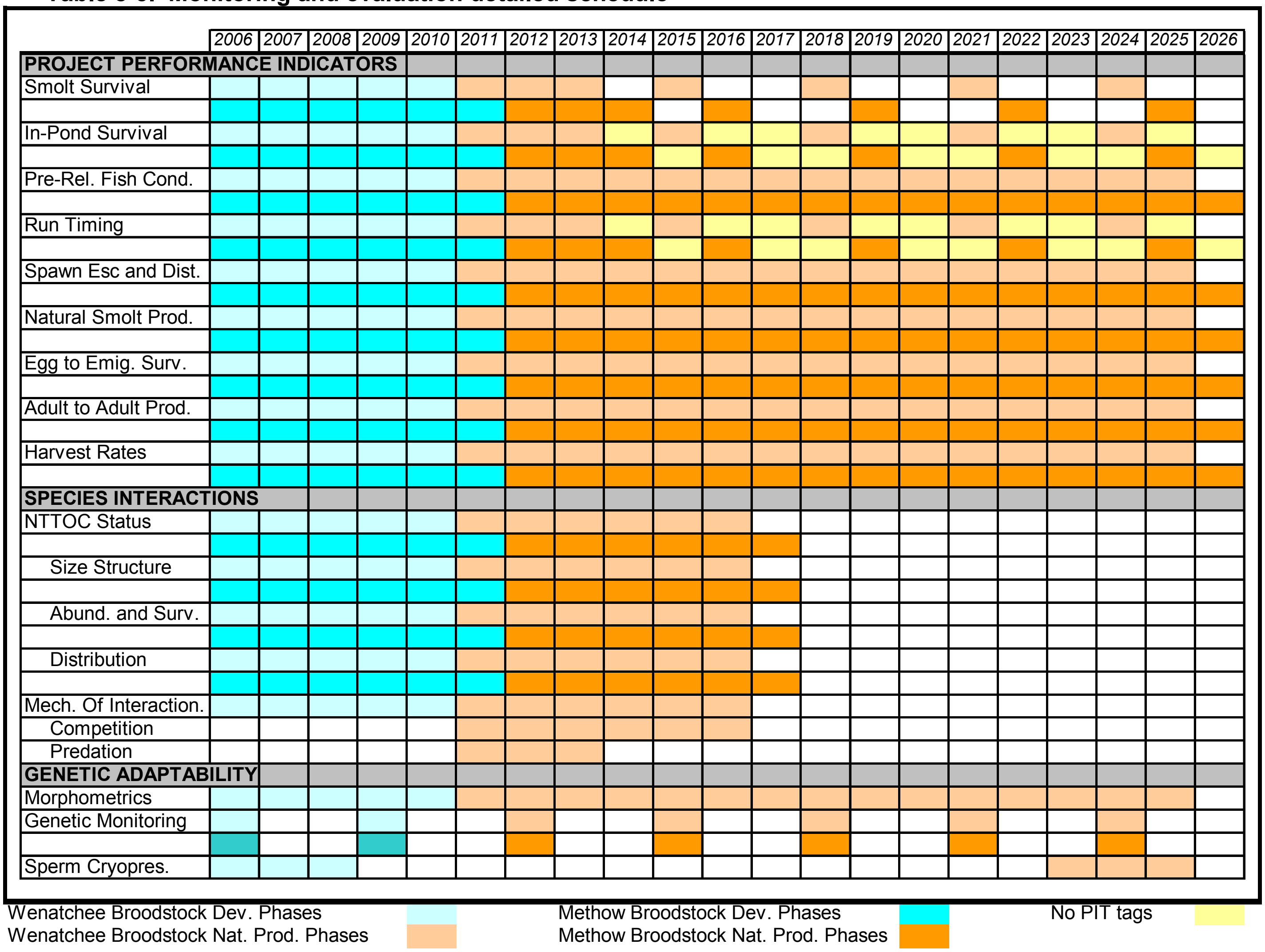
ELEMENTS	2006				2007				2008				2009				2010			
Tasks	*JFM*	*AMJ*	*JAS*	*OND*	*JFM*	*AMJ*	*JAS*	*OND*	*JFM*	*AMJ*	*JAS*	*OND*	*JFM*	*AMJ*	*JAS*	*OND*	*JFM*	*AMJ*	*JAS*	*OND*
NPPC STEP REVIEW																				
Step 1	Step 1	Step 1	Step 1	Step 1																
Step 2											Step 2									
Step 3																Step 3				
PLANNING																				
Coord. Step Process	Step 1	Step 1	Step 1	Step 1																
Site Data Collection					Step 2	Step 2	Step 2	Step 2	Step 2	Step 2										
FACILITY DESIGN																				
Preliminary																				
Wenatchee					Step 2	Step 2	Step 2	Step 2	Step 2	Step 2										
Methow					Step 2	Step 2	Step 2	Step 2	Step 2	Step 2										
Final																				
Wenatchee												Step 3	Step 3	Step 3	Step 3					
Methow												Step 3	Step 3	Step 3	Step 3					
PERMITS																				
Surveys, Studies																				
Cultural Resources						Step 2	Step 2													
Wetlands, Plants						Step 2	Step 2													
Flood						Step 2	Step 2													
Ground Water						Step 2	Step 2													
Surface Water						Step 2	Step 2													
Listed Species					Step 2	Step 2	Step 2	Step 2	Step 2	Step 2										
Other Species					Step 2	Step 2	Step 2	Step 2	Step 2	Step 2										
Discharge Impacts					Step 2	Step 2	Step 2	Step 2	Step 2	Step 2										
NEPA																				
Scoping, SOW					Step 2															
Draft EIS						Step 2	Step 2	Step 2												
Public/Agency Input						Step 2	Step 2	Step 2												
Final EIS, ROD									Step 2	Step 2										
ESA																				
HGMP, BA					Step 2	Step 2	Step 2													
Public/Agency Input							Step 2	Step 2	Step 2											
Facility																				
Water Rights					Step 2	Step 2	Step 2	Step 2	Step 2	Step 2	Step 2	Step 3	Step 3	Step 3	Step 3					
JARPA												Step 3	Step 3	Step 3	Step 3					
Critical Areas												Step 3	Step 3	Step 3	Step 3					
Construction												Step 3	Step 3	Step 3	Step 3					
CONSTRUCTION																				
Real Estate Appraisals																	Construction			
Environ. Land Audits																	Construction			
Land Purchase																	Construction			
Wenatchee Con.																	Construction	Construction		
Methow Con.																				Construction

Key: Step 1 (yellow) Step 2 (green) Step 3 (pink) Construction (blue)

8.2.3 Monitoring and Evaluation

Table 8-3 shows the planned schedule for the monitoring and evaluation tasks. The tasks are described in detail in Chapter 7.

Table 8-3. Monitoring and evaluation detailed schedule



8.3 Capital Costs

The total estimated project capital cost is $9,922,000. Planning, design, and permitting make up $1,916,000 of this total, land purchases total $1,789,000, capital equipment totals $1,280,000 and facility construction makes up the remaining $4,937,000.

The conceptual design for the natural production phases proposes that lower river hatcheries rear 85% of the program fish and that two new constructed habitats on the Methow would rear the remaining 15%. A spawning and early incubation facility is proposed near Dryden in the Wenatchee basin.

The acclimation system features multiple sites, with emphasis placed on the use of existing ponds that have gravity flow, and surface water supplies. In both Wenatchee and Methow subbasins, 9 release sites form the recommended natural production acclimation system for a project total of 18 sites. Two of these sites are the constructed habitats; of the other 16, 7 exist and have previously been used by the MCCRP.

8.3.1 Planning, Design, and Permits

Table 8-4 summarizes the subcontractor costs for the planning, design, and permitting element of the proposed program by task, by NPCC step, and by year. Table 8-5 details these costs and their timing. Yakama Nation personnel will be major contributors to these efforts; their costs are included under *Operating Costs*, *General and Administrative*.

Table 8-4. Planning, design, and permits cost summary

SUMMARY BY TASK		
PLANNING	$	388,000
DESIGN	$	652,975
PERMITS	$	875,355
SUMMARY BY STEP		
STEP 1	$	40,000
STEP 2	$	1,325,840
STEP 3	$	550,490
SUMMARY BY YEAR		
2006	$	40,000
2007	$	993,590
2008	$	469,872
2009	$	412,867
TOTAL	**$**	**1,916,330**

Table 8-5. Planning, design, and permits costs details
(in Dollars /1,000)

	2006				2007				2008				2009			
	JFM	*AMJ*	*JAS*	*OND*	*JFM*	*AMJ*	*JAS*	*OND*	*JFM*	*AMJ*	*JAS*	*OND*	*JFM*	*AMJ*	*JAS*	*OND*
PLANNING																
Coordinate Step Process	10.0	10.0	10.0	10.0	13.3	13.3	13.3	13.3	13.3	13.3		7.0	7.0	7.0	7.0	
Site Data Collection					40.0	40.0	40.0	40.0	40.0	40.0						
FACILITY DESIGN																
Preliminary																
Wenatchee					24.6	24.6	24.6	24.6	24.6	24.6						
Methow					11.7	11.7	11.7	11.7	11.7	11.7						
Final																
Wenatchee												73.8	73.8	73.8	73.8	
Methow												35.0	35.0	35.0	35.0	
TOTAL PLAN. & DESIGN	**10.0**	**10.0**	**10.0**	**10.0**	**89.6**	**89.6**	**89.6**	**89.6**	**89.6**	**89.6**	**0.0**	**115.8**	**115.8**	**115.8**	**115.8**	**0.0**
PERMITS																
Surveys, Studies																
Cultural Resources						6.0	6.0									
Wetlands, Plants						6.0	6.0									
Flood						10.0	10.0									
Ground Water Withdrawal						10.0	10.0									
Surface Water Withdrawal						12.5	12.5									
Listed Species					3.3	3.3	3.3	3.3	3.3	3.3						
Survey and Manage Species					3.3	3.3	3.3	3.3	3.3	3.3						
Discharge Impacts					3.3	3.3	3.3	3.3	3.3	3.3						
NEPA																
Scoping, SOW					50.0											
Draft EIS						100.3	100.3	100.3								
Final EIS, Record of Decision								110.0	110.0							
ESA																
Edit HGMP, BA					6.7	6.7	6.7									
Public, Agency Review								3.3	3.3	3.3						
Facility																
Water Rights					5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	
JARPA												6.0	6.0	6.0	6.0	
Critical Areas												5.1	5.1	5.1	5.1	
Construction												5.3	5.3	5.3	5.3	
TOTAL PERMITS	**0.0**	**0.0**	**0.0**	**0.0**	**72.1**	**167.0**	**167.0**	**229.1**	**128.8**	**18.8**	**5.5**	**21.8**	**21.8**	**21.8**	**21.8**	**0.0**
TOTAL PLAN, DESIGN, PERMITS	**10.0**	**10.0**	**10.0**	**10.0**	**161.7**	**256.6**	**256.6**	**318.7**	**218.4**	**108.4**	**5.5**	**137.6**	**137.6**	**137.6**	**137.6**	**0.0**

Key: Step 1 (blue) Step 2 (green) Step 3 (pink)

Following are notes on the *Planning, Design, and Permits* tasks.

Planning

- Coordinate Step Process - these are the costs for subcontractors to support completion of the master plan, preliminary design, NEPA and ESA evaluations, and final design.
- Site Data Collection - data (listed in the C. appendices) will be collected during the preliminary design phase. These costs are derived from similar costs for developing the current MCCRP facilities.

Facility design

- Preliminary - Preliminary and final design costs are estimated at 15% of construction costs. Of the 15%, preliminary design will be one-third of this amount.
- Final - these costs include preparation of engineering designs, value engineering reviews, bid documents, and management of the contractor bid process.

Permits

A full list of fish facility permits is shown in Table 8-6. Every permit listed will not be required for each site due to differing levels of development and local conditions. NEPA and ESA work will be done concurrently. Much of the effort will be interrelated, with listed species impacts forming an important part of NEPA analyses.

Table 8-6. Environmental process and permit requirements

NAME	AGENCY	COMMENTS
SEPA and NEPA		
ENVIRONMENTAL CHECKLIST (SEPA)	Lead Agency	Agency makes Determination of Significance (DS) decision based on checklist. DS (forces an EIS), Mitigated DNS, or DNS issued
DRAFT EIS	Lead Agency	Scoping helps determine the content of the EIS
FINAL EIS	Lead Agency	Addresses comments received during 45-day draft EIS comment period
ROD	Lead Agency	Record of Decision
JARPA - Joint Aquatic Resource Permits Application		
HYDRAULIC PROJECT APPROVAL (HPA)	WDFW	Use, divert, obstruct, or change natural flow Screens: 0.4 fps, 1.75mm bar, 2.4mm perf plate, 2.2mm wire mesh
SHORELINES SUBSTANTIAL DEVELOPMENT	Local Govt	In 100-yr. floodplain or within 200 ft. of high water > $2,500
COMPLIANCE WITH CRITICAL AREAS STANDARDS	Local Govt	Critical areas are designated by local governments
FLOODPLAIN MANAGEMENT	Local Govt	
401 WATER QUALITY CERT.	WDOE	Applicant for Fed license or permit for filling or exc. in water or wetlands
EXCEEDANCE OF WATER QUALITY STANDARDS	WDOE	Temporary exceedance (may not be included in new JARPA)
SECTION 404 PERMIT	US ACE	Locating structures, filling, or excavating in water or wetlands
OTHER STATE PERMITS		
ARCHAEOLOGICAL EXCAVATION	Ofc of Arch. & Historic Pres.	Fed projects require section 106 review
NPDES - GENERAL PERMIT FOR UPLAND HATCHERIES	WDOE	May not be needed for <20,000lbs. fish/yr. or <5,000lbs of feed/mo.
PRELIMINARY WATER RIGHT PERMIT	WDOE	Required for drilling and testing
CERT. OF WATER RIGHT	WDOE	Water use permit is the original application
CHANGE OF WATER RIGHT	WDOE	Location or use changes require permit
FISH/EGG TRANSPORT	WDFW	Main tool for WDFW to control movement of fish
OTHER LOCAL PERMITS		
CONSTRUCTION	Local govt	Building permits (including grading), vary by county
CONDITIONAL USE	Local govt	Activities use subject to public hearings
ZONING CODE VARIANCE	Local govt	
ESA RELATED PERMITS		
BIOLOGICAL EVALUATION (BE or BA)	USFWS, NMFS	Consultation used to show minimal impacts; if services agree, a concurrence letter is written
BIOLOGICAL OPINION (BO)	USFWS, NMFS	Issued after formal consultation
HATCHERY & GENETICS MGMT PLAN (HGMP)	NMFS	Replaces the BE for NMFS purposes
OTHER		
WETLAND AND FLOODPLAIN ASSESSMENT	BPA	Normally part of the NEPA document; requirement for federally funded projects
ENVIRONMENTAL LAND AUDIT	BPA	

Many of the permit and study costs are derived from similar projects completed by the MCCRP and Yakama Nation in the recent past. These include: ground water withdrawal impact studies, well construction and water rights applications for the MCCRP Rohlfing and Two Rivers sites; flood studies, groundwater studies, and facilities permit applications for the YKFP (Yakama Klickitat Fisheries Project) Wahkiacus Hatchery and Acclimation Facility; acclimation discharge impact study done on the MCCRP Rohlfing, Butcher, and Beaver sites; cultural resources, plant, and wetland evaluations done for several potential acclimation sites in the Wenatchee watershed;

and floodplain and wetland assessments, Joint Aquatic Resources Permit Application (JARPA) and environmental checklist applications submitted for several MCCRP acclimation sites including Two Rivers and Rohlfing.

Environmental review cost estimates were provided by Nancy Weintraub (BPA, Team Lead for Fish and Wildlife Environmental Review). The BPA estimate of $750,000 includes NEPA and ESA reviews, and the surveys and studies listed in Table 8-6.

Permit task descriptions:

- Surveys, Studies
  - Cultural Resources — 3 separate surveys of multiple sites are assumed.
  - Wetlands, Plants — 3 separate surveys of multiple sites are assumed.
  - Flood — 3 separate surveys of multiple sites are assumed.
  - Ground Water Withdrawal — 4 of the sites require ground water withdrawal studies. These include the digging of test pits, as well as evaluating potential yields and impacts on both the environment and other users of the planned withdrawal. Well construction is included under *Capital Costs*.
  - Surface Water Withdrawal — 5 sites plan on new surface water withdrawals. These impacts on stream flow will need to be studied.
  - Listed Species — to determine the presence of ESA-listed species at or near the facilities and the potential impacts from construction and operation.
  - Other Species — work on non-listed species will be done in conjunction with listed species.
  - Discharge Impacts — the effect of feeding coho in existing natural ponds will be investigated.
- NEPA
  - Scoping, SOW — this first step in the NEPA process includes preparing a Notice of Intent and a Statement of Work, meeting with cooperating agencies, and holding scoping meetings.
  - Draft Environmental Impact Statement (EIS) — prior to drafting the EIS, scoping comments will be reviewed, issues identified, and public and agency input evaluated. Results from surveys and studies will be included in the draft EIS.
  - Final EIS, Record of Decision — comments received from public review of the draft EIS are evaluated during production of the final EIS.
- ESA
  - Prepare a Hatchery and Genetics Management Plan (HGMP) and Biological Assessments (BAs) — the MCCRP HGMP will need to be rewritten to reflect program changes; assessments of the impacts of the proposed master plan facilities and activities impacting listed species will need to be prepared.
  - Public and Agency Review

- Facility
  - Water Rights — results from the completion of the ground water and surface water withdrawal studies will be used to support the water rights applications.
  - JARPA — the Joint Aquatic Resources Permit Application includes several separate permits (see Attachment 2).
  - Critical Areas — the proposed facilities are near water, requiring shorelines and critical areas permits.
  - Construction — local grading and building approvals are required.

As a check of these estimates, a comparison of permit costs with other projects can be made. The permit total for the MCCRP is estimated to be $875,000 (see Table 8-4). Costs for other projects are:

- NE Oregon Hatchery Project: Approximately $1,000,000 (personal communication Mickey Carter, Supervisory Environmental Protection Specialist, BPA)
- Average EIS costs of a wide range of Department of Energy (DOE) projects completed in 2005 (USDOE 2005): $1,434,000.

The MCCRP permit costs are expected to be lower than these values because significant amounts of environmental evaluation have been completed during the feasibility phase of this project. Impacts on listed fish have been studied for several years by the MCCRP monitoring and evaluation program in coordination with the project's TWG, members of which helped guide study designs and reviewed results. Also, work done during master plan development will be applied to permitting, further reducing costs.

8.3.2 Facilities and Capital Equipment

This cost element includes land purchase, facility construction, and capital equipment used in the operation of the sites. Two estimating methods were used. One is based on the average values of similar projects and is detailed in Appendices B.1 and B.2. The other is based on site-specific facility designs and is shown in Appendices C.1, C.2, C.3, and C.4. The averaging method uses actual facility costs, reducing variations that result from site properties that are not known until preliminary design studies are completed (such as ground water depths, soil conditions, etc.). The site-specific cost estimates take into account unique features of sites that are known, such as access road lengths, piping distances, etc. The site-specific costs were used in the capital cost estimates in Table 8-7; the average values in the B appendices provide a comparison.

Land purchases totaling $1,789,500 are included in these capital costs. Purchases are planned at five sites: Dryden, Tall Timber, Chikamin, Goat Wall, and Heath Ranch. Because most of these sites are in areas that have important habitat for coho and other species, other agencies such as WDFW may be willing to share costs of land purchases. All other sites (acclimation) are either on private land that will be leased or on federal/state land where land use agreements will be obtained.

Construction and land

Existing hatcheries that have no associated capital cost will provide the bulk of pre-smolt production. Several of the proposed new facilities have multiple functions: the adult holding, spawning, and incubation facility near Dryden in the Wenatchee basin (see Section 6.2.3 and Appendix C.1 for design and cost details) and two constructed habitats proposed as rearing/acclimation sites in the Methow (see Section 6.2.4 and Appendix C.2).

These multi function sites have the following design features:

- Dryden – an incubation building, spawning shed, and 3 concrete adult holding raceways supplied by water from a constructed infiltration gallery.
- Eightmile – a constructed habitat supplied with a surface water intake on Eightmile Creek and ground water from existing and new wells.
- Heath – an existing habitat with a new outlet structure for controlling and monitoring fish passage.

Like other aspects of the proposed program, acclimation also relies on existing sites with little capital cost. The five new facilities (see Section 6.3 and Appendices C.3 and C.4 for design and cost details) have low costs relative to other acclimation sites in the region due to their use of constructed or existing natural ponds and water supplies where available.

The acclimation sites that require major construction have the following design features:

- Tall Timber — this is planned to be a fully constructed acclimation site, with two ponds supplied by pumped surface and ground water.
- Chiwawa — second-use or excess water from the existing acclimation site will operate two new coho acclimation ponds.
- Chikamin — a new large pond and a gravity flow water intake will be constructed.
- Lincoln — existing ponds will be supplied by new wells.
- Goat Wall — a small well and an existing spring will supply a new acclimation pond.

Table 8-7. Facility construction cost

	2009	2010	2011	2012
MULTI-FUNCTION				
Dryden		$ 1,897,072		
Eightmile			$ 1,024,571	
Heath			$ 551,651	
ACCLIMATION				
Tall Timber		$ 1,144,508		
Chikamin		$ 733,047		
Chiwawa		$ 459,603		
Misc Wenatchee		$ 93,600		
Lincoln			$ 254,183	
Goat Wall			$ 536,817	
Misc Methow			$ 30,680	
TOTAL		**$ 4,327,831**	**$ 2,397,902**	

Capital equipment

Capital equipment is assumed to have a 10-year average life. Replacements at this interval are included in the cost schedule in Table 8-8.

Table 8-8. Capital equipment cost schedule
(in Dollars /1,000,000)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
CAPITAL EQUIPMENT																					
M&E Equipment		0.02										0.02									
O&M Equipment		0.01	0.02									0.01	0.02								
Multi-Function Fac.					0.20	0.13									0.20	0.13					
Acclimation Fac.					0.13	0.12									0.13	0.12					
TOTAL	**0.00**	**0.04**	**0.02**	**0.00**	**0.33**	**0.25**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.04**	**0.02**	**0.00**	**0.33**	**0.25**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Capital Equipment costs include the following:

- M&E Equipment – the main capital purchases for the Monitoring and Evaluation program are two rotary smolt traps and electrofishing gear.
- O&M Equipment – fish transport tanks and CWT detection systems are needed for broodstock collection.
- Multi-Function Facility Equipment – major equipment to be used at the adult holding and incubation facility and the constructed habitats includes chillers, pumps, generators, and trailers.
- Acclimation Facility Equipment - capital equipment needed at the acclimation sites includes pumps, generators, and trailers.

8.4 Operating Costs

8.4.1 Operation and Maintenance

Rearing

The rearing costs estimated in Table 8-9 are for production of fish to pre-smolt size while in hatcheries. Transportation of these smolts is included, as is adult holding, spawning, and incubation of Methow brood under contract with the U.S. Fish and Wildlife Service (USWFS). Wenatchee brood and egg handling will be done by Yakama Nation personnel when the Dryden facility is completed and is included in the next section (Other O&M).

Hatchery rearing cost estimating procedures are detailed in Appendix B.1. They are based on the average operating costs of five existing Columbia River hatcheries. A formula was developed using these data that allows predictions to be made for the cost of producing various numbers of fish.

340,000[.4+ 0.6*[(number of fish produced)/1,000,000]*

Reference comparisons on the accuracy of this formula reveal that it matches the current operating costs for full hatcheries, and it also compares closely with the amounts currently being paid by the MCCRP.

This same formula is applied to existing hatcheries, with the exception of Willard, and to the constructed habitats. The Willard costs are independent of the number of fish produced because the entire hatchery is dedicated to MCCRP coho production. The habitats have lower culturing costs than hatcheries due to natural management approaches; however, predator control methods that have been effective at existing acclimation sites include non-lethal hazing by personnel, which will increase overall operating costs to levels that are similar to conventional hatcheries.

The last cost element in Table 8-9 is cost sharing. This is the amount of contribution being made by fishery agencies to the MCCRP for hatchery operations. NOAA, through the Mitchell Act, supports operation of Willard ($128,000 per year) and Cascade ($277,000 per year) hatcheries. The USFWS also contributes a portion (assumed to be 10% of the total, or $31,400 per year) of the maintenance fees for operating the Leavenworth, Entiat, and Winthrop hatcheries.

Table 8-9. Rearing cost detail
(in Dollars /1,000,000)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
HATCHERIES																					
Cascade	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.27	0.22	0.22	0.22	0.22	0.22	0.13
Willard	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32							
Winthrop	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Hauling	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Adult Hold., Spawn	0.29	0.29	0.29	0.29	0.29	0.31	0.40	0.40	0.34	0.29	0.29	0.29	0.29	0.29	0.22	0.16	0.16	0.16	0.16	0.16	0.09
CONSTRUCTED HABITATS																					
Eightmile							0.18	0.18	0.18	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.15	0.15
Heath Ranch							0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.14	0.14
SUBTOTAL	**1.10**	**1.09**	**1.09**	**1.09**	**1.09**	**1.12**	**1.55**	**1.55**	**1.48**	**1.41**	**1.41**	**1.41**	**1.41**	**1.41**	**1.00**	**0.87**	**0.87**	**0.87**	**0.87**	**0.87**	**0.71**
COST SHARING																					
Rearing	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.42	0.38	0.38	0.38	0.38	0.38	0.29
TOTAL	**0.66**	**0.66**	**0.66**	**0.66**	**0.66**	**0.68**	**1.11**	**1.11**	**1.05**	**0.97**	**0.97**	**0.97**	**0.97**	**0.97**	**0.58**	**0.49**	**0.49**	**0.49**	**0.49**	**0.49**	**0.42**

Other O&M

This cost element (Table 8-10) covers all the facility operating and maintenance costs except rearing. These include the expenses of operating acclimation, brood collection, spawning, and incubation facilities. Estimates are based on recent MCCRP expenses. The 2006 budget was used as the basis for predicting the costs of future program phases. Adjustments were made to reflect changes in the number of facilities operated and numbers of fish handled. This total does not include: rearing, planning or design costs, monitoring and evaluation, or general and administrative costs.

During the Broodstock Development Phases (BDP1 and 2), Methow costs will be lower than in the Wenatchee. During BDP1, four acclimation sites will operate in the Wenatchee and one in the Methow. During BDP2, six are planned for the Wenatchee and three in the Methow. During the natural production phases, coho will be released from 9 sites in both the Wenatchee and Methow basins. As release numbers are reduced in future natural production phase years, the number of acclimation sites used will also be reduced.

Table 8-10. Operation and maintenance cost detail
(in Dollars /1,000,000)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Acclimation																					
Personnel	0.17	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Operating Supplies	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01
Vehicles	0.02	0.03	0.03	0.03	0.03	0.04	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.03
Land Agreements	0.01	0.01	0.01	0.01	0.02	0.02	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.02
Broodstock Collection																					
Personnel	0.16	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Operating Supplies	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Vehicles	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.05	0.03	0.03	0.03	0.03	0.03	0.02
Spawning																					
Personnel	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.01
Operating Supplies	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Vehicles	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Incubation																					
Personnel	0.05	0.06	0.06	0.06	0.07	0.08	0.08	0.08	0.08	0.07	0.07	0.05	0.05	0.05	0.06	0.05	0.05	0.05	0.05	0.05	0.01
Operating Supplies	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Vehicles	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
TOTAL	**0.52**	**0.59**	**0.59**	**0.59**	**0.64**	**0.67**	**0.74**	**0.74**	**0.74**	**0.73**	**0.72**	**0.66**	**0.66**	**0.66**	**0.69**	**0.63**	**0.63**	**0.63**	**0.63**	**0.63**	**0.47**

8.4.2 Monitoring and Evaluation

Estimates of the program costs for the monitoring and evaluation program element are based on current MCCRP expenses. The 2006 monitoring and evaluation budget, with tagging excluded, is $290,000. This budget was divided by task, and the cost for each was extended to future years. Estimates were made for tasks that will not begin until after 2006. Coded wire tagging costs were changed proportionate to the numbers of fish released per year. PIT tags are expected to remain approximately the same, independent of total release numbers.

Monitoring & Evaluation (M&E) costs are shared with WDFW, the HCP hatchery compensation M&E plan, and BPA project number 2003-017-00. Smolt traps at Monitor, Chiwawa, White, Upper Wenatchee, Methow, and Twisp, currently funded through alternate sources, are an integral part of the proposed M&E plan; they would provide data to monitor natural coho production and NTTOC status. The total on the last line of Table 8-11 shows the estimated yearly sum for M&E with these cost-share amounts provided by other agencies removed (shown in red).

Table 8-11. Monitoring and evaluation cost detail
(in Dollars /1,000,000)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
PROJECT PERFORMANCE INDICATORS																					
Smolt Survival	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	-	0.04	-	-	0.04	-	-	0.04	-	-	0.04	-	-
In-Pond Survival	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.00
Pre-Rel. Fish Cond.	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Run Timing	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.00
Spawn Esc and Dist.	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Natural Smolt Prod.	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.01
Egg to Emig. Surv.	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.01
Adult to Adult Prod.	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01
Harvest Rates	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
SPECIES INTERACTIONS																					
NTTOC Status																					
Size Structure	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-	-	-	-	-	-	-	-	-	-
Abund. and Surv.	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-	-	-	-	-	-	-	-	-	-
Distribution	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-	-	-	-	-	-	-	-	-	-
Mech. Of Interaction.																					
Competition	-	-	-	-	-	0.02	0.02	0.02	0.02	0.02	0.02	-	-	-	-	-	-	-	-	-	-
Predation	-	-	-	-	-	0.03	0.03	0.03	0.03	0.03	0.03	-	-	-	-	-	-	-	-	-	-
GENETIC ADAPTABILITY																					
Morphometrics	-	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.01
Genetic Monitoring	0.06	-	-	0.06	-	-	0.06	-	-	0.06	-	-	0.06	-	-	0.06	-	-	0.06	-	-
Sperm Cryopres.	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02	0.02	0.02	-
SMOLT TRAPS																					
Operation and Maint.	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
SUBTOTAL	1.01	1.17	1.17	1.21	1.15	1.19	1.26	1.19	1.13	1.26	1.13	0.94	1.06	0.94	0.94	1.06	0.94	0.95	1.07	0.95	0.86
COST SHARING																					
Smolt Trap	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
TOTAL	0.24	0.39	0.39	0.44	0.38	0.42	0.48	0.42	0.36	0.48	0.36	0.16	0.28	0.16	0.16	0.28	0.16	0.18	0.30	0.18	0.08

8.4.3 General and Administrative

The general and administrative cost element (Table 8-12) covers expenses that are spread over all project functions. These include: program administration; support for planning and design; indirect services; and running project offices. Numbers are based on current MCCRP expenses.

Table 8-12. General and administrative cost detail
(in Dollars /1,000,000)

	2006	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*	*2025*	*2026*
G&A																					
Administration	0.09	0.09	0.09	0.09	0.10	0.10	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.11	0.10	0.10	0.10	0.10	0.10	0.07
Office, Facility Maint.	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.05
Indirect	0.20	0.20	0.20	0.20	0.21	0.22	0.24	0.24	0.24	0.24	0.24	0.22	0.22	0.22	0.23	0.21	0.21	0.21	0.21	0.21	0.16
TOTAL	0.34	0.34	0.34	0.34	0.37	0.39	0.43	0.43	0.43	0.42	0.42	0.39	0.39	0.39	0.40	0.37	0.37	0.37	0.37	0.37	0.27

8.5 Total Program Cost Schedule

The yearly cost for all project elements is shown in Table 8-13, for the 20-year project lifetime. The values on the last line show the estimated total yearly project sum, with cost-share amounts provided by other agencies removed (shown in red).

Table 8-13. MCCRP total project cost schedule
(in Dollars /1,000,000)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
CAPITAL																					
Plan, Design, Per.	0.04	0.99	0.47	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Construction	0.00	0.00	0.00	0.00	4.33	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Capital Equipment	0.00	0.04	0.02	0.00	0.33	0.25	0.00	0.00	0.00	0.00	0.00	0.04	0.02	0.00	0.33	0.25	0.00	0.00	0.00	0.00	0.00
TOTAL CAPITAL	**0.04**	**1.03**	**0.49**	**0.41**	**4.66**	**2.65**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.04**	**0.02**	**0.00**	**0.33**	**0.25**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
OPERATING																					
Rearing	1.10	1.09	1.09	1.09	1.09	1.12	1.55	1.55	1.48	1.41	1.41	1.41	1.41	1.41	1.00	0.87	0.87	0.87	0.87	0.87	0.71
Other O&M	0.52	0.59	0.59	0.59	0.64	0.67	0.74	0.74	0.74	0.73	0.72	0.66	0.66	0.66	0.69	0.63	0.63	0.63	0.63	0.63	0.47
M&E	1.01	1.17	1.17	1.21	1.15	1.19	1.26	1.19	1.13	1.26	1.13	0.94	1.06	0.94	0.94	1.06	0.94	0.95	1.07	0.95	0.86
Tagging	0.48	0.48	0.48	0.48	0.48	0.52	0.65	0.65	0.48	0.48	0.40	0.40	0.48	0.40	0.29	0.28	0.20	0.20	0.28	0.20	0.09
G&A	0.34	0.34	0.34	0.34	0.37	0.39	0.43	0.43	0.43	0.42	0.42	0.39	0.39	0.39	0.40	0.37	0.37	0.37	0.37	0.37	0.27
TOTAL OP.	**3.46**	**3.67**	**3.67**	**3.71**	**3.74**	**3.89**	**4.62**	**4.56**	**4.26**	**4.29**	**4.09**	**3.80**	**4.00**	**3.80**	**3.33**	**3.21**	**3.01**	**3.02**	**3.22**	**3.02**	**2.40**
TOTAL COST	**3.50**	**4.70**	**4.16**	**4.13**	**8.4**	**6.5**	**4.62**	**4.56**	**4.26**	**4.29**	**4.09**	**3.83**	**4.02**	**3.80**	**3.67**	**3.46**	**3.01**	**3.02**	**3.22**	**3.02**	**2.40**
Rear. Cost Share	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.42	0.38	0.38	0.38	0.38	0.38	0.29
M&E Cost Share	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
TOTAL COST	**2.29**	**3.49**	**2.95**	**2.92**	**7.19**	**5.33**	**3.41**	**3.35**	**3.05**	**3.08**	**2.88**	**2.62**	**2.81**	**2.58**	**2.47**	**2.31**	**1.86**	**1.87**	**2.07**	**1.87**	**1.33**

Notes:

- Abbreviations used in the table: O&M — Operation and Maintenance; G&A — General and Administrative; M&E — Monitoring and Evaluation.
- Capital construction costs are assumed to be incurred one year before site operation begins.
- Cost sharing support for the project is removed from the total to produce the values in the last row.
- M&E cost-share represents only current cost share opportunities and does not include HCP coho mitigation.
- Capital costs do not include depreciation. All amounts are in 2005 dollars and are not inflated.

Chapter 9. References

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The following appendices are provided as separate documents to this Master Plan.

Appendix A Fish Culture Guidelines

Appendix B.1 Rearing Facilities Alternatives

Appendix B.2 Acclimation Facilities Alternatives

Appendix C.1 Wenatchee Rearing Facilities

Appendix C.2 Methow Rearing Facilities

Appendix C.3 Wenatchee Acclimation Facilities

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Appendix D Schedules and Costs

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APPENDIX A – FISH CULTURE GUIDELINES

Yakama Nation Fisheries Resource Management

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I. *SUMMARY*

The pre-smolt and acclimation rearing environments have a large impact on survival to adulthood. Densities, flow rates, water temperatures, water quality, feeding methods, and rearing unit conditions are important aspects of those environments. Due to the high value of returning adults to the coho reintroduction program, emphasis is placed on maximizing adult return rates.

Optimal coho culturing guidelines for the Mid-Columbia Coho Reintroduction Plan (MCCRP) are selected based on reviews of the scientific literature and discussions with fish culturists. Successful systems described by researchers include very low rearing densities, large volume rearing units, natural water temperatures, limited fish transportation in the pre-smolt or smolt stages, low flow densities, and limited predation. Specific culturing conditions are proposed to approximate those conditions:

- *First and second winter water temperatures*: 33° to 40° F.
- *Summer water temperature*: daily peak of 65° F and maximum daily average of 62° F. Minimum of 55° F.
- *Water pathogen load*: minimized for as long as possible—priority for incubation and early rearing.
- *Maximum volume density*: a maximum of 0.3 lb/cft for fish larger than 100/lb; 0.1 lb/cft for facilities with less reliable water supplies (acclimation sites).
- *Maximum flow density*: water temperature and fish size dependent: 9 lbs/gpm for 20/lb fish in 50º F water.
- *Main rearing units*: large ponds or constructed natural habitat for fish larger than 100/lb, with minimum dimensions of 30 feet wide by 100 feet long by 4 feet deep.
- *Trucking*: no movement after fish begin smolting (assumed to begin at a size larger than 40/lb in March). No transport between watersheds is preferred.
- *Acclimation period*: 6 or more months for sites that can function through the winter; 6 weeks for those that cannot.

Practical considerations may not allow all of these conditions to be met. Water and space availability, construction costs and operational considerations may place limits on facility options.

II. *INTRODUCTION*

Studies (discussed in the following sections) demonstrate the impact of specific changes in individual culturing parameters on smolt to adult survival rates. Insight into the general importance of the rearing environment can also be obtained by comparing the adult return rates of wild and hatchery reared smolts. Data on adult survival rates (Chandler to Prosser) has been collected on the Yakima River for the past 4 years (see Bosch et al. 2005). Naturally produced smolts had 3.5 to over 16 times higher survival rates. Because the genetics of the hatchery and naturally produced fish in the Yakima are similar, differences in the egg to smolt rearing environment explains much of the large survival advantage of natural fish. Other data show similar results. For example, Johnson (1996) estimated survival to be two to three times higher for wild Oregon coastal stocks than for hatchery smolts with similar genetics. Culturing conditions are proposed for MCCRP production that attempt to produce smolts with “wild” characteristics.

III. *WATER*

The availability of both ground and surface water supplies at rearing sites adds flexibility and reliability. The preferred supply for most of the rearing cycle is surface water, with ground water providing a low-pathogen source for early rearing and a stable back-up.

A. TEMPERATURES

A natural water temperature profile may be important to producing quality fish. It is clear from the literature that low second winter water temperatures improve smolt characteristics. Studies that demonstrate the importance of cold winter temperatures and a natural fish growth profile include:

- Steelhead held in 4 to 10° C (39 to 50° F) water for several months prior to release had higher survivals than fish reared in constant 15° C (59° F) water (Bjorn and Ringe 1984).
- Spring chinook at Columbia River hatcheries had adult survivals that were positively correlated with fast growth rates during the 1-2 months prior to release (Dickoff et al. 1995).
- Atlantic salmon reared in natural water temperatures (winter temperatures down to 42° F), survived at higher rates than fish reared on a constant winter temperature of 52° F, when transferred to seawater (Dickoff et al. 1998). The authors concluded that increasing late winter temperatures are important to the smolting process.
- Recent research indicates that spring growth rates are important to adult survival. Beckman et al. (1999) state: *"Maintaining fish at a relatively small size initially, then inducing rapid growth in the final spring, may result in high-quality smolts…".* Small size until the final spring is optimally managed with low incubation and second winter temperatures. Growth manipulation can be done by adjusting feed rates, but low ration in warm water may cause nutritional stress.
- Compensatory growth following winter starvation has been demonstrated (Griffioen 1976) for coho and fish condition is not impaired (Larsen et al. 2001).

Clear beneficial results from rearing on cold winter temperatures have not been demonstrated in all cases. Appleby et al. (2002) in a study of spring chinook at the Klickitat hatchery, showed that adult survivals were not increased with 6-week-long exposure to cold acclimation water. However, other investigators, as cited in the paper, did find that winter temperature fluctuations enhanced smoltification and emigration of salmonid juveniles.

Low first winter temperatures are also important. Chilling incubation water is relatively inexpensive and helps match the hatchery growth profile to that of natural fish. Rapid growth in the summer and second spring can then be used to attain smolt size targets. Keeping fish small as they enter the first summer also keeps pond flow and volume densities low, minimizing stress.

There were no peer-reviewed studies found that evaluate the impact of warm summer temperatures. However, the Samish, Puyallup, and Toutle Washington Department of Fish and Wildlife (WDFW) hatcheries have some of the highest adult coho return rates in the state, although these facilities all see occasional temperatures in the low 70s F in summer months (Harry Senn, Fish Management Consultants, personal communication, 2002).

There is conflicting information on the upper limit for rearing temperatures in coho facilities. For the purposes of this siting work, an upper limit for the daily maximum is 65° F and for the daily average, 62° F. The Wenatchee River near Wenatchee and the Columbia River at Rock Island Dam are above this value; both supplies are generally considered too warm for yearling salmonid culture. Cascade Hatchery (Eagle Creek) in Oregon is just below this value and at the upper limit of temperature for coho. These numbers are general guidelines only and are site- and facility-specific. Hatcheries that have recurring disease problems, high rearing volume densities, and/or low flow volumes require reduced upper limits.

B. DISEASE

The fish pathogen load of the water supply is another consideration when choosing a rearing site. The prevalence of certain pathogens may impact fish transportation restrictions between watersheds and the operation of rearing facilities. The most serious of these are the “regulated” diseases (from Northwest Indian Fish Commission(NWIFC) and WDFW 1998):

- Viral Infectious Hematopoietic Necrosis virus (IHNV)
- Viral Infectious Pancreatic Necrosis virus (IPNV)
- North American Viral Hemorrhagic Septicemia virus (VHSV)
- Viral pathogens not known to exist in Washington
- Myxobolus cerebralis parasite

Currently the entire Columbia is one Fish Health Management Zone, and transfers anywhere in the drainage are allowed. In the future, smaller Columbia Basin zones may be created to minimize disease transfers (personal communication, Kevin Amos, WDFW/NMFS, 1999; the possibility of this as a restriction is a siting consideration. Egg Health Management Zones may remain large due to the effectiveness of egg disinfection methods. Facilities that use pathogen-free water supplies exclusively are not subject to the same transfer restrictions that untreated surface supplies are.

C. FLOW DENSITY

Flow densities, if kept above minimum values, do not appear to have a large impact on survival rates. In a study of pond vs. raceway rearing for cutthroat (Tipping 1998), the flow densities in pond groups were higher than in raceway groups that survived at lower rates (see Table 1). The Banks (2002) density study (Figure 2) did not show any survival differences for flow densities in the range from 3 to 8 lbs/gpm. In general, water supply systems are expensive components of hatcheries. As a result, flow densities at these low values are not proposed.

The method used for calculating water requirements used by WDFW is described in Piper (1982). It assumes that water temperatures, elevations, and fish size impact the amount of water needed per unit weight of fish being reared. A flow index number taken from a table for a given water temperature and elevation is multiplied by the fish length in inches to yield the water requirement in lbs/gpm. Specifically, standard WDFW tables for 50° F and 1,000 feet of elevation yield a flow index of 1.7. A 20/lb coho is 5.5 inches, resulting in a flow density of 9.6 lbs/gpm. This calculation is performed for changing water temperatures and fish sizes to predict water needs for potential hatchery sites. A safety factor would also be applied that varies depending on water quality considerations and on supply reliability.

D. WATER CHEMISTRY

Other quality parameters considered when evaluating the rearing environment include turbidity, dissolved gases, heavy metals, hardness, pH, and miscellaneous contamination potential. Very high turbidity levels (above 100,000 ppm) may cause problems such as gill irritation for fry; reduced growth rates when fish visibility is reduced; and silt removal problems. Air super-saturation downstream of dams, high dissolved carbon dioxide/low oxygen levels in groundwater (assumed for all supplies and easily corrected), and the presence of dissolved hydrogen sulfide are potential gas issues. Heavy metals are generally introduced to water through improper facility construction; however, natural supplies can also contain them. Sensitivity of fish to toxic pollutants, including metals, increases at low alkalinity. Chemical spills from truck accidents, agricultural pesticides, and herbicide applications are other sources of water supply contamination. Suggested upper limits for many of these quality parameters are listed in Piper (1982) and in the Alaska Fish Culture Manual (ADFG 1986). Due to the interactive aspects of chemical reactions in water, developing specific criteria is difficult. Most water supplies have some values outside these limits, yet coho are successfully reared in a variety of conditions throughout the Northwest. The standards can be used as general guidelines, but quality determinations should not be made until testing with live fish for a full rearing cycle is completed.

IV. REARING UNITS

Various options exist for rearing unit designs. Ponds, circular tanks, and raceways are among the types of systems in which fish are cultured. The use of different rearing units for fish at different stages of development is a standard practice. Concrete raceways have operational advantages which are important for small fish that need to be fed frequently and handled for activities like tagging. Moving fish from raceways to ponds for grow-out may improve adult survival rates (see Table 1 and discussion below).

A. VOLUME DENSITY

Rearing volume density appears to be one of the most important variables impacting adult survivals. Numerous studies (discussed below and summarized in Table 1) have demonstrated significant impacts. Many of these studies included compounding experimental variables such as water flow rates and rearing environment. However, volume density is an important and common difference between controls and experimental groups in the studies.

Table 1. Summary of Rearing Studies

Author	*Comparison*	*Species*	*Study Volume Density (lbs/ft^3)*	*Control Volume Density (lbs/ft^3)*	*Study Flow Density (lbs/gpm)*	*Control Flow Density (lbs/gpm)*	*Study Length (mo)*	*Avg. Survival*	*Survival Advantage of Study Groups*
COHO									
Banks, 1995	Rwys (Willard)	Coho	0.87	2.59	3.5	8.1	12	0.5%	23%
Fuss, 2002	Ponds (Elochoman)	Coho	0.19	3.30	1.0	11.8	10	1.5%	270%
Ewing, et al, 1995	Rwys (Washougal)	Coho	0.21	0.52	6.2	14.7	6	2.0%	23%
	Rwys (Cowlitz)	Coho	1.31	2.27	11.0	23.0	7	1.4%	0%
	Rwys (Sandy)	Coho	0.72	2.59	14.7	12.8	12		0%
	Rwys (Capilano)	Coho	0.34	0.57	3.3	5.7	12	13.0%	0%
	Ponds (Clatsop)	Coho	0.07	0.14			4	2.2%	500%
OTHER SPECIES									
Tipping, 1998	Rwys vs pond	Cutthroat	0.02	1.12	14.5	5.7	7		60%
Banks, 2002	Rwys vs. rwys	S. Chnk.	1.0	3.0	2.5	7.5	9.5		300%
Ewing, 1995	Rwys vs. rwys (Elk)	S. Chnk.	0.6	1.0	4.7	8.5	10		170%
Ewing, 1995	Circs vs. circs (Deer)	S. Chnk.	0.4	2.0	1.8	8.1	9.5		600%
Beckman,1999	Rwys vs pond	S. Chnk.	0.1	1.0			4.5		60%

A study that showed a large survival advantage due to changes in rearing conditions was done by Fuss and Byrne (2002). They compared coho reared in a large “natural” pond at low densities for 10 months to fish reared in conventional raceways for 6-9 months and then transferred to hatchery ponds for the final 2-3 months of rearing. Volume density was one of the significant differences between the test groups. Important compounding variables included the mechanical introduction of feed, the presence of rock and large woody debris, and high predation rates (50%) in the treatment pond. Survivals were 140% higher for the natural pond than for the controls or for other coho releases in the region.

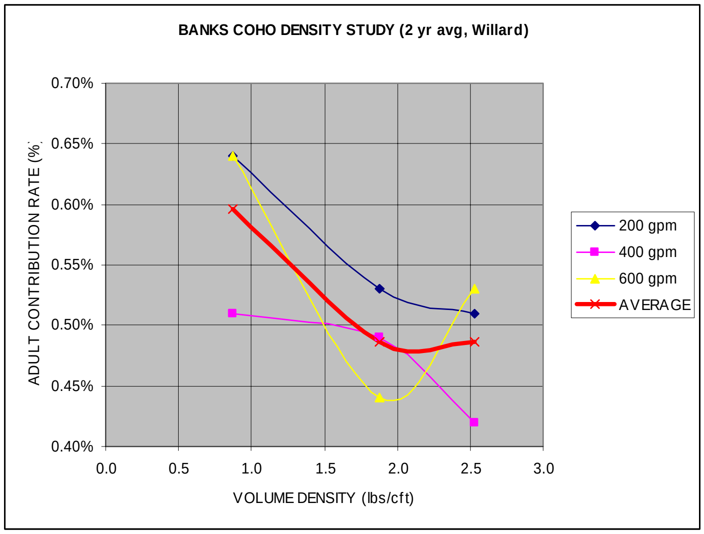

Figure 1. Coho volume density and adult coho contribution rate

(adapted from Banks (2002))

Data from Banks (2002) coho density study is plotted in Figure 1. It shows an increase in adult survivals with reduced densities in raceways.

Ewing (1995) found that in 7 of 20 brood years for coho salmon, increased rearing density resulted in a reduced percent survival to adulthood. Most of these evaluations were done in conventional hatchery raceways at different facilities at relatively high densities. Data from two of the study locations are plotted in Figure 2. Results from Washougal show that at very low densities, there was a survival advantage for lower densities, but at higher densities at Cowlitz, there was not.

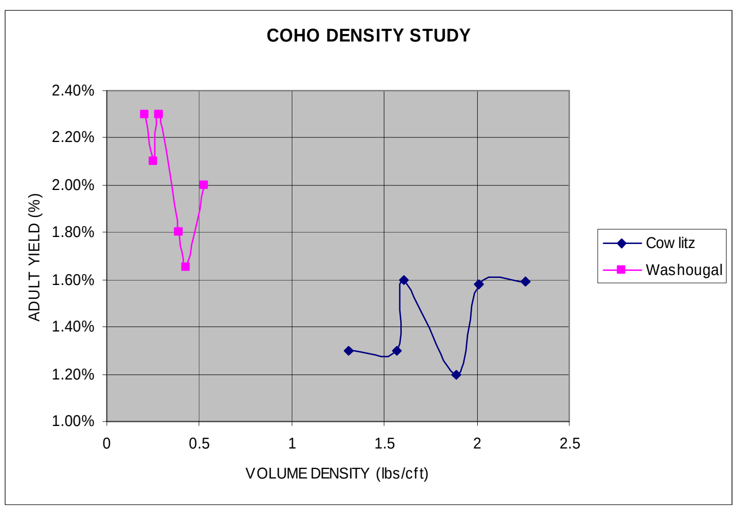

Figure 2. Coho volume density and adult yield

(adapted from Ewing (1995))

The duration of time salmonids spend in large volume rearing units may be important as well. Tipping (2001a) found that cutthroat showed a 31% improvement in survival for 4-7 months of rearing in a large pond vs. 1 month.

Natural smolt densities are much lower than those used in fish culture. A study of western Washington streams (Sharma and Hilborn 2001) evaluated smolt densities in pool habitats. In an engineered habitat experiment, fish were allowed to emigrate out of the system voluntarily at any life stage. Smolts remained at low densities even where feed was not a limiting factor. Comparative density data (Table 2) indicate that coho choose densities that are two orders of magnitude lower than standard hatchery values.

Table 2. Rearing Density Comparison

	Smolts /Acre
Natural Ponds and Side Channels	3,460
Engineered Habitat, Voluntary Out Migration	6,100
Low Density Pond, 3' Deep, 18/lb, 0.3 lbs/cft	706,000
Standard Raceway, 3' Deep, 18/lb, 1.0 lbs/cft	2,353,000

B. REARING UNIT SIZE

Studies have shown an additional survival benefit when comparing pond rearing to raceways. The benefits of pond rearing have been demonstrated for coho salmon (Fuss 2002), cutthroat trout (Tipping 1998), and spring chinook salmon (Beckman 1999).

It is unclear why large rearing units perform well. They may reduce stress by providing escape areas when fish perceive threats. The relationship between stress and disease (Wedemeyer 1984) and the impact of stress on growth rates (McCormick et al. 1998) have been described. There may also be a relationship between stress and survival fitness.

There are practical limits to the size of rearing ponds. One limitation on width is the distance that feed can be thrown. For example, fry typically may be ponded after tagging in June at approximately 250/fpp. The 3.5 mm pellets that are fed to fish of this size can be spread up to 30 feet. Also, the length-to-width ratio affects pond hydraulics: long and narrow increases flow velocities. The final determination of overall rearing unit dimensions will be based on the size of evaluation tag groups.

Water depth may also be an important consideration, as it provides security from predators and moderates water temperatures in both winter and summer. However, where depth needs to be limited by human safety considerations, it should be kept to less than 4 feet.

Large ponds do increase the cost of disease treatments that are applied to water. They also make removal of all fish by seining more difficult and reduce the ability to visually monitor fish. Yet advantages beyond that of increasing adult survivals include:

- Large oxygen reserves, which provide back-up in case of emergency water flow interruptions.
- Room for exercise and for schooling. Exercise may be beneficial to smolt quality (Khovanskiy et al. 1993).
- Reduced disease problems due to the low stress environment and low pathogen density.
- Low construction costs, with large water volume to pond bottom and side surface ratios.

C. ENVIRONMENT

Natural rearing environments in artificial production systems have been proposed. Flagg et al. (1999) propose a strategy for conservation hatcheries that emphasizes the production of fish with "wild-like" attributes. Some testing of this concept has occurred, with varying degrees of success. Large scale experiments with spring chinook at the Cle Elum Supplementation Hatchery have not demonstrated advantages in survival due to the use of some natural rearing strategies. Painted walls, floating covers, and subsurface feed introduction did not substantially improve adult survivals when compared with standard raceways.

Maynard (2004) describes a Puget Sound coho study currently underway that looks at the impact on coho adult survival rates of bottom substrate, fir tree structure, and camouflage net covers in a raceway environment. Adult return data show that these features have little impact.

Tipping (2001b) demonstrated that for cutthroat, fish fed with demand feeders had a 10% higher survival rate to adulthood. Similarly Fuss (2002) also used mechanical feeding. Based on this evidence, there may be a small advantage to avoiding hand feeding methods.

Water flow patterns in streams and rivers are different than in the controlled environments of ponds and raceways. A key difference is that wild fish are faced with a high degree of hydraulic complexity; including turbulence, eddies, high shear, and very low flow velocities. Fish react to changes in flow conditions (Smith 2003 and Goodwin et al. 2004), and behavior learned in the captive environment may affect success in the wild.

Noise levels in fish hatcheries are another area of recent interest. Acoustic noise can be 20 to 50 dB higher than in natural habitats (Browman et al. 2005). Frequencies (a typical source is electric motors at 60 Hz) are also much different. The impacts of artificial noise on fish are not understood.

Other new rearing unit designs and practices are showing some value, primarily involving water temperature profiles and growth rates, volume density, and rearing unit sizes, as discussed above. Strategies that have less of an impact or that are just starting to receive interest also have been identified. Where research gives clear direction, mimicking natural conditions has been shown to improve adult survival rates. Where it does not, the assumption will be made that natural conditions are the default, wherever possible.

V. TRUCKING

Fish reared at lower Columbia River hatcheries and transported to upper watersheds in the mid-Columbia region may be in haul trucks for up to 8 hours. Several authors have evaluated the response of salmonids to hauling activities (see Specker 1908; Schreck et al. 1988; and Maule et al. 1989). They concluded that the greatest stress occurs during loading and during the first few hours of transportation. Fish transported 4 hours or 12 hours did not show large differences in overall stress levels. Also, elevated levels of stress are reduced to pre-transportation levels within periods of days. If fish are given adequate time to recover, there does not appear to be a significant stress-related decrease in survival for hauling fish long distances.

Other transportation issues need to be considered when selecting the program design. Fish should not be hauled during or after the smolting period. High stress levels and handling during this critical time may reduce survival. For example, scales become loose during smolting, and loading fish into trucks and confining them in tanks causes scale loss. There may be unknown impacts to the smolting process itself. In addition, long trucking distances increase the chances of smolt loss due to mechanical failures.

Disease considerations may affect transportation plans. As discussed previously, stress is a contributing factor in disease epizootics and fish are stressed during trucking. Also, there are diseases that can prevent the transportation of fish between watersheds. Disease transfer is one of the motivations for policies limiting the movement of fish between Puget Sound basins (see NWIFC 1998). Such policies may be developed for the Columbia region in the future. The existence of certain diseases in hatcheries (viruses such as VHS, for example) would prevent the movement of fish to upstream release sites under current conditions.

In summary, the impact of hauling on smolting, in addition to the risks due to disease, means that the preferred system would involve no hauling. Fish reared and released at the same location would eliminate many of these potential problems. Operational and cost considerations make this impractical. Reducing the requirement to transport fish between watersheds and moving fish well prior to release is the next best alternative.

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APPENDIX B.1. REARING FACILITIES

- ALTERNATIVE AND PROPOSED PLAN EVALUATIONS

Yakama Nation Fisheries Resource Management

CONTENTS

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I. *SUMMARY*

The Mid-Columbia Coho Restoration Program (MCCRP) alternatives for the rearing component of the project are evaluated and a proposed fish production plan is described. Guidelines are developed to support the selection of the basic types of systems and specific sites that would form the rearing plan. They are intended to support the main objective of producing quality pre-smolts that return to release areas in high numbers.

The rearing environment in which fish are cultured is critical to meeting the restoration goal. High quality juveniles can survive significantly better than fish reared in a compromised hatchery environment. The availability of the correct amount and quality of reliable water supplies and the capability of sites to include effective rearing units are important site requirements. Other siting guidelines involve construction and operating costs, the environmental impacts of construction and operation, the flexibility to meet changing needs, and operational considerations.

The different basic types of fish rearing system options evaluated include:

- Existing public hatcheries.
- A new, large, central hatchery.
- Several small rearing facilities located in the watersheds.
- A central hatchery using constructed, natural habitat.
- Extended rearing at acclimation sites.
- Constructed habitat.
- Combinations of the above.

Specific sites that could be used in these systems include existing Yakama Nation, US Fish and Wildlife Service, and Mitchell Act funded hatcheries; existing acclimation sites with long-term rearing capability; and locations that require new development and construction.

These production systems and sites were compared. Based on the comparison a preferred rearing plan is proposed. The plan places heavy emphasis on existing hatcheries due to cost considerations. Existing facilities will generate over 85% of MCCRP fish, with new facilities producing the remainder. A new, small facility with only adult holding and incubation capabilities is proposed for the Wenatchee basin. Fry to smolt production in constructed habitats is proposed for a portion of the Methow releases. This rearing plan, along with the MCCRP acclimation plan, will cost effectively produce smolts that will be capable of surviving to adulthood at rates that are expected to restore naturally producing coho in the Wenatchee and Methow basins.

Table 1. Proposed Production Plan Summary

	Location	Type	Fish
Wenatchee	Cascade	Existing Hatchery	250,000
	Willard	Existing Hatchery	905,000
Methow	Eightmile	Constructed Habitat	200,000
	Heath Ranch	Constructed Habitat	100,000
	Cascade	Existing Hatchery	450,000
	Winthrop	Existing Hatchery	250,000
TOTAL			**2,155,000**

II. *INTRODUCTION*

This appendix evaluates program rearing options. A rearing plan is selected from these options and is described in detail in appendices C.1 and C.2. The following is a list of master plan facility appendices, with this appendix highlighted.

A. FISH CULTURE GUIDELINES
B. ALTERNATIVE AND PROPOSED PLAN EVALUATIONS
    B.1 REARING FACILITIES
    B.2 ACCLIMATION FACILITIES
C. PROPOSED PLAN SITE DESCRIPTIONS AND CAPITAL COSTS
    C.1. WENATCHEE REARING FACILITIES
    C.2. METHOW REARING FACILITIES
    C.3. WENATCHEE ACCLIMATION FACILITIES
    C.4. METHOW ACCLIMATION FACILITIES
D. PROJECT SCHEDULE AND COSTS

Plans require the identification of facilities that will produce a maximum of 2155,000 coho pre-smolts by the year 2012 when the Natural Production Phase is implemented in both subbasins. This release number is expected to be the maximum production requirement and will be reduced after one generation, as natural smolt production increases.

Current releases are approximately 1,000,000 in the Wenatchee and 300,000 in the Methow. These fish are being produced as pre-smolts at the US Fish and Wildlife Service (USFWS) Willard National Fish Hatchery and the Oregon Department of Fish and Wildlife (ODFW) Cascade Fish Hatchery; and as smolts at the USFWS Winthrop National Fish Hatchery.

III. *SITING AND DESIGN GUIDELINES*

Rearing program design development requires two steps. The first is to determine what type of rearing system is to be used and the second is to select individual sites for the systems chosen. Guidelines are identified that support the evaluation of both basic systems and specific sites.

A. ADULT RETURN RATES

Rearing systems will have a large impact on the success of the MCCRP. See Appendix A, FISH CULTURE GUIDELINES for more detail and references). Evidence of the importance of rearing includes reports that show that naturally produced smolts survive at rates that can be several times higher than hatchery produced smolts. Literature also indicates that smolts reared in conditions that simulate natural conditions survive to adulthood at increased rates.

1. Rearing Environment

Optimal coho culturing conditions are described in Appendix A and summarized below. They have been selected based on literature reviews and discussions with fish culturists. The conditions include low rearing densities, large volume production units, natural water temperatures, limited fish transportation of fully smolted fish, low flow densities and limited predation. Specific culturing guidelines are proposed that provide those conditions:

- *First and second winter water temperatures*: 33 to 40 F.
- *Summer water temperature*: daily peak of 65 F and maximum daily average of 62 F.
- *Water pathogen load*: minimized for as long as possible, a priority for incubation and early rearing.
- *Maximum volume density*: 0.3 lb/cft for fish larger than 100/lb. 0.1 lb/cft for facilities with less reliable water supplies (acclimation sites).
- *Maximum flow density*: water temperature and fish size dependant, a maximum of 10 lbs/gpm for 20/lb fish in 50 F water. Safety factors reduce this value.
- *Main rearing units*: large ponds or constructed natural habitat for fish larger than 100/lb.
- *Trucking*: no movement after fish begin smolting (assumed to begin at a size larger than 40/lb in March). No transport between watersheds is preferred.
- *Acclimation period*: 6 or more months for sites that can function through the winter, 6 weeks for those that cannot.

2. Water Quantity and Quality

Facility locations will be chosen using the availability, reliability, and quality of water supplies as important criteria. Water parameters are critical for producing fish that not only have high egg-to-smolt survival rates but also high smolt-to-adult survivals (see Appendix A).

Water availability at potential sites in the late fall during low flow periods are important for surface supplies. Water requirements are greatest in the late summer, prior to transportation to acclimation sites, because the high water temperatures result in high metabolic rates.

The reliability of flow is critical. Site selection can reduce flow risk by identifying locations with water supply features that are described below. Facility design can also reduce this risk through back-up power generation, redundant delivery systems, and the use of large volume rearing units.

As discussed in Appendix A, the natural temperature profile of surface water helps produce quality fish. However, surface supplies have several potential problems that can result in water supply loss. These include: ice formation on intake screens, migration of stream channels away from intakes, and debris deposition on intakes during floods. Surface water intakes in deep pools, at a stable section of a stream channel, and with adequate sweeping velocities solve many of these problems.

Infiltration galleries are a water supply option that can be considered at some new sites. Infiltration galleries tap shallow water aquifers. With hydraulic connectivity to surface water, infiltration galleries have the advantage of more yearly and daily temperature fluctuation than water from deep aquifers and are easier to permit. Gallery construction is generally more expensive than wells because construction is more complex. The galleries must be correctly designed to avoid maintenance problems.

Dual water supplies reduce both reliability and quantity problems. Groundwater supplies do not suffer from the same intake vulnerability issues and low flow conditions that surface water supplies do. Sites that have groundwater supply capability, either in the form of deep wells or shallow infiltration galleries, were given higher priority.

Underground aquifers that yield the large quantities of water needed for fish culture are uncommon. Thick layers of high permeability material (clean gravel) well below the water table must be located. Several such aquifers in the Columbia basin have been identified, but are developed for public supplies and existing hatcheries. Continuous, large water withdrawals required by fish culture facilities can affect surrounding wells and siting must consider this potential impact.

Gravity flow for both surface and ground water is preferred. With gravity flow, the cost of development of water supplies, the risks due to mechanical or power failures, brown-outs, and operating costs are all reduced.

Water treatment can artificially produce desired water supply conditions. There are varying degrees of water conditioning; following is a list of treatment processes in increasing order of complexity, cost, and reliability:

- Temperature control during incubation and early rearing. Chillers can delay hatching and first feeding reliably yet cost effectively due to the low water requirements during these rearing stages.
- Re-use water through aeration. Simple aeration methods can cut water requirements by approximately one-half.
- Cooling ground water in winter and warming in summer using large impoundments. Natural water temperatures help produce high quality smolts (See Appendix A).
- Turbidity reduction. Primary settling of the incoming supplies can reduce the solids loads of surface supplies.
- Sterilization of incubation and early rearing water. Ozone, UV, or chlorination/dechlorination sterilization techniques can reduce the incoming fish pathogen load of surface water supplies. The techniques are most effective with supplies that have a low turbidity (groundwater or treated surface water).
- Temperature control during later rearing. Chillers and heaters can change rearing water temperatures, but the large flow volumes make this option expensive even when applied with re-use technology.
- Full re-use through aeration and ammonia removal. Water requirements can be reduced by up to 90% with bio-filtration and sterilization. These methods have high capital and operating costs and add elements of risk if sterilization is not effective or if mechanical systems fail.

The first choice for water supplies will be those that do not need altering or conditioning. Requiring the first bullet above, hatchery water chilling, will not be considered a major site drawback. Requiring the last, full water re-use, will be and such sites will have a low priority.

Water re-use without complex treatment is also possible. At hatcheries that use low rearing flow densities and/or have excess head that can be used for gravity flow with re-aeration in the water supply, the quality of second use water may be acceptable. Such water is routinely used in many existing hatcheries. The major disadvantage of re-use is disease transmission from the upstream population. This is minimized by low-stress rearing environments and good fish health practices. Flooding imposes a risk to both fish and facilities. Because of the dependence of rearing sites on the proximity of large streams, they are subject to flood damage. The option of building facilities above 100 year flood elevations is not always possible due to impacts that result from the reduction of flood storage capacity, imposing restrictions on siting. Future changes to the upstream watershed may change flood characteristics and should be considered as well.

3. Adaptability

Fish rearing technology has changed frequently over the past 80 years. Incubation systems, rearing units (Foster Lucas ponds, to Burroughs ponds, to flow through raceways, for example), feeding practices, etc. have all changed significantly. Sites should have the flexibility to adapt to future changes.

Choices of water supplies (ground and surface) should be available to future managers and the space for constructing new facilities should exist. Increasing (and decreasing) production levels and rearing other species are future possibilities. Sites that have excess water and space will have this capability.

B. COST

Both capital and operating costs are important evaluation considerations. In this appendix, average values of costs to construct and operate rearing facilities in the region are used to compare different systems (Appendices C.1 and C.2 estimate site specific costs for the proposed rearing alternative). The details of the cost estimating procedures used are listed in Attachment 4, CAPTIAL AND OPERATING COST BASIS.

C. OTHER

1. Environmental Impacts

The potential environmental impacts of proposed facilities will be reviewed in detail during the NEPA, ESA, and site permitting processes. The length of time, cost, and difficulty of obtaining the necessary construction and operating permits are important site selection considerations.

Surface water withdrawals impact streams for the distance between the removal and the return. Hatcheries are non-consumptive except in the withdrawal reach. Sites and designs that allow discharge to occur just downstream of the intake minimize impacts. Large-scale groundwater use can affect users within the cone of influence of the well or gallery. Due to these potential impacts, the new water rights permit application process for both supplies can be long and difficult.

The potential impact to listed species can change a site’s development status. Other environmental and permit considerations include local land use zoning codes, flood impacts, disease transmission from the hatchery to downstream fish populations (both in hatcheries and in the wild), cultural resources, and receiving water quality standards.

Mitigation for disturbance of wetlands is possible but expensive and requires a lengthy design review process. Also, the shoreline, zoning variance, and building permit processes can be difficult if there is local opposition to construction. Cultural resources and impacts to floodplain storage capacity need to be evaluated at all locations. A thorough review of potential environmental issues early in the site development process will be required at new facilities.

2. Operation

Proximity to other program facilities, especially acclimation sites, is also a consideration. Rearing facilities that are closer to acclimation sites will be given a higher priority.

Existing facilities that are operated by other agencies have both advantages and disadvantages. YN control and program flexibility are limited under these conditions in which hatchery personnel often follow different operating protocols. However, professional support from experienced staff can be a major asset provided by the other agencies.

3. Site Considerations

Large capital investments in rearing facilities require that property be usable for long periods. Property control can be obtained through purchase, long-term lease, or by legal agreement with public agencies.

Other site development concerns include the availability of power, environmental liability, and access. Three-phase power is required to operate water pumps, chillers, and other major motor driven machinery. Sites that have previously had other uses may have ground contamination, resulting in liability exposure. Access to remote sites in upstream areas may be limited by flooding and winter snow.

IV. *SYSTEM AND SITE ALTERNATIVES*

There are several rearing systems that can meet the MCCRP coho production requirements. "Systems" is used as a term for describing various general types of facilities and rearing methods. Each system has advantages and disadvantages which are evaluated in the first section below. Specific sites that can be used as components of these general rearing systems are identified in the section B.

A. PRODUCTION SYSTEM OPTIONS

Basic rearing systems are listed separately below in order to evaluate their strengths and weaknesses. However, a combination of the different systems is the proposed alternative selected (see Chapter V. RECOMMENDATIONS). Specific sites are chosen from lists in Section B of this chapter to help demonstrate how the rearing systems would operate.

The cost estimates shown in the following tables are developed using procedures outlined in the Attachment 4, CAPITAL AND OPERATING COST BASIS. They are based on recent hatchery construction projects and on current facility operating cost data. These estimates do not include other components of the program: brood capture, acclimation (for most rearing system options), and monitoring and evaluation.

1. Descriptions

a. Existing Public Hatcheries

This system option makes use of hatcheries with existing capacity. Most of these facilities are located along the lower Columbia River near or below Bonneville Dam: Washougal, Cascade, Eagle Creek, and Willard hatcheries.

Disadvantages of this system includes long trucking distances to the Wenatchee and Methow, potential for spreading diseases to mid-Columbia watersheds, and decreased adult return rates expected from traditional concrete raceway rearing systems. The main advantage is that that large capital construction expenses are not incurred. Existing hatcheries also have secure water rights, experienced staff, completed construction and operating permits, known disease histories, and well-tested components.

Table 2. Hypothetical Rearing System – Existing Hatcheries

	Facility Example	Production (#)	Capital Cost	Operating Cost
Wenatchee	Willard NFH	1,000,000	$ -	$ 320,000
Methow	Winthrop NFH	300,000	$ -	$ 186,000
	Cascade NFH	700,000	$ -	$ 262,000
TOTAL		**2,000,000**	**$ -**	**$ 768,000**

b. New, Central, Conventional Hatchery

The second type of rearing system considered is construction of a single, large hatchery that would be capable of rearing over 2,000,000 coho. Water requirements generally limit locations to major rivers in the region with enough minimum flow to allow the withdrawal of over 45 cfs.

Eggs from brood stock captured in the watersheds would be hatched and reared to pre-smolt at this facility. The pre-smolts would be trucked to acclimation sites for final rearing and release.

For purposes of developing costs, standard hatchery designs are used for the estimates. Egg incubation in vertical stack incubators, first feeding in high density fry tanks, and rearing in concrete raceways are assumed. Both ground and surface water supplies are included. It is likely that both water supplies would need to be pumped. Reliable back-up power supplies and alarm systems are part of the cost estimates.

Advantages of this rearing system include reduced operating costs resulting from economies of scale, simplified management and control, reduced trucking distances, and new construction that incorporates the latest hatchery designs. Disadvantages include high construction costs, the risk of rearing all the valuable, locally adapted stock at one location; the difficulty of developing large ground water supplies; and the concentration of hatchery environmental impacts in one location.

Table 3. Hypothetical Rearing System - Large Central Hatchery

	Facility Example	Production (#)	Capital Cost	Operating Cost
TOTAL	Dryden	**2,000,000**	**$ 21,050,000**	**$ 512,000**

c. Multiple Small, Watershed Rearing Facilities

Small rearing facilities in each watershed could be developed to meet the production requirement in that area. This system has several drawbacks; including the difficulty of developing multiple water supplies that can reliably function year-round, the cost of obtaining long-term leases or ownership of multiple properties, and high operating costs due to multiple hatchery locations. Advantages to multiple small facilities includes: rearing near the release locations may increase homing fidelity, trucking distances and resulting stress is reduced, risk of loss is lessened by rearing fish in multiple locations, and the spread of disease between watersheds is minimized.

Table 4. Hypothetical Rearing System – Multiple Small Watershed Rearing Facilities

	Facility Example	Production (#)	Capital Cost	Operating Cost
Wenatchee	Dryden	500,000	$ 9,100,000	$ 224,000
	Chiwawa	500,000	$ 9,100,000	$ 224,000
Methow	Heath Ranch	500,000	$ 9,100,000	$ 224,000
	Poorman	500,000	$ 9,100,000	$ 224,000
TOTAL		**2,000,000**	**$ 36,400,000**	**$ 896,000**

d. Natural Habitat Rearing Facility

This production concept uses constructed, natural habitats as primary rearing units. Multiple habitats covering a large area are included at a single, central, rearing facility. Fingerlings or pre-smolts produced are trucked to acclimation sites.

Rearing habitats would be similar to those described below in Section f., CONSTRUCTED HABITAT. However, the facility would include adult holding, egg hatching, and raceway first-feeding as optional functions. Pre-smolt collection structures, predation controls, automatic feeding systems, and effluent treatment are also important features.

This is a new production concept that has not been fully tested. Design details have not been developed and the return rate benefit that is assumed for smolts produced in such a facility has not been demonstrated.

Table 5. Hypothetical Rearing System – Natural Habitat Rearing Facility

	Facility Example	Production (#)	Capital Cost	Operating Cost
TOTAL	Unknown	**2,000,000**	**$ 16,200,000**	**$ 512,000**

e. Long-Term Rearing at Acclimation Sites

Extended rearing (from fry to smolt) could occur at selected acclimation sites, reducing hatchery rearing capacity requirements. In order for acclimation sites to operate for 10-12 months, they would need to have dependable water supplies. High flow requirements during late summer/fall and icing conditions in winter complicate this type of rearing system. Gravity flow spring water or surface supplies with pumped groundwater back-up are supply options.

Advantages include rearing in a natural environment for a long period to time, the elimination of fish transport stress, possible improved homing fidelity, and low construction cost. However, the difficulty of operating sites in remote areas makes this an option that needs close scrutiny during evaluation.

Fish would be transferred into the acclimation sites after tagging in June, after rearing in a conventional hatchery. The costs below include both early hatchery rearing and grow-out in the acclimation ponds. A hypothetical program that releases fish from 20 different locations is used to develop the following cost estimate.

Table 6. Hypothetical Rearing System – Long-Term Rearing at Acclimation Sites

	Facility	Production (#)	Capital Cost	Operating Cost
Wenatchee	Various	1,000,000	$ 8,000,000	$ 464,000
Methow	Various	1,000,000	$ 8,000,000	$ 464,000
TOTAL		**2,000,000**	**$ 16,000,000**	**$ 928,000**

f. Constructed Habitat

Constructed habitat is a rearing environment that mimics ideal natural conditions. Key differences between constructed habitat and natural habitat include controlled predation, higher densities, artificial feed, and restricted migration out of the system. The differences allow higher smolt production rates per unit of area than natural environments.

These habitats consist of constructed pools, runs, riffles, alcoves, and ponds. Additional features include strategic placement of woody debris and overhead cover. Controlled water flow can be supplied by existing springs, by gravity flow intakes on surface streams, or by pumped wells. Eyed-eggs or fed fry are planted in the habitat and reared to sizes up to full smolt.

Smith et al. (2004) describe a test of a constructed rearing habitat using these concepts with coho on the Dungeness River. Migrating fish produced in the system exhibited wild-like behavior and appearance. 7,300 ft^2 of habitat was constructed and stocked with 50,000 eggs, producing 3,000 smolts after most fish migrated out as fry. By controlling fry migrations out of the habitat, recommended smolt densities have been increased to $0.5/ft^2$.

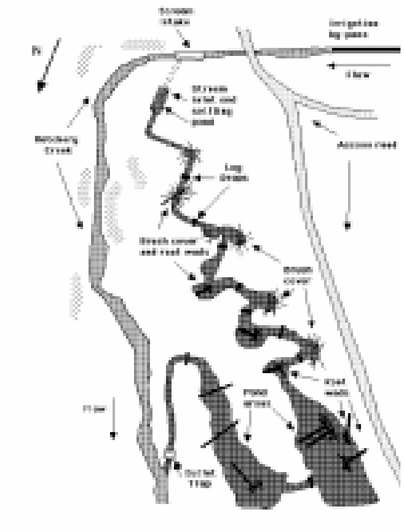

Figure 1. Constructed Habitat Example

Spawning habitat could also be included in the constructed system. The low gradient, small stream conditions that coho prefer for spawning could be duplicated. Fry produced in the system that exceed the capacity of the constructed habitat could be allowed to migrate out after emergence and seed existing natural rearing habitat in the area. Constructed spawning habitat could result in a significant quantity of naturally produced fry in a watershed and be used by other natural anadromous juveniles that volitionally migrate in for freshwater rearing.

The main advantage of constructed habitat is that it produces fish with “wild-like” behavior and characteristics. Adult return rates are expected to be high for such fish. These habitats will also double as acclimation sites. However, the concept has not yet completed long-term evaluation. A demonstration project in the Yakima subbasin with coho is planned to test the constructed habitat system in the Columbia watershed. Also, used on a large scale, multiple sites with reliable water supplies in upstream habitat will need to be located.

For fish that are not produced in the system through natural spawning, fry would be planted into the habitat after tagging in June. This avoids some of the high mortality that fry in less controlled environments will encounter. Until that time, early rearing occurs in raceways in a conventional hatchery. Therefore, the costs below reflect both the early hatchery rearing and grow out in the constructed habitat for the entire production program.

Table 7. Hypothetical Rearing System – Constructed Habitat

	Facility	Production (#)	Capital Cost	Operating Cost
Wenatchee	Various	1,000,000	9,000,000	$ 400,000
Methow	Various	1,000,000	9,000,000	$ 400,000
TOTAL		**2,000,000**	**$ 18,000,000**	**$ 800,000**

g. Other Methods

Private contract growers offer another rearing option. Reduced cost is the main advantage; there would be no capital costs charged to the programs for existing hatcheries that do not need modification. Operating costs could also be lower. One such option is the Troutlodge Hatchery at Winchester, WA about 40 miles from Wenatchee and 135 miles from Winthrop. Troutlodge is a gravity flow, spring water facility that could be devoted completely to coho production. However, the 13 C constant water temperature may not produce pre-smolts of optimum quality because of the lack of seasonal temperature regimes (see Appendix A).

Planting adults or fry into the existing habitat could be a replacement for artificial production. Coho fry plants in the Yakima were not successful in the past, with the notable exception of originating a natural run in Ahtanum Creek. Adult plants have not yet been fully evaluated in the region but tests have begun in the Yakima and Wenatchee watersheds. For both adult and fry plants, high mortality during fresh water rearing limits their practicality. However, adult and/or fry plants may be useful in isolated circumstances. For example, excess adults that return to broodstock development release sites (the Icicle on the Wenatchee and Winthrop NFH on the Methow) could be transported to appropriate spawning habitat.

Another option is mining eyed eggs from stream redds, full life history rearing in a hatchery, and then planting the adults back in targeted streams. This has shown some promise in helping with salmonid recovery efforts in Hood Canal (Berejikian et al., in press).

2. System Comparison Summary

The operating and capital costs of the described rearing systems are summarized in the table below. The operating cost is converted to a net present value (using and assumed long-term rate of inflation of 3%) for comparison purposes. A project life of 20 years is assumed in this calculation. The last column is the total of the capital cost and the present value of the operating cost.

Table 8. Rearing System Cost Comparison

PRODUCTION SYSTEM OPTIONS	CAPITAL COST	ANNUAL OPERATING	PRESENT VALUE OF OP. COST	TOTAL PRESENT VALUE
EXISTING HATCHERIES	$0	$768,000	$11,400,000	**$11,400,000**
CENTRAL, CONVENTIONAL HATCHERY	$21,050,000	$512,000	$7,600,000	**$28,650,000**
SMALL WATERSHED REARING FACILITIES	$36,400,000	$896,000	$13,300,000	**$49,700,000**
NATURAL HABITAT REARING FACILITY	$16,200,000	$512,000	$7,600,000	**$23,800,000**
LONG TERM REARING AT ACCLIMATION SITES	$16,000,000	$928,000	$13,800,000	**$29,800,000**
CONSTRUCTED HABITAT	$18,000,000	$800,000	$11,900,000	**$29,900,000**

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 calculation of the present value of the operating costs demonstrate that the difference between producing all the fish at one location versus at multiple locations may be over $6,000,000 over a 20 year period. Differences in capital cost are the result both of the number of locations constructed and the complexity of the facilities.

This analysis 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. Multiple, small, watershed hatcheries have a very high total cost; all the other options are intermediate.

As discussed in Section III, SITING AND DESIGN GUIDELINES, important factors used to evaluate rearing system options include the ability to produce fish that return to targeted areas at high survival rates, along with other evaluation criteria discussed below. Table 9 summarizes the discussion of the production options. The Good, Fair, and Poor ratings are described in detail in Attachment 2, SITE COMPARISON KEY.

Table 9. Comparison of Production System Options

PRODUCTION SYSTEM OPTIONS	ADULT SURVIVAL RATE	COST	OTHER CRITERIA
EXISTING HATCHERIES	Poor	Good	Fair
CENTRAL, CONVENTIONAL HATCHERY	Poor	Fair	Fair
SMALL WATERSHED REARING FACILITIES	Fair	Poor	Fair
CENTRAL, NATURAL HABITAT REARING FACILITY	Good	Fair	Poor
LONG-TERM REARING AT ACCLIMATION SITES	Good	Fair	Poor
ENGINEERED HABITAT	Good	Fair	Poor

The degree of difference between the various systems' adult survival rates is unknown. However, published literature includes enough detail to allow the determination of which systems are likely to be the most successful (see Appendix A for more detail). Adult return rates are expected to be impacted by the type and length of acclimation. Long acclimation periods in natural conditions will improve the performance of fish produced from conventional hatcheries (see Appendix B.2).

The "other criteria" used in the table include:

- Adaptability to changing production technology. Can the rearing system be changed to match new production and acclimation methods?

- Adaptability to changes in program design. Can the rearing system capacity be expanded or reduced as changes in production numbers occur due to program adaptation?
- Environmental impacts. Are there significant impacts? All rearing systems must meet permit conditions, which assures that there will be a limit to the level of environmental impact.
- Program risk management. Will fish losses due to facility failures or transfer interruptions due to disease outbreaks be catastrophic to the program?
- Operational considerations. Is the system difficult to manage and operate? Long distance hauling of fish, multiple rearing sites, and locations in areas with access problems are system operating considerations.

None of the systems were rated “good” in the “other criteria” category. Each has characteristics, discussed above, that prevent it from being ideal. Long-term rearing at acclimation sites and constructed habitat are rated poor because of the potential difficulty of operating multiple sites in upstream areas through the winter.

Conclusions can be drawn through this comparison of rearing system alternatives. The central, conventional hatchery and the small, watershed rearing facility systems did not have any “good” ratings. Also, the natural habitat rearing facility is an untested concept. These three alternatives will not be part of the proposed rearing plan.

Of the remaining options each has benefits. Existing hatcheries have a very low program cost. Constructed habitats and long-term rearing at acclimation sites will produce smolts with increased survival rates. These two options will be included in the proposed rearing system; sites are proposed in Chapter V.

B. IDENTIFIED SITES

Identification of specific potential rearing sites began with a review of existing literature. There have been several notable, thorough searches for fish hatchery sites in the Mid-Columbia region, including: Bugert, 1996; Senn, 1987; and Frederikson and Kamine & Associates, Inc., 1981; and Delarm, 1990. Other documents also provided insight into site identification and are listed in these references. Some literature reviews have concluded that the availability of new ground water supplies for major hatchery construction is limited in the Columbia basin.

Site visits are an ongoing step in the identification process. Information about water supplies, presence of wetlands, flooding risks, current land use, construction layout, access, and utilities is collected during these visits. This information is integrated with reviewed document and from discussions with regional experts to supply data needed to make rearing site location decisions.

A full list of all identified sites is included in Attachment 3, SITE LIST. Following is a discussion of the high priority sites from that list and a map showing their location.

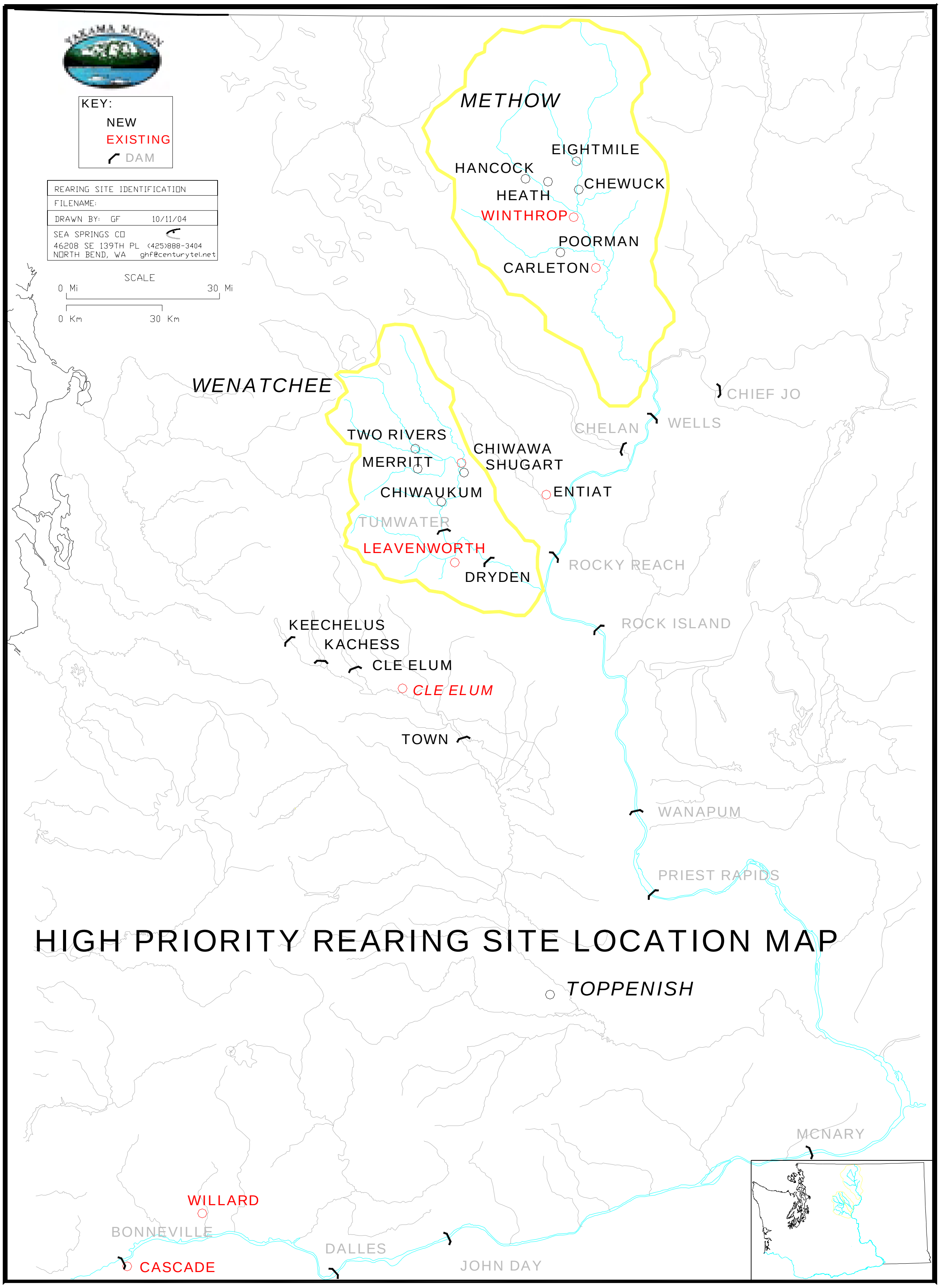

Figure 2. High Priority Rearing Site Map

1. Existing Rearing Facilities

a. YN Hatcheries

<u>*Cle Elum FH (YKFP).*</u> Operates on pumped well and Yakima River water (water rights of 25 cfs surface and 17 cfs ground). Designed to produce 810,000 spring chinook smolts at 15/lb. Well water is 100% used for the high priority spring chinook program during spring and summer. An infiltration gallery near the Yakima River, additional surface water rights, and/or re-use water could allow coho expansion.

b. USFWS Hatcheries

<u>*Leavenworth NFH.*</u> Currently used for acclimating coho for the mid-Columbia program, with a capacity of 600,000 smolts held in re-use water. Supply is a combination of surface and well water. New water development opportunities are limited. The possibility of a full rearing program in old concrete raceways exists using re-use water. Leavenworth NFH produces 1.7 million spring chinook smolts, total water rights of 57 cfs from Icicle Creek and wells.

<u>*Winthrop NFH.*</u> Currently used for rearing coho for the mid-Columbia program, with a capacity of 250,000 smolts. New water development opportunities are limited. Winthrop NFH also produces 600,000 spring chinook and 100,000 summer steelhead; total water rights of 66 cfs from the Methow, springs, and infiltration galleries.

<u>*Entiat NFH.*</u> Currently used for holding and spawning adult coho for the mid-Columbia program. Continued use of the hatchery for the MCCRP is dependant upon programmatic changes currently under consideration. Under current operating plans there is limited water available for additional rearing. Production goals are 400,000 yearling and 400,000 sub-yearling spring chinook; total water rights are 34 cfs from the Entiat River, Packwood Springs, and wells.

c. Mitchell Act Hatcheries

<u>*Cascade FH (ODFW).*</u> Currently rearing 700K coho pre-smolts for the Mid-Columbia and 1.0M for the Umatilla coho programs. Capacity of 1.7 million coho smolts, with a water right of 44 cfs (actual use is less) from Eagle Creek. Each of the 30 concrete raceways are 78' long by 15' wide by 4' deep. There is no ground water at the facility. Summer water temperatures are high. Predator covers have recently been installed to reduce predation and improve rearing conditions. Eagle Creek has a highly fluctuating temperature profile (see plot below) which may be beneficial for smolt quality (see Appendix A. CULTURING GUIDELINES). Cascade FH is a Mitchell Act funded facility; current coho production costs are not charged to the Yakama Nation.

<u>*Willard NFH (USFWS).*</u> Currently rearing 600K coho pre-smolts for the mid-Columbia program. Shade covers have been recently installed over the raceways to improve rearing conditions. The Little White Salmon River provides surface water which is heavily ground water influenced. Flow rates are stable and relatively high through the summer and fall periods. Each of the 50 small concrete raceways measures 72' long by 8' wide, by 2' deep. Reduced temperature fluctuation due to ground water influence may reduce smolt quality since it moderates natural seasonal variation (see plot below). Willard NFH as a capacity of 2.5 million coho smolts, and water use of up to 54 cfs.

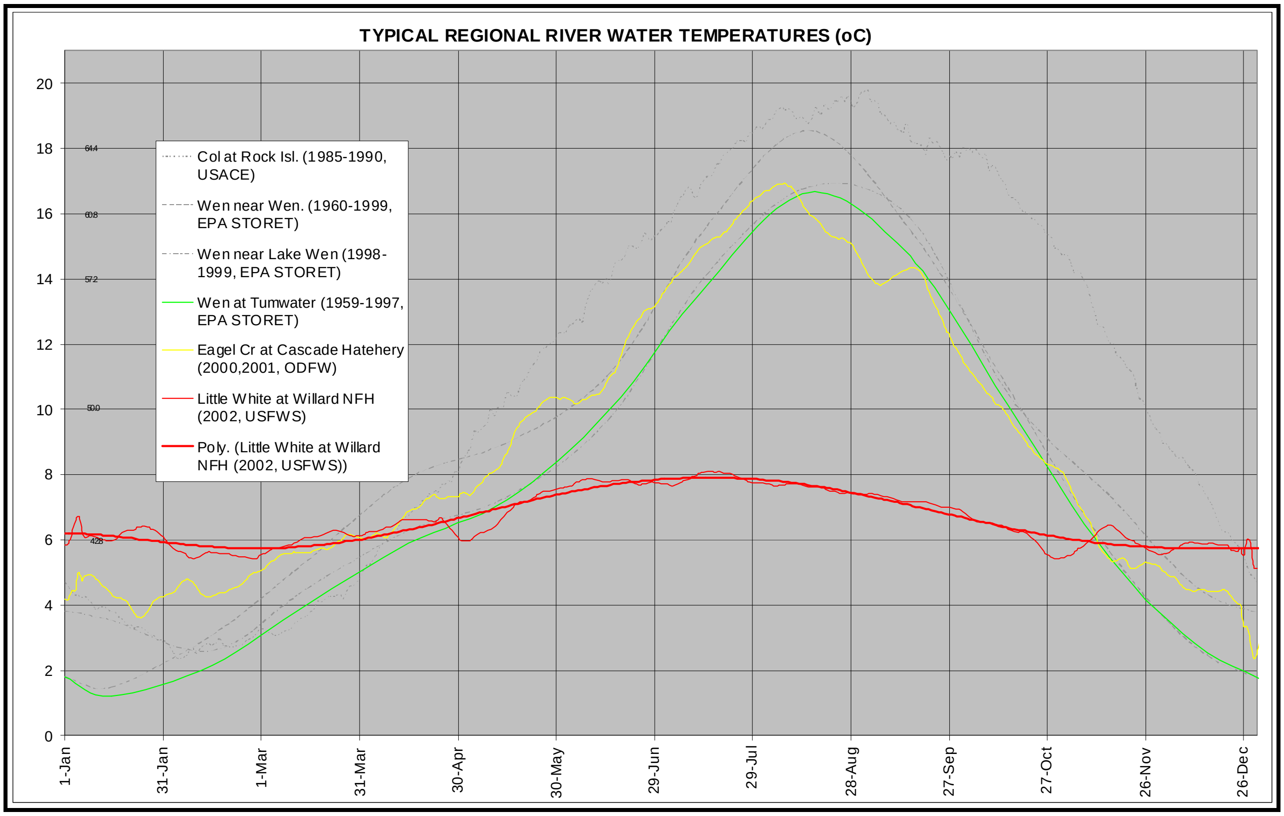

Figure 3. Water Temperatures

d. Acclimation Sites

Existing acclimation sites being used by other programs in the region may have potential to be expanded into yearling rearing facilities. Ground water supplies would need to be developed at most existing acclimation sites to add necessary winter water supply security and flexibility:

Carleton Acc. Site (WDFW). Summer chinook acclimation facility. The Carlton Acclimation Site has a moderately good intake on the Methow (15 cfs) which supplies surface water. High summer river temperatures, and low flow/winter icing conditions at the intake may be problems. Ground water development potential is untested.

Chiwawa Acc. Site (WDFW). Spring chinook acclimation facility. Dual surface water intakes exist on the Wenatchee (12 cfs max) and Chiwawa (21 cfs). The Wenatchee intake is high quality, located in a deep pool at a site that has minimal winter icing. Cold winter temperatures limit the use of the Chiwawa intake but the icing issue at the Chiwawa intake is currently being addressed and remedied by Chelan PUD (facility owner) and WDFW (facility operator) . Local geology indicates that large groundwater withdrawals from the shallow Chiwawa alluvial fan may be possible, but test wells in the area were not highly productive.

2. New Rearing Facility Sites

a. At Existing Dams

Facilities built near dams have several advantages as potential rearing locations:

- Reservoir pools make good intake locations, usable in all flow conditions.
- Water temperature control may be possible at larger dams by varying the intake depth.
- Gravity flow supplies are possible at some locations.

- Water rights issues are minimized when water is returned to the base of the dam, allowing large withdrawals.
- Water heads created by the impoundments can allow facilities built downstream to be above flood elevations.
- Some dams have a potential source of groundwater supply with seepage under and around the structure. This “toe drain” water is sometimes collected into accessible locations.

A potential disadvantage is the loss of water when dam reservoirs are drained for maintenance.

Potential sites include:

Cle Elum Dam. Moderate head irrigation diversion dam on Cle Elum R. Toe drain water may be an option for a second source.

Dryden Dam. Low head irrigation diversion dam on Wenatchee. Groundwater potential is untested but infiltration galleries may be productive due to the Peshastin Creek alluvial fan. Proximity of other wells may preclude deep water withdrawals. The dam produces good conditions for a surface water intake on the Wenatchee River. Warm summer temperatures and icing conditions in winter may be problems. Wenatchee stock coho adults are trapped at Dryden Dam so adult transport would be minimized. The potential site is owned by the Washington State Department of Transportation and a private orchard.

Kachess Dam. Moderate head irrigation storage dam on Kachess R. Toe drain water may be an option for a second source.

Keechelus Dam. Moderate head irrigation storage dam on Yakima. Toe drain water is an option for a second source. Keechelus Dam is being rebuilt; toe drain flows will likely be reduced.

Town Dam. Low head irrigation dam on Yakima. Well field exists near the site.

b. Other

These sites currently are undeveloped and were not used during the feasibility phase of this project. They all have surface water and either existing springs or some potential for developing ground water.

Chewuch. On the lower Chewuch River, a Methow tributary. Groundwater study evaluations have not been conducted. Private ownership.

Chiwaukum. On the Wenatchee River near the mouth of Chiwaukum Creek. Groundwater study evaluations have not been conducted but development potential exists. Conditions for a river intake are moderate to poor. Public ownership.

Eightmile. On the Chewuch, a Methow River tributary. Wells exist. USFS ownership, Eightmile Ranch.

Hancock Spring. Springs on the Methow River upstream of Winthrop. Valuable habitat created by spring flow. Conditions for a river intake near the springs are poor. Private ownership.

Heath Ranch. Springs on the Methow River upstream of Winthrop. Spring water and a surface water intake on the Methow are possible water sources. Conditions for a river intake in the area are poor. High flood risk. Private ownership.

Merritt. On Nason Creek (Wenatchee Basin). Groundwater potential is untested. Private ownership.

Poorman. On the lower Twisp (Methow Basin). Groundwater study evaluations have not been done. Private ownership.

Shugart Flat. Undeveloped site on the Wenatchee River downstream of the Chiwawa River confluence. Groundwater study (GeoEngineers, 2000) identified this site as having potential. Conditions for a river intake are moderate. Private ownership.

Two Rivers. Undeveloped site between the White and the Little Wenatchee near their mouths. A ground water study and pump test (GeoEngineers, 2003) at the nearby Two Rivers site demonstrated the potential for development of large groundwater supplies. Pumped White River or Little Wenatchee River water could also be used. The area is subject to flooding from the Little Wenatchee and White Rivers. Private ownership.

3. Site Comparison Summary

Table 10 below compares the high priority sites. It allows a general picture of the benefits and drawbacks of sites to be viewed using all the identified criteria. The comparison guidelines are described in Section III The key that defines the Good, Fair, and Poor ratings is in Attachment 2.

Table 10. Site Comparison

Site	Cle Elum FH	Leavenworth NFH	Entiat NFH	Cascade FH	Willard FH	Winthrop NFH	Butcher	Carleton Acc. Site	Chiwawa Acc. Site	Twisp	Cle Elum Dam	Dryden Dam	Kachess Dam	Keechelus Dam	Chewuck	Chiwaukum	Eightmile	Hancock Spring	Heath Ranch	Merritt	Poorman	Schugart Flat	Lake Wenatchee
Site Type	EXISTING HATCHERIES						EXISTING ACCLIMATION				DAMS				OTHER UNDEVELOPED SITES								
Rearing System (see key)	1	1	1	1	1	1	5,6	2,3,4	2,3,4	5,6	2,4	2,3,4	2,4	2,4	5,6	2,3,4	5,6	5,6	5.6	2,3,4	5,6	2,3,4	2,3,4
Effectiveness																							
Adult return rates	F	P	F	F	P	F	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Cost																							
Permits	F	G	G	G	G	F	F	F	F	F	P	P	P	P	P	P	P	P	P	P	P	P	P
Purchase/lease	G	F	F	F	F	F	F	F	F	F	P	P	P	P	P	P	P	G	P	P	P	P	P
Design and construction	F	G	F	G	G	G	F	G	G	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Operation	G	F	F	F	F	F	F	F	F	F	F	F	F	F	P	P	P	P	P	P	P	P	P
Other program functions	F	F	F	P	P	F	G	G	G	G	P	G	P	P	F	F	F	F	F	G	G	G	G
Water supply																							
Summer flow and temperature	G	G	G	F	P	F	G	G	G	G	G	F	G	G	G	G	G	G	G	G	G	G	G
Second winter flow and temp	G	G	G	G	P	F	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Back-up supply	G	G	F	P	P	G	F	G	F	F	F	G	F	F	F	F	G	P	P	G	F	G	G
Water quality	G	P	G	G	G	G	G	F	G	G	G	F	G	G	F	G	G	G	G	G	G	G	G
Disease risk	P	P	F	P	P	F	F	F	F	F	P	F	P	P	G	G	G	G	G	G	G	G	G
Intake location	F	F	F	G	G	F	F	F	G	F	G	G	G	G	F	F	F	G	G	F	F	F	F
Flow volume stability	F	F	F	F	G	F	P	F	G	P	G	G	G	G	G	F	P	G	G	F	F	G	G
Expansion potential	P	P	P	P	F	P	P	F	G	P	G	G	G	G	F	F	P	P	F	G	F	G	G
Permitting/Impacts																							
Water rights	F	G	G	G	G	G	F	F	F	F	F	F	F	F	P	P	P	P	P	P	P	P	P
Endangered species	G	G	G	G	G	G	P	F	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Shorelines	G	G	G	G	G	G	F	G	G	F	F	F	F	F	F	F	F	F	F	F	F	F	P
Wetlands	G	G	G	G	G	G	P	G	G	P	G	G	G	G	G	G	F	F	P	F	F	F	F
Other	G	G	G	G	G	G	F	F	G	F	G	G	G	G	F	F	F	G	P	F	F	F	P
Operation																							
Space availability	G	P	G	P	P	F	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Flooding	G	G	G	F	G	G	P	F	F	P	G	P	G	G	F	F	F	F	P	F	F	F	F
Hauling distance	P	F	F	P	P	F	G	F	F	G	P	F	P	P	G	F	G	G	G	G	G	F	G
Other fish facilities	G	G	G	F	F	G	G	G	G	G	F	G	F	F	G	G	F	F	F	G	P	P	G
Adaptability	F	P	F	P	P	P	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Access	G	G	G	G	G	G	P	F	F	F	F	F	F	F	F	F	P	F	F	P	P	P	P
Site control	F	P	P	P	P	P	G	F	F	F	F	F	F	F	G	G	G	F	G	G	G	G	G

KEY: G = Good, F = Fair, P=Poor

1 EXISTING HATCHERIES
2 CENTRAL, CONVENTIONAL HATCHERY
3 SMALL WATERSHED REARING FACILITIES
4 NATURAL HABITAT REARING FACILITY
5 LONG-TERM REARING AT ACCLIMATION SITES
6 ENGINEERED HABITAT

As discussed in Section IV.A.2. SYSTEM COMPARISION SUMMARY, existing hatcheries, constructed habitat, and long-term rearing at acclimation sites are the preferred production systems. The site comparison summary above helps identify the preferred sites for those systems.

Cascade FH, Willard NFH, and Winthrop NFH are the proposed sites for the existing hatchery rearing system option. These hatcheries have similar ratings, existing rearing capacity, and were used during the feasibility phase of this project. First use water is available at all three facilities. Cascade FH has a surface water supply which we expect produces smolts with high return rates. Winthrop NFH is close to Methow acclimation sites. Willard NFH has a stable, high quality water supply and a cooperative staff but the constant temperature water may be a disadvantage.

The proposed constructed habitat sites are Eightmile and Heath Ranch. The proposed sites have relatively secure water supplies that can function year round. The sites may have available property and are both located near quality habitat.

Dryden was chosen as the preferred adult holding and incubation facility location based on attributes that result in a high rating as a new central or small, watershed hatchery. Many of the reasons that make Dryden useful for those rearing systems also make it useful for the adult and egg functions. Also, the site has the potential to expand into a full hatchery at some point in the future if needed.

V. *PROPOSED REARING PLAN*

A. PLAN DESCRIPTION

The alternative rearing systems were compared in section IV.A.2 and specific sites were compared in IV.B.3. Using the results of those evaluations a proposed plan has been developed. It is a combination of rearing systems that makes extensive use of available production capacity, with 85% of all program fish being reared in existing hatcheries. The remainder would be produced in the constructed habitats in the Methow watershed.

The low adult return rates of fish produced from the conventional, existing hatcheries will be mitigated by acclimating fish in natural conditions. Where sites allow, program fish will be held at these acclimation locations through the winter. If over winter acclimation is not possible then fish will be acclimated 4-6 weeks until release. The acclimation plan is described in Appendix B.2.

The proposed MCCRP rearing plan is summarized in the table below. The 5 facilities identified for use are described in detail in Appendix C.1 and C.2.

Table 11. Proposed Rearing Plan

	Location	Type	Fish
Wenatchee	Cascade	Existing Hatchery	250,000
	Willard	Existing Hatchery	905,000
Methow	Eightmile	Constructed Habitat	200,000
	Heath Ranch	Constructed Habitat	100,000
	Cascade	Existing Hatchery	450,000
	Winthrop	Existing Hatchery	250,000
TOTAL			**2,155,000**

The Methow presents unique challenges to the goal of developing a naturally spawning coho population. The long migration path through 9 mainstem dams results in high downstream smolt mortality and upstream adult drop out. Maximizing adult survival rates and migration motivation is a priority to offset these impacts. The proposed constructed habitats at Eightmile and Heath Ranch are expected to produce smolts with the "wild" characteristics that result in high return rates. Cascade Fish Hatchery is a surface water facility that is expected to produce quality coho smolts. Adult holding and spawning for the all Methow River production is planned for the Winthrop NFH, along with production of 250,000 pre-smolts.

All Wenatchee River fish will be produced at the Cascade and Willard hatcheries. Adults trapped in the Wenatchee watershed would be transported to the Dryden facility where they will be held for ripening and spawning. Eggs will be incubated to the eyed stage (500-600 temperature units) at Dryden and at the existing Peshastin incubation site. Eyed eggs from the proposed Dryden facility would be shipped to Cascade and Willard for rearing.

A new, adult holding and incubation facility is necessary because the Entiat NFH, where Wenatchee adult coho are currently held, will not be available in the future; other hatcheries in the region do not have the capacity for coho holding and spawning. The proposed Dryden facility gives MCCRP managers control over important parts of the fish culture program, is centrally located within the project area, and reduces the transfer of fish and gametes between watersheds.

This preferred production plan minimizes costs while still producing smolts that will achieve the program goal of helping create a coho population that will successfully spawn in the wild. The preferred plan makes efficient use of existing hatchery capacity, maintains program flexibility, minimizes risks, and, together with the acclimation program, will return adults to Wenatchee and Methow preferred habitat locations.

B. STEP 2 SITE EVALUATIONS

Future facility work supporting the Step 2 NPPC step review process will include the collection of the following data at the Dryden, Eightmile, Heath sites:

- Surface water intake conditions - channel stability, sweeping flows, and river stage/discharge data.
- Surface water flow, temperature, and quality.
- Surface water withdrawal impacts.
- 100 year flood elevations.
- Ground water availability - quantity and depth.
- Ground water temperature and quality.
- Ground water withdrawal impacts - nearby well locations.
- Land ownership and property boundaries.
- Zoning.
- Topographic data.
- Environmental land conditions and previous uses.
- Cultural resources.
- Critical habitat.
- Utilities and access.

Selected sites may not be available for variety of reasons. As a result, alternative locations will be studied through the evaluation and permitting phases in parallel with the primary sites.

VI. ATTACHMENTS

1. REFERENCES

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2. SITE COMPARISON KEY

Effectiveness		
Adult return rates	Good	Return rates higher than other mid-Columbia hatcheries.
	Fair	Rates similar to other facilities.
	Poor	Rates lower than other facilities.
Cost		
Permits	Good	Most permits and environmental evaluations in place.
	Fair	Moderate cost and time to obtain permits.
	Poor	Long, complex permit application process.
Purchase/lease	Good	Immediately available site at no capital or lease cost.
	Fair	Moderate cost.
	Poor	High cost, long negotiations.
Design and construction	Good	Land and water supply conditions favorable for construction.
	Fair	Moderate site conditions.
	Poor	Difficult, expensive site conditions.
Operation	Good	Location allows low cost maintenance, administration, and operation.
	Fair	Moderate operating costs.
	Poor	Remote location, high pumping costs, high manpower reqrts, etc.
Other program functions	Good	Adult holding, incubation, full rearing, and acclimation are options.
	Fair	Acclimation and rearing are possible.
	Poor	Rearing only.
Water supply		
Summer flow and temperature	Good	Avg. daily high temps < 62 F and flows meet conservative criteria.
	Fair	Avg. daily high temps < 65 F and flows meet moderate criteria.
	Poor	Avg. daily high temps >65 F and flows do not meet moderate criteria.
Second winter flow and temp	Good	Avg. daily temps 33 - 40 F and flows meet conservative criteria.
	Fair	Avg. daily high temps 33-45 F and flows meet moderate criteria.
	Poor	Avg. daily high temps >45 F and flows do not meet moderate criteria.
Back-up supply	Good	100% of water requirement available both from surface and ground water.
	Fair	50% back-up from independent source.
	Poor	No independent back-up supply.
Water quality	Good	No current of future water quality problems.
	Fair	Minimal water quality problems.
	Poor	Low water quality now and in the future.
Disease risk	Good	Low disease water supply, export out of watershed not necessary.
	Fair	Non-reportable diseases present in the water supply.
	Poor	Exports out of watershed may be prevented by reportable diseases.
Intake location	Good	Stable channel, deep pool, high sweeping velocities.
	Fair	Two of the three intake conditions met.
	Poor	None of the intake conditions are met.
Flow volume stability	Good	Stable short /long-term volumes; flood debris, icing minimal; gravity flow.
	Fair	Flow volumes stable, flood debris and icing moderate.
	Poor	Volumes unreliable, high flood debris and icing, pumped supplies.
Expansion potential	Good	Double the current required quantity of quality water is available.
	Fair	50% of the current required quantity of quality water is available.
	Poor	No excess water.
Permitting/Impacts		
Water rights	Good	Water rights for hatchery use currently exist.
	Fair	Minimal problems encountered in obtaining rights.
	Poor	Withdrawals cause significant environmental impacts.
Endangered species	Good	No listed or threatened species are present.
	Fair	Species are in the surrounding area and impacts are indirect.
	Poor	Significant impacts.
Shorelines	Fair	No permit opposition.
	Poor	Some opposition.
	Fair	Long process with heavy opposition.
Wetlands	Good	No wetlands in the area.
	Fair	Minor wetland disturbances can be mitigated.
	Poor	Wetlands disturbances require large-scale mitigation.
Flooding	Good	Construction does not impact flood elevations.
	Fair	Minor impacts can be mitigated.
	Poor	Significant impacts to flood elevations.
Cultural resources	Good	Inventory completed and cultural resources not present.
	Fair	Minor resource impacts.
	Poor	Important resources expected.
Water discharge	Good	Discharge does not impact receiving waters.
	Fair	Moderate impacts.
	Poor	Significant impacts.
Local zoning codes	Good	Hatchery use allowed.
	Fair	Variances can be obtained.
	Poor	Use is not allowed and variances are complex.
Operation		
Space availability	Good	Space is adequate for low density rearing and future expansion.
	Fair	Space is adequate for low density rearing.

3. SITE LIST

	Type	Owner	Operator	Water Source
POTENTIAL REARING FACILITY SITES - EXISTING				
YN OPERATED FACILITIES				
Cle Elum	Existing hatchery	Yakama Nation	YKFP	Yakima R., wells
Marion Drain	Existing hatchery	Yakama Nation	YKFP	Marion Drain
Prosser	Existing hatchery	Yakama Nation	YKFP	Yakima R., wells
USFWS HATCHERIES				
Entiat	Existing hatchery	USFWS	USFWS	Entiat R., springs
Leavenworth	Existing hatchery	USFWS	USFWS	Icicle R., wells
Winthrop	Existing hatchery	USFWS	USFWS	Methow R., galleries
MITCHELL ACT HATCHERIES				
Abernathy	Existing hatchery		USFWS	
Beaver	Existing hatchery		WDFW	
Big Cr	Existing hatchery		ODFW	
Bonneville	Existing hatchery		ODFW	
Carson	Existing hatchery		USFWS	
Cascade	Existing hatchery		ODFW	
Clackamas	Existing hatchery		ODFW	
Eagle	Existing hatchery		USFWS	
Elochoman	Existing hatchery		WDFW	
Fallert Cr	Existing hatchery		WDFW	
Gnat Cr	Existing hatchery		ODFW	
Grays R.	Existing hatchery		WDFW	
Kalama Falls	Existing hatchery		WDFW	
Klaskanine	Existing hatchery		ODFW	
Klickitat	Existing hatchery		WDFW	
Little White Salmon	Existing hatchery		USFWS	
N Toutle	Existing hatchery		WDFW	
Oxbow/Herman	Existing hatchery		ODFW	
Ringold	Existing hatchery		WDFW	
Sandy	Existing hatchery		ODFW	
Skamania	Existing hatchery		WDFW	
Spring Cr	Existing hatchery		USFWS	
Stayton Pond	Existing hatchery		ODFW	
Washougal	Existing hatchery		WDFW	
Willard	Existing hatchery		USFWS	
EXISTING ACCLIMATION SITES				
Beaver	Acclimation site	Private	YN	
Carleton	Acclimation site	Douglas PUD	WDFW	
Chewuch	Acclimation site	Douglas PUD	WDFW	
Chiwawa	Acclimation site	Chelan PUD	WDFW	
Dam 5	Acclimation site	Private/USFWS	YN	
Dryden	Acclimation site	Chelan PUD	WDFW	
Mahar	Acclimation site	Private	YN	
Twisp	Acclimation site	Douglas PUD	WDFW	
Two Rivers	Acclimation site	Private	YN	
OTHER EXISTING HATCHERIES				
Gloyd Springs	Existing hatchery	Grant PUD	Grant PUD	
Winchester	Existing hatchery	Private	Troutlodgte	

POTENTIAL REARING FACILITY SITES - NEW				
DAMS				
Chelan	Power	Chelan County PUD	Chelan County PUD	Chelan
Cle Elum	Irrigation	USBOR	Kittitas Rec. District	Cle Elum
Chief Jo	Dam	USACE	Seattle District	Columbia
Cowiche DD	Irrigation diversion			Naches
Dryden	Irrigation diversion	Chelan County PUD	Chelan County PUD	Wenatchee
Easton DD	Irrigation diversion	USBOR	Kittitas Rec. District	Yakima
Kachess	Irrigation	USBOR	Kittitas Rec. District	Kachess
Keechelus	Irrigation	USBOR	Kittitas Rec. District	Yakima
Priest Rapids	Power	Grant County PUD	Grant County PUD	Columbia
Rock Island	Power	Chelan County PUD	Chelan County PUD	Columbia
Rocky Reach	Power	Chelan County PUD	Chelan County PUD	Columbia
Sunnyside DD	Irrigation diversion	USBOR	Sunnyside ID	Yakima
Town DD	Irrigation diversion	City of Ellensburg	City of Ellensburg	Yakima
Tumwater	Dam	Chelan County PUD	Chelan County PUD	Wenatchee
Wanapum	Power	Grant County PUD	Grant County PUD	Columbia
Wapato DD	Irrigation diversion	Wapato ID	BIA	Yakima
Wapatox DD	Dam	PacificCorps	Puget Power	Naches
Wells	Power	Douglas County PUD	Douglas County PUD	Columbia
OTHER NEW SITES				
Chewuck		Private		Ground, Methow
Hancock Spring		Private		Spring, Methow
Heath Ranch		Private		Springs, Methow
Mitchell Pit		Private		Ground, Methow
Nile Spring		Private		Spring, Naches
Pasco Springs		NMFS		Springs, Columbia
Poorman		Private		Springs, Methow
Shugart Flat		Private		Ground, Wenatchee
Toppenish		Private		Marion, Yakima, gournd
Unamed		Private		Spring, Klickitat
Yakima		Private		Springs
Waikiki Springs		WDFW		Springs, Spokane
White		Private		Ground, White

4. CAPITAL AND OPERATING COST BASIS

CAPITAL COSTS

EXISTING PUBLIC HATCHERIES

The hatcheries proposed for use have existing capacity and do not require significant capital expenses.

NEW, CONVENTIONAL HATCHERY

Construction costs of recent hatchery projects in the region are shown below. The values are updated to 2005 dollars by assuming an annual interest rate of 3% (the historic, average, effective rate). The water flow capacity of each facility is also shown.

HATCHERY	START OF OPERATION	2005 VALUE	CFS
Colville	1990	$6,400,000	13
Imnaha (est)	Future	$8,700,000	17.3
Merwin	1993	$9,500,000	11
Methow	1992	$10,800,000	28
Chief Jo	Future	$16,700,000	46

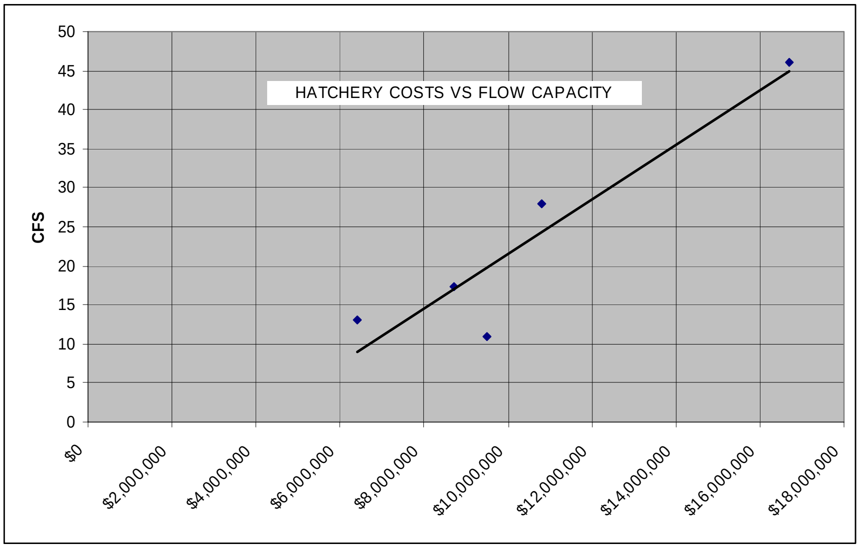
Hatchery details:

- The Colville Hatchery is operated by the Confederated Tribes of the Colville Reservation (CTCR) and produces 50,000 lbs of trout per year. It has 13 cfs of pumped ground water and no surface water capability.
- The Imnaha Hatchery is planned as part of the NE Oregon Hatchery Project. Expected capacity is 490,000 (24.500 lbs) spring chinook with a peak water use of 14.5 cfs.
- The Merwin Hatchery is operated by WDFW. It uses 11 cfs of gravity flow surface water from Merwin dam. Construction costs are relatively high due to the addition of an ozone water treatment system.
- The Methow Hatchery is a spring chinook facility operated by WDFW. It has 10 cfs of pumped ground an 18 cfs, gravity flow surface water right. The production capability is 550,000 smolts (62,000 lbs) per year.
- A new hatchery at the Chief Joseph dam is planned by the CTCR. The capacity is expected to be 145,000 lbs with a water flow of 46 cfs.

Each of these hatcheries have different production capabilities, different functions, and different site characteristics, which result in the wide range of construction costs. They are representative of the types of facilities that are proposed as new, central hatcheries.

Flow capacity is a design variable that is closely tied to facility construction cost. Fish production requirements set water flow rates and rearing volume capacity. As a result, flow is also a general measure of the physical size and cost of hatchery rearing facilities. Flow capacity is a more direct cost predictor than rearing volume because it determines the size of the water intake/supply system. Flow capacity will be the design variable used to develop a predictive formula for coho hatcheries of various sizes that is based on these other hatchery costs. The plot below shows the relationship between flow and cost, with a linear trend line included. The formula for this line is:

$$Cost = (Flow + 14.4) / (.0000036)$$



The above costs include capital construction expenses only. Other capital costs incurred during rearing facility development that are not included above are:

- *Environmental evaluation and permitting* (excluding NEPA and ESA): In their analysis of Pacific Northwest rearing facilities, Senn and Mack (1984) estimate the costs of hatchery permitting at 11% of construction costs. Estimates in the Northeast Oregon Hatchery Project (Ashe et al, 2000) for the Imnaha Hatchery are $100,000, or 1.3% of construction costs. An average of these values is assumed, 6% of construction costs.
- *Facility design, engineering, and construction management*: Senn and Mack (1984) estimate design costs at 23%. Estimates in the Chief Jo Master Plan (CTCR, 2004) are 18% and for the Imnaha Hatchery they are expected to be 6-12%. An average of these values is assumed, 17%.
- *Capital equipment*. Estimated for the Chief Jo hatchery to be 3.4%.
- *Land purchase*. Estimated for the Imnaha hatchery to be .7% to 2.9%.

These other capital total 28% of construction costs. The formula for hatchery capital costs then becomes:

Cost = [(Flow + 14.4) / (.0000036)] x 1.28

LONG-TERM REARING AT ACCLIMATION SITES

The construction costs for acclimation sites are discussed in Appendix B.2, ACCLIMATION FACILITIES ALTERNATIVES. Acclimation sites that can function for long-term rearing will require relatively high cost water systems such as pumped ground water supplies and predator control structures. However, the rearing unit design can be simple and the capacity of the sites will be less than those in the summary above. An average cost per site is assumed to be $800,000.

CONSTRUCTED HABITAT

The cost for 1.8 acres of new habitat for a project on the Dungeness River was estimated to be $220,000 (David Smith, S.P Cramer and Associates, personnel communication). This value includes design and permitting but does not include land purchase. It is estimated that these other costs would increase the total to $320,000, or $180,000 per acre. Constructed habitat is expected to produce 20,000 smolts per acre (Dave Smith, S.P Cramer and Associates, personal communication). Capital costs are then $9.00 per fish ($6 per fish without land purchase).

NATURAL HABITAT REARING FACILITY

Capital costs for a large facility using constructed natural habitat are assumed to be less than to those for constructed habitat. Land purchase costs and permits will be lower for the single site. Partially offsetting the cost reduction is the higher cost of the facilities. Smolt collection systems add complexity to the design. Costs are assumed to be 90% of those of constructed habitat, or $8.10 per fish.

OPERATING COSTS:

The annual operating expenses of existing hatcheries are used for estimating. Data from several public hatcheries are summarized below. Support services such as maintenance, administration, tagging, transportation, and pathology are included.

HATCHERY	DIRECT HATCH. OP.	SUPPORT	ANNUAL CAPITAL AT (5%)	TOTAL	YEAR OF EST.	2004 VALUE AT (3%)	YEARLY PROD. (LBS)	COST ($/lb)
Methow	$371,000		18,550	$ 389,550	1996	$ 493,000	62,000	$ 7.95
Willard	$310,000		15,500	$ 325,500	2005	$ 326,000	40,000	$ 8.15
Cascade	$588,000	$ 94,080	29,400	$ 711,480	2002	$ 777,000	147,000	$ 5.29
Klickitat	$517,000	$191,290	25,850	$ 734,140	2002	$ 802,000	170,000	$ 4.72
Eagle	$826,000		41,300	$ 867,300	2003	$ 920,000	180,000	$ 5.11

Hatcheries with high yearly production have lower per pound operating costs. After factoring in this production level impact and averaging the above values, it is assumed that the costs for 1,000,000 coho (40,000 lbs) will be $8/lb or $320,000 per year.

Scaling this amount for facilities that produce more or less than 1,000,000 coho will be done assuming that 40% of this cost does not change based on production and the other 60% changes ratiometrically. The unchanged portion estimates the fixed operating costs. The formula for calculating rearing site operating expenses for hatchery options is:

320,000*[.4+ 0.6*[(number of fish produced)/1,000,000]

Checks of the accuracy of this formula are that it matches the operating costs for current, full hatcheries and it also matches the amounts being paid by the MCCRP for partial operation of Willard Hatchery.

The options that do not involve full hatchery operation, long-term rearing at acclimation sites and constructed habitat, are expected to have higher production costs because multiple sites must be operated. The fixed costs per site will be lower, and formulas for them will be:

320,000*[(number of sites).05+ 0.95*[(number of fish produced)/1,000,000]

APPENDIX B.2. ACCLIMATION FACILITIES
- ALTERNATIVE AND PROPOSED PLAN EVALUATIONS
Yakama Nation Fisheries Resource Management

CONTENTS

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List of Figures

I. ***SUMMARY***

Mid-Columbia Coho Restoration Program (MCCRP) alternatives for the acclimation component of the project are evaluated and a proposed smolt release plan is described. Guidelines are developed to support the selection of the basic types of systems and specific sites that would form the acclimation plan. The guidelines support the main objective of producing quality smolts that return as adults to habitat areas that will support natural production.

The impact of acclimation systems on overall adult survival rates; return rates to natural production areas; capital and operating costs; flexibility to adapt to changing release numbers, locations, and methods; and site development considerations help determine the program design. Guidelines based on these elements are used to evaluate both general types of acclimation system alternatives and specific sites that comprise those systems.

Acclimation options evaluated in selecting a proposed program conceptual design include:

- Length of acclimation period.
- Number of release locations.
- Location of sites within watershed.
- Type of water supplies.
- Design of acclimation rearing systems.

A comparison of these options based on the selection guidelines demonstrates that a program based on multiple, low density, natural ponds fed by gravity flow surface water is the most cost effective system that meets program objectives. The proposed program emphasizes these types of sites while also including other designs dictated by practical, watershed dependant considerations.

An acclimation system is proposed that has one or more release sites in each of the tributary streams that are targeted for reintroduction. A combined total of 18 release sites are proposed in the Wenatchee and Methow watersheds. Eleven of these sites exist now and do not require significant amounts of construction; many are currently being used by the MCCRP. Of the remaining 7 locations that do require construction, 2 will be used for rearing as well as acclimation/release.

This acclimation system is expected to produce high adult return rates, distribute fish into appropriate habitat, have low overall project costs, and is designed to have the flexibility to adapt to planned and unplanned changes in program release protocols.

II. *INTRODUCTION*

This appendix evaluates program acclimation options. An acclimation plan is selected from these options using siting and design guidelines. The sites proposed for use in the plan are described in detail in appendices C.3 and C.4. The following is a list of master plan facility appendices, with this appendix highlighted.

A. FISH CULTURE GUIDELINES
B. ALTERNATIVE AND PROPOSED PLAN EVALUATIONS
  B.1 REARING FACILITIES
  B.2 ACCLIMATION FACILITIES
C. PROPOSED PLAN SITE DESCRIPTIONS AND CAPITAL COSTS
  C.1. WENATCHEE REARING FACILITIES
  C.2. METHOW REARING FACILITIES
  C.3. WENATCHEE ACCLIMATION FACILITIES
  C.4. METHOW ACCLIMATION FACILITIES
D. PROJECT SCHEDULE AND COSTS

Plans require the identification of facilities that will acclimate prior to release a total of up to 2,155,000 coho smolts. Release numbers by restoration phase are summarized in the table below.

Table 1. Proposed Acclimation Plan Summary
(*numbers of smolts released*)

	BDP I	BDP II	NPIP	NPSP I	NPSP F
WENATCHEE					
Icicle	750,000	500,000	75,000	50,000	25,000
Beaver and Nason	250,000				
Beaver, Nason, Chiwawa		500,000			
Nason			210,000	147,000	73,500
White			210,000	147,000	73,500
Upper Wenatchee			100,000	70,000	35,000
Chiwawa			440,000	308,000	154,000
Little Wenatchee			120,000	84,000	42,000
BASIN TOTAL	*1,000,000*	*1,000,000*	*1,155,000*	*806,000*	*403,000*
METHOW					
Winthrop NFH	300,000	300,000			
Wells Hatchery	200,000	200,000			
Chewuch			325,000	227,500	113,750
Twisp			275,000	192,500	96,250
Wolf			50,000	35,000	17,500
Upper and Mid Mainstem			350,000	245,000	122,500
BASIN TOTAL	*500,000*	*500,000*	*1,000,000*	*700,000*	*350,000*
REGION TOTALS	***1,500,000***	***1,500,000***	***2,155,000***	***1,506,000***	***753,000***

The plan phase titles are: Broodstock Development Phase I (BDP I), Broodstock Development Phase II (BDP II), Natural Production Implementation Phase (NPIP), Natural Production Supplementation Phase Initial (NPSP I), and Natural Production Supplementation Phase Final (NPSP F).

Current releases are approximately 1,000,000 in the Wenatchee Basin and 300,000 in the Methow Basin. These smolts are released in numbers and at locations required to achieve the objectives of the broodstock development phases. New acclimation facilities will not be required until the natural production implementation phase begins.

III. *SITING AND DESIGN GUIDELINES*

Release locations are proposed based upon conditions that prepare artificially produced fish for success in the wild and that return adults to appropriate habitat. Acclimation sites must also meet other criteria; such as cost effectiveness, functionality, and flexibility. Many of the site specific development criteria for acclimation are similar to those for rearing, which are described in Appendix B.1. Culturing guidelines for both program components are discussed in detail in Appendix A.

An acclimation program involves both a proposed system and specific sites to be used. "Systems" is used as a term for describing various general types of facilities and methods, including options such as the number of sites per watershed, their location, the type of rearing units, and the duration of acclimation. Systems and sites are closely interrelated; the type of facility used is tied to its location. As a result, criteria are developed and used in evaluations of both general program design and individual sites.

A. ADULT SURVIVAL RATES

1. Water Quantity and Quality

The natural temperature profile of surface water is predicted to improve adult return rates (see Appendix A for references). Rising temperatures during the weeks preceding release will be considered a priority for acclimation sites.

Gravity flow is optimal, especially at remote release locations. With gravity flow, the cost of developing water supplies, the risks due to mechanical or power failures, and operating costs may all be reduced.

A standard value for minimum water flow density at average springtime water temperatures will be 6 lbs/gpm (0.7 kg/lpm, or a flow index of 0.05, see Appendix A for details). This assumes a fully oxygen saturated incoming water supply. One-hundred thousand smolts, at 18/lb, require 900 gpm, or 2.0 cfs. Minimum flow quantities are increased for sites where supply interruption risks are higher.

Flooding can potentially impact acclimation sites. Locations where rearing/acclimation is expected to occur through winter can accept less flood risk than short-term acclimation sites since premature escape of smolts is unlikely to impact the project to the extent that early releases of fingerlings or pre-smolts would. Long-term acclimation sites can minimize the risk of premature release by keeping pond berms one foot higher than 100 year flood elevations.

2. Rearing Environment

In general, an environment that mimics nature improves adult survival rates (see Appendix A for details). Acclimation site guidelines include:

- *Minimum volume density*: 0.3 lb/ft^3 (4.8 kg/m^3, or a density index of .05) at release for water supplies with high reliability. 0.1 lb/cft for sites without back-up water supply systems. 100,000, 18/lb smolts, at sites without back-up water supplies, require 55,000 cft, or 14,000 sft at an average depth of 4 ft.
- *Acclimation rearing units*: large ponds.

3. Length of Acclimation

Several studies demonstrate the value of acclimation and compare various acclimation periods. A coho study on the Oregon coast (Johnson et al., 1990) showed higher adult survival rates for fish acclimated for 6 weeks prior to release than for fish truck planted without acclimation. Paired releases of chinook salmon in the Mid-Columbia (Wenatchee, Methow, and Similkameen) have shown significantly higher smolt to adult return rates for fish acclimated on river water for 7 months over those acclimated for 2 months. Over the five year study, the overwinter acclimation period typically resulted in a 200% increase in SARS (A. Murdoch unpublished data). Studies with other species (Isaksson et al., 1978 and Whitesal, 1994) confirm that fish acclimated prior to release survive at higher rates and have improved homing fidelity. MCCRP studies are underway now to evaluate very short and very long coho acclimation periods.

Direct truck plants of smolts have not been successful in establishing large-scale natural populations of coho in the Yakima River. As described in the Yakima Coho Master Plan (Yakima/Klickitat Fisheries Project, 2003), “The Yakama Nation has released between 85,000 and 1.4 million coho smolts in the Yakima basin annually since 1985. However, before 1995, the primary purpose of these releases was harvest augmentation; after 1995, the primary purpose became a test of the feasibility of re-establishing natural production...” Releases in the 1985-1995 time period were mainly direct truck plants in the mainstem Yakima. Beginning in 1995, fish were acclimated for approximately 6 weeks prior to release. As shown in the plot below, also from the Yakima Coho Master Plan, adult return numbers were low until acclimation of smolts was begun.

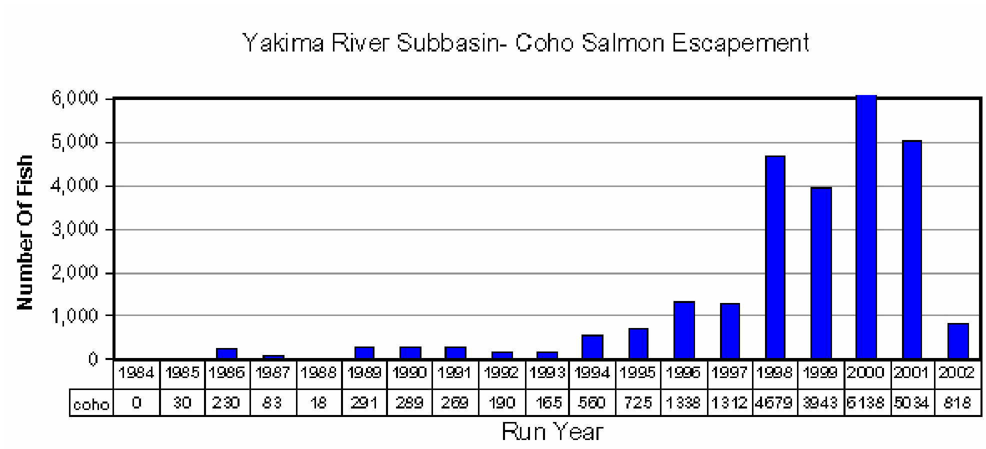

Figure 1. Yakima River Escapement

It is unclear how the pre-smolt, hatchery rearing environment impacts the effectiveness of the length of acclimation. If fish are reared in a low density, semi-natural rearing environment prior to acclimation, some of the advantages of acclimation may be reduced. However, until further information is available, it will be assumed that overwinter acclimation will be a significant benefit.

B. ADULT RETURN LOCATION

A goal of siting acclimation facilities is to return adults to natural production areas. Meeting this goal depends on understanding the behavior of returning adults and identifying the habitat that allows successful reproduction.

1. Dispersal Patterns

If returning adults disperse widely, fewer release locations can be used and their exact siting is not critical. If returning adults disperse mainly below release sites, the release sites should be located in the upper reaches of habitat. Both Mid-Columbia (Murdoch et al., 2004) and Yakima (Bosch et al., 2005) monitoring and evaluation studies are showing that reintroduced coho are widely dispersing in areas downstream of points of release.

Dispersal range is decreasing and adults are moving closer to the release points as locally adapted stocks develop. The expectation is that local adaptation will result in stocks that have traits, such as increased adult energy reserves, that allow greater returns to upstream habitat (Murdoch et al., 2004). However, it is unclear how focused the dispersal patterns will be after full adaptation has occurred. A high degree of homing fidelity to release sites means that location criteria should include acclimation very close to, or in, spawning habitat.

With low survival rates, wide dispersal results in low spawner concentration. Nickelson et al. (1998), in an Oregon coho model, concluded that spawner density (impacted by both dispersal in space and time) was a high extinction risk factor. If survival rates to upstream habitat areas continue at low levels, emphasis on acclimation systems that minimize dispersal may be needed.

2. Habitat Preferences

Estimating stocking rates in tributaries and determining the location of acclimation sites within those tributaries will be supported by habitat evaluations. Smolt carrying capacity estimates, which included an Ecosystem Diagnosis and Treatment analysis, are the basis for the smolt release numbers in Table 1.

Identifying the specific location of spawning and rearing habitat within the watersheds is a more complex task. Spawning habitat may be in different areas than rearing habitat and the relationship between them can impact program design. The objective of the MCCRP is to encourage adults to return to spawning areas that have associated quality rearing habitat.

Coastal coho rearing preferences have been evaluated in several studies. Hilborn et al. (2001) found that pool and pond densities, low valley slopes, low road densities, and low stream gradients were correlated with high coho smolt densities in western Washington. Rosenfeld (2000) concluded that the best predictor of coho abundance in British Columbia watersheds in the June-September time period was stream width (the highest densities occurring in widths under 5 meters).

Puget Sound (WDFW coho biologist Jeff Haymes, personal communication) and review of SalmonScape, the WDFW habitat mapping program) and Thompson River (Mike Bradford, Fisheries and Oceans Canada, personal communication) coho demonstrate a spawning preference for low gradient, low flow streams that have rearing habitat a short distance downstream. During years when these streams are not accessible, spawning occurs in larger bodies of water. Although significant large stream spawning occurs, reintroduced Columbia basin coho are being attracted to low flow, low gradient streams as well. Examples include Marion Drain, Ahtanum Creek, Nelson Springs, Sulphur Drain in the Yakima and small tributaries between Wanapum and Rock Island dams for Wenatchee released coho. Low flow streams will not support large numbers of fingerlings or pre-smolts and migrations to separate rearing habitat are necessary. Imprinting during these fresh water movements (Dittman et al., 1996) allows natural coho to return to spawning areas, despite beginning seaward migration as pre-smolts from rearing habitat. Since returns to specific spawning habitat are a goal, releases directly from those areas could replace fry migration imprinting with smolt migration imprinting.

Much of the literature on coho habitat preferences is written for coastal, rain dominated watersheds. The mid-Columbia has snow dominated watersheds with hydrograph peaks during spring run-off. Interior Fraser coho stocks face similar flow conditions and migration distances and these stocks originated from the Columbia River (Smith et al., 2001). They show a preference for spawning in the upper reaches of the low gradient sections of watersheds. For example, spawning ground counts show the highest abundance in the upper reaches of the Coldwater River (Nelson et al., 2001 and Nicola Tribal Association, personal communication) and the most productive stream in the Fraser system is the Eagle River above Three Valley (Richard Bailey, program head Stock Assessment/Resource Management, BC Interior Area, DFO personal communication). Interior Fraser stocks show a preference for areas that are similar to those in the Chiwawa, White, Chewuch, Twisp and upper Methow rivers.

There are other aspects of interior B.C. coho spawning behavior that can be applied to MCCRP program design. Interior B.C. coho stocks show a high degree of adaptability and plasticity in spawning habitat selection. When the small streams that are preferred habitat are not accessible due to low flow conditions or beaver dam construction, spawning can occur in nearby areas of larger tributaries. Spawning occurs in about 1 out of 3 or 4 years in the North Thompson when normally productive, small tributaries like Lion Creek and Mud Creek are not accessible. Spawning preferences may also be highly influenced by the presence of groundwater in both the smaller and larger tributaries (Richard Bailey, personal communication).

A common theme with both spawning and rearing habitat evaluations in coastal and interior populations is coho preference for low gradient stream environments. A first order approximation of habitat location has been made based on stream slope. Figures 8 and 9 are maps that show the low gradient (less than .5% and 2%) stream sections in the Wenatchee and Methow watersheds. Acclimation sites are situated using them as a general guideline.

C. ACCESS

Transport of pre-smolts to acclimation sites requires road access. Due to their weight, size, and the value of the coho cargo; fish transport trucks are restricted to plowed roads. Daily feeding and screen cleaning are activities that require access. During storm events, debris may need to be removed from water intake screens at a high frequency. These factors limit the location of acclimation sites to those that have nearby accessible roads.

D. COST

Both capital and operating costs are important evaluation considerations. In this appendix, average values of costs to construct and operate acclimation facilities in the region are used to compare different systems (Appendices C.3 and C.4 estimate site specific costs for the proposed acclimation system alternative). The details of the cost estimating procedures used are listed in Attachment 1, CAPTIAL AND OPERATING COST BASIS. Other program components; brood capture, rearing, and monitoring and evaluation, are not included in these operating and construction cost estimates.

E. ENVIRONMENTAL IMPACTS

Environmental factors play an important role in selecting sites and acclimation methods. Facility construction that limits access to and from streams with habitat used by other species is one of these factors. Some water intake structures and coho migration barrier designs prevent adult and fry migrations. The primary species of concern in the small tributaries of the region are bull trout and steelhead. Impacts to both their movement and use of habitat will be evaluated during NEPA, ESA and site permitting processes and were considered during the conceptual site selection and design phase. Acclimation site locations away from important migration paths with designs that do not impede natural passage will be used to minimize these impacts.

The effect of fish waste on downstream water quality and on the acclimation pond environment is another major design consideration. Current National Pollution Discharge Elimination System (NPDES) policy allows the administering agency, Washington Department of Ecology (WDOE), to waive the requirement for a discharge permit if production gains at a specific site are less than 20,000 pounds per year or food fed is less than 5,000 lbs per month and if impacts are considered minor. Most acclimation sites in the proposed plan will be under this limit. 5,000 pounds will feed approximately 200,000 coho smolts per month. However, WDOE is now evaluating the cumulative impact of multiple acclimation sites. Permits may be required in the future, which at the minimum would involve water quality monitoring. It is also possible that waste treatment procedures may have to be implemented.

Ponds and the constructed habitats that are built for the program are intended to be positive environmental features. Acclimation ponds will be naturally populated by various plant and animal species. Anadramous fish species in particular will benefit from the addition of more rearing habitat.

F. FLEXIBILITY

Future changes in adult dispersal patterns and spawning habitat preferences as local adaptation proceeds and changes in the numbers of fish to be released in each tributary will influence acclimation site selection. Acclimation facilities will need to be able to adapt to these changes. The ability to change site locations and sizes cost effectively is important features of an acclimation plan.

G. OTHER

Trucking impacts are discussed in Appendix A, CULTURING GUIDELINES. In general, trucking distances are not critical since most stress is induced during loading operations. However, disease transfer considerations may place limits on trucking between major watersheds.

Many acclimation sites are in the upstream areas of watersheds. Operating facilities in these areas will be difficult. Snow will affect access and stream icing conditions will impact water availability. Multiple remote sites make emergency response more complex and add to risk.

Other siting criteria for acclimation facilities are similar to those discussed for rearing facilities in Appendix B.1. Water use impacts, ESA issues, wetlands, construction permits, environmental impacts, land availability, expansion capability, utilities, and road access are all siting considerations.

IV. *ACCLIMATION ALTERNATIVES*

The various options for acclimation and release systems are described and compared in the following two sections, A and B. The last chapter, C, lists the specific sites that can be used in the systems that best meet program objectives. Chapter V describes the proposed acclimation plan alternative.

A. ALTERNATIVE SYSTEM DESCRIPTIONS

1. Number of Sites

The following discussion of the number of sites uses these definitions:

Watersheds: Wenatchee, Methow

Tributaries:

- Wenatchee Basin: White River, Peshastin Creek, Icicle Creek, Beaver Creek, Chiwawa River, Little Wenatchee River, Icicle Creek
- Methow Basin: Chewuch, Twisp, Wolf Creek, Upper and Mid Mainstem, Gold Creek, Beaver Creek

a. No acclimation sites used

Truck planting adults, fry, and/or smolts are alternatives to acclimation. Adult plant based restoration has shown some promise in helping with steelhead recovery efforts in Hood Canal (Berejikian et al., in press). Direct plants allow the widespread distribution of coho to all areas with road access. Acclimation facility costs are eliminated and the flexibility to change release locations and numbers is maximized as well. However, adult and fry plants result in high early life history mortality. Direct smolt plants in the Yakima River failed to generate widespread naturally reproducing populations, as previously described. Adult stray rates are lower for acclimated smolts (Johnson et al., 1990 and Labelle, 1992) and the impact of trucking on fully smolted fish can be severe. As a result, direct plants will be used only in isolated circumstances, seeding areas with poor access or where acclimation sites cannot be built.

b. One per Watershed

If adult dispersal patterns remain very broad and centered below the point of release, a single, large acclimation site in an upstream area may seed an entire watershed. With wide distribution and high survivals, adults would enter all tributaries and find appropriate spawning habitat. During the natural production implementation phase, such a site in the Methow and Wenatchee would acclimate and release 1,000,000 smolts each.

Due to economies of scale and the reduced cost of operating single sites, this system option has the lowest operating costs of all the alternatives that use acclimation. Reliability would be high due to the water supply redundancies that could be built into a large facility and long-term acclimation would be possible.

However, if the current dispersal patterns continue the rapid changes associated with local adaptation, this system may not adequately seed adults into all tributaries. As the population becomes more capable of returning to release origins, distant tributaries may be bypassed. Also, the impact of catastrophic losses (from disease outbreaks or facility failures) at single sites would be severe, the capital cost of building a large acclimation site is high, and the environmental impact of the large water withdrawal required of such a site would be significant. Mega-sites will have limited flexibility. Changes in release locations would not be feasible as the program evolves.

c. One per Tributary

A system that moderates some of the limitations of the mega-site is a system where smaller facilities are used on each tributary. Returning adults would be expected to disperse and find correct spawning habitat only in that tributary.

Catastrophic fish loss impacts would be reduced by having multiple release locations; however, the risk of losing individual site production is higher due to the need to depend on lower cost water supply systems. Long-term acclimation may not be possible at some of the sites due to water supply stability and winter access issues.

The long-term plan identifies 6 tributaries in the Wenatchee Subbasin and 4 tributaries in the Methow Subbasin for proposed coho releases. With this alternative, each tributary would have a single acclimation site.

d. Multiple per Tributary

Multiple sites per tributary reduce release numbers per site, increasing the opportunity to use existing natural small ponds and side channels. Natural sites are predicted to produce smolts with wild characteristics that survive at high rates.

Predator control is more difficult with multiple sites, especially in natural ponds where fencing and netting may not possible. Predator control would be manpower dependant, using methods currently employed by the project at upstream Wenatchee watershed acclimation sites.

With a heavy emphasis on existing ponds, the capital cost of this system will not be large. However, the cost of operating many sites in remote locations would be high.

2. Location Options

a. Downstream of Habitat

Traditional hatchery practices release smolts directly from hatcheries, which are frequently located downstream or in the lower reaches of natural habitat. Adults not needed for spawning can be returned to the river and some may continue moving upstream above the hatchery. Coho acclimation sites could operate on a similar principal if returning stocks were motivated and capable of moving past release locations. However, releases well downstream of habitat may encourage spawning in marginal areas and is unlikely to result in sufficient dispersal of returning adults.

Acclimation facilities in downstream areas are relatively easy to construct and operate. There is generally private land available and project environmental impacts are minimized when previously disturbed land is developed. Multiple water supply options would be available due to the wider area that would be suitable for siting.

b. Upstream of Habitat

Imprinted releases in areas upstream of habitat may allow returning adults to distribute into more suitable areas as they move toward acclimation sites. This is behavior that MCCRP adults are, to a degree, exhibiting now.

Pumped water facilities, seasonal stream water supplies, and use of mainstem tributary water may also encourage wide dispersal. If imprinting water is not being discharged from the acclimation facility in the fall when adults are returning, they may be less focused on a specific area.

Releasing upstream of spawning and rearing habitat may also result in some spawning in less favored areas. Streams feeding tributaries may not be fully populated if acclimation occurs some distance above them.

Construction and operation of facilities in upstream areas will be more difficult than in downstream areas. Winter access, water supply, and permitting considerations may make sites in these areas expensive and will add elements of risk. In areas without plowed roads, acclimation sites may be accessible for limited times during the late winter and spring. A flexible program that allows fish to be transported based on year-to-year road conditions may be required.

c. In Spawning Habitat

If natural mid-Columbia River coho stock behavior becomes similar to coastal stocks, acclimation sites on small streams may be effective. This would be encouraged by releasing smolts directly into spawning habitat in several locations in each tributary. After establishing successfully reproducing populations in those streams, straying from them may colonize other appropriate areas in the tributary (Nickelson et al. 1998).

Water flows in small streams will limit the number of smolts that can be acclimated. This system would require multiple sites to be developed and operated. Steep valley walls that are close distances to tributary channels are typical of many Mid-Columbia areas. These conditions limit the quantity of low gradient, small stream spawning habitat available as potential acclimation sites.

3. Water Supply Options

There are several options for supplying water to constructed acclimation ponds. A preferred system is the in-line option in which an entire creek flows through a pond. The in-line option eliminates the need for an intake structure and provides a high degree of reliability. The disadvantage to the in-line option is that barrier nets would block upstream and downstream fish passage during the acclimation period.

Surface water can be diverted to rearing units. For remote sites, maintaining intakes during storm events may be difficult and pumped ground water systems with back-up generators may be required.

The constant temperature of ground water may negatively affect smolting (see Appendix A). However, ground water during the spring acclimation period will be warmer than winter surface water. The change from rearing in cold water to acclimating on warm ground water will mimic natural conditions and reduce negative impacts. An advantage of ground water is that warmer temperatures allow long-term (over-winter) acclimation. Operation through the winter will be significantly easier with spring or pumped well water than with surface water that is subject to icing, low flows, and heavy flood debris loads.

4. Design Options

a. Existing Ponds

Many beaver ponds, side channels, and man-made ponds exist throughout the Mid-Columbia region. Existing ponds in appropriate locations and that have adequate water flow is suitable for coho acclimation. An example of an existing beaver pond that has been successfully used for acclimation is on Coulter Creek (Figure 2).

Figure 2. Coulter Acclimation Site

The highly natural conditions of many existing sites are expected to improve adult return rates. Low density rearing, some natural feed, mature vegetation cover, and hydraulic diversity are conditions that may enhance smolt quality. Many of the identified ponds have the advantage of in-line water supplies as well, although they will be difficult to operate through the winter.

Feeding and predator control may be complicated by large pond sizes and thick vegetation at some sites. Existing natural sites do not have fish waste removal capability, possibly limiting use for acclimation. Also, these sites typically require blocking access by other species to and from the ponds during the acclimation period. ESA consultations would be needed to address these impacts..

b. Constructed Pools

Simple earthen ponds can be constructed at many locations. The preferred method is to excavate a pond in a creek channel. Barrier nets would be used to block pond exits during acclimation; no permanent structures are needed.

Advantages of constructed pools include low cost construction, a wide range of siting alternatives, fish culture friendly design, and high water supply reliability. Constructed pools may also be a positive habitat feature as they are populated by other species when not used for coho acclimation. However, permitting may be difficult in undisturbed areas and where ESA listed species are present. An example of a constructed natural pond with an in-line water supply is the Rohlfing pond on Nason Creek (Figure 3).

Figure 3. Rohlfing Acclimation Site

c. Constructed Acclimation Facilities

Several acclimation facilities (Chewuch, Twisp, Chiwawa, Dryden, and Carlton) currently exist in the Wenatchee and Methow basins. Constructed Acclimation Facilities have lined bottoms, predator net systems, water inlet and outlet structures, and are fenced (Figure 4). Both gravity flow water from irrigation canals and pump stations are used for water supplies.

Constructed Acclimation Sites have the advantages of full predator control and managed waste removal. Facilities with pumped water supplies can be built in a variety of areas and can be located based on biological criteria and land ownership. If ground water is available, they would be capable of winter operation.

Figure 4. Carleton Acclimation Site

d. Constructed Natural Habitats

Constructed natural rearing habitat is discussed in Appendix B.1 as a combined rearing and acclimation strategy. Constructed habitat consists of engineered pools, runs, riffles, alcoves, and ponds (Smith et al., 2004). Additional features include woody debris and overhead cover. Controlled water flow can be supplied by existing springs, by gravity flow intakes on surface streams, or by pumped wells. Tagged fingerlings are planted in the habitat and reared to sizes up to full smolt. The main benefit of constructed habitat is the production of smolts with close to wild characteristics. This type of system is expected to maximize adult return rates.

The large amount of land needed is a significant disadvantage to constructed habitat as an acclimation system. Expanding preliminary production rates to a full 2,000,000 smolt program results in an estimated land requirement of approximately 90 acres of constructed habitat (density of 0.5 smolt per square ft, Dave Smith, S.P. Cramer, personal communication) scattered throughout the Mid-Columbia region. Although construction is relatively simple and there is a cost advantage to combining rearing and acclimation at one site, costs are high due to this large land requirement.

At some sites it may be possible to construct spawning habitat into the habitat design. Spawning habitat may be useful in locations where natural production is spawning habitat limited.

e. Concrete Raceways

Acclimation rearing units constructed with concrete have the advantage of allowing exact replicates to be built to support studies. The Yakima spring chinook supplementation project uses raceways for this purpose (Figure 5).

Figure 5. Easton Spring Chinook Acclimation Facility

Predator control, fish waste handling, and feeding systems are very functional at this type of facility. However, rearing in concrete raceways may produce smolts with relatively low adult survival rates (see Appendix A). The cost of construction, lack of adaptability to changing program needs, and potential environmental impacts are other drawbacks.

B. ALTERNATIVE SYSTEM COMPARISONS

1. Comparison Summary

The acclimation options are compared using the evaluation criteria developed in Chapter III. In general, it is expected that adult return rates will be highest from systems that have long (over-winter) acclimation periods, use surface water, and have a natural design. Costs will be lowest for alternatives that are based on existing ponds and constructed pools with gravity flow water supplies (see the next section and Attachment 1 for more detail on costs). The matrix below summarizes the evaluation of acclimation system alternatives and is used to develop the recommended acclimation plan described in Chapter V.

Table 2. Comparison of Acclimation System Options

	NUMBER OF SITES				LENGTH OF ACCLIMATION			LOCATION			WATER SUPPLY				DESIGN				
Criteria	None	One per Watershed	One per Tributary	Multiple per Tributary	None	6 Weeks	6 Months	Below Habitat	Above Habitat	In Spawning Habitat	Surface Gravity	Surface Diverted	Surface Pumped	Ground	Existing Ponds	Constructed Pools	Constructed Acc. Facilities	Constructed Habitat	Concrete Raceways
Adult Return Rates	P	G	G	G	P	G	G	G	G	G	G	G	G	P	F	F	F	G	P
Returns to Habitat	P	P	G	G	P	F	G	P	G	G									
Returns to Spawn. Habitat	P	P	F	G	P	F	G	P	F	G									
Capital Cost	G	P	F	G	G	F	P	G	F	F	G	F	P	P	G	G	F	F	P
Operating Cost	G	G	F	P	G	F	P				G	F	P	P					
Winter Operation	G	G	F	P	G	F	P	G	P	P	F	P	P	G					
Environmental	G	G	F	P	G	F	P	G	F	F	P	F	F	G	G	G	F	F	P
Program Flexibility	G	P	F	G	G	F	F								G	G	F	P	P

Key: G = Good, F = Fair, P = Poor

In evaluating the various acclimation alternatives, certain options and combinations of options will not be considered for use as the basic system in the proposed plan for reasons summarized below. The above sections give more detail on the rationale for excluding these options, the master plan details program goals and Attachment 1 includes cost information referenced below. The low priority options and combinations are:

- The no-acclimation option will not produce the numbers of returning adults needed to meet program goals.
- The one-site per watershed is unlikely to disperse adults into habitat at a rate that will meet program goals.
- The constructed concrete raceway option has a high capital cost.
- The combination of one release site per tributary and existing ponds is not realistic in the major tributaries. The capacity of the existing ponds is not large enough to acclimate the planned numbers.
- The combinations of pumped waters supplies and/or constructed acclimation facilities along with multiple sites per watershed will have a capital cost that is too high.
- Releasing all program fish from constructed habitats will have a high capital cost and is a technique that has not yet been fully evaluated.

2. System Cost Evaluation

The cost of constructing and operating several remaining program option combinations can be compared as part of the evaluation process. These alternatives are general designs developed for analysis purposes only. They are all, however, practical alternatives.

- *Alternative 1. Multiple release sites consisting of existing, gravity fed ponds*. There are 6 different tributaries in the Wenatchee and 5 in the Methow that are targeted for releases (for the purposes of this comparison, the upper and mainstem Methow is divided into two release groups). The total number of release areas is then 11. This alternative uses existing ponds which are generally small. It will be assumed that an average of 3 will be needed per release area for a total of 33 release locations.
- *Alternative 2. Multiple release sites consisting of small, gravity fed, constructed pools.* These pools can be larger than the existing ponds, an average of 2 per tributary is assumed for a total of 22.
- *Alternative 3. One release site per tributary from constructed habitat facilities using pumped water*. Each of the 11 main release areas would have one of these facilities constructed on it.

The estimated capital and acclimation (only) operating costs for these alternatives are shown in the table below. The estimating methods are described in Attachment 1. The capital costs were based on recent construction projects in the region and the operating costs are based on the current MCCRP budget. The present value of the operating costs was calculated assuming a 20 year life and a 3% annual interest rate (the long-term historical average).

Table 3. Cost Comparison of Acclimation Options

	Capital Cost	Annual Operating Cost	Total Present Value of Operating Cost	**TOTAL PRESENT VALUE**
Alternative 1	$330,000	$450,478	$6,700,000	**$7,030,000**
Alternative 2	$6,270,000	$356,932	$5,300,000	**$11,570,000**
Alternative 3	$16,126,000	$263,387	$3,900,000	**$20,026,000**

The table demonstrates that Alternatives 1 and 2 have lower lifetime costs than Alternative 3. This is mainly the result of the high capital cost of constructing water supply systems and structured rearing systems. Specific acclimation sites, where possible, have been selected that can be used in alternative systems 1 and 2.

C. IDENTIFIED SITES

Figures 6 and 7 show the location of sites that are currently identified as potential acclimation sites. Sites have been selected that have the water flow and rearing space available for holding more than 50,000 smolts (a minimum spring time flow of 1 cfs and at least 30,000 cft of rearing volume) and that best meet the siting and design guidelines.

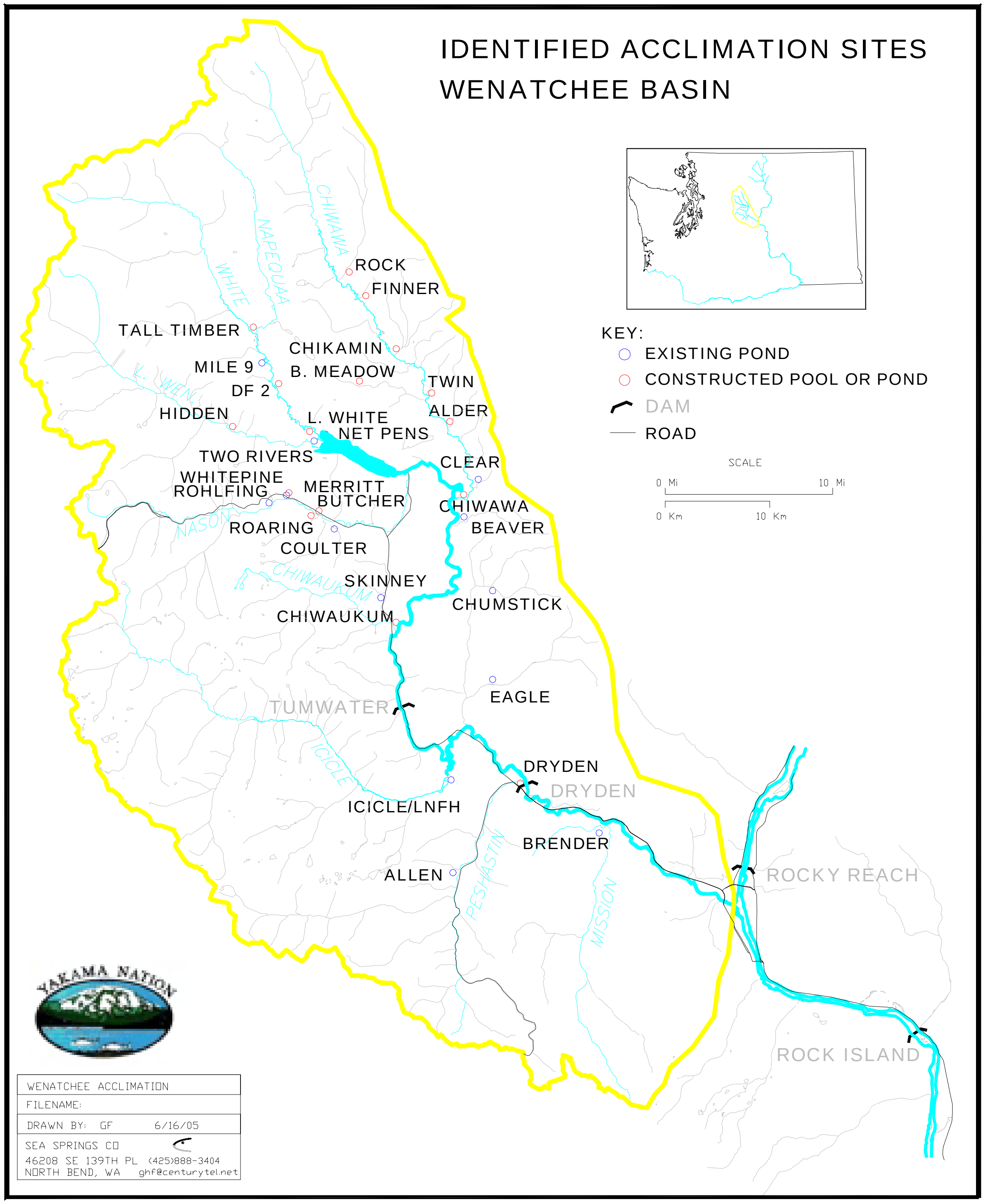

Figure 6. Identified Acclimation Site Map, Wenatchee

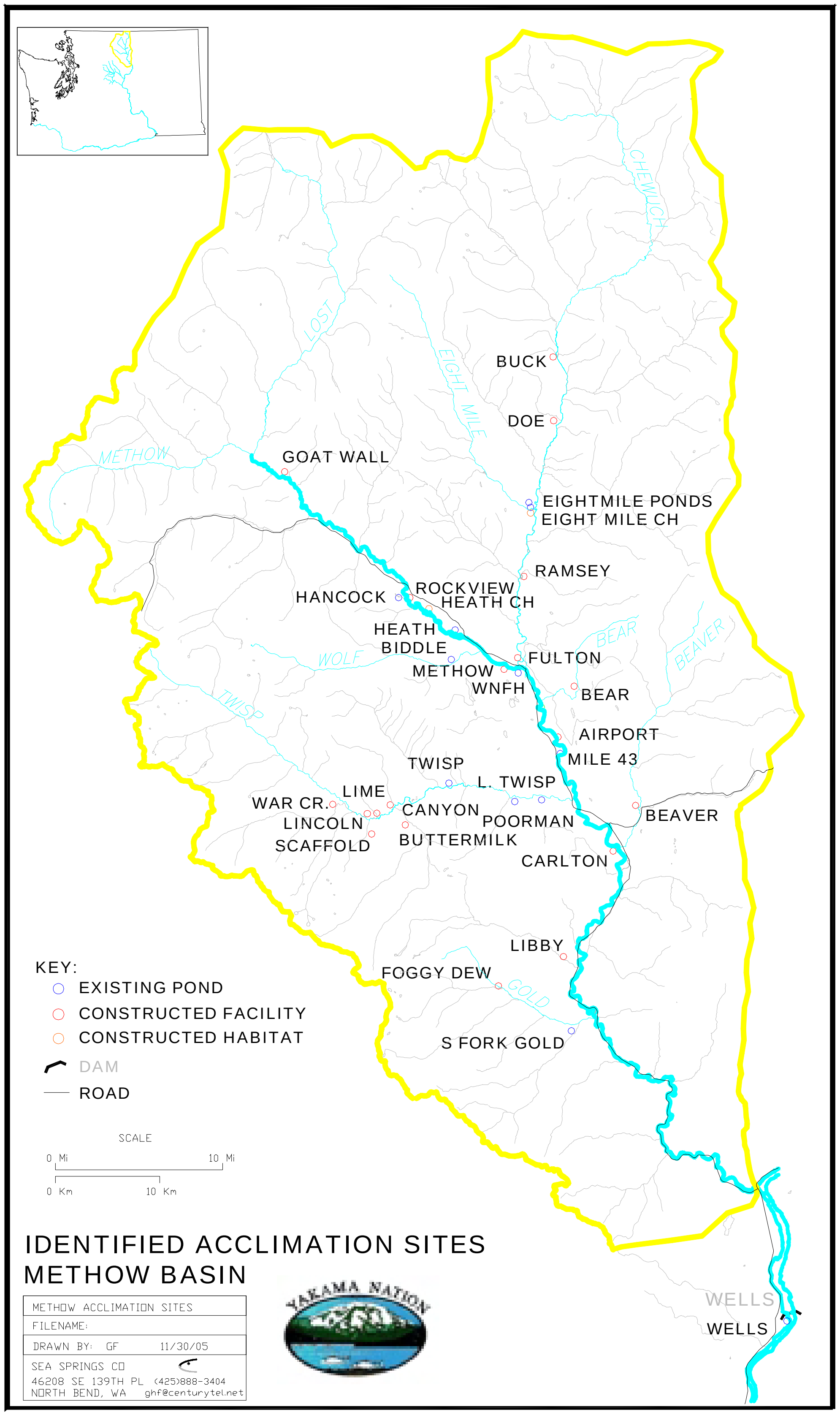

Figure 7. Identified Acclimation Site Map, Methow

The tables below present information on the identified sites (Table 4 and 5).

1. Existing

Table 4. Identified Existing Sites - Characteristics

SITE	BEAVER POND	MANMADE POND	NATURAL CHANNEL	GRAVITY, GROUND	GRAVITY, SURFACE	DIVERSION	PUMPED, GROUND	PUMPED SURFACE	BULL T, SH, SP CHNK	NO FISH IMPACTS	BROOD DEVELOPMENT	WINTER USE	OWNERSHIP	TRIB	NOTES
WENATCHEE	Site Count =				15										
Brender		X			X					X		X	PR	Mission	15,000 cft pond
Icicle						X	X	X		X	X	X	PU	Icicle	Hatchery raceways or Dam 5, brood development purpose
Chumstick		X			X					X			PR	Chumstick	Pond formed by dam
Eagle			X		X					X			PR	Chumstick	
Allen		X			X	X				X			PR	Peshastin	Community pond
Skinney	X				X				X				PR	Chewaukum	
Beaver		X			X				X				PR	Nason	75,000 coho released per year, in use since 2002
Butcher	X				X					X			PR	Nason	100-150,000 coho released per year, in use since 2000
Coulter	X				X				X				PR	Nason	80-110,000 coho released per year, in use since 2003
Whitepine	X			X					X			X	PU	Nason	Spring fed creeks, site near campground, ponds shallow
Rohlfing		X			X		X		X			X	PR	Nason	36,000 cft pond, limited fall flow, well on site
Clear		X		X					X			X	PR	Chiwawa	Ponds on existing private campground
Mile 9	X				X				X				PU	White	Access from west side of river in winter limited
LW Net Pens		X			X					X		X	PU		Purpose would be wide distribution in the Wenatchee system
Two Rivers		X					X	X		X		X	PU	L. Wen.	100,000 smolts in 2003 and 04. Water pumped from mine lake
METHOW	Site Count =				16										
Wells		X				X	X	X		X	X	X	PU	Columbia	Purpose is broodstock development and back-up
S Fork Gold		X			X				X				PR	Gold	
Lower Twisp		X			X		X		X			X	PR	Twisp	Water is diverted from the Twisp and wells exist as back-up.
Poorman		X		X						X		X	PR	Twisp	
Twisp Acc Site	X				X	X				X			PR	Twisp	Pond downstream of existing facility, water could be added from canal
Lincoln		X			X			X					PR	Twisp	Two ponds that natrually flow during high water
War Ponds	X				X				X				PU	Twisp	Large beaver pond complex
Mile 43			X		X				X				PR	Methow	Limited flow
Winthrop NFH		X				X	X	X		X	X	X	PU	Methow	This is currently an active rearing and release site
Biddle		X			X	X				X			PR	Wolf	
Heath	X			X					X			X	PR	Methow	Value of existing habitat may require new pond construction
Big Valley	X			X		X			X			X	PR	Methow	Value of existing habitat may require new pond construction
Hancock			X	X					X			X	PR	Methow	Recent rehabilitation project improves conditions for coho
Ramsey		X			X				X				PR	Chewuck	Large private pond
Sherwood	X				X				X				PU	Eightmile	
Eightmile		X			X	X				X			PR	Chewuck	Used in the past for coho acclimation

2. New

Table 4. Identified New Sites - Characteristic

SITE	POOL	ACCLIMATION FACILITY	CONSTRUCTED HABITAT	GRAVITY, GROUND	GRAVITY, SURFACE	DIVERSION	PUMPED, GROUND	PUMPED SURFACE	BULL T, SH, SP CHNK	NO FISH IMPACTS	LOCAL SPAWNING	BROOD DEVELOPMENT	WIDE DISTRIBUTION	WINTER USE	OWNERSHIP	TRIBUTARY	NOTES
WENATCHEE	Site Count =				17												
Dryden		X					X	X		X			X	X	PR	Wenatchee	Hatchery site at the mouth. Pumped shallow ground and Wenatchee water
Chiwaukum		X			X	X			X		X			X	PU	Chiwaukum	Near the mouth of Chiwaukum adjacent to Tumwater Campground
Butcher			X		X				X				X		PR	Nason	Less than 4 acres of land, pumped groundwater and gravity flow surface
Roaring	X				X				X		X				PR	Nason	Good spawning habitat in creed, good rearing habitat in pond complex below
Merritt		X					X	X		X			X	X	PR	Nason	Pumped shallow ground and Nason water
Whitepine	X			X					X				X	X	PU	Nason	Nason Ridge springs, site near the Whitepine campground.
Hidden	X				X				X		X		X		PU	L. Wenatchee	Could be above Bull trout and Steelhead habitat, road closed in winter
Lower White		X					X	X		X			X	X	PR	White	Pumped ground and White water
DF 2			X		X				X		X				PR	White	Good potential spawning habitat in creek
Tall Timber		X						X		X			X	X	PR	White	Pumped White and possible ground water
Chiwawa		X						X		X			X	X	PU	Chiwawa	Potential hatchery site that could also release fish
Alder	X				X				X		X		X		PU	Chiwawa	Road closed in winter, snowmobile use. Bull t., SH presence may require intake
Twin	X				X				X		X		X		PU	Chiwawa	Road closed in winter, snowmobile use. Bull t., SH presence may require intake
Big Meadow	X				X				X		X		X		PU	Chiwawa	Road closed in winter, snowmobile use. Bull t., SH presence may require intake
Chikamin	X				X				X		X		X		PU	Chiwawa	Road closed in winter, snowmobile use. Bull t., SH presence may require intake
Finner	X				X				X		X		X		PU	Chiwawa	Road closed in winter, snowmobile use. Bull t., SH presence may require intake
Rock	X				X				X		X		X		PU	Chiwawa	Road closed in winter, snowmobile use. Bull t., SH presence may require intake
METHOW	Site Count =				17												
Foggy Dew	X				X				X		X				PU	Gold	Site near mouth at campground
Libby	X				X				X		X				PR	Gold	
Carleton		X					X	X		X			X	X	PR	Methow	Site near acclimation facility could use existing intake and new wells
Buttermilk	X				X				X		X		X		PR	Twisp	Bull t., SH presence may require intake
Canyon	X				X					X	X		X		PR	Twisp	Could be above Bull trout and Steelhead habitat
Lime	X				X					X	X		X		PR	Twisp	Could be above Bull trout and Steelhead habitat, very small creek
Scaffold	X		X		X				X		X		X		PU	Twisp	Could be above Bull trout and Steelhead habitat, access on south bank difficult
War Cr	X				X				X		X		X		PU	Twisp	Could be above Bull trout and Steelhead habitat, access on south bank difficult
Airport	X				X	X				X			X	X	PR	Methow	Irrigation intake return flow
Bear	X				X				X		X				PR	Bear	Bull t., SH presence may require intake
Methow FH		X		X	X					X		X		X	PU	Methow	Pond using hatchery discharge water
Rockview	X				X				X		X		X	X	PU	Methow	Bull t., SH presence requires new pond construction, irrigation return flow
Goat Wall	X			X					X		X		X	X	PR	Methow	Spring, upstream of dry section of Methow
Fulton	X				X	X				X			X		PR	Chewuck	Irrigation ditch on lower Chewuch
Eightmile			X		X				X		X		X	X	PU	Chewuck	Constructed habitat site near mouth, existing wells may allow winter use
Doe	X				X				X		X		X		PU	Chewuck	Road closed in winter, snowmobile use. Bull t., SH presence may require intake
Buck	X				X				X		X		X		PU	Chewuck	Road closed in winter, snowmobile use. Bull t., SH presence may require intake

V. ***RECOMMENDATIONS***

A. PROPOSED ALTERNATIVE

Details about the site locations, designs, and costs of the proposed acclimation plan are included in Appendices C.3 and C.4. This chapter discusses the general program configuration and summarizes the selection rationale.

The comparison summary and cost tables in Chapter IV.B show that the acclimation systems that will produce the highest adult return rates at the lowest cost with the most program flexibility are those that use existing ponds and constructed pools and have gravity flow water supplies. This acclimation system reduces water requirements, reduces risks due to single site losses, reduces environmental impacts, releases fish into a variety of habitats, and completes rearing in highly natural environmental conditions.

The rearing system proposed (see Appendix B.1) makes extensive use of existing hatchery capacity. Fish produced and released directly from these systems would be expected to have relatively low return rates (see Appendix A). However, the effect of this hatchery rearing environment can be mitigated by acclimation. Long-term acclimation, through the second winter and spring, is therefore emphasized in the proposed acclimation plan.

Selection of most release locations assume that adults will disperse widely around the point of release. General consensus is that coho will find appropriate spawning habitat, irrespective of specific imprinting clues. Many release locations are near high quality rearing habitat and some are located directly in spawning habitat.

Practical considerations that are the result of specific conditions in the watersheds and tributaries suggest that acclimation systems other than existing ponds and constructed pools be developed in some cases. These sites are described in the following sections.

A total of 18 release locations are proposed in the Wenatchee and Methow watersheds. Eleven of these sites exist now and do not require significant amounts of construction (6 of these 11 are currently being used by the MCCRP). Of the remaining 7 locations that do require construction, 2 will be used for rearing as well as acclimation/release. Following is a summary of features of the recommended system:

- Multiple sites in most of the large tributaries.
- Gravity flow, surface water supplies at most sites.
- Existing ponds and constructed pools at most sites.
- Combined acclimation/rearing at select locations.

The overall shape of ponds at sites that require new construction will be semicircular. This shape will allow the distribution of feed to all fish from one location on the interior shoreline (see the drawings in Appendices C3 and C4), minimizing the conditioning of fish to associate food with large moving bipeds objects. The shorelines of the ponds will be irregular, forming alcoves and peninsulas. This will add hydraulic and general environmental complexity. Trees planted around the perimeter will add shade and along with the pond shape will reduce bird landing areas.

1. Wenatchee

The proposed alternative for the Wenatchee Natural Production Implementation Phase includes releases at 9 different locations. Six of the locations are existing sites; one is a new, conventional acclimation facility on the upper White River; one is a new pond adjacent to the existing Chiwawa Acclimation Facility; and one is a constructed pond on Chikamin Creek, a tributary of the Chiwawa River. Over half of the releases will be from acclimation sites capable of overwinter acclimation.

Large releases relative to habitat capacity are proposed for Icicle Creek. The Icicle Creek release has a dual purpose; to develop a naturally spawning population and to serve as a back-up source for local broodstock.

The proposed Chiwawa sites are important parts of the Wenatchee program, with 40% of the planned releases for the entire Wenatchee basin. However, roads to the high quality habitat areas are closed in winter. As a result, releases in the lower section of the river, at the Chiwawa Acclimation Facility and Clear Creek, are proposed. One upstream acclimation location, Chikamin, would be accessed with snowmobiles or after the snow clears in spring.

The Little Wenatchee River site also has winter access problems. Acclimation is proposed in the more accessible lower part of the habitat.

Habitat analysis and capacity estimates indicate that the White has significant amounts of coho habitat. Winter access to most of that habitat is good. The road is plowed up to Tall Timber Ranch (RM 10). There are a limited number of small tributaries and no existing ponds that are accessible. Therefore, a conventional, standard acclimation facility with a pumped water supply is proposed on the White.

Nason Creek has an existing site at the upper end of the low slope section that is capable of winter operation. The purpose of the Rohlfing site, which is currently being used by this project, will be to disperse adults into downstream areas. The Coulter/Roaring site that is also existing and being used is further downstream and discharges into a large beaver pond complex that is expected to be productive rearing habitat.

Table 5. Wenatchee Acclimation Proposed Alternative, NPIP

Stream Location / *Site*	*Total for Stream* / *Type of Site*	*Water Supply (G = Gravity, P = Pumped)*	*Overwinter Acclimation*	*Short-term Acclimation*
Icicle	*75,000*			
Icicle	Existing	P ground & P surface	75,000	
Nason	*210,000*			
Rohlfing	Existing pond	P ground & G surface	105,000	
Coulter/Roaring	Existing pond	G surface		105,000
White	*210,000*			
Tall Timber	Constructed facility	P ground & P surface	210,000	
Upper Wenatchee	*100,000*			
Beaver	Existing pond	G surface		100,000
Chiwawa	*440,000*			
Clear Creek	Existing pond	G spring	170,000	
Chiwawa	Constructed pool	G surface	170,000	
Chikamin	Constructed pool	G surface		100,000
Little Wenatchee	*120,000*			
Two Rivers	Existing pond	P ground & P surface		120,000
TOTALS	**1,155,000**		**730,000**	**425,000**

2. Methow

A total of 9 release locations are proposed for the Methow watershed. Five of the release locations are existing ponds, two are constructed habitat projects, one is a new, pumped water site on the upper Methow River, and one is a site that requires a new pumped water supply. Over half of the releases are from sites that are capable of overwinter acclimation.

During the winter, the Chewuch River Road is plowed up to Eightmile Creek, which is in the upper half of the low slope reach. Releases at Eightmile are proposed as a result, from one of the constructed habitat projects.

The Twisp River has good road access and some existing ponds in potential habitat areas. The Lincoln site has existing ponds but water must be pumped to them. The location in the upstream part of the low gradient section of the Twisp and the plowed access road make it a valuable release location. Poorman is downstream of most of the low gradient section but has existing ponds as well.

The upper and mid mainstem Methow presents some unique challenges and opportunities. The river above Weeman Bridge to the mouth of the Lost River goes dry periodically. However, coho will be able to access the area after fall rains improve passage. The Goat Wall release site is proposed to encourage seeding of this area. Below Weeman Bridge, surface recharge creates several large springs. Hancock Springs and springs on Heath and Big Valley ranches create important spawning and rearing habitat. Constructed habitat and long-term acclimation sites are planned for this area.

The Winthrop NFH is both a rearing and release facility. Winthrop NFH is near habitat areas and will be an important contributor to both brood collection and habitat seeding objectives.

Table 6. Methow Acclimation Proposed Alternative, NPIP

Stream Location / *Site*	*Total for Stream* / *Type of Site*	*Water Supply (G = Gravity, P = Pumped)*	*Overwinter Acclimation*	*Short-term Acclimation*
Chewuch	*325,000*			
Eight Mile	Constructed habitat	P ground & G surface	200,000	
Ramsey	Existing pond	G surface		125,000
Twisp	*275,000*			
Poorman	Existing pond	G spring		137,500
Lincoln	Existing pond	P surface	137,500	
Wolf Creek	*50,000*			
Biddle	Existing pond	G surface		50,000
Upper and Mid Main.	*350,000*			
WNFH	Existing pond	G surface & P ground	100,000	
Heath Ranch	Constructed habitat	G surface & G ground	100,000	
Hancock	Constructed pool	G spring	100,000	
Goat Wall	Constructed pool	P surface & G ground		50,000
TOTALS	**1,000,000**		**637,500**	**362,500**

B. STEP 2 SITE EVALUATIONS

Future facility work supporting the Step 2 NPPC step review process will include the collection of data on high priority locations and their alternatives. Information such as the following will be collected and evaluated:

- Road access.
- Presence of listed species.
- Presence of survey and manage species.
- Proximity to natural coho spawning and rearing habitat.
- Water flow, temperature, and quality.
- 100-year flood elevations and topographic data.
- Ground water availability and withdrawal impacts.
- Land ownership and zoning.
- Environmental land conditions and previous uses.
- Other environmental data: Wetlands, Cultural resources, etc.

VI. *ATTACHMENTS*

1. COST COMPARISON DETAIL

These cost estimates were used to evaluate acclimation system options.

a. Capital

Recent acclimation projects (see the table below) in the region are used for capital cost estimating purposes. Although they are not all coho facilities, a capacity for each site using similar criteria (5.4 smolts per cubic ft of rearing volume, or .3 lbs/ft^3, or a DI of .05) is calculated in the last column for comparison purposes. Costs are for construction only.

Table 7. Acclimation Sites Used for Cost Estimating

ACCLIMATION SITE	Type	Size (cft)	Construction Cost (2005 $)	Coho Capacity
Coulter	Existing natural pond, gravity flow	20,000	$5,000	100,000
Rohlfing	Constructed pool, gravity flow	36,000	$20,000	120,000
Carlton	Constructed acclimation facility, pumped	53,000	$780,000	176,667
Twisp	Constructed acclimation facility, gravity flow	22,000	$470,000	73,333
Chief Jo (ea)	Constructed acclimation facility, pumped	53,000	$590,000	176,667
Dungeness	Constructed natural habitat, gravity	87,000	$400,000	20,000
Cle Elum (ea)	Concrete raceways, pumped	27,000	$1,600,000	145,800

Original costs are updated to 2005 dollars by assuming an annual interest rate of 3% (the historic, average, effective rate).

In the tables below (Table 7), site construction costs were estimated by scaling the above sample project costs to the various fish production capacities used in evaluating acclimation alternatives 1, 2, and 3. Table 8 shows the number of smolt releases per site for each alternative. A total release number of 2,000,000 was used in the evaluation. The scaling assumes that 40% of the construction costs are independent of numbers of fish acclimated (fixed costs include contractor bonding, equipment mobilization, etc.) and the other 60% are a function of fish production quantities. The scaling formula:

Table 7 Construction Cost =

(Table 6 Construction Cost)/[(0.4+(0.6 x Table 7 Fish Numbers)/Table 6 Fish Numbers]

is used to estimate the construction costs in Table 7. The accuracy of the formula can be demonstrated by applying it to constructed facilities of similar design with different production numbers.

Costs for design and contingencies for all sites are estimated to be 50% of construction costs. This includes engineering design (15%) and construction management (5%). Permit costs are assumed to be low for the existing ponds and higher for increasing amounts of construction. Permits include water rights, HPA, shorelines, critical areas, floodplain, wetlands, and local construction permits.

Land purchase costs, except for the constructed habitats, are assumed to average $250,000 for a 5-acre lot. This is a value derived from a survey done by Yakama Nation Fisheries staff of waterfront, undeveloped property sales in the region. In the areas where acclimation sites are proposed, 5-acre lot size minimums apply in most cases. The constructed habitats will need to be built on sites larger than 5 acres, lot sizes of 20 acres are assumed.

Facility permit costs are assumed to be $5,000 per site for the existing ponds and $10,000 per site for the constructed pools. The other alternatives, which require water supply and major rearing unit construction, are assumed to have $25,000 per site in permit costs. These permit and study costs were based on similar projects completed by the MCCRP and Yakama Nation in the recent past (see Appendix D).

Table 8. Typical Acclimation Site Capital Costs

DEVELOPMENT COSTS FOR SITES WITH A SMOLT CAPACITY OF: 182,000

ACCLIMATION TYPE	Design & Contingency	Permits	Land	Construction	**TOTAL**
Existing natural pond, gravity flow	$ 3,450	$ 5,000	$ -	$6,900	**$ 15,000**
Constructed pool, gravity flow	$ 12,500	$ 10,000	$ 250,000	$25,000	**$ 298,000**
Constructed acclimation facility, pumped	$ 397,000	$ 25,000	$ 250,000	$794,000	**$ 1,466,000**
Constructed natural habitat, gravity	$ 429,000	$ 25,000	$ 400,000	$858,000	**$ 1,712,000**
Concrete raceways, pumped	$ 908,500	$ 25,000	$ 100,000	$1,817,000	**$ 2,851,000**

DEVELOPMENT COSTS FOR SITES WITH A SMOLT CAPACITY OF: 91,000

ACCLIMATION TYPE	Design & Contingency	**Permits**	Land	Construction	**TOTAL**
Existing natural pond, gravity flow	$ 2,350	$ 5,000	$ -	$4,700	**$ 12,000**
Constructed pool, gravity flow	$ 8,400	$ 10,000	$ 250,000	$16,800	**$ 285,000**
Constructed acclimation facility, pumped	$ 249,250	$ 25,000	$ 250,000	$498,500	**$ 1,023,000**
Constructed natural habitat, gravity	$ 376,050	$ 25,000	$ 400,000	$752,100	**$ 1,553,000**
Concrete raceways, pumped	$ 587,650	$ 25,000	$ 100,000	$1,175,300	**$ 1,888,000**

DEVELOPMENT COSTS FOR SITES WITH A SMOLT CAPACITY OF: 61,000

ACCLIMATION TYPE	Design & Contingency	**Design & Permits**	Land	Construction	**TOTAL**
Existing natural pond, gravity flow	$ 1,800	$ 5,000	$ -	$3,600	**$ 10,000**
Constructed pool, gravity flow	$ 6,500	$ 10,000	$ 250,000	$13,000	**$ 280,000**
Constructed acclimation facility, pumped	$ 182,500	$ 25,000	$ 250,000	$365,000	**$ 823,000**
Constructed natural habitat, gravity	$ 335,000	$ 25,000	$ 400,000	$670,000	**$ 1,430,000**
Concrete raceways, pumped	$ 436,000	$ 25,000	$ 100,000	$872,000	**$ 1,433,000**

Values in the last column in Table 8, Capital Cost/Site, are taken from Table 7 above. Alternative 1 is existing natural ponds with gravity flow, Alternative 2 is constructed pools with gravity flow, and Alternative 3 is constructed acclimation facilities with pumped water supplies (see IV.B.2 for details).

Table 9. Acclimation Alternative Details

	# of Sites	# of Fish per Site	Capital Cost per site
Alternative 1	33	61,000	$10,000
Alternative 2	22	91,000	$285,000
Alternative 3	11	182,000	$1,466,000

b. Operating

Operating cost estimates are based on current program expenses. The 2006 MCCRP acclimation budget totals $220,866 (from the 2006 MCCRP Budget). The estimated budget for the year 2012 is $322,916 (see Appendix D). During 2006, 6 acclimation sites will be operated and in 2012, 18 will be operated. The cost of operating those 12 additional sites is $8,504 each. This cost per site value was used to make the calculation in the “Cost of Additional Sites” column in Table 9. This amount is added to the 2006 base price to estimate the total operating cost for each alternative.

Table 10. Alternative Acclimation System Yearly Operating Costs

	Number of Sites	2006 Acclimation Cost	Cost of Additional Sites	**TOTAL ACCLIMATION**
Current Program	6	$ 220,866	$ -	**$ 220,866**
Alternative 1	33	$ 220,866	$ 229,612	**$ 450,478**
Alternative 2	22	$ 220,866	$ 136,067	**$ 356,932**
Alternative 3	11	$ 220,866	$ 42,521	**$ 263,387**

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MCCRP SITE DESIGN REPORTS

APPENDIX C.1. WENATCHEE AND COLUMBIA REARING FACILITIES

Yakama Nation Fisheries Resource Management

CONTENTS

List of Figures

I. *INTRODUCTION*

This report presents site information for proposed Mid-Columbia coho program rearing facilities located in the Wenatchee subbasin and on the lower Columbia River. The Wenatchee facilities will produce fish (adult spawning, early incubation, and acclimation) for release in the Wenatchee subbasin. The lower Columbia hatcheries will rear fish (hatching through pre-smolt) for release in both the Wenatchee and Methow. A separate report describes proposed Methow subbasin rearing facilities. Following is a list of master plan facility appendices, with this appendix highlighted.

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    C.3 WENATCHEE ACCLIMATION FACILITIES
    C.4 METHOW ACCLIMATION FACILITIES
D. PROJECT SCHEDULE AND COSTS

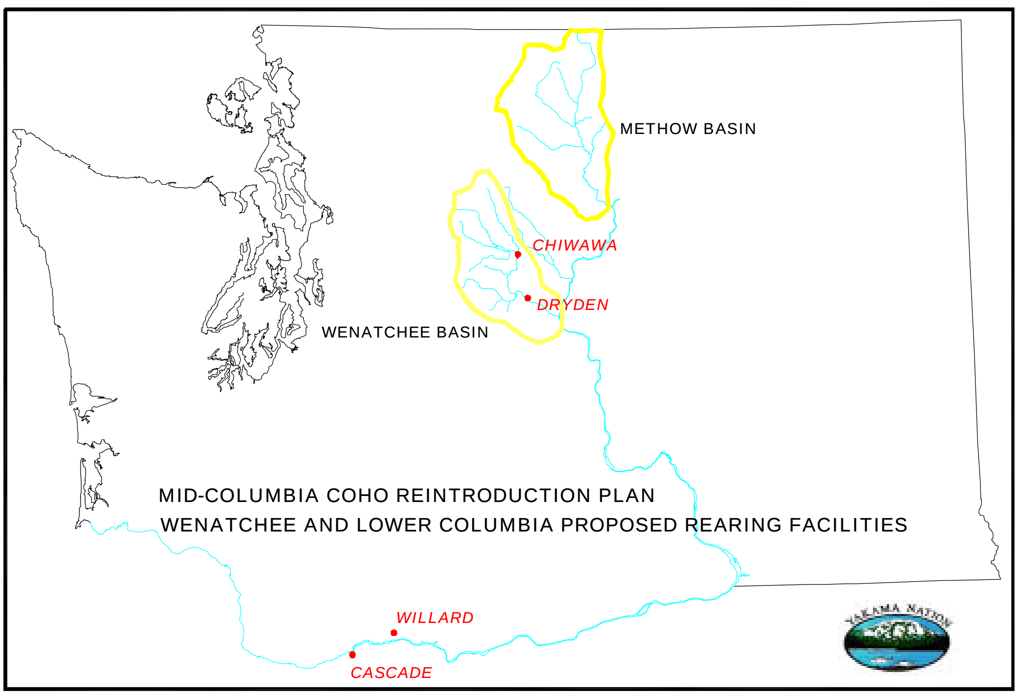


Figure 1. Location Map

II. ***PROPOSED REARING FACILITIES***

For the duration of the program, project proponents propose to continue to rear coho at the existing Willard National Fish Hatchery and Cascade Fish Hatchery on the lower Columbia River. However, due to the distance of these hatcheries from the Wenatchee basin, adult holding and early incubation will need to be done at other locations. Currently, Entiat NFH is being used for these functions; however, Entiat NFH is being considered for a programmatic change which would preclude its use by the MCCRP during the fall.

A. ADULT HOLDING AND INCUBATION FACILITY

A new, small adult holding and early incubation facility is proposed on the Wenatchee River. This facility would provide a centrally located site for handling the valuable local broodstock and incubation of eggs to the eyed stage.

1. DRYDEN

The preferred location for this facility is near Dryden Dam at the mouth of Peshastin Creek. Ground water supplies would be developed to supply adult holding raceways and incubators. The site is in a location that would allow the development of rearing capacity with a surface water intake in the future, if required.

a. Facility Requirements

? Site functions: The Dryden facility would perform limited 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 they would be moved to the two lower river facilities, Cascade FH and Willard NFH, for hatching and early rearing.

? Production numbers: 1,300 adults and 1,300,000 eyed eggs.

? Development timing: Current plans call for hatchery construction to start during the second quarter of 2008, testing to occur in 2009, and operation to begin in 2010.

Period	Rearing Unit	Water Source	Water Temp. (° F)	Number Trucked	Number at Hatchery at Month End	Fish Size lbs	Fish Size #/lb	Fish Size inch	Flow Index	Vol. Index	Flow Density lbs/gpm	Volume Density lbs/cft	Weight at Hatchery lbs	Min. Flow gpm	**Min. Flow cfs**	Min. Volume cft	**# of Units**
10/1	Adult	Ground	48		1,248	7								624	**1.4**	4,992	**2**
11/1	Adult	Ground	48		1,248	7								624	**1.4**	4,992	**2**
12/1	Inc	Ground	45		1,300,000									58	**0.1**		**10**
1/1	Inc	Ground	45		1,275,625									57	**0.1**		**10**
2/1	Inc	Ground	45		1,251,707									56	**0.1**		**10**
3/1	Inc	Ground	45		1,228,238	0.001	1000	1.49	1.09	0.17	1.6	0.25	1,228	55	**0.1**		**10**
4/1	Inc	Ground	45		1,205,208	0.001	1000	1.49	1.09	0.17	1.6	0.25	1,205	54	**0.1**		**9**

PROGRAM INPUTS		
ADULTS		
Adult size:	7	lb
Eggs per female:	2500	
Adult loss during holding:	20%	
Pond space per fish	4	cft
Water flow per fish	0.5	gpm
Adult water pond volume:	3000	cft
INCUBATION		
Inc. capacity (#/per tray)	9,000	
Max. eggs/stack	135,000	
Water flow per full stack	6	gpm
REARING		
Number released:	1,000,000	
Inc. to release mort.:	30%	
Raceway Vol. Index:	1.0	
Pond Volume Index:	0.3	
Flow multiplier	2.0	
Volume multiplier	6	
Trough water volume:	189	cft
Raceway water vol.:	3000	cft
Pond water volume:	15750	cft

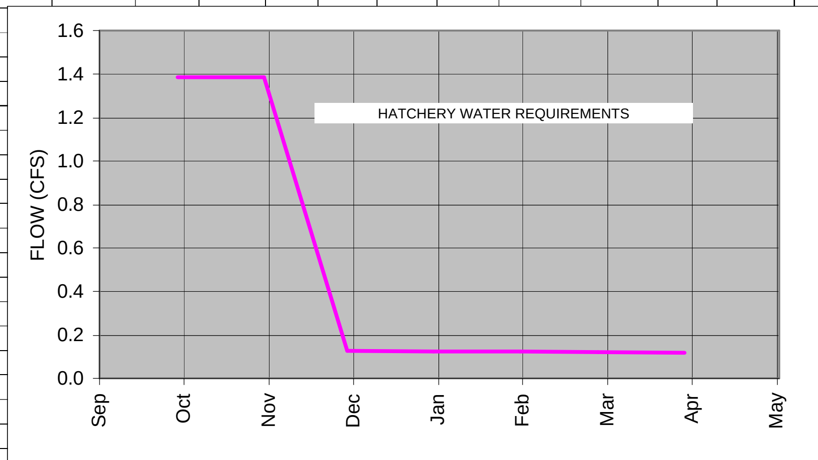


Figure 2. Dryden Water and Space Programming

b. Site Information

- Location, elevation: Near the mouth of Peshastin Creek; in T24N, R18E, SW ¼ of S22 in Chelan County; adjacent to Dryden Dam; elevation 980 feet.
- Tributary of: The Wenatchee at river mile 18.
- Ownership: The 8.5-acre Washington State Department of Transportation (WSDOT) property (see Figure 4), is lot number 241822745006, zoned Commercial Agricultural Lands (AC). The 15.5-acre Willow Springs Orchards property (see Figure 4) is lot number 241822745055, zoned Rural Residential /Resource (RR2.5).
- Geotechnical conditions: Soils are likely AASHTO classifications A-1 to A-2.
- Critical areas designation: Unknown.
- Flood designation: Zone X500 (between 100 and 500 year floods). The proposed site sits on a bench that is 20 to 40 feet above the Peshastin Creek delta. Construction in this area will allow the hatchery to sit above the 100-year flood elevation without placing fill in the floodplain.
- Current land use: The proposed hatchery site is an orchard; the proposed infiltration gallery area is used by WSDOT for storage of highway sand.
- Access: Plowed, paved roads.

- Utilities: 3-phase power is available at the nearby Dryden right bank ladder facility; telephone lines at the road could be brought into the facility.
- Trucking distances: Approximately 40 miles from the upstream acclimation sites on the White, Chiwawa, and Little Wenatchee rivers and Nason Creek.

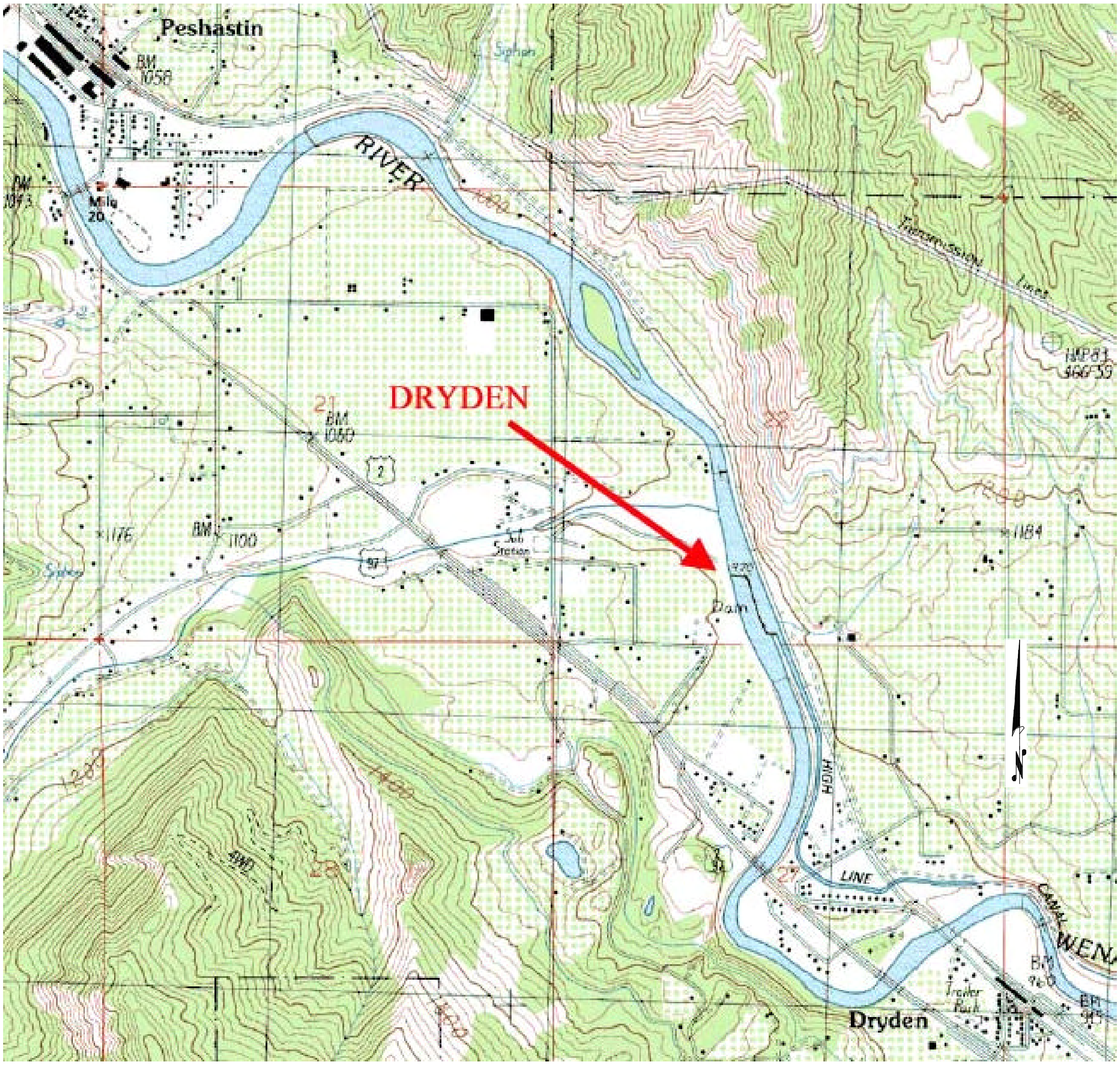


Figure 3. Dryden USGS Map

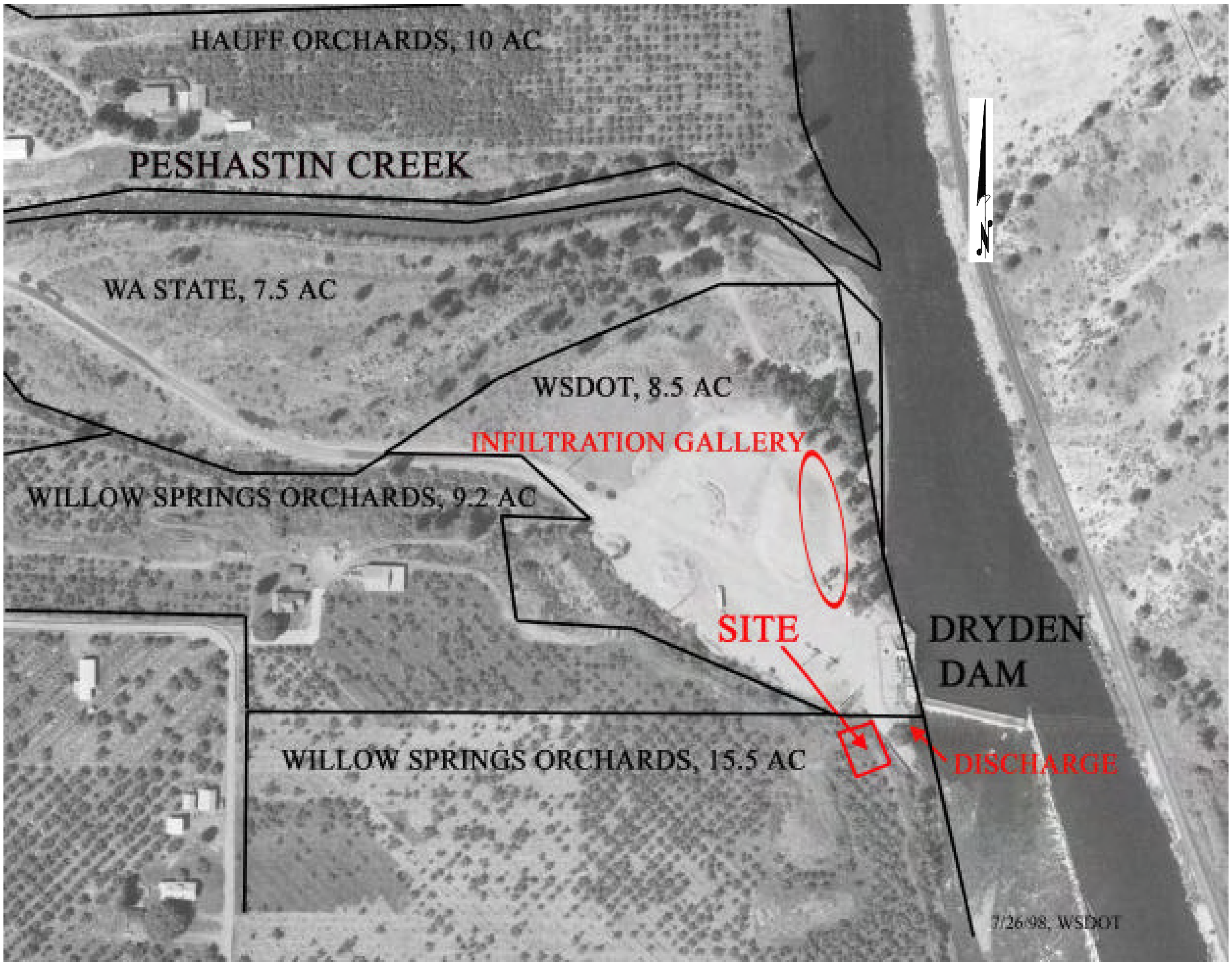


Figure 4. Dryden Aerial Photo

Figure 5. Dryden Oblique Aerial

Figure 6. Dryden Site Photo

c. Water Supply

? Groundwater availability: The geology of the site suggests productive groundwater conditions. Historic gravel deposition at the Peshastin alluvial fan may have left thick layers of clean gravel.

? Groundwater withdrawal. An infiltration gallery is proposed, although deeper well water may also be available.

? Flood levels: The area where an infiltration gallery is proposed is within the 100-year flood boundaries; the facility site is above it.

? Groundwater temperature: Unknown, likely close to the average annual air temperature in the area, 48° F at Dryden (data from the Western Regional Climate Center).

d. Proposed Design

? Water supply: Water from the infiltration gallery would be piped to the facility site, then run through a packed column to put it into gas equilibrium with air.

? Adult holding: 3 concrete raceways (the 2 required plus a back-up), will be available for holding adults. Multiple divisions in the raceways will allow fish at different levels of development to be held separately.

? Incubation: 10 vertical stack incubators will be capable of incubating 1,300,000 coho eggs.

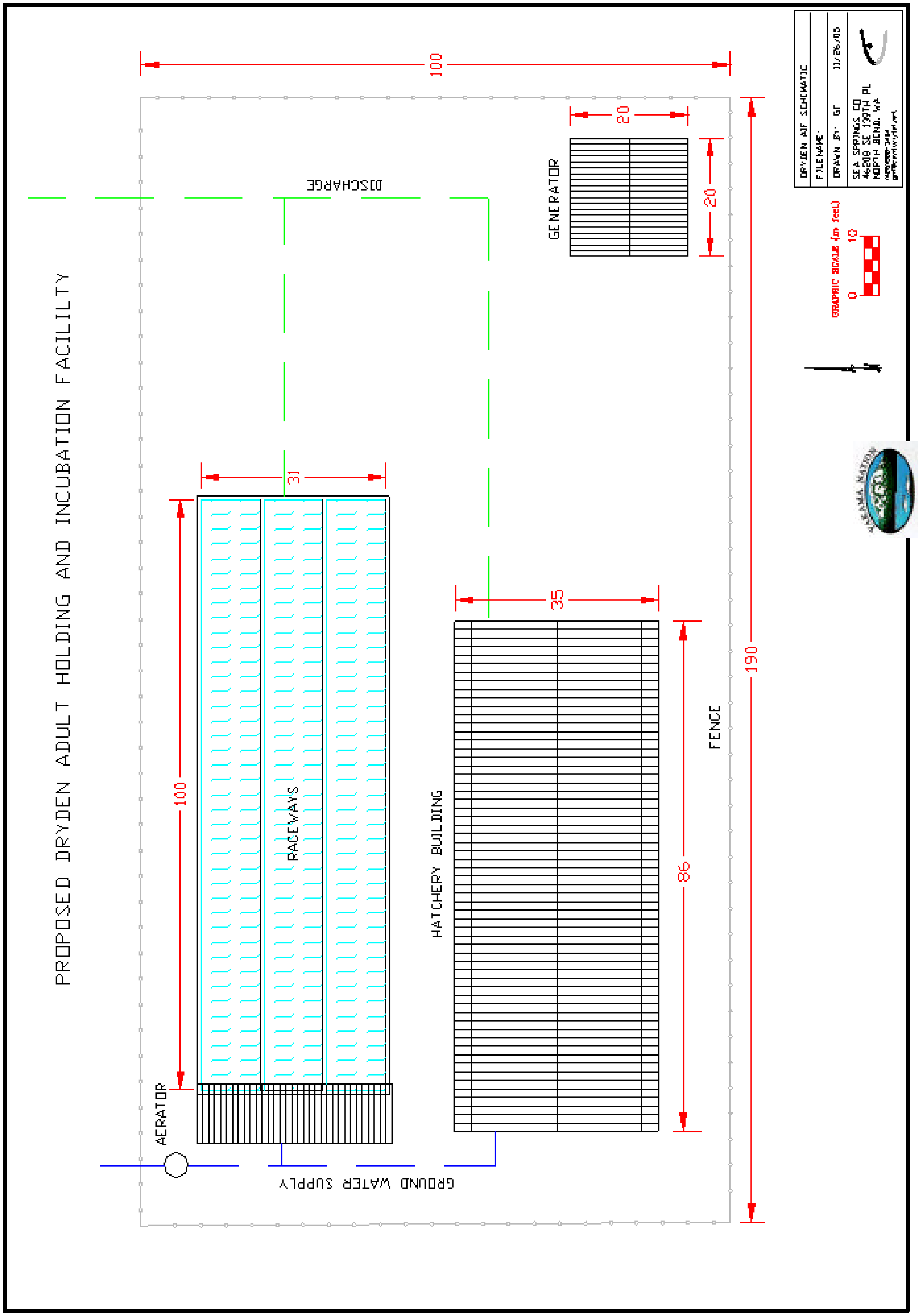
? Water discharge: Return of water to the Wenatchee is proposed at the Dryden right bank ladder entrance to improve attraction for returning fish.

? Predator control, cover: The site will be fenced and an overhead net system will be installed.

? Waste treatment: Adults will not be fed so raceway discharge will not be treated. Incubation effluent will require formalin removal. This will be done in the facility building.

? Facility size: The proposed layout requires 19,000 square feet (0.4 acres) of land.

? Site plan: See Figure 7.


PROPOSED DRYDEN ADULT HOLDING AND INCUBATION FACILILTY
100
DISCHARGE
GENERATOR
20
20
31
100
RACEWAYS
35
HATCHERY BUILDING
86
FENCE
190
AERATOR
GROUND WATER SUPPLY
DRYDEN AJF SCHEMATIC
FILENAME:
DRAWN BY: GF
11/26/05
SEA SPRINGS CO
46200 SE 139TH PL
NORTH BEND, WA
GRAPHIC SCALE (in feet)
0
10

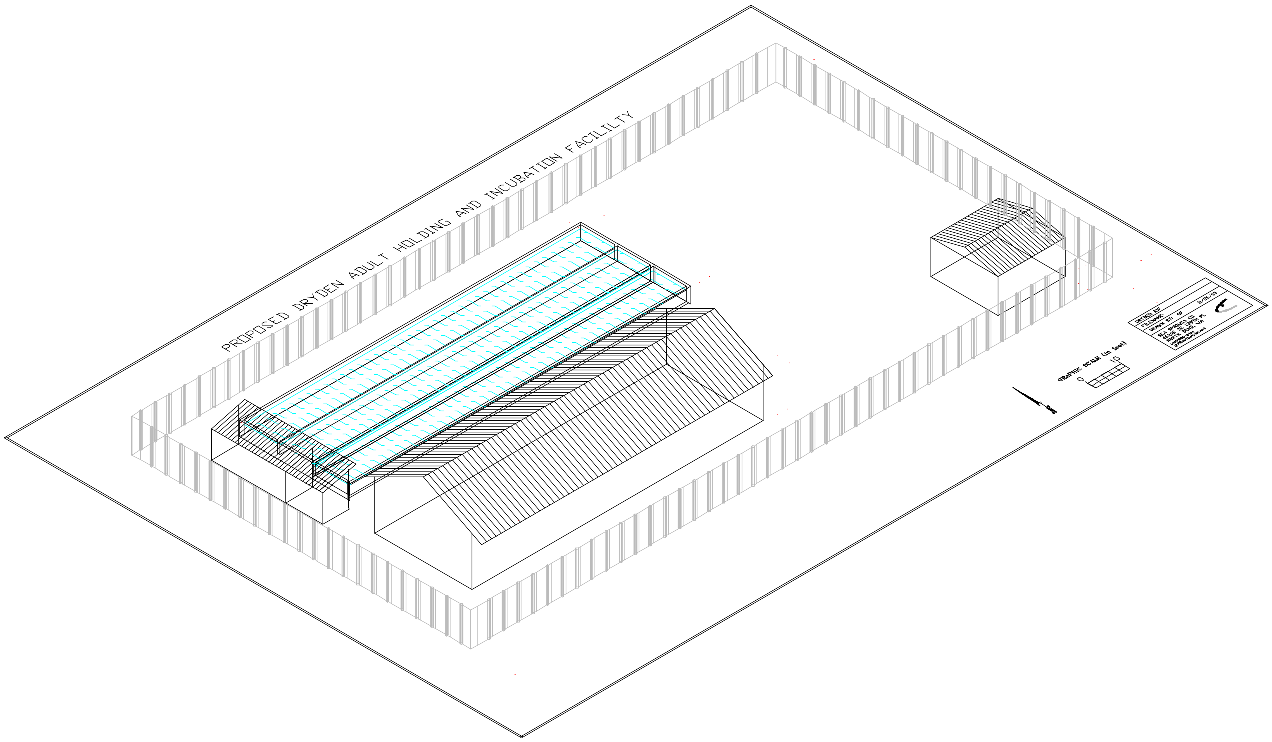


Figure 7. Dryden Facility Plan

e. Environmental Issues

- Listed species: Bull trout, steelhead, and spring chinook migrate through the Wenatchee River but would not be adversely affected by the facility. The water intakes from the Wenatchee and Peshastin Creek would meet NMFS screening and design criteria for listed fish (NMFS 2004).
- Floodplains: The facility structures will be outside the 100-year floodplain and the infiltration gallery will be below grade, resulting in no net impact to flood storage capacity.
- Water rights: Due to the presence of a large number of wells in the area and the potential large hatchery withdrawals, well operation may affect surrounding property owners. An infiltration gallery would have less impact on deeper aquifers because it draws water from a surface aquifer that is recharged by surface water. Hydrologic impacts on flow in Peshastin Creek are possible and will need to be evaluated.
- Other fish operations: Other fish operations upstream of the proposed site will not likely impact operation of this coho facility. The only fish facility in the vicinity is Chelan PUD's Dryden Summer Chinook Acclimation Pond, which is located across the Wenatchee River (left bank) and downstream a half mile. However, the water intake for this acclimation pond is upriver of the proposed Dryden site, and the summer chinook acclimation facility is not used during the months the proposed facility would be used, so discharge from the proposed facility would not impact the PUD acclimation pond.

f. Development Risks

- Groundwater availability: Lack of groundwater would prevent development of the site; however, geologic conditions (see c. above) are favorable for groundwater development.
- Water quality: Use of agricultural chemicals in nearby farmland could adversely affect water quality at the proposed facility.

- Other permits: A general permit summary is included in Attachment 1. Because the required environmental processes would not be completed until later phases of the decision-making process, risks exist of not being able to obtain some of these required permits. Risks include local property owner opposition. Farmers may be threatened by fish restoration projects in general if they believe that their irrigation water rights will be reduced because of minimum instream flow requirements for fish.
- Land availability: Negotiations with the private land owners for use of the hatchery property, with Chelan PUD for construction near the Dryden ladder, and with WSDOT for use of land for infiltration gallery construction would not be conducted until later phases of the decision-making process; therefore, availability of these properties is not yet known.

2. ALTERNATIVE

A site on the Chiwawa River immediately adjacent to the existing Chelan Public Utility District (PUD) Chiwawa Acclimation Pond is identified as an alternative to Dryden. Dryden has been selected as the preferred option because development risks, particularly land ownership, are somewhat lower than for Chiwawa. Development risks, including ownership issues, are detailed below.

Site Information

- Location, elevation: Near the mouth of the Chiwawa; in T27N, R17E, SE ¼ of S36 in Chelan County; adjacent to the Chiwawa acclimation facility; elevation 1,870 feet.
- Tributary of: The Wenatchee at river mile 49.
- Ownership: Parcel 271736100000 is a 538 acre site owned by the USFS, ownership boundaries are shown on Figure 8. The Chiwawa intake is on a parcel (26170121025) owned by Chelan County PUD. (See also: Figure 9).
- Geotechnical conditions: Site development is not limited by physical terrain characteristics. Soils are likely AASHTO classifications A-1 to A-2.
- Zoning: Rural Residential /Resource (RR20).
- Critical areas designation: Unknown.
- Flood designation: Zone X500 (between 100 and 500 year floods).
- Current land use: Forested with an acclimation site adjacent to the proposed hatchery site. Recreation and permanent homes are located within a thousand feet.
- Access: Plowed, paved roads.
- Utilities: 3-phase power and telephone are available at the acclimation site.
- Expansion capability: Land would be available for expansion.
- Trucking distances: Within 20 miles of the upstream acclimation sites on the White, Chiwawa, and Little Wenatchee rivers and Nason Creek.
- Current rearing capacity: None.

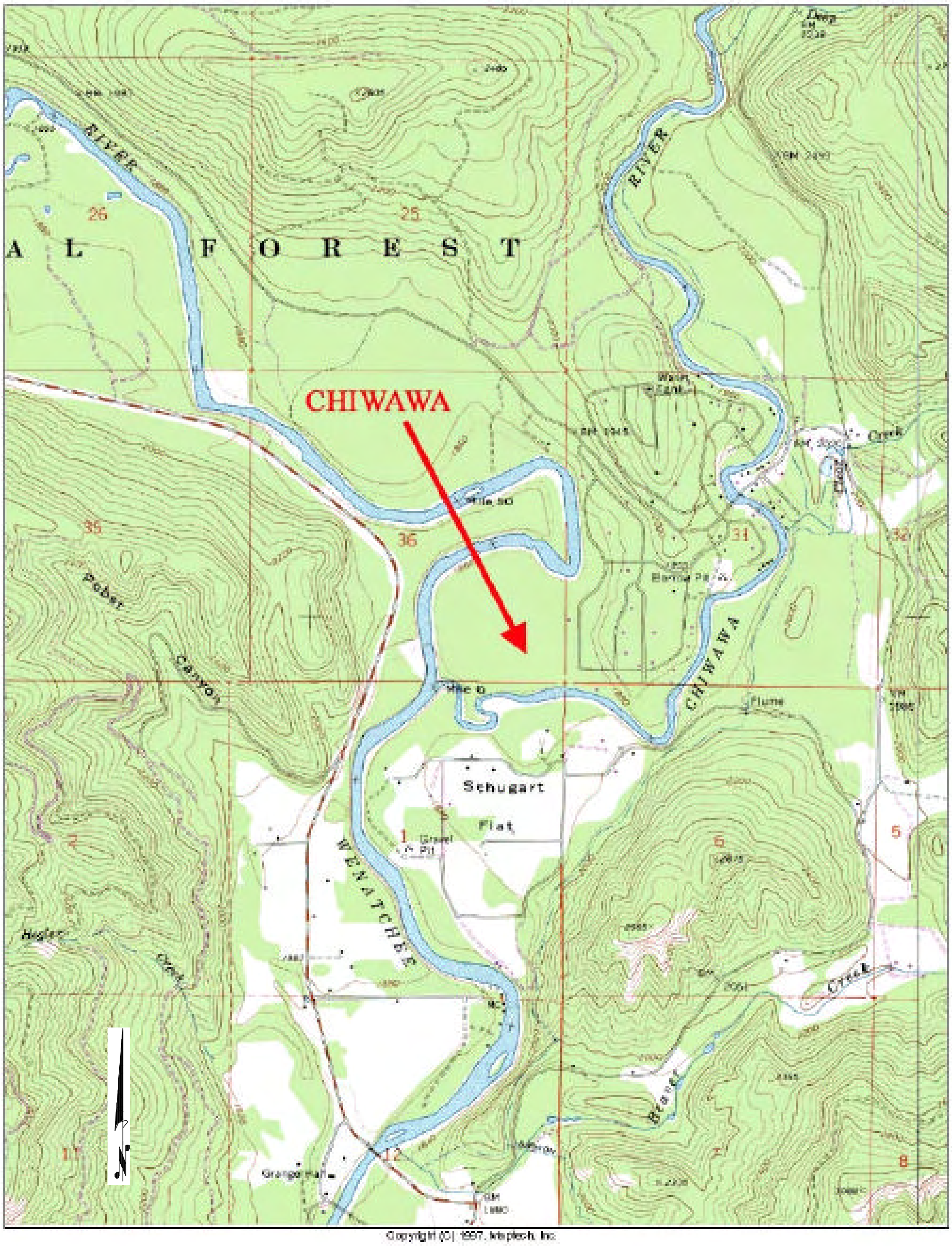


Figure 8. Chiwawa USGS Map

Water Supply

? Groundwater availability: GeoEngineers (2002) suggested that the geology of the site could produce significant amounts of groundwater. Historic gravel deposition at the Chiwawa alluvial fan may have left thick layers of clean gravels. However, 6 test wells to depths up to 90 feet were drilled in the vicinity of the acclimation site in 1988 and none produced more than 50 gallons per minute (gpm). A shallow infiltration gallery may be more likely to produce larger quantities of water due to geologic conditions.

- Groundwater temperature: Unknown, likely close to the average annual air temperature in the area, which is 45° F at Plain (data from the Western Regional Climate Center).

Environmental Issues

- Listed species: The area is potential wolf, lynx, grizzly bear, bald eagle, spotted owl, Nelsons checker-mallow, and Ute ladies'-tresses habitat. The site is within spotted owl reserve habitat designated by the USFS; the construction or presence of a coho facility could disturb owls. Bull trout, steelhead, and spring chinook exist in the Chiwawa and Wenatchee rivers. During the feasibility phase of the mid-Columbia coho program, negative interactions between hatchery coho and other fish species were found to be unlikely (see Chapter 3 of the master plan). Project proponents propose to monitor negative effects of naturally produced coho on ESA-listed and other sensitive species (see Chapter 7 of the master plan). Analysis of facility development effects on other ESA-listed and USFS sensitive species would be done during the NEPA process that must be completed before final location decisions are made.
- Site development: Infiltration gallery and facility construction require that vegetation be disturbed. Listed species might be found at these sites, which must be surveyed and evaluated during the NEPA process, as discussed above.
- Water rights: Impacts of withdrawals from the shallow aquifer are likely to be minimal. Hydrologic impacts to flow in the Chiwawa are possible and will need to be evaluated.
- Wetlands and floodplains: A wetlands survey has not been done on the site. Because the potential gallery is close to the river's edge, wetlands could be present. A survey is needed to determine if there are wetlands. The site is out of the 100-year floodplain.
- Other fish operations: There are no fish production facilities upstream of the proposed site and there are no downstream facilities within 15 miles that would be impacted by the hatchery discharge. Though water intakes and discharge could potentially be shared with Chelan PUD's spring chinook facility, the coho facility would be physically isolated to prevent pathogen transfer

Development Risks

- Groundwater availability: Lack of groundwater would require that surface water be used for adult holding and incubation. This is an acceptable alternative.
- Other permits: Local property owners may oppose expansion of the fish rearing operations at Chiwawa for reasons similar to those described for the Dryden facility. The USFS may oppose construction of an infiltration gallery or the facility itself in spotted owl reserve habitat. A general permit summary is included in Attachment 1. Because the required environmental processes would not be completed until later phases of the decision-making process, risks exist of not being able to obtain the required permits.
- Land availability: Negotiations with the USFS for use of the hatchery property and with Chelan PUD for use of the infiltration gallery property would not be conducted until later phases of the decision-making process, so availability of these properties is not yet known.

B. LOWER COLUMBIA RIVER

1. CASCADE HATCHERY

The Mid-Columbia coho program master plan calls for the continued production of 700,000 pre-smolts from Cascade Hatchery for the life of the proposal. The Methow would receive 550,000 of these and the Wenatchee 150,000.

The Cascade Fish Hatchery was authorized under the Mitchell Act and began operating in 1959 as part of the Columbia River Fisheries Development Program. It is operated by the Oregon Department of Fish and Wildlife (ODFW). The hatchery is supplied with surface water from Eagle Creek and has full rearing capability, with the following facilities (information from IHOT 1996):

? Adult holding: 1 concrete adult holding pond - 22,500 cubic feet

? Incubation: Vertical stack incubators

? Raceways: 30 concrete raceways – 16 feet by 78 feet by 2.5 feet deep; 3,120 cubic feet each (see Figure 11). Figure 12 shows raceways and frames for predator nets and overhead covers

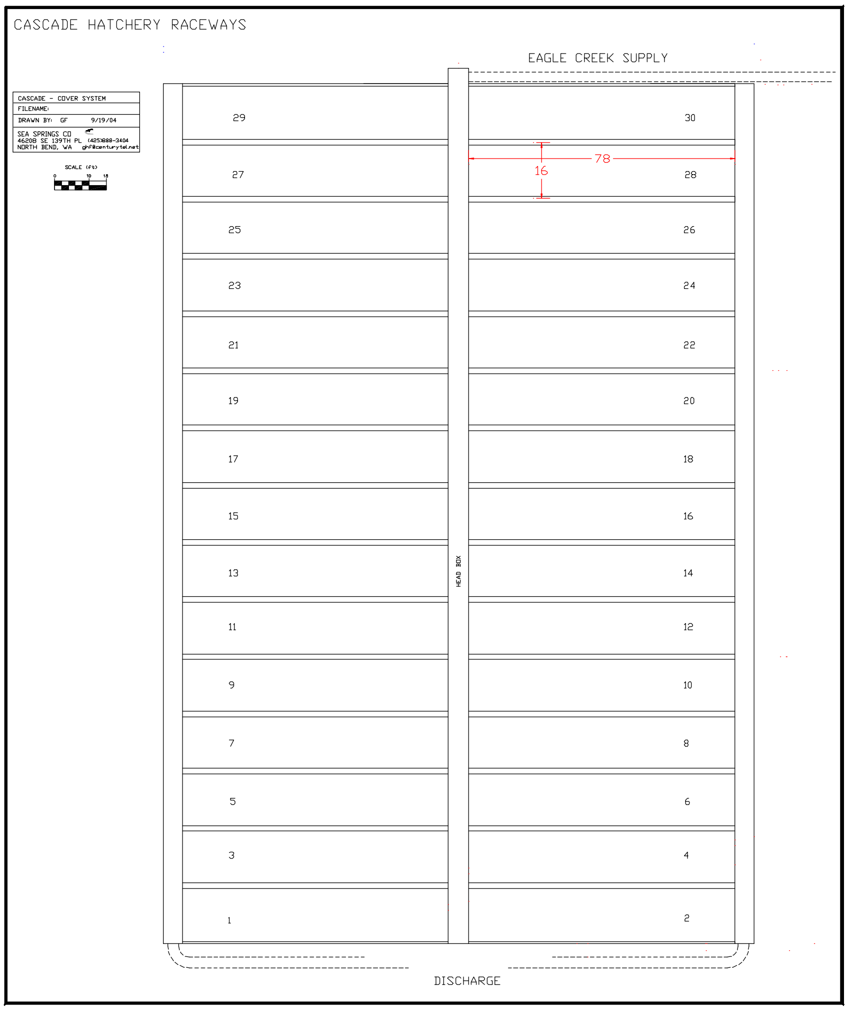


Figure 9. Cascade Hatchery Raceways

Figure 10. Cascade Raceways and Net Frame Photo

(raceways 2,4,6 without overhead cover or predator nets in place)

The 2005 production goals are 700,000 coho for the mid-Columbia coho program, 1,000,000 coho for the Confederated Tribes of the Umatilla Nation, and 600,000 coho for the Clatsop Economic Development Commission. Water is supplied by gravity from Eagle Creek. The total water right is 20,200 gpm (45 cfs) with an actual average water usage of about 7,117 gpm (16 cfs). Typical Eagle Creek water temperatures 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 produce smolts that survive to adulthood in high numbers (Appendix A).

Fish will need to be trucked up to 250 miles to the upstream acclimation/release sites on the White, Chiwawa, and Little Wenatchee rivers and Nason Creek.

In 2005, the Mid-Columbia coho program reared 700,000 pre-smolts in 8 raceways, or 87,500 fish per rearing unit. Fish sizes for the March transport dates average 20/lb (4,375 lbs/raceway), resulting in volume densities in the raceways of 1.4 lbs per cft, typical for raceway culture but considerably higher than the MCCRP target value for new pond-based hatcheries (0.3 lbs per cft) due to space limitations.

2. WILLARD NATIONAL FISH HATCHERY

The mid-Columbia coho master plan calls for the production of 350,000 pre-smolts from Willard NFH for the Wenatchee program. Production from this facility would continue for the life of the program.

Willard NFH 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. It operates on surface water and has full rearing capability, with the following facilities (information from IHOT 1997):

- 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 (see Figure 13). Figure 14 shows raceways with overhead covers.
- 24 full stacks of vertical tray incubators (384 trays)

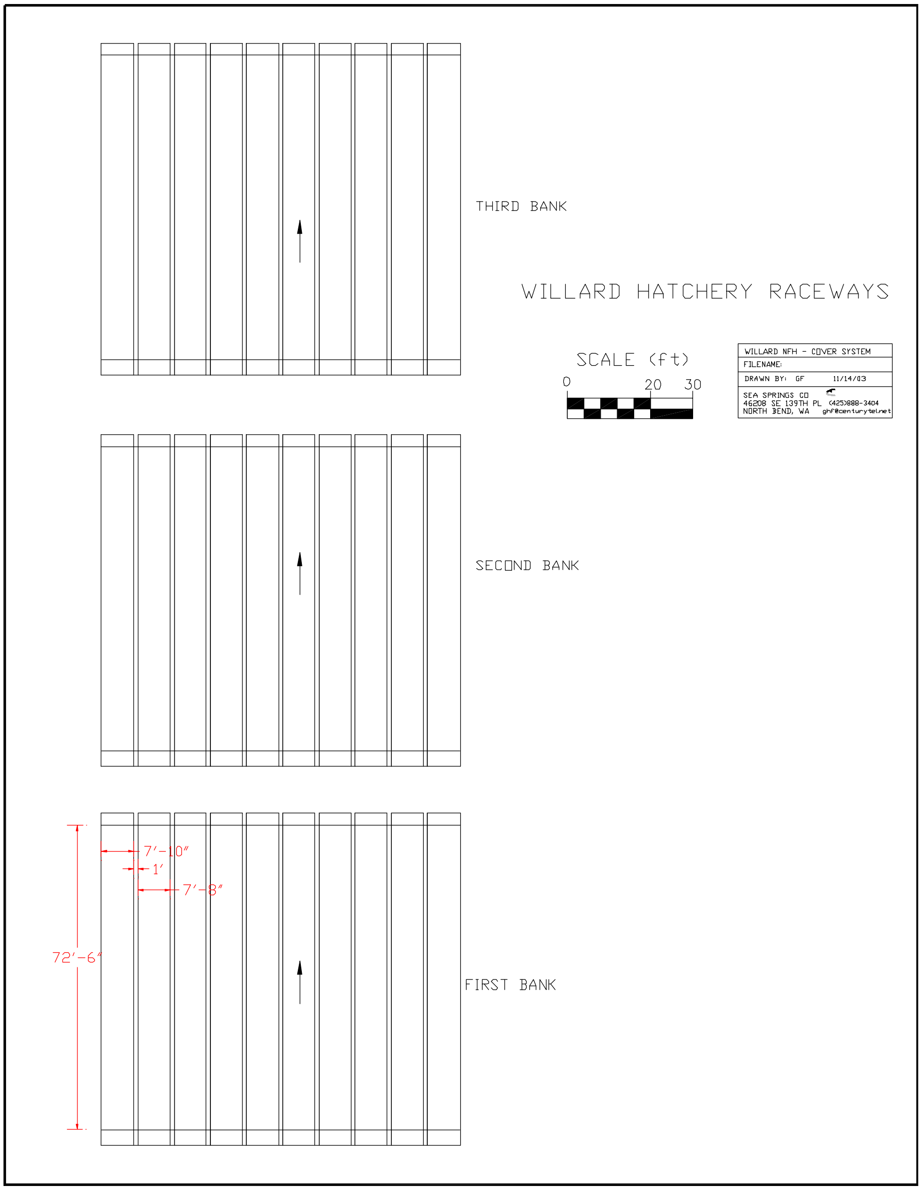


Figure 11. Willard Hatchery Raceways

Figure 12. Willard Raceways Photo

(bank 1 with overhead covers)

The 1997 hatchery production goal was 2,500,000 coho smolts, or 166,600 lbs. Current production is much lower than this and is focused on supporting tribal programs. In 2005 planned production from the hatchery is rearing 600,000 coho for the Mid-Columbia program.

The hatchery is exempt from an NPDES discharge permit because the effluent disappears into porous lava before reaching the Little White Salmon River. Cold water disease has been a problem in the past but is being controlled with improved fish culture techniques. Fish will need to be trucked up to 250 miles to the upstream release sites on the on the White, Chiwawa, and Little Wenatchee rivers and Nason Creek.

The concrete raceways are narrow and shallow, which may have a negative impact on smolt quality (Appendix A). The overhead covers are installed close to the water surface, providing effective shade. The general condition of the hatchery is good. A recent intake rebuild has improved water supply reliability.

Figure 13. Willard Intake

Water is supplied by gravity from the Little White Salmon River, along with some well and spring water for incubation and early rearing (about 1,500 gpm). Water use at the hatchery ranges from 11,221 (25 cfs) to 24,442 gpm (54 cfs). Typical Willard surface water temperatures vary little throughout the year; normally temperatures are between 6 and 8° C. The well water is 4.4° C in December.

The Little White Salmon River originates in the Gifford Pinchot National Forest west of Monte Cristo Peak. It drains 135 square miles of Skamania and Klickitat counties over a distance of approximately 19 miles. The topography in the watershed ranges from gentle slopes formed by lava flows and volcanic cones to steep rugged landforms. The relatively stable flow and temperature of the Little White Salmon indicates strong groundwater influences. Anadromous fish passage upstream of the Willard hatchery is blocked by a series of waterfalls. Therefore, transfer of fish pathogens into the hatchery water supply that could impact coho production is not possible.

Willard typically rears 35,000 coho smolts per raceway. Fish sizes for the March transport dates average 20/lb (1,700 lbs/raceway), resulting in volume densities in the raceways of 1.2 lbs per cft.

3. ALTERNATIVES

Other existing Mitchell Act hatcheries in the region have excess rearing capacity. Several facilities have been closed in recent years including Klaskanine, Gnat, Beaver, Stayton and Abernathy. Currently operating Mitchell Act hatcheries (Big, Elochoman, Coweeman, Lower Kalama, Kalama Falls, Lewis, Carson, Oxbow, Spring Creek, Bonneville, Skamania, Sandy, Clackamas, Eagle) are facing reduced production as funding for lower Columbia River releases is decreased. These facilities could potentially produce coho for the MCCRP if Willard or Cascade are not available.

III. *CAPITAL COSTS*

A. COST ESTIMATE

No capital costs are expected for the existing rearing facilities. The expected costs for constructing the Dryden adult holding and incubation facility are summarized in the table below.

	Description	Quan.	Units	Unit Cost	Cost	Totals
CONSTRUCTION						
SITEWORK		1.0	acre			$ 95,307
Mobilization/demobilization		1	ls	$ 30,000	$ 30,000	
Roads	Gravel access and site roads	800	lft	$ 18.00	$ 14,400	
Erosion Control	Silt fences, vegetation mats	1	ls	$3,500.00	$ 3,500	
Earthworks	Drop the site an average of 10', move cut 300'	7,407	cy	$ 6.40	$ 47,407	
GROUND WATER SUPPLY		4.0	cfs			$ 386,400
Infiltration gallery	100', yield of 18 gpm per ft	1	ea	$ 325,000	$ 325,000	
Pump chamber	Concrete vault	1	ea	$ 10,000	$ 10,000	
Aeration towers	Packed columns	2	ea	$ 5,000	$ 10,000	
Piping	18" PVC SDR35, sand bedding, fittings	600	ft	$ 69.00	$ 41,400	
ELECTRICAL/GENERATORS						$ 112,950
Power delivery	Poles, lines to deliver power to site	500	ft	$ 4.90	$ 2,450	
Generator building	With air cooling system	400	sft	$ 120	$ 48,000	
Conduit	To infiltration gallery	1,500	lft	$ 15.00	$ 22,500	
Site electrical	Service drop, wire pumps, generator	1	ls	$ 30,000	$ 30,000	
Alarm system	Alarms, conduit, autodialer	1	ls	$ 10,000	$ 10,000	
RACEWAYS	3 @ 10'x100'x4'					$ 155,237
Raceways	8" walls and floor	136	cy	$ 800	$ 109,037	
Spawning shed	30'x10'	300	sft	$ 70	$ 21,000	
Predator net system	Predator nets and overhead covers	3,600	sft	$ 7.00	$ 25,200	
MISC						$ 273,400
Discharge piping	18" PVC SDR35, sand bedding, fittings	200	ft	$ 69	$ 13,800	
Water outlet	Discharge stabilization, cover 400 sft	60	tons	$ 90	$ 5,400	
Hatchery building	Incubation, shop, office	2,400	sft	$ 100	$ 240,000	
Fencing	8' chain link	600	lft	$ 22	$ 13,200	
Site revegetation		1	acres	$ 1,000	$ 1,000	
CONSTRUCTION SUBTOTAL						**$ 1,023,294**
Unlisted item allowance	Contingencies	30%				$ 306,988
Contractor overhead	Construction management, profit	20%				$ 204,659
Sales tax		7.0%				$ 71,631
CONSTRUCTION SUBTOTAL						**$ 1,606,572**
CAPITAL EQUIPMENT						
Chillers, incubators	2 chillers @ 10 ton, 18 incubator stacks	1	ls	$ 78,000	$ 78,000	
Ground water pump, controls	2 cfs ea, 30' head, 10 hp ea, sequential start, overloa	3	ea	$ 7,000	$ 21,000	
Generators	36 Kw ea, 48 hour fuel tank	2	ea	$ 38,000	$ 76,000	
Haul Tanks	1 at 1,000 gal	4	ea	$ 3,000	$ 12,000	
Sales tax		7.0%			$ 13,090	
CAPITAL EQUIPMENT SUBTOTAL						**$ 200,090**
LAND PURCHASE						
Real estate appraisal		1	ea	$ 5,000	$ 5,000	
Land audit	Environmental appraisal, soils	1	ea	$ 3,000	$ 3,000	
Land purchase	Purchase from private owner	5	acre	$ 50,000	$ 250,000	
Real estate tax		13%			$ 32,500	
LAND PURCHASE SUBTOTAL						**$ 290,500**
TOTAL						**$ 2,097,200**

KEY: LS = Lump Sum, EA = Each, LFT = Linear Feet, SFT = square feet, CFT = cubic feet, CY = Cubic Yards, MO = month, HRS = hours

Figure 14. Dryden Capital Cost

B. BASIS FOR THE COST ESTIMATE

In as many cases as possible, cost estimates in this and the other C appendices were based on vendor invoices and subcontractor budgets for similar projects completed by the MCCRP and Yakama Nation coho programs. These projects include:

? Prosser Hatchery

? Marion Drain Hatchery

? Rohlfing well and acclimation pond

? Entiat chillers

? Prosser inlet settling pond fencing

? Two Rivers well

? Beaver Creek outlet structure

? Biddle outlet structure

? Beaver Creek discharge stabilization

? Hancock Springs wood placement and tree plantings

? Cascade, Leavenworth, and Willard hatchery predator net systems

Costs for other recent, regional projects were used as well; they include the Winthrop infiltration gallery; Wahkiacus 3-phase power; Wahkiacus hatchery building (design and cost estimates by Cascade Design Professionals); and the McCreedy acclimation site on the Klickitat.

Where actual cost data were not available, estimates were developed by Sea Springs Co. using standard construction cost estimating methods. The 2006 Heavy Construction Costs Estimating Software was used to confirm these costs from other sources and to produce estimates where needed.

Land costs were based on a review of recent real estate listings of property for sale in the area. Averages of values for comparable property were used to estimate the Dryden land cost.

IV. *REFERENCES*

Craftsman Book Company, 2005. National Estimator – 2006 Heavy Construction Costs.

GeoEngineers. 2002. Memorandum: Preliminary Recommendations Regarding the Potential for an Infiltration Gallery at Chiwawa. Yakama Nation.

IHOT (Integrated Hatchery Operations Team). 1996. Hatchery Evaluation Report, Cascade Hatchery – Coho. December 1996.

IHOT. 1997. Hatchery Evaluation Report, Willard Hatchery – Coho. February 1997.

NMFS. 2004. Anadramous Salmonid Passage Facility Guidelines and Criteria. National Marine Fisheries Service, Northwest Region. January 31, 2004.

Piper, R., I. McElwain, L. Orme, J. McCraren, L. Fowler, J. Leonard. 1982. Fish Hatchery Management. U.S. Dept. of the Interior, Fish and Wildlife Service.

V. *ATTACHMENT 1. PERMIT SUMMARY*

JARPA - Joint Aquatic Resource Permits Application		
HYDRAULIC PROJECT APPROVAL (HPA)	WDFW	Use, divert, obstruct, or change natural flow Screens: 0.4 fps, 1.75mm bar, 2.4mm perf plate, 2.2mm wire mesh
SHORELINES SUBSTANTIAL DEVELOPMENT	Local Govt	In 100-yr. floodplain or within 200 ft. of high water > $2,500
COMPLIANCE WITH CRITICAL AREAS STANDARDS	Local Govt	Critical areas are designated by local governments
FLOODPLAIN MANAGEMENT	Local Govt	
401 WATER QUALITY CERT.	WDOE	Applicant for Fed license or permit for filling or exc. in water or wetlands
EXCEEDANCE OF WATER QUALITY STANDARDS	WDOE	Temporary exceedance (may not be included in new JARPA)
SECTION 404 PERMIT	US ACE	Locating structures, filling, or excavating in water or wetlands
OTHER STATE PERMITS		
ARCHAEOLOGICAL EXCAVATION	Ofc of Arch. & Historic Pres.	Fed projects require section 106 review
NPDES - GENERAL PERMIT FOR UPLAND HATCHERIES	WDOE	May not be needed for <20,000lbs. fish/yr. or <5,000lbs of feed/mo.
PRELIMINARY WATER RIGHT PERMIT	WDOE	Required for drilling and testing
CERT. OF WATER RIGHT	WDOE	Water use permit is the original application
CHANGE OF WATER RIGHT	WDOE	Location or use changes require permit
FISH/EGG TRANSPORT	WDFW	Main tool for WDFW to control movement of fish
OTHER LOCAL PERMITS		
CONSTRUCTION	Local govt	Building permits (including grading), vary by county
CONDITIONAL USE	Local govt	Activities use subject to public hearings
ZONING CODE VARIANCE	Local govt	
ESA RELATED PERMITS		
BIOLOGICAL EVALUATION (BE or BA)	USFWS, NMFS	Consultation used to show minimal impacts; if services agree, a concurrence letter is written
BIOLOGICAL OPINION (BO)	USFWS, NMFS	Issued after formal consultation
HATCHERY & GENETICS MGMT PLAN (HGMP)	NMFS	Replaces the BE for NMFS purposes
OTHER		
WETLAND AND FLOODPLAIN ASSESSMENT	BPA	Normally part of the NEPA document; requirement for federally funded projects
ENVIRONMENTAL LAND AUDIT	BPA	

APPENDIX C.2 METHOW REARING FACILITIES

PROPOSED PLAN SITE DESCRIPTIONS AND CAPITAL COSTS

Yakama Nation Fisheries Resource Management

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I. *INTRODUCTION*

This report presents site information for proposed Mid-Columbia Coho Reintroduction Plan (MCCRP) rearing facilities that will be producing fish for release in the Methow. A separate report describes proposed Wenatchee watershed rearing facilities. It includes a description of the Cascade Hatchery which will rear fish for both basins. Other reports describe acclimation facilities. Following is a list of master plan facility appendices, with this appendix highlighted.

A. FISH CULTURE GUIDELINES
B. ALTERNATIVE AND PROPOSED PLAN EVALUATIONS
 B.1 REARING FACILITIES
 B.2 ACCLIMATION FACILITIES
C. PROPOSED PLAN SITE DESCRIPTIONS AND CAPITAL COSTS
 C.1. WENATCHEE REARING FACILITIES
 C.2. METHOW REARING FACILITIES
 C.3. WENATCHEE ACCLIMATION FACILITIES
 C.4. METHOW ACCLIMATION FACILITIES
D. PROJECT SCHEDULE AND COSTS

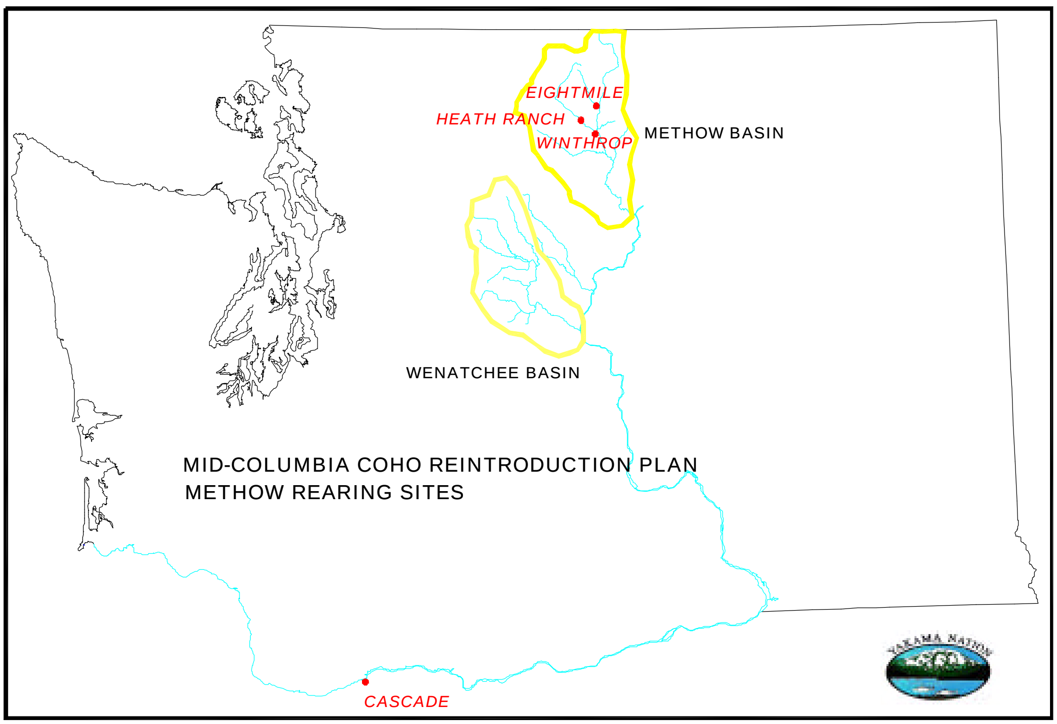

Figure 1. Location Map

II. *PROPOSED REARING FACILITIES*

Fish are proposed to be reared at the existing Cascade and Winthrop hatcheries and at two constructed habitats. The total reared per year at the hatcheries for Methow release is shown in the table below.

Table 1. Methow Rearing Locations and Numbers

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
EXISTING HATCHERIES																					
Cascade	0.25	0.25	0.25	0.25	0.25	0.25	0.45	0.45	0.45	0.24	0.24	0.24	0.24	0.24	0.24	0.00	0.00	0.00	0.00	0.00	0.00
Winthrop	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
CONSTRUCTED HABITATS																					
Eightmile							0.20	0.20	0.20	0.14	0.14	0.14	0.14	0.14	0.14	0.07	0.07	0.07	0.07	0.07	0.07
Heath Ranch							0.10	0.10	0.10	0.07	0.07	0.07	0.07	0.07	0.07	0.04	0.04	0.04	0.04	0.04	0.04
TOTAL	**0.50**	**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**

A. CONSTRUCTED HABITATS

1. HABITAT DESIGN

The basic principles of the constructed habitats are described in Appendix B.1, REARING FACILITIES ALTERNATIVES and in the literature (Smith et al. 2004). They consist of pools, runs, riffles, alcoves, and ponds (see Figure 2) and include woody debris and overhead cover. Constructed habitat is a rearing environment that mimics natural conditions.

The program proposes to use Winthrop National Fish Hatchery (WNFH) to hold all adults that return to Methow constructed habitats, to incubate their eggs and rear them to fingerling size. Fingerlings are moved to the habitats after tagging in June. They are reared in the habitats to smolt size and released in April. Migrations out of the habitat will be prevented until fish are fully smolted. Exit fish screens will be maintained throughout the 10-month production cycle. These habitats function as both rearing and acclimation/release sites.

Predation control will be an important feature of the habitats. Fences will be used where possible and heavy tree cover will limit access by birds with long landing flight paths such as mergansers. Other bird predation will be controlled by deterrence through human presence, a technique that has been used effectively at sites currently operated by the MCCRP as well as at federal and state hatcheries..

Natural foods (aquatic insects and macro-invertebrates) will be produced in the habitats, but the mass is not expected to be enough to meet nutritional demands. Therefore, supplemental hatchery fish food will be provided.

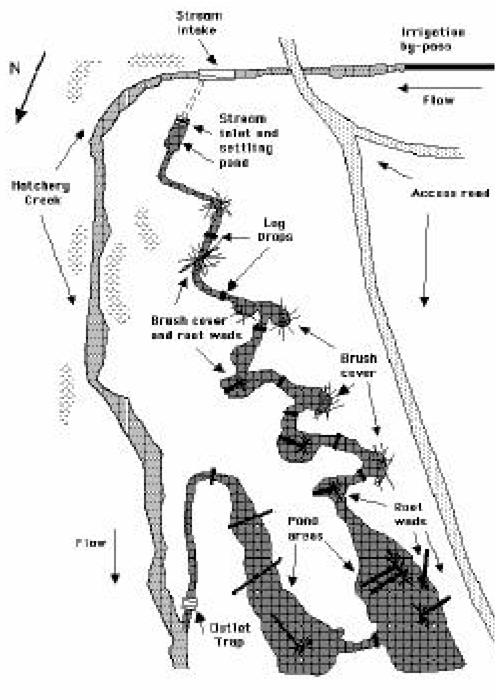

Figure 2. Typical Constructed Habitat

(from Smith et al. 2004)

2. EIGHTMILE

A potential constructed habitat site has been identified near the mouth of Eightmile Creek, a tributary of the Chewuch River, on U.S. Forest Service property at Eightmile Ranch. A combination of surface water from Eightmile Creek and well water is proposed for the water supply.

a. Facility Requirements

? Fish numbers: 200,000 are proposed in the MCCRP master plan.

? Water and space programming: Space requirements have been developed through experience with a test site on the Dungeness River (Smith et al. 2004). Minimum water flow rates are determined using standard hatchery procedures (Piper et al. 1982). Higher water flows may be used to provide additional hydraulic complexity. The figure below details water and space needs at assumed water temperatures.

? Land requirement: Assuming that the water surface area takes up 33% of the site, 15 acres of land are required.

? Development timing: Current plans call for releases to begin as early as 2010. Construction and testing would then need to be completed by the summer of 2009.

Period	Rearing Unit	Water Source	Water Temp. (^{0}F)	Number at Site at Month End	Fish Size *lbs*	Fish Size *#/lb*	Fish Size *inch*	Flow Index	Flow Density *lbs/gpm*	Total Weight *lbs*	Min. Flow *gpm*	**Min. Flow cfs**	Water Area *sft*
7/1	Habitat	Surface	53	400,000	0.009	111	3.22	0.78	2.5	3,600	1,443	**3.2**	400,000
8/1	Habitat	Surface	60	377,778	0.014	71	3.63	0.62	2.3	5,289	2,350	**5.2**	400,000
9/1	Habitat	Surface	61	355,556	0.020	50	4.05	0.61	2.5	7,111	2,902	**6.4**	400,000
10/1	Habitat	Surface	55	333,333	0.024	42	4.36	0.73	3.2	7,937	2,511	**5.6**	400,000
11/1	Habitat	Surface	46	311,111	0.027	37	4.57	1.05	4.8	8,408	1,761	**3.9**	400,000
12/1	Habitat	Surface	39	288,889	0.029	35	4.57	1.35	6.2	8,254	1,338	**3.0**	400,000
1/1	Habitat	Surface	35	266,667	0.030	33	4.81	1.55	7.5	8,081	1,084	**2.4**	400,000
2/1	Habitat	Surface	35	244,444	0.033	30	4.81	1.55	7.5	8,148	1,093	**2.4**	400,000
3/1	Habitat	Surface	37	222,222	0.037	27	5.10	1.45	7.4	8,230	1,113	**2.5**	400,000
4/1	Habitat	Surface	41	200,000	0.045	22	5.33	1.25	6.7	9,091	1,364	**3.0**	400,000

REARING	
Number released:	200,000
Plant to release mortality:	100%
Production (smolts/sft):	0.5
Flow multiplier	2.0

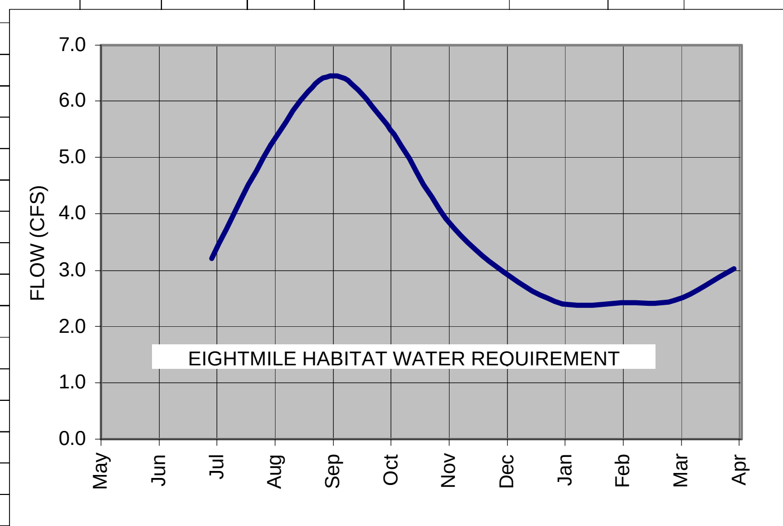

Figure 3. Eightmile Water and Space Programming

b. Site Information

? Location, elevation: Near the mouth of Eightmile Creek; in T36N, R21E, SE ¼ of S23 in Okanogan County; elevation 2,100 feet.

? Tributary of: The Chewuch at river mile 11.

? Ownership: U.S. Forest Service. The USGS (US Geological Survey) map, Figure 4, shows approximate property boundaries.

? Geotechnical conditions: Site development is not limited by physical terrain characteristics. Soils are likely AASHTO classifications A-1 to A-2.

? Zoning: None.

? Shoreline designation: None.

? Comprehensive plan designation: U.S. Forest Service.

? Flood designation: Out of flood hazard zones.

? Wetlands designation: none

? Current land use: Pasture.

? Access: Plowed, paved roads.

? Expansion capability: Land may be available for expansion.

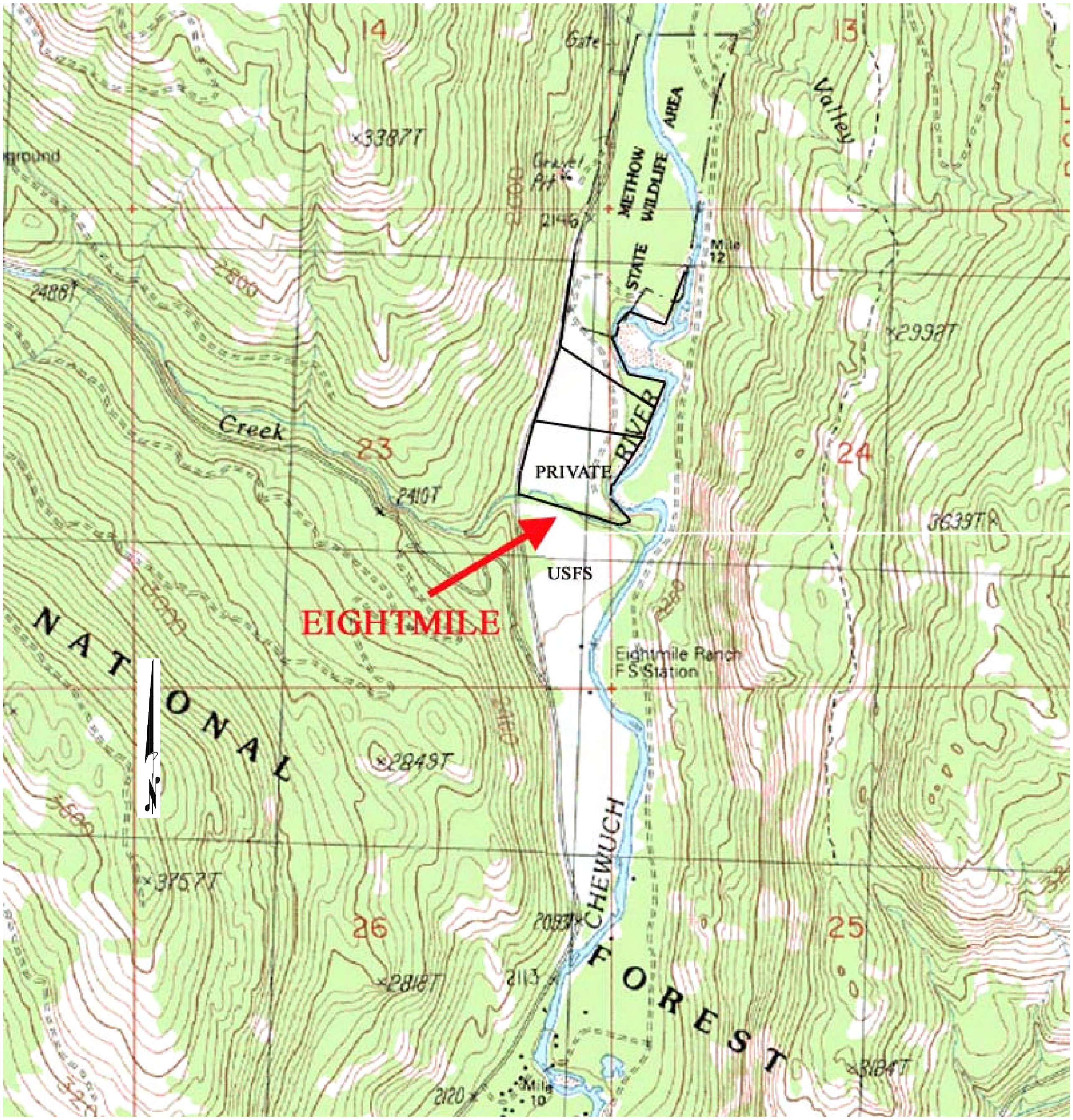

Figure 4. Eightmile USGS Map

c. Water Supplies

- Surface water flow: The site has 2 potential surface water sources, an abandoned irrigation intake on Eightmile Creek (Figure 5) and existing wells on the Eightmile Ranch. Mean monthly runoff volumes per square mile for analog gages and resulting Eightmile Creek mean monthly flow estimates (Smith 2005) are shown in Table 2. The proposed peak withdrawal of 6.5 cfs in September would result in about half the flow being removed from the creek between the intake and discharge location.
- Surface water temperature: Data is not available but will be collected.
- Surface water quality: Excellent due to the undeveloped nature of the watershed.

Table 2. Eightmile Hydrology

Gage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chewuch River (cfs/mi^2)	0.13	0.13	0.21	0.79	2.65	2.82	0.94	0.29	0.14	0.19	0.19	0.16
Andrews Creek (cfs/mi^2)	0.19	0.16	0.19	0.78	4.93	6.79	2.05	0.64	0.39	0.33	0.30	0.23
Average (cfs/mi^2)	0.16	0.15	0.20	0.79	3.79	4.81	1.49	0.46	0.27	0.26	0.25	0.19
Eightmile estimate (cfs)	**7.5**	**7.0**	**9.1**	**36.6**	**176.6**	**223.9**	**69.5**	**21.7**	**12.5**	**12.0**	**11.5**	**9.0**

Figure 5. Eightmile Intake

(2/27/2005)

- Icing potential: High for Eightmile Creek, groundwater pumped to the intake will reduce icing problems.
- Flood levels: Above flood elevations.
- Groundwater availability: The US Forest Service has developed a well field on the Eightmile Ranch property for irrigation. Two new production wells were constructed and one existing well was reconditioned in 2002. Pump test results show potential yields of up to a total of 875 gpm. The availability of part of this capacity for operation of the constructed habitat has not yet been discussed or evaluated with stakeholders (USFS, Washington Dept. of Ecology, and irrigators), One new well is proposed for the location that will be dedicated to the habitat operation and potentially to mitigate impacts of surface water withdrawal.
- Groundwater temperature: Unknown but will be determined in the future.

d. Proposed Design

The conceptual design shown in Figure 7 was developed in cooperation with Dave Smith of C.P. Cramer and Associates.

- The habitat will require approximately 10 acres of water surface area in a variety of sizes and shapes.
- Construction will involve balancing cut and fill. Material excavated to form the water environments will be used to construct the surrounding land areas. No fill will be removed from the site.
- Surface water for the habitat will be withdrawn from the abandoned irrigation intake upstream (the location is shown in Figure 6) of the road culvert. To reduce the impact of this withdrawal from Eightmile Creek, water will be pumped from the discharge of the habitat up to a point close the intake during low flow periods.

? Ground water from the existing and new wells will be used in the winter to add water supply security and to reduce icing conditions on the intake. It will also be used in the summer to reduce discharge water temperatures.

? Tree, brush, and grass plantings will provide shade and stabilize habitat shorelines. Large, woody debris will be hauled to the site and strategically placed throughout the system.

? The discharge channel will be constructed with log sills to allow passage of adults into spawning areas below the habitat.

? Outlet structures will prevent premature downstream movement and will include fish counters to enumerate migration.

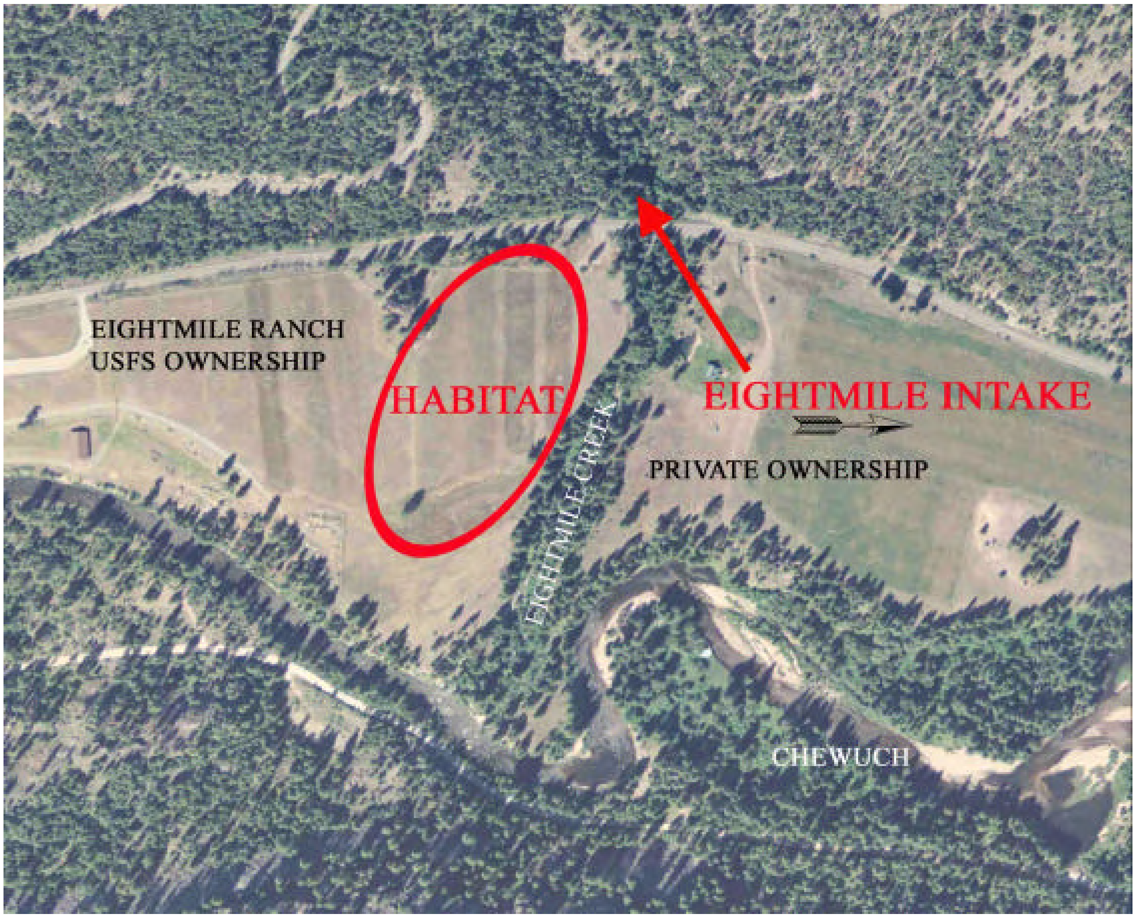

Figure 6. Eightmile Aerial Photo

(7/22/2004)

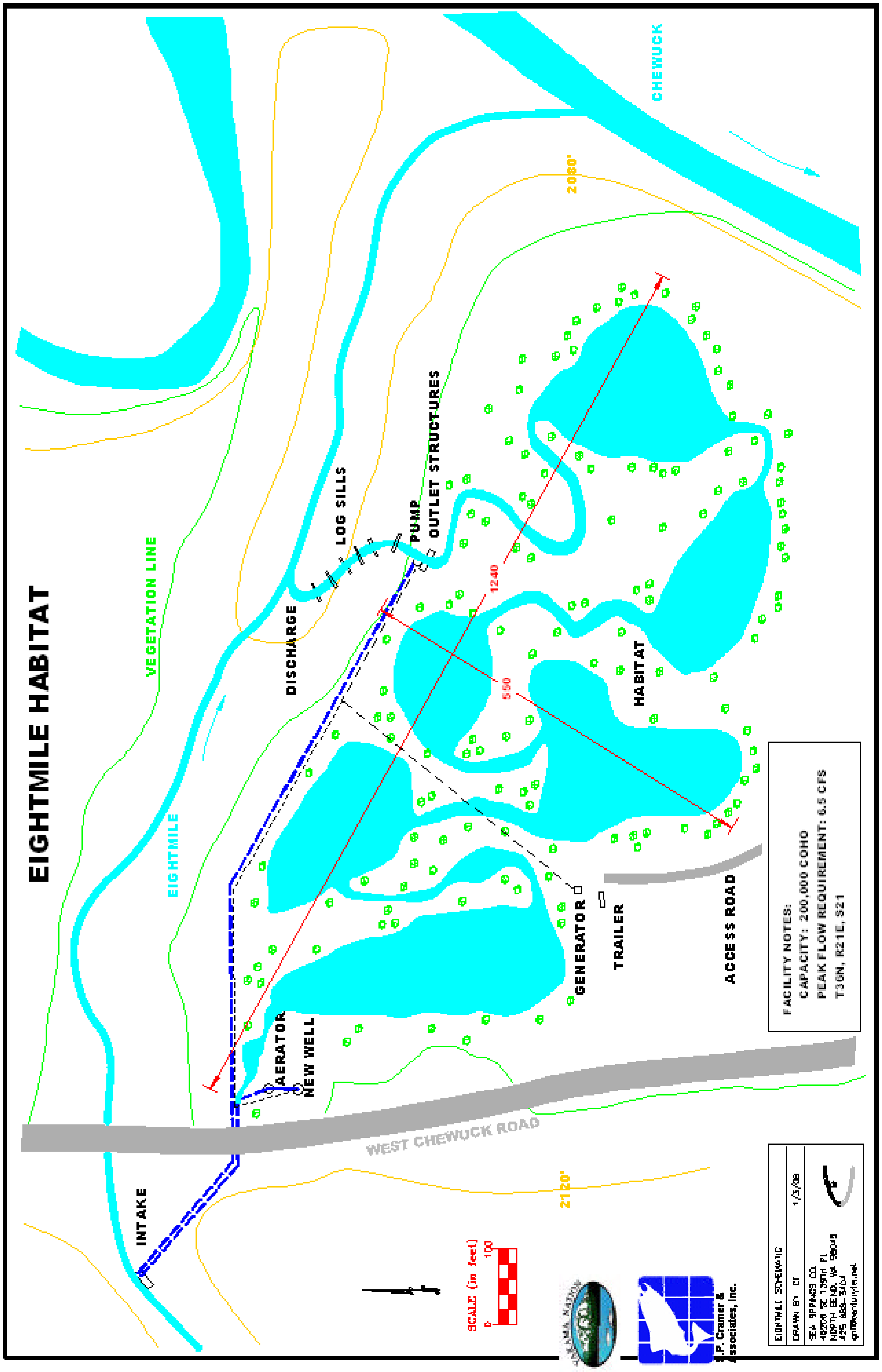

Figure 7. Eightmile Conceptual Design

e. Environmental Issues

- Listed species: The area is potential wolf, lynx, grizzly bear, bald eagle, spotted owl, Nelsons checker-mallow, and Ute ladies'-tresses habitat. Bull trout, steelhead, and spring chinook exist in the Chewuch River. Steelhead and bull trout use the lower section of Eightmile Creek.
- Water rights: Withdrawal of surface water from a section of Eightmile Creek has potential impacts on migration conditions for area fish. Passage improvements in Eightmile Creek may be necessary to mitigate for changed flow conditions. This could entail strategically placing or rearranging boulders and woody debris and adding rock filled gabions to establish reliable flows for passage.
- Water temperature: Increasing the retention time of Eightmile Creek water by holding it in a constructed habitat will increase water temperatures in the summer. However, groundwater from wells will be added to the habitat to reduce temperature impacts.

f. Development Risks

- Water rights: Obtaining the rights to withdraw water from Eightmile Creek and changing the period of use of the groundwater may be issues.
- Land availability: Negotiations with the U.S. Forest Service (USFS) for use of the property have not been conducted. The development of a constructed habitat would reduce the pasture land available for Eightmile Ranch.
- Local opposition: The re-introduction of coho into the Methow and construction of a habitat at Eightmile may be opposed by local citizens for a variety of reasons, which will be addressed during NEPA scoping and document reviews.

g. Next Steps

- Discuss plan details with the USFS. Obtain land use agreements.
- Meet with Department of Environment (DOE) to determine the steps necessary to obtain surface water rights, a new ground water right, and to extend the period of use of the existing ground water right.
- Schedule cultural resources, wetlands, plant, survey and manage species, environmental land audit, discharge impact, and Endangered Species Act (ESA) species evaluations.
- Submit water rights permit applications.
- Conduct topographic and soil surveys.
- Complete design details and final cost estimates.
- Submit construction and operation permit applications.

h. Alternatives

Alternatives to the Eightmile site are located on other Chewuch tributaries. Boulder and Ramsey creeks are potential water sources for constructed habitats. Another option is to use the existing Eightmile ponds that are on property adjacent to the Eightmile Ranch. This alternative would not provide all the benefits of constructed habitats but is a low-cost alternative if the primary options are not possible.

3. HEATH RANCH

A potential constructed habitat site has been identified on the Heath Ranch, with a very small portion of the continuous waterway at the southern boundary of Big Valley Ranch, in the Methow watershed. Existing spring water is the proposed water source. Much of the habitat currently exists and is planned to be used by this project.

a. Facility Requirements

? Fish numbers: A 100,000 smolt release is proposed for this site..

? Water and space programming: Space requirements have been developed through experience with a test site on the Dungeness River (Smith et al. 2004). Minimum water flow rates are determined using standard hatchery procedures (Piper et al. 1982). Higher water flows may be used to provide additional hydraulic complexity. The figure below details water and space needs at assumed water temperatures.

? Development timing: Current plans call for releases to begin as early as 2013. Construction and testing would then need to be completed by the summer of 2012.

Period	Rearing Unit	Water Source	Water Temp. (^0F)	Number at Site at Month End	Fish Size *lbs*	Fish Size *#/lb*	Fish Size *inch*	Flow Index	Flow Density *lbs/gpm*	Total Weight *lbs*	Min. Flow *gpm*	**Min. Flow cfs**	Water Area *sft*
7/1	Habitat	Surface	47	200,000	0.009	111	3.22	1.00	3.2	1,800	559	**1.2**	200,000
8/1	Habitat	Surface	47	188,889	0.014	71	3.63	1.00	3.6	2,644	728	**1.6**	200,000
9/1	Habitat	Surface	46	177,778	0.020	50	4.05	1.05	4.2	3,556	840	**1.9**	200,000
10/1	Habitat	Surface	45	166,667	0.024	42	4.36	1.09	4.8	3,968	835	**1.9**	200,000
11/1	Habitat	Surface	45	155,556	0.027	37	4.57	1.09	5.0	4,204	844	**1.9**	200,000
12/1	Habitat	Surface	44	144,444	0.029	35	4.57	1.13	5.2	4,127	799	**1.8**	200,000
1/1	Habitat	Surface	43	133,333	0.030	33	4.81	1.18	5.7	4,040	715	**1.6**	200,000
2/1	Habitat	Surface	42	122,222	0.033	30	4.81	1.22	5.9	4,074	694	**1.5**	200,000
3/1	Habitat	Surface	43	111,111	0.037	27	5.10	1.18	6.0	4,115	687	**1.5**	200,000
4/1	Habitat	Surface	44	100,000	0.045	22	5.33	1.13	6.0	4,545	755	**1.7**	200,000

REARING	
Number released:	100,000
Plant to release mortality:	100%
Production (smolts/sft):	0.5
Flow multiplier	2.0

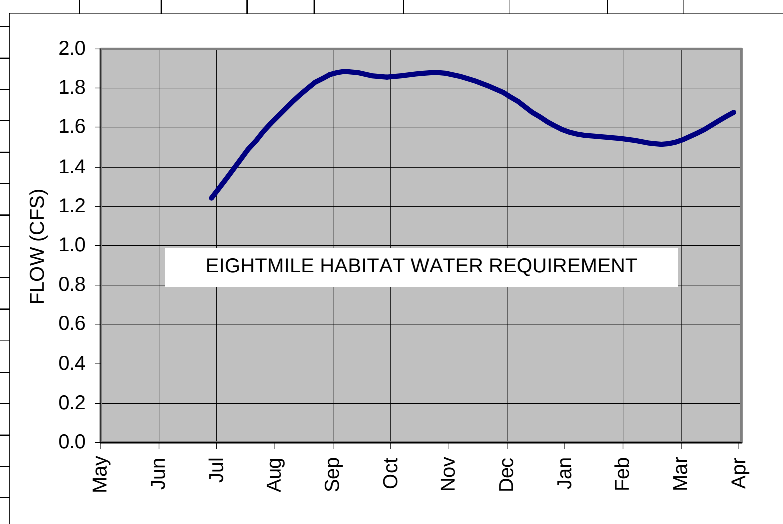

Figure 8. Heath Ranch Water and Space Programming

b. Site Information

- ? Location, elevation: T35N, R21E, SE ¼ of S30 in Okanogan County; elevation 1,800 feet.
- ? Tributary of: The Methow at river mile 54.
- ? Ownership: Big Valley Ranch – Washington Department of Fish and Wildlife (WDFW), Heath Ranch – private.
- ? Zoning: Rural Residential.
- ? Shoreline designation: Rural Development.
- ? Comprehensive plan designation: Big Valley Ranch – state land; Heath Ranch – agricultural.
- ? Wetlands designation: Palustrine in the National Wetlands Inventory.
- ? Current land use: Wildlife management, recreation.
- ? Access: Plowed, paved road (Hwy 20) to within 1,000 feet of the site, gravel road access road.
- ? Expansion capability: Land may be available for expansion.
- ? Trucking distances: None.

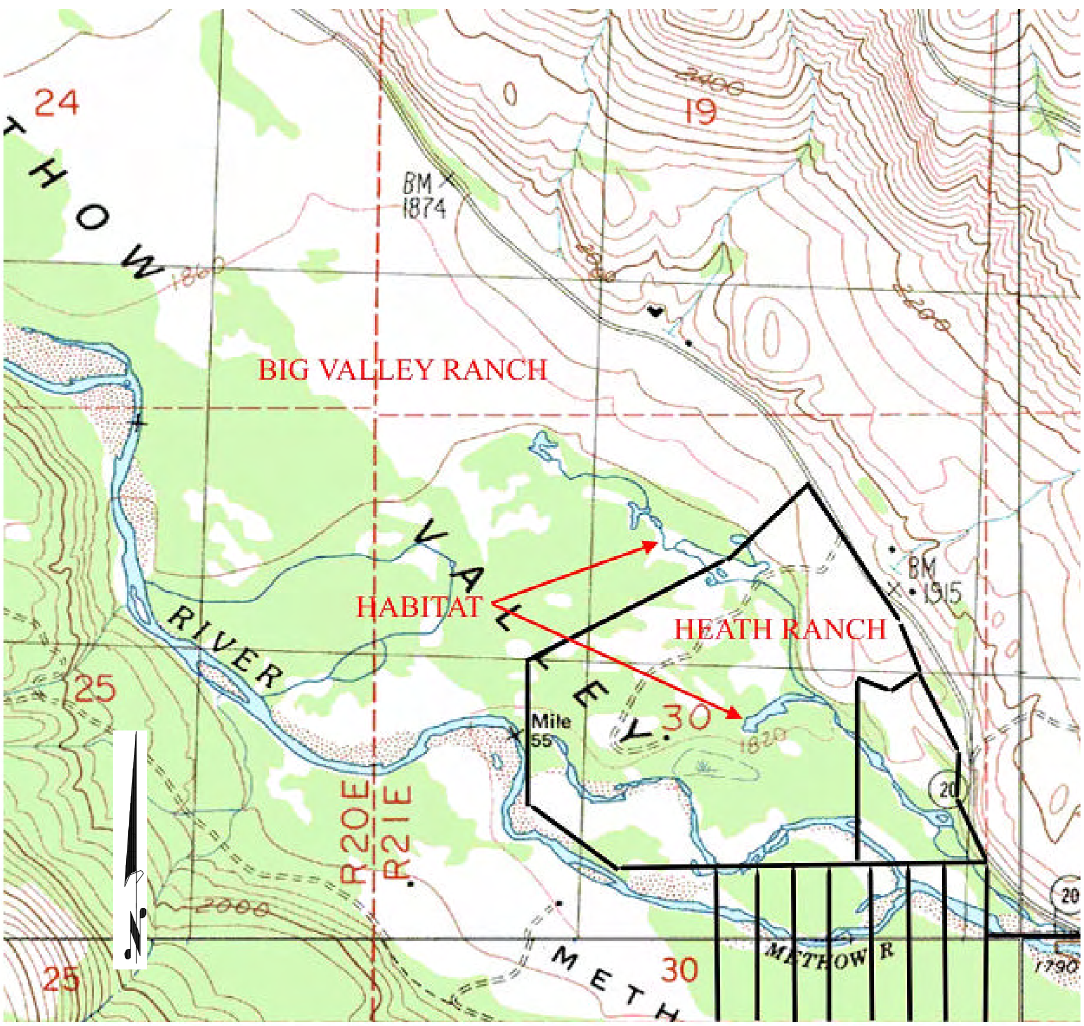

Figure 9. Heath Ranch USGS Map

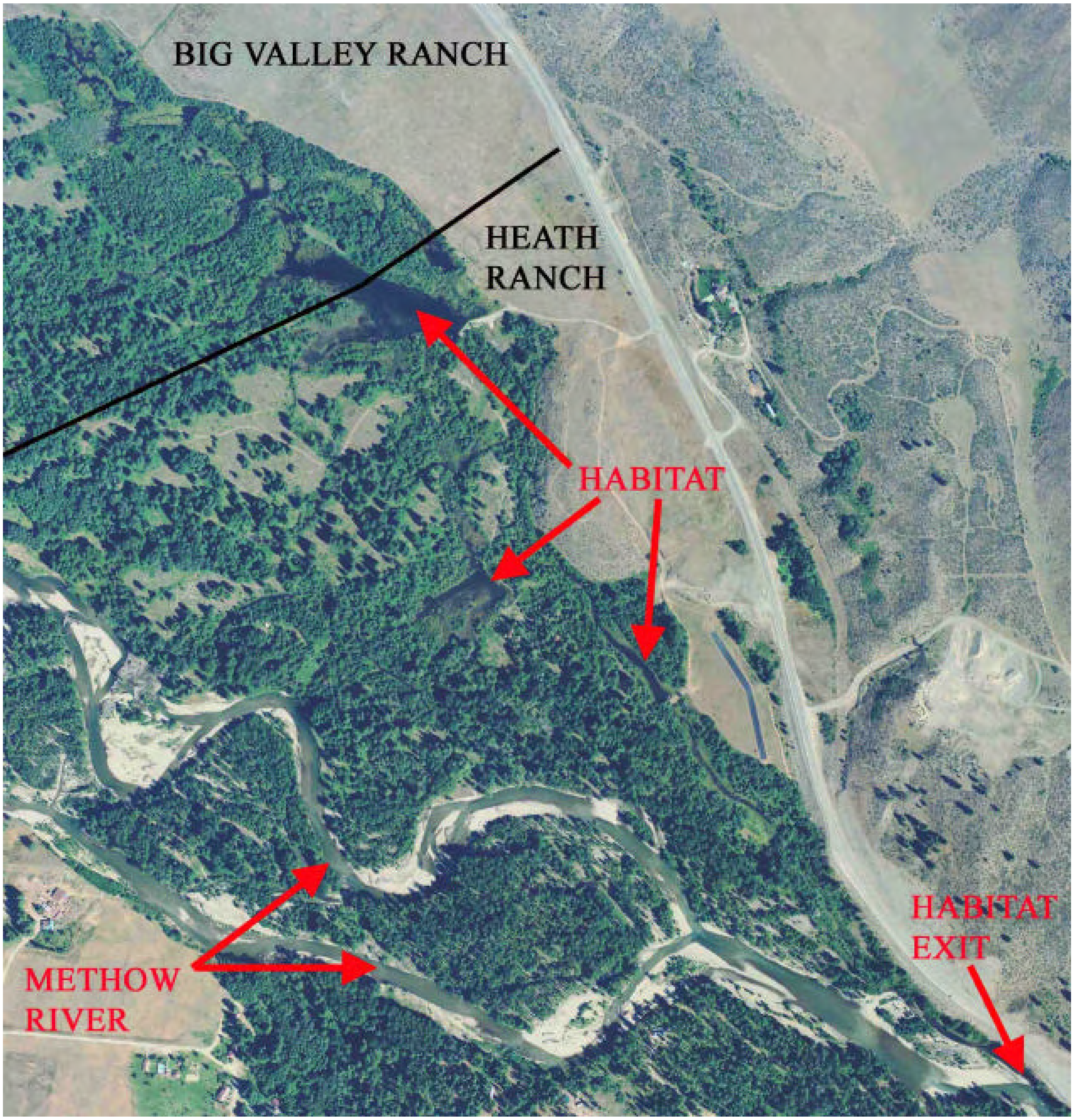

Figure 10. Heath Ranch Aerial Photo
(8/10/2000)

c. Water Supplies

- Water flow: Flows have not been measured but will be in the future.
- Water temperature: Data not available but will be collected in the future.
- Surface water quality: Likely excellent.
- Icing potential: Low.
- Flood levels: The site is within the 100-year flood elevation boundary.

d. Proposed Design

- Spring water flows through the series of ponds and wetlands. Additional water supply development is not planned.
- The spring channel is 1.5 miles long. To have the required 200,000 square feet of water surface area, the spring channel needs to average over 3 feet in width, which is the case. A detailed survey will allow a more precise estimate of surface area. Some minor construction may be planned to improve habitat conditions. Access to the habitat by migratory fish may not be possible now (Bob Jateff, WDFW biologist, personal communication, 2005), so barriers may need to be removed.
- Fencing may not be possible on the Big Valley section of the habitat due to WDFW wildlife management preferences (open range). Though optimal, fencing is not necessary for meeting the site's objectives for producing quality coho smolts. Other predation reduction options could include human presence for extended periods of time and/or using only the portion of the habitat that is on Heath property where fencing may be allowed.
- A downstream fish barrier would be constructed to prevent early migration of coho out of the system. The barrier will also include fish counting systems.

e. Environmental Issues

- The area is potential wolf, lynx, grizzly bear, bald eagle, spotted owl, Nelsons checker-mallow, and Ute ladies'-tresses habitat. Bull trout, steelhead, and spring chinook exist in the Methow River. Listed and other fish species currently do not have access to this off channel habitat. This project would link it to the river, making the habitat accessible when channel outlet traps and intake screens are removed after release of the coho smolts. Some non-target species may residualize until the next brood year of coho is introduced, but this could benefit those fish by increasing prey density and by providing supplemental feed.
- Impacts to wildlife on the Big Valley Ranch from site operation must be minimized. Disturbances from construction and/or operation will need to be controlled to meet wildlife management objectives.

f. Development Risks

- Land availability: Negotiations with the WDFW and the private land owners for use of the property have not been conducted.
- Local opposition: The re-introduction of coho into the Methow may be opposed by local citizens for a variety of reasons.

g. Next Steps

- Survey the existing spring channel system. Determine flow rates, water volumes, and evaluate migration blockages.
- Discuss use of the habitat with WDFW and private land owners.
- Schedule survey and manage species, discharge impact, and ESA species evaluations.
- Complete design details and final cost estimates.
- Submit construction and operation permit applications.

h. Alternatives

Alternatives to the Heath Ranch site include digging wells or infiltration galleries to supply water to a constructed habitat in the area. This option does not require a surface water stream, which increases the number of land options for the project. A third option is to use part of the existing Heath spring complex as a simple pond acclimation site. Coho would be enclosed in a net barrier in all or in parts of a pond and released into the Methow after smolting in the spring.

B. WINTHROP NATIONAL FISH HATCHERY

The MCCRP master plan calls for the continued production of 250,000 pre-smolts from the Winthrop Hatchery. Starting with Broodstock Development Phase 2 (BDP2), only part of this production will continue to be released on station. The removal of fish prior to reaching full smolt size will reduce hatchery loadings.

Plans also call for Winthrop to hold all captured Methow broodstock. With minor modifications of less than $5,000 to the water delivery system, adult holding area, and incubation system, this facility will hold the 1,300 adults (600 gpm and 5,000 cft of adult holding water volume), and incubate up to the eyed stage, the 1,300,000 eggs that this plan requires.

The Winthrop National Fish Hatchery 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 U.S. Fish and Wildlife Service.

The following information is from Integrated Hatchery Operations Team (IHOT) 1998 and the Hatcheries 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 total capacity). Water use ranges from 8,528 to 27,686 gpm, with the Methow River providing the majority of the flow. Rearing systems include:

Adult Holding Ponds: 2 concrete ponds at 25,000 cft each that are not currently being used.

Incubation: 150 iso buckets and 150 vertical stack trays.

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 cft each (design flow of 300 gpm).

Raceways: 7 at 100 feet x 12 feet x 1.8 feet — 2,200 cft each (design flow of 350 gpm).

Foster-Lucas Ponds: 7 at 2,750 cft each (design flow of 350 gpm).

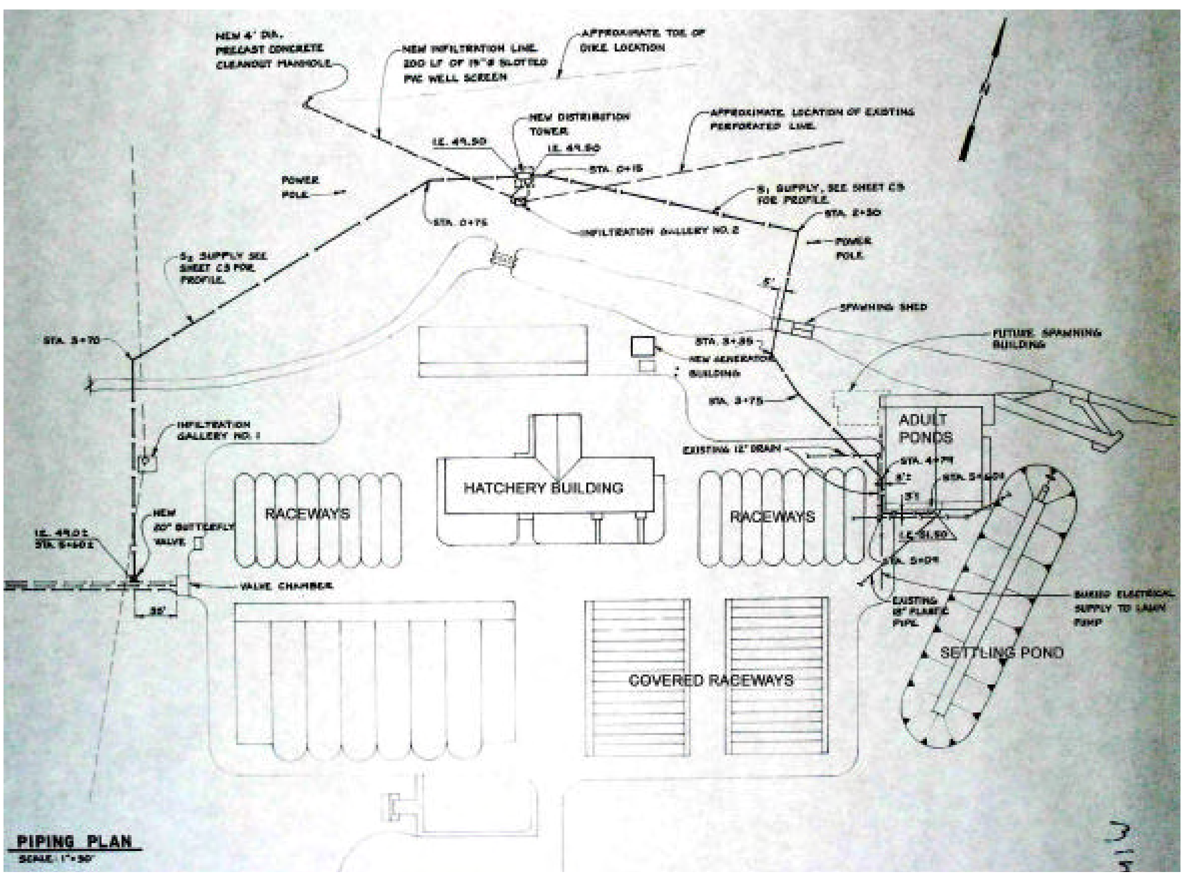

Figure 11. Winthrop NFH Site Plan

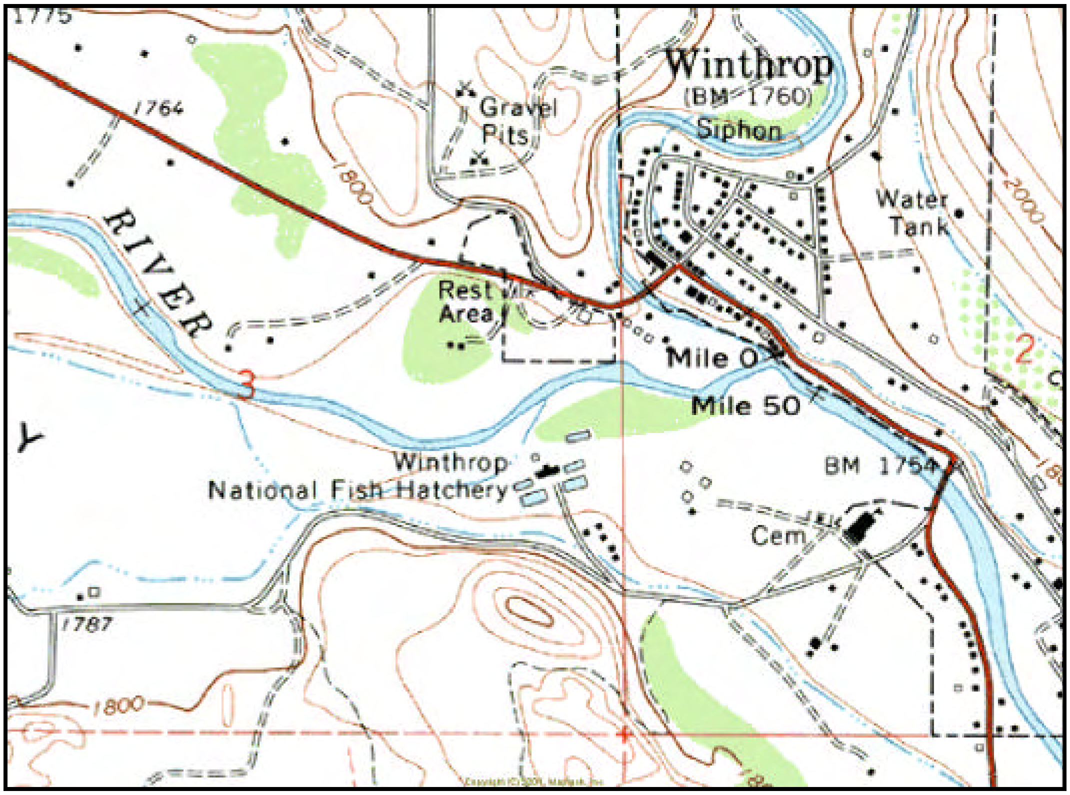

Figure 12. Winthrop NFH Location Map

Figure 13. Winthrop NFH Photo

The 2005 production goals are 600,000 spring chinook, 100,000 summer steelhead, and 250,000 coho for the MCCRP. Coho stocking sizes average 18/lb (4,375 lbs/raceway) resulting in maximum volume densities in the raceways of 1.4 lbs per cft, typical for raceway culture but considerably higher than the target value for new pond-based hatcheries (0.3 lbs per cft).

The option to producing MCCRP coho at Winthrop is Willard on the lower Columbia River near Cook, Washington, where the capacity exists to produce additional Methow coho. Winthrop is preferred due to the shorter hauling distances and more natural water temperatures and conditions.

III. *CAPITAL COSTS*

A. Cost Estimate

Following are construction, capital equipment, permitting, and land purchase costs for the proposed constructed habitats. Table 3 summarizes these costs which are detailed in Tables 4 and 5. All prices are in 2005 dollars.

Table 3. Constructed Habitat Capital Cost Summary

	Construction	Capital Equipment	Land Cost	Total
Eightmile	$1,024,571	$109,140	$0	$1,133,711
Heath	$93,651	$16,050	$458,000	$567,701
TOTAL	**$1,118,222**	**$125,190**	**$458,000**	**$1,701,412**

Because it is valuable habitat that would benefit from preservation, other agencies may help with this purchase. The Heath property abuts WDFW ownership (Big Valley ranch) and adding it to public ownership would increase the effective size of the Methow Wildlife Area.

Unlike traditional acclimation/release sites for salmon, constructed habitat serves both as a rearing/release site as well as enhancement of habitat for a watershed. When the constructed habitat is not used for acclimation/release; or when a production program is suspended, as the mid-Columbia coho master plan proposes; the enhanced habitat remains indefinitely to be used by multiple species as part of salmon restoration.

Table 4. Eightmile Capital Cost Detail

	Description	Quan.	Units	Unit Cost	Cost	Totals
CONSTRUCTION						
SITEWORK		15	acre			$ 61,900
Mobilization/demobilization		1	ls	$ 30,000	$ 30,000	
Erosion Control	Silt fences, vegetation mats	5	acre	$ 3,500	$ 17,500	
Roads	Gravel access road	800	lft	$ 18	$ 14,400	
EIGHTMILE WATER SUPPLY		6.4	cfs			$ 50,000
Intake structure improvements	Upgrade to NMFS/WDFW screen criteria	1	ls	$ 40,000	$ 40,000	
Screens	Structural aluminum	1	ls	$ 10,000	$ 10,000	
GROUND WATER SUPPLY		2	cfs			$ 48,850
New well	8" diameter, 100' deep	1	ea	$ 25,000	$ 25,000	
Aeration tower	Packed column	1	ea	$ 2,500	$ 2,500	
Piping	12" PVC SDR35, sand bedding, fittings	350	ft	$ 61	$ 21,350	
HABITAT						$ 309,643
Excavation	Excavate ponds and channel, regrading	56,240	cy	$ 4.70	$ 264,328	
Large woody debris	Cleaned LWD	390	ea	$ 45	$ 17,550	
Rock	Cleaned cobble	851	ton	$ 15	$ 12,765	
Overhead cover	Trees	500	ea	$ 30	$ 15,000	
OUTLET/DISCHARGE						$ 139,200
Screen and counting facility	Prefabricated steel structures	2	ea	$ 10,000	$ 20,000	
Water discharge channel	Channel construction, rock	2,500	cy	$ 7	$ 17,500	
Discharge ladder	Log and rock ladder, 12" drop per sill	6	sill	$ 4,100	$ 24,600	
Return flow pump vault	Concrete vault	1	ea	$ 10,000	$ 10,000	
Piping	12" PVC SDR35, sand bedding, fittings	1,100	ft	$ 61	$ 67,100	
MISC						$ 43,000
Alarm system	Alarms, conduit, autodialer	1	ea	$ 10,000	$ 10,000	
Site electrical	Well and return flow pumps, service drop, alarms	1	ls	$ 10,000	$ 10,000	
Conduit	To pumps	1,200	ft	$ 15	$ 18,000	
Revetation		5	acre	$ 1,000	$ 5,000	
CONSTRUCTION SUBTOTAL						**$ 652,593**
Unlisted item allowance	Contingencies	30%				$ 195,778
Contractor overhead	Construction management, profit	20%				$ 130,519
Sales tax		7.0%				$ 45,682
CONSTRUCTION SUBTOTAL						**$ 1,024,571**
CAPITAL EQUIPMENT						
Trailer	Office, storage, living quarters	2	ea	$ 15,000	$ 30,000	
Generators	14 Kw ea, 48 hour fuel tank	2	ea	$ 24,000	$ 48,000	
Return flow pumps	3.2 cfs, 10 hp each	2	ea	$ 7,000	$ 14,000	
Well pumps, controls	1 cfs ea, 40' head, 8 hp, sequential start, overloads	2	ea	$ 5,000	$ 10,000	
Sales tax		7.0%			$ 7,140	
CAPITAL EQUIPMENT SUBTOTAL						**$ 109,140**
TOTAL						**$ 1,133,711**

KEY: LS = Lump Sum, EA = Each, LFT = Linear Feet, SFT = square feet, CFT = cubic feet, CY = Cubic Yards, MO = month, HRS = hours

Table 5. Heath Capital Cost Detail

	Description	Quan.	Units	Unit Cost	Cost	Totals
CONSTRUCTION						
SITEWORK		20	acre			$ 27,900
Mobilization/demobilization		1	ls	$ 10,000	$ 10,000	
Erosion Control	Silt fences, vegetation mats	1	acre	$ 3,500	$ 3,500	
Roads	Gravel access road	800	lft	$ 18	$ 14,400	
OUTLET/DISCHARGE						$ 31,750
Screen and counting facility	Prefabricated steel structures	3	ea	$ 10,000	$ 30,000	
Water discharge channel	Channel construction, rock	250	cy	$ 7	$ 1,750	
CONSTRUCTION SUBTOTAL						**$ 59,650**
Unlisted item allowance	Contingencies	30%				$ 17,895
Contractor overhead	Construction management, profit	20%				$ 11,930
Sales tax		7.0%				$ 4,176
CONSTRUCTION SUBTOTAL						**$ 93,651**
CAPITAL EQUIPMENT						
Trailer	Office, storage, living quarters	1	ea	$ 15,000	$ 15,000	
Sales tax		7.0%			$ 1,050	
CAPITAL EQUIPMENT SUBTOTAL						**$ 16,050**
LAND PURCHASE						
Real estate appraisal		1	ea	$ 5,000	$ 3,000	
Land audit	Environmental appraisal, soils	1	ea	$ 3,000	$ 3,000	
Land purchase	Purchase from private owner	20	acre	$ 20,000	$ 400,000	
Real estate tax		13%			$ 52,000	
LAND PURCHASE SUBTOTAL						**$ 458,000**
TOTAL						**$ 567,701**

KEY: LS = Lump Sum, EA = Each, LFT = Linear Feet, SFT = square feet, CFT = cubic feet, CY = Cubic Yards, MO = month, HRS = hours

B. Basis for the Cost Estimate

Construction cost estimates were developed in cooperation with Dave Smith of SP Cramer and Associates. Where applicable, they are based on the expenses of constructing the test habitat on the Dungeness River on the Olympic Peninsula. Estimates for capital equipment and construction costs that were not incurred at Dungeness but will be at the Eightmile and Heath sites were derived from vendor invoices and subcontractor budgets for similar projects completed by the MCCRP and Yakama Nation coho programs. These projects are listed in Appendix C1. In addition, the 2006 Heavy Construction Costs Estimating Software was used to confirm these costs from other sources and to produce estimates where needed.

Land costs were based on a review of recent real estate listings of property for sale in the area. Averages of values for comparable property were used to estimate the Heath Ranch land cost.

IV. *REFERENCES*

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APPENDIX C.3

WENATCHEE ACCLIMATION FACILITIES

PROPOSED PLAN SITE DESCRIPTIONS AND CAPITAL COSTS

Yakama Nation Fisheries Resource Management

CONTENTS

List of Tables

List of Figures

I. ***INTRODUCTION***

This report presents site information for proposed Mid-Columbia Coho Reintroduction Plan (MCCRP) acclimation facilities that are located in the Wenatchee watershed. A general discussion of the acclimation component of the MCCRP, information about the criteria used to select the acclimation systems and the specific sites, and brief descriptions of those sites are included in Appendix B.2: Acclimation Facilities Alternatives. More detailed site information, designs, and capital costs are presented in this appendix. Appendix C.4 describes proposed Methow watershed acclimation facilities. The following is a list of master plan facility appendices, with this appendix highlighted.

A. FISH CULTURE GUIDELINES
B. ALTERNATIVE AND PROPOSED PLAN EVALUATIONS
 B.1 REARING FACILITIES
 B.2 ACCLIMATION FACILITIES
C. PROPOSED PLAN SITE DESCRIPTIONS AND CAPITAL COSTS
 C.1. WENATCHEE REARING FACILITIES
 C.2. METHOW REARING FACILITIES
 C.3. WENATCHEE ACCLIMATION FACILITIES
 C.4. METHOW ACCLIMATION FACILITIES
D. PROJECT SCHEDULE AND COSTS

Smolts are proposed to be released from a total of 9 locations in the Wenatchee watershed. Six of these sites currently exist and 3 require substantial amounts of construction. Most of the proposed acclimation sites in the Wenatchee subbasin have been used in the past by the MCCRP. The map below shows the locations of the sites that form the proposed plan for the Wenatchee.

As described in Appendix B.2, the identification of back-up sites is critical. Many factors can result in a preferred location not being available for use. In all the watersheds, back-ups to the proposed sites discussed below have been identified. These alternatives are listed in Appendix B.2.

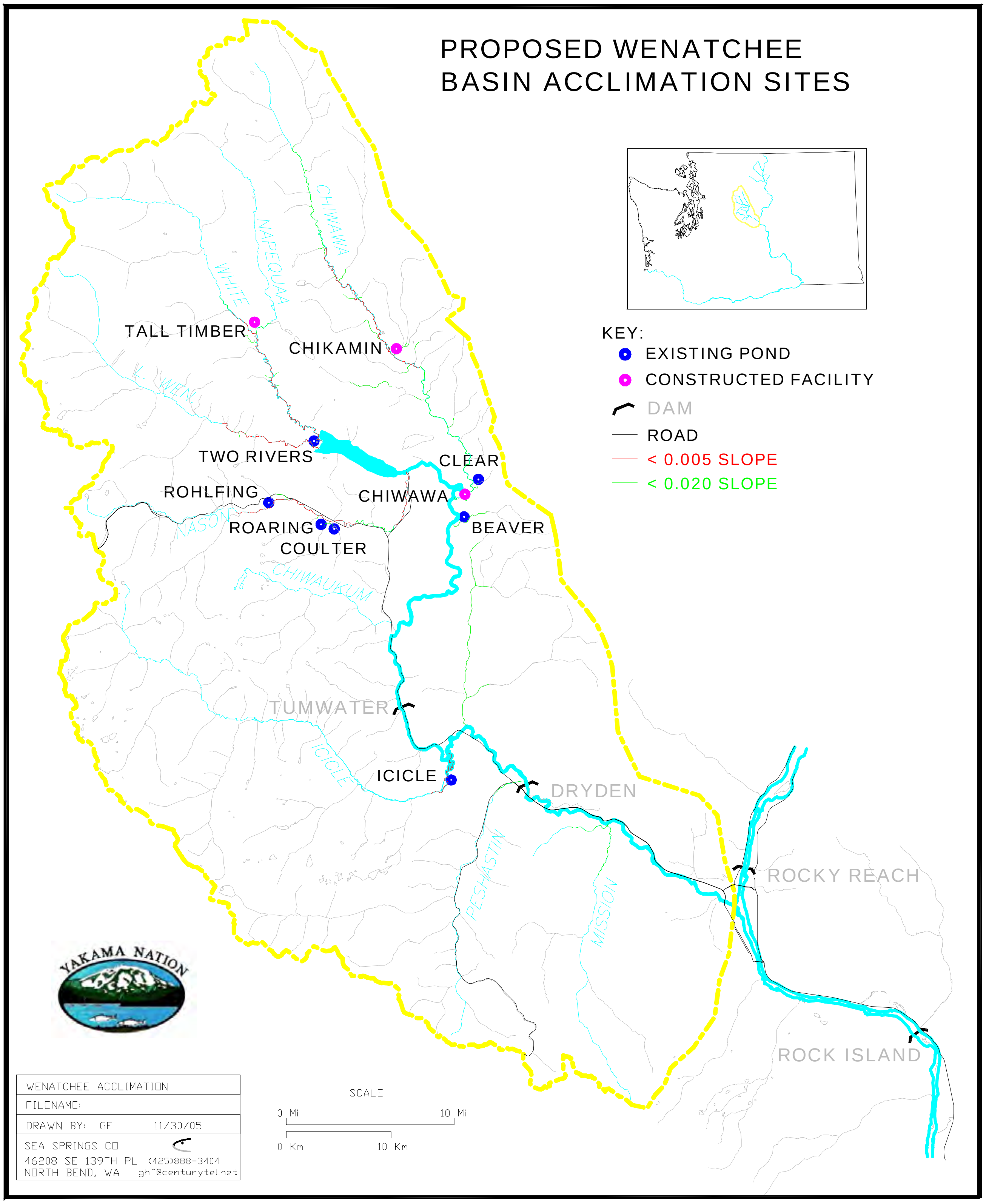

Figure 1. Site Map

II. *SITE DESCRIPTIONS*

A. General Information

Information about the location of the sites, their purpose, their type, their accessibility, and the presence of utilities is summarized in Table 1. In the location section, the tributary column lists the stream that the acclimation ponds drain into. River miles and elevation give a rough indication of the migratory difficulty for each proposed site.

The purpose section of the table provides some information about the proximity to habitat and about the main purpose of the site. Some locations function to release smolts so that returning adults are imprinted on spawning habitat located near the release site, some sites are used mainly for broodstock development (with adults returning to downstream locations), and some sites are intended to distribute adults widely within the targeted stream. The slope data (for the approximately one mile of stream below the release point) is a rough approximation of the quality of nearby habitat. Slopes less than 0.5% have been identified on watershed maps as approximating low gradient habitat.

The site type section indicates whether ponds currently exist or must be constructed and the type of facility proposed. The site type section also lists whether the locations have reasonable potential for over winter acclimation. In all of the following tables, the sites in red require significant amounts of construction. This includes the construction of ponds and pumped water supply systems at Tall Timber, ponds and a gravity water intake at Chikamin, and construction of both ponds at Chiwawa.

Table 1. General Information

	LOCATION							PURPOSE				SITE TYPE					OTHER	
	MAIN TRIBUTARY	RIVER MI. TO MOUTH OF WEN.	TOWNSHIP	RANGE	SECTION	1/4 SECTION	ELEVATION	LOCAL SPAWNING	BROOD DEVELOPMENT	WIDE ADULT DISTRIBUTION	DOWNSTREAM SLOPE (%)	WINTER USE	EXISTING NATURAL POND	EXISTING MANMADE POND	CONSTRUCTED POND	CONSTRUCTED FACILITY	PLOWED ACCESS	UTILITIES
Rohlfing	Nason	68	26	16	5	NE	2,240			✓	0.29	✓		✓			✓	✓
Coulter/Roaring	Nason	64	26	16	11	SE	2,170	✓			0.32		✓				✓	✓
Tall Timber	White	70	28	16	18	SW	1,930			✓	0.21	✓				✓	✓	✓
Beaver	Wenatchee	47	26	17	12	NE	1,900	✓	✓		1.33			✓			✓	
Chikamin	Chikamin	62	28	17	21	SW	2,400	✓			0.12				✓			
Clear	Chiwawa	50	27	18	31	NE	2,000			✓	0.85	✓		✓			✓	✓
Chiwawa	Chiwawa	48	27	17	36	SE	1,860			✓	0.90	✓				✓	✓	✓
Two Rivers	L. Wen.	60	27	16	21	SW	1,880			✓	0.16	✓		✓			✓	✓

B. Water and Space

Minimum water requirements were calculated based on a flow density of 6 pounds of fish per gallon/minute of flow, with an average release size of 18 fish per pound (see Appendix A Fish Culture Guidelines, for more detail and references). This is an average minimum value based on approximate spring-time water temperatures and assumes saturated inflow. Flow rates should be higher than the values indicated above, to provide a safety margin. Space requirements were calculated using 0.3 pounds of fish per cubic foot of water at sites with 24 hour security and 0.1 lbs/cft at all other sites. The land requirement assumes that the water surface covers half of the site.

Table 2 describes the water source and provides some flow data. These are preliminary measurements; more flow data will be collected. In general, locations that have either gravity or pumped ground water supplies are capable of operating through the winter. Sites with intakes require a high degree of security.

Table 2. Water and Space

	REQUIREMENTS									WATER SUPPLY							SPACE
	PROPOSED RELEASE NUMBER	CURRENT CAPACITY	WATER NEEDED (CFS)	REARING SPACE RQRT (CFT)	WATER SURFACE RQRT (ACRES)	Number of Ponds	POND LENGTH	POND WIDTH	LAND SURFACE RQRT (ACRES)	WATER SOURCE	APRIL FLOW (CFS)	GRAVITY, GROUND	GRAVITY, SURFACE	INTAKE REQUIRED	PUMPED, GROUND	PUMPED SURFACE	CURRENT POND SIZE (CFT)
Rohlfing	105,000	105,000	2.2	19,000	0.1					Unnamed			✓		✓		36,000
Coulter/Roaring	105,000	200,000	2.2	19,000	0.1					Coulter			✓				32,400
Tall Timber	210,000		4.3	39,000	0.3	2.0	139.6	46.5	0.6	Napeequa				✓		✓	
Beaver	100,000	75,000	2.1	19,000	0.1					Beaver	2.0		✓	✓			25,120
Chikamin	100,000		2.1	19,000	0.1	1.0	137.8	45.9	0.3	Minnow	30.0		✓	✓			
Clear	170,000	170,000	3.5	31,000	0.2					Clear	2.0	✓					NA
Chiwawa	170,000		3.5	31,000	0.2	2.0	124.5	41.5	0.5	Chiwawa	Large					✓	
Two Rivers	120,000	120,000	2.5	22,000	0.2					Lake	1.3				✓	✓	30,000

C. Environmental Conditions

Table 3 shows land use designations, ESA-listed fish species that might be near the sites, and other potential development risks for proposed Wenatchee basin sites. These and other impacts will be evaluated in more detail during permit and decision processes, including the National Environmental Policy Act (NEPA) analysis.

Chelan County zoning designations are defined as follows: 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 recreational; and FC, commercial forest. Flood designations have the following meanings: X500 is between the 100-year and 500-year flood elevations; A is within the 100-year floodplain and possibly in a floodway; and X is out of the floodplain.

Check marks under the species listed in the Environmental Impacts column indicate that they are likely to be present near the intake or pond. The main impacts to listed fish are barriers or intakes which impede migration around or through acclimation sites. Site designs aim to minimize these impacts.

Development risks list some of the major issues that may prevent construction and/or operation of the sites and affect the facility development process. They include: local opposition during construction permit application; low flow volumes; water rights issues; waste discharge addressed through the National Pollutant Discharge Elimination System (NPDES) process; the availability (lease, purchase, or use agreement) of land and access. A check mark in these columns means that preliminary analysis indicates the issue might be a problem at that site.

Table 3. Environmental Conditions

	LAND USE				ENV. IMPACTS				DEV. RISKS					
	ZONING	FLOOD DESIGNATION	LAND USE	OWNERSHIP	MINIMAL FISH IMPACTS	BULL TROUT LIKELY	STEELHEAD LIKELY	SPRING CHINOOK LIKELY	LOCAL OPPOSITION	FLOW QUANTITIES	WATER RIGHTS	DISCHARGE IMPACTS	LAND OWNERSHIP	ACCESS
Rohlfing	RR5	X	Rural residential	Private		✓	✓			✓		✓		
Coulter/Roaring	RR5	X	Rural residential	Private		✓	✓					✓		
Tall Timber	RR20	X	Guest ranch	Private	✓				✓		✓		✓	
Beaver	RR5	X	Guest ranch	Private			✓			✓		✓		
Chikamin	FC	X	Private forestry	Private		✓	✓	✓		✓		✓	✓	✓
Clear	RRR	X	Private campground	Private	✓					✓		✓	✓	
Chiwawa	RR20		Acclimation	Public	✓						✓		✓	
Two Rivers	RR20	A	Gravel mine	Private	✓								✓	

D. Additional Site Information

Water effluent treatment systems that are separate from acclimation ponds are not planned. Relatively small numbers of fish will be held at low densities in large ponds. The minimum retention time for water flowing through the pond will be 2.5 hours and in most cases will be several times longer than this. Fish wastes 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. Most acclimation ponds developed for other species in the region do not include off-line effluent treatment systems.

Avian and mammalian predation is a major consideration for remote acclimation sites. At some locations, chain link fences and overhead bird netting will be installed. At other sites, electric fences and overhead wires could be used. 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 and will be employed at locations where no structures are possible.

Many of the ponds at proposed sites could become inundated during floods, which can occur in the spring during coho acclimation/migration periods. For that reason, the program will not prevent the unplanned release of fish due to flooding.

1. Existing Sites

- *Rohlfing*. This site is currently being used by the MCCRP. The recent addition of a well will allow it to be used for over-winter acclimation. Low flows in this intermittent stream that supplies surface water limit the number of fish that can be acclimated. Installation of fencing has been approved by the landowner to reduce predation. The site is located near the upstream end of accessible habitat on Nason Creek.
- *Coulter/Roaring*. These sites are very close together and will be managed as one. Coulter is a beaver pond that is currently being used by the MCCRP. The Roaring wetland complex (much of which is owned by Yakama Nation) has several large beaver ponds that can be used for acclimation. Steelhead are known to migrate through the complex and to spawn in Roaring Creek. Net enclosures for coho in the beaver ponds would allow the free passage of other species through the system. These sites will introduce smolts into one of the important habitat areas of Nason Creek.
- *Beaver*. This site is currently being used by the MCCRP. The pond has an existing intake that allows free passage of migrants throughout Beaver Creek while coho are acclimating. Bird predation is limited to some extent by the surrounding tree cover, but otters are present. Beaver Creek has similar habitat attributes as many streams used by coastal coho salmon; however, to date it has seen limited spawning activity. Use may be limited by obstructions to migration including culverts and an irrigation diversion. Improvements to migration will be addressed during the habitat improvement phase of the proposed reintroduction program.
- *Clear*. This pond is on property owned by a private campground. Owners have been approached in the past about coho acclimation and have been receptive. The large pond volume and secure water supply will allow large numbers of fish to be acclimated through the winter. An acclimation site on Clear Creek would introduce smolts into the lower Chiwawa, downstream of low-gradient, high-quality habitat.
- *Two Rivers*. This site previously has been used by the MCCRP. Water was pumped from a lake formed by a gravel mine operation to an existing pond. Gravel excavation through the winter and spring creates relatively high turbidity in the lake. To minimize sediment discharge, water was returned to the lake rather than to the Little Wenatchee River. The site introduces coho into the lower section of the Little Wenatchee.

2. New Facilities

- *Tall Timber*. There are no accessible, existing ponds on the White that can be used for acclimation and few tributary streams that would allow gravity fed ponds to be constructed. For this reason. a conventional pumped water acclimation site is proposed. The proposed location is in the upper part of the low-gradient section of the White River. Plans are to drill a well and to construct a surface water intake and two ponds. Groundwater from the well will be spread over the river water intake to reduce icing impacts and allow use of the site through the winter. Predation control will include fences and overhead nets. The operation of a pumped surface water intake will require effective alarm systems and 24-hour security. Recent attempts to build a spring chinook acclimation facility on the site have been met with public opposition. We believe the coho project may be more acceptable because the purpose is reintroduction rather than supplementation of an existing population, and because the proposed facility will be temporary.
- *Chikamin*. An existing pond on private property exists where Minnow Creek enters the Chikamin. The pond is likely important habitat for other species and is not large enough to segregate with net enclosures. As a result, an off-channel pond is proposed for construction near the mouth of Minnow Creek, on land to be purchased. Water from a gravity flow intake on Chikamin would feed the ponds. The Chikamin itself, and the low-gradient section of the Chiwawa where it enters, are likely high-quality coho habitat.
- *Chiwawa*. Construction of an earthen pond adjacent to the Chiwawa Spring Chinook Acclimation Facility is proposed. Second-use water from the facility would supply the coho pond. No new water systems are constructed and it is assumed that land would not need to be purchased. Over-winter operation, good site security and predation control will be possible. The site reintroduces smolts into the lower section of the Chiwawa.

E. Conceptual Design Drawings

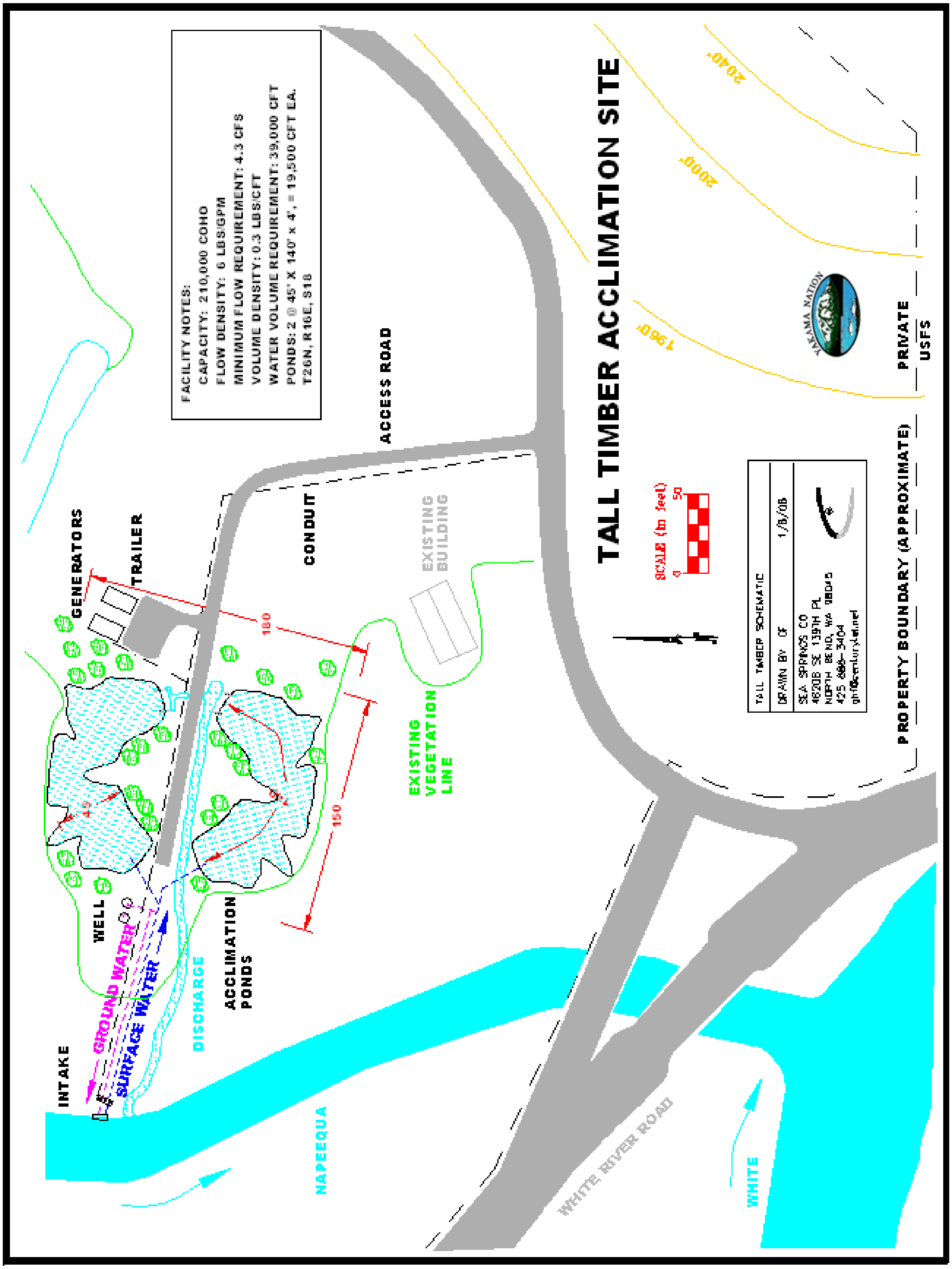

Figure 2. Tall Timber Conceptual Design

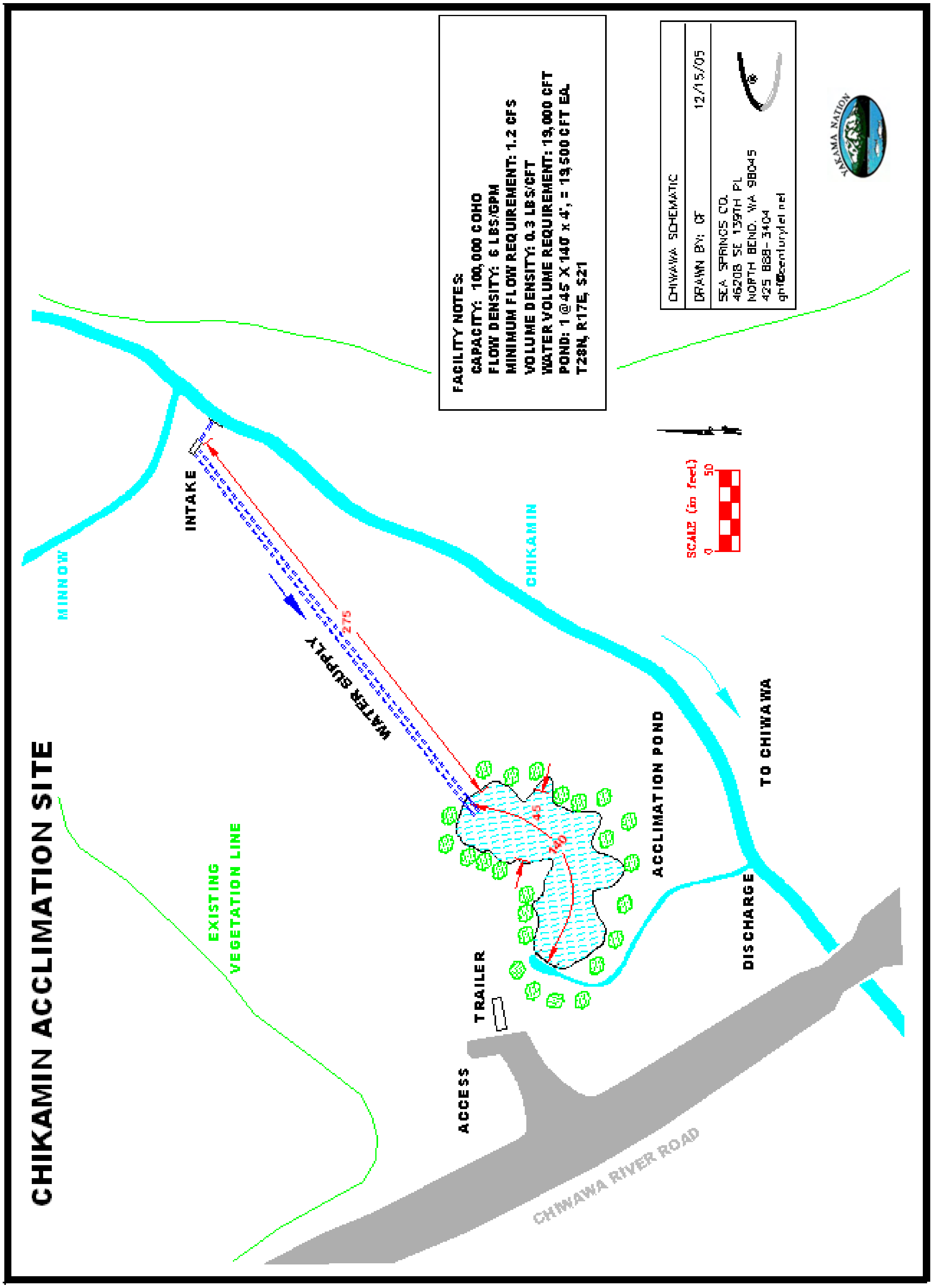

Figure 3. Chikamin Conceptual Design

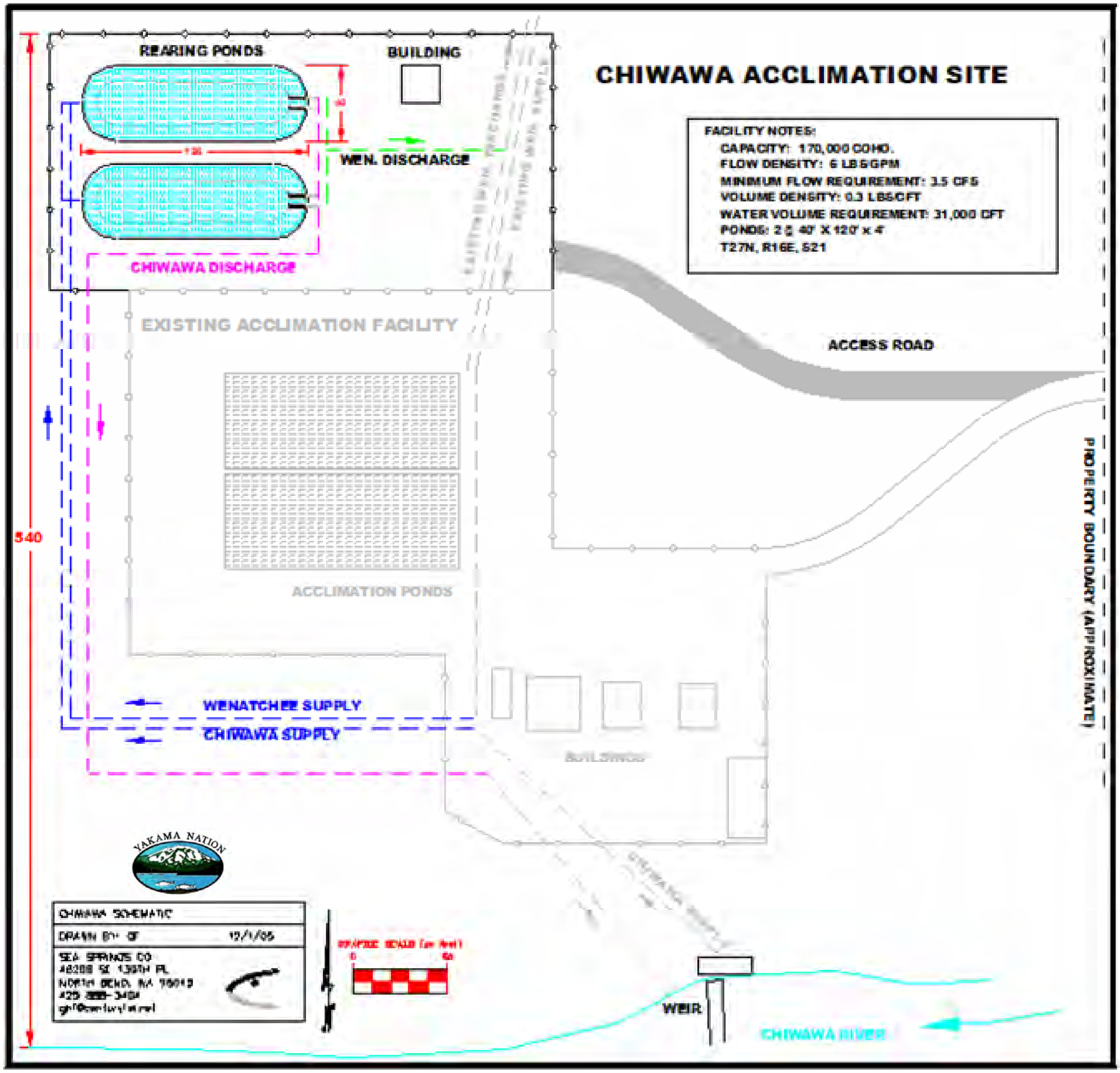

Figure 4. Chiwawa Conceptual Design

III. *FACILITY CAPITAL COSTS*

Following are construction, capital equipment,, and land purchase costs for the proposed acclimation sites. Table 4 summarizes these costs which are detailed in the following sections. All prices are 2005 dollars.

Table 4. Wenatchee Acclimation Site Capital Cost Summary

	Construction	Capital Equipment	Land Cost	Total
Tall Timber	$854,008	$117,700	$290,500	$1,262,208
Chikamin	$273,047	$16,050	$460,000	$749,097
Chiwawa	$459,603	$0	$0	$459,603
Existing	$93,600	$0	$0	$93,600
TOTAL	**$1,680,258**	**$133,750**	**$750,500**	**$2,564,508**

A. Existing Sites

Relatively minor capital improvements are proposed for sites with existing ponds. The only new barrier nets required are at the Roaring site. Adding new gravel to existing roads is included at 3 of the 5 sites. An improved water intake screen is planned for Beaver Creek. Predator control measures include stringing overhead wires and electric fences. At sites where it is possible, chain link fence will surround acclimation ponds. None of these existing sites will require land purchase or significant construction.

Table 5. Existing Wenatchee Acclimation Site Capital Costs

	Net barriers	Roads ($18/ft)	Water intake	Predator Control	Fencing ($24/ft)	Unlisted items allowance (30%)	TOTAL
Rohlfing	$0	$3,600	$0	$3,000	$7,200	$4,140	**$17,940**
Coulter/Roaring	$1,000	$1,800	$0	$3,000	$0	$1,740	**$7,540**
Beaver	$0	$14,400	$5,000	$3,000	$0	$6,720	**$29,120**
Clear	$0	$0	$0	$3,000	$0	$900	**$3,900**
Two Rivers	$0	$0	$0	$3,000	$24,000	$8,100	**$35,100**
TOTAL	**$1,000**	**$19,800**	**$5,000**	**$15,000**	**$31,200**	**$21,600**	**$93,600**

B. New Facilities

Table 6. Tall Timber Capital Costs

TALL TIMBER	Description	Quan.	Units	Unit Cost	Cost	Totals
CONSTRUCTION						
SITE WORK		1.0	acres			$ 56,781
Mobilization/demobilization	Equipment delivery, removal	1	ea	$ 40,000	$ 40,000	
Roads	Gravel access roads	460	lft	$ 18	$ 8,281	
Erosion Control	Silt fences, vegetation mats	1	ls	$ 3,500	$ 3,500	
Earthwork	Grub, clear, grade site	1.0	acre	$ 5,000	$ 5,000	
SURFACE WATER SUPPLY		4.3	cfs			$ 209,785
Intake screen structure	Precast concrete screen base, screens (12 sft)	1	ea	$ 30,000	$ 30,000	
Intake installation	Sheet pile, dewatering, structure placement	1	ea	$ 60,000	$ 60,000	
Riprap	Intake stabilization, 800 sft	120	tons	$ 90	$ 10,800	
Pump/settling chamber	Poured in place, 30' x20' x20'	81	cy	$ 800	$ 65,185	
Airblast/groundwater systems	Compressor, piping, timer, groundwater manifold	1	ls	$ 20,000	$ 20,000	
Piping	18" PVC SDR35, sand bedding, fittings	200	ft	$ 69	$ 13,800	
Pond supply manifolds	Manifold, control valves	2	ea	$ 5,000	$ 10,000	
GROUND WATER SUPPLY		1.0	cfs			$ 39,200
Well	8" diameter, 100' deep	1	ea	$ 25,000	$ 25,000	
Aeration tower	Packed columns	1	ea	$ 2,000	$ 2,000	
Piping	10" PVC SDR35, sand bedding, fittings	200	ft	$ 61	$ 12,200	
ELECTRICAL/GENERATORS						$ 64,509
Power delivery	Poles, lines to deliver power to site	410	ft	$ 4.90	$ 2,009	
Site electrical	Water pumps, generators, service drop, alarms	1	ls	$ 50,000	$ 50,000	
Conduit	To surface water intake and well	500	lft	$ 15	$ 7,500	
Alarm system	Alarms, conduit, autodialer	1	ls	$ 5,000	$ 5,000	
PONDS	2 @ 45'x140'x4'	1,806	cy			$ 98,759
Pond construction	Excavate, form berms	1,806	cy	$ 6.60	$ 11,917	
Bottom drain system	Water removal system under ponds	650	lft	$ 10	$ 6,500	
Bottom preparation	4" of sand spread and compacted	179	cy	$ 50	$ 8,967	
Outlet structures	Pre-fabricated steel, with screens	4	ea	$ 2,000	$ 8,000	
Liners	Hypalon, installed	16,250	sft	$ 0.90	$ 14,625	
Predator net system	Supports with nets	24,375	sft	$ 2.00	$ 48,750	
MISC						$ 74,920
Water discharge channel	Channel construction, rock	1,500	cy	$ 7.00	$ 10,500	
Site building	Generators, storage	400	sft	$ 120	$ 48,000	
Fencing	8' chain link	660	lft	$ 22	$ 14,520	
Overhead cover	Tree plantings	30	ea	$ 30	$ 900	
Site revegetation		1.0	acres	$ 1,000	$ 1,000	
CONSTRUCTION SUBTOTAL						**$ 543,954**
Unlisted item allowance	Contingencies	30%				$ 163,186
Contractor overhead	Construction management, profit	20%				$ 108,791
Sales tax		7.0%				$ 38,077
CONSTRUCTION SUBTOTAL						**$ 854,008**
CAPITAL EQUIPMENT						
Trailer	Office, storage, living quarters	1	ea	$ 15,000	$ 15,000	
Surface water pumps, controls	3 cfs ea, 10' head, 5 hp each, sequential start, ov	2	ea	$ 5,000	$ 10,000	
Ground water pump, controls	Well pump, 40' head, 8 hp, sequential start, overl	1	ea	$ 5,000	$ 5,000	
Generators	50 Kw, 48 hour fuel tank	2	ea	$ 40,000	$ 80,000	
Sales tax		7.0%			$ 7,700	
CAPITAL EQUIPMENT SUBTOTAL						**$ 117,700**
LAND PURCHASE						
Real estate appraisal		1	ea	$ 5,000	$ 5,000	
Land audit	Environmental appraisal	1	ea	$ 3,000	$ 3,000	
Land purchase	Purchase from private owner	5	acre	$ 50,000	$ 250,000	
Real estate tax		13%			$ 32,500	
LAND PURCHASE SUBTOTAL						**$ 290,500**
TOTAL						**$ 1,262,200**

Table 7. Chikamin Capital Costs

CHIKAMIN	Description	Quan.	Units	Unit Cost	Cost	Totals
CONSTRUCTION						
SITE WORK		1.0	acres			$ 19,940
Mobilization/demobilization	Equipment delivery, removal	1	ea	$ 10,000	$ 10,000	
Roads	Gravel access roads	80	lft	$ 18	$ 1,440	
Erosion Control	Silt fences, vegetation mats	1	ls	$ 3,500	$ 3,500	
Earthwork	Grub, clear, grade site	1.0	acre	$ 5,000	$ 5,000	
SURFACE WATER SUPPLY		2.1	cfs			$ 124,970
Intake screen structure	Precast concrete screen base, screens (6 sft)	1	ea	$ 20,000	$ 20,000	
Intake installation	Dewatering, structure placement	1	ea	$ 50,000	$ 50,000	
Riprap	Intake stabilization, 800 sft	80	tons	$ 90	$ 7,200	
Piping	18" PVC SDR35, sand bedding, fittings, 2 lines	550	ft	$ 78	$ 42,770	
Pond supply manifolds	Manifold, control valves	1	ea	$ 5,000	$ 5,000	
ELECTRICAL/GENERATORS						$ 6,000
Alarm system	Alarms, conduit, cellular autodialer	1	ls	$ 6,000	$ 6,000	
POND		880	cy			$ 14,806
Pond construction	Excavate, form berms	880	cy	$ 6.60	$ 5,806	
Outlet structures	Pre-fabricated steel, with screens	2	ea	$ 2,000	$ 4,000	
Predator net system	Supports with nets	1	ls	$5,000.00	$ 5,000	
MISC						$ 8,200
Water discharge channel	Channel construction, rock	900	cy	$ 7.00	$ 6,300	
Overhead cover	Tree plantings	30	ea	$ 30	$ 900	
Site revegetation		1.0	acres	$ 1,000	$ 1,000	
CONSTRUCTION SUBTOTAL						**$ 173,916**
Unlisted item allowance	Contingencies	30%				$ 52,175
Contractor overhead	Construction management, profit	20%				$ 34,783
Sales tax		7.0%				$ 12,174
CONSTRUCTION SUBTOTAL						**$ 273,047**
CAPITAL EQUIPMENT						
Trailer	Office, storage, living quarters	1	ea	$ 15,000	$ 15,000	
Sales tax		7.0%			$ 1,050	
CAPITAL EQUIPMENT SUBTOTAL						**$ 16,050**
LAND PURCHASE						
Real estate appraisal		1	ea	$ 5,000	$ 5,000	
Land audit	Environmental appraisal	1	ea	$ 3,000	$ 3,000	
Land purchase	Purchase from private owner	20	acre	$ 20,000	$ 400,000	
Real estate tax		13%			$ 52,000	
LAND PURCHASE SUBTOTAL						**$ 460,000**
TOTAL						**$ 749,097**

KEY: LS = Lump Sum, EA = Each, LFT = Linear Feet, SFT = square feet, CFT = cubic feet, CY = Cubic Yards, MO = month, HRS = hours

Table 8. Chiwawa Capital Costs

CHIWAWA	Description	Quan.	Units	Unit Cost	Cost	Totals
CONSTRUCTION						
SITE WORK		1.0	acres			$ 25,700
Mobilization/demobilization	Equipment delivery, removal	1	ea	$ 10,000	$ 10,000	
Roads	Gravel access roads	400	lft	$ 18	$ 7,200	
Erosion Control	Silt fences, vegetation mats	1	ls	$ 3,500	$ 3,500	
Earthwork	Grub, clear, grade site	1.0	acre	$ 5,000	$ 5,000	
SURFACE WATER SUPPLY		3.5	cfs			$ 85,900
Piping	18" PVC SDR35, sand bedding, fittings	1,100	ft	$ 69	$ 75,900	
Pond supply manifolds	Manifold, control valves	2	ea	$ 5,000	$ 10,000	
PONDS	2 @ 40'x120'x4'	1,435	cy			$ 71,190
Pond construction	Excavate, form berms	1,435	cy	$ 6.60	$ 9,472	
Bottom drain system	Water removal system under ponds	650	lft	$ 10	$ 6,500	
Bottom preparation	4" of sand spread and compacted	144	cy	$ 50	$ 7,176	
Outlet structures	Pre-fabricated steel, with screens	4	ea	$ 2,000	$ 8,000	
Liners	Hypalon, installed	12,917	sft	$ 0.90	$ 11,625	
Predator net system	Supports with nets	14,208	sft	$ 2.00	$ 28,417	
MISC						$ 109,951
Discharge piping	18" PVC SDR35, sand bedding, fittings	700	ft	$ 69	$ 48,300	
Site building	Storage	400	sft	$ 120	$ 48,000	
Fencing	8' chain link	575	lft	$ 22	$ 12,651	
Site revegetation		1.0	acres	$ 1,000	$ 1,000	
CONSTRUCTION SUBTOTAL						**$ 292,741**
Unlisted item allowance	Contingencies	30%				$ 87,822
Contractor overhead	Construction management, profit	20%				$ 58,548
Sales tax		7.0%				$ 20,492
TOTAL						**$ 459,603**

KEY: LS = Lump Sum, EA = Each, LFT = Linear Feet, SFT = square feet, CFT = cubic feet, CY = Cubic Yards, MO = month, HRS = hours

C. Basis for the Cost Estimates

In as many cases as possible, estimates for capital equipment and construction costs are based on the actual costs for recent fish facility projects completed by the MCCRP and Yakama Nation coho programs. These projects are listed in Appendix C1. In addition, the 2006 Heavy Construction Costs Estimating Software was used to confirm these costs and to produce estimates where needed.

Land costs were based on a review of recent real estate listings of property for sale in the area. Averages of values for comparable property were used to estimate the Chikamin and Tall Timber land costs.

IV. *PHOTOS*

Beaver.jpg

Coulter.jpg

Roaring.jpg

Rolfing.jpg

Figure 5. Group 1 Photos

Chikamin.jpg

Chiwawa.jpg

Clear Creek.jpg

Two Rivers.jpg

Figure 6. Group 2 Photos

APPENDIX C.4

METHOW ACCLIMATION FACILITIES

PROPOSED PLAN SITE DESCRIPTIONS AND CAPITAL COSTS

Yakama Nation Fisheries Resource Management

CONTENTS

List of Tables

List of Figures

I. ***INTRODUCTION***

This report presents site information for proposed Mid-Columbia Coho Reintroduction Plan acclimation facilities that are located in the Methow watershed. A general discussion of the acclimation component of the MCCRP, information about the criteria used to select the acclimation systems and the specific sites, and brief descriptions of those sites are included in Appendix B.2 Acclimation Facilities Alternatives. More detailed site information and capital costs are presented in this appendix. Appendix C.3 describes proposed Wenatchee watershed acclimation facilities. The following is a list of master plan facility appendices, with this appendix highlighted.

A. FISH CULTURE GUIDELINES
B. ALTERNATIVE AND PROPOSED FACILITY PLANS - EVALUATIONS
  - B.1 REARING FACILITIES ALTERNATIVES
  - B.2 ACCLIMATION FACILITIES ALTERNATIVES

C. PROPOSED FACILITY PLAN DETAIL – SITE DESCRIPTIONS AND CAPITAL COSTS
  - C.1 WENATCHEE REARING FACILITIES
  - C.2 METHOW REARING FACILITIES
  - C.3 WENATCHEE ACCLIMATION FACILITIES
  - ***C.4 METHOW ACCLIMATION FACILITIES***

D. PROJECT SCHEDULE AND COSTS

Smolts are proposed to be released from a total of 9 locations in the Methow watershed. Three of these are also rearing sites: the Winthrop National Fish Hatchery (NFH); the Eightmile constructed habitat; and the Heath constructed habitat. These sites are described in Appendix C.2 Methow Rearing Facilities. Of the remaining 6, 5 have existing ponds that can be used. Two of the 6 sites require substantial amounts of construction.

The identification of back-up, or alternative, sites is critical. Many factors could result in a preferred location not being available for use. Alternatives to the proposed sites discussed below have been identified. These alternatives are listed in Appendix B.2.

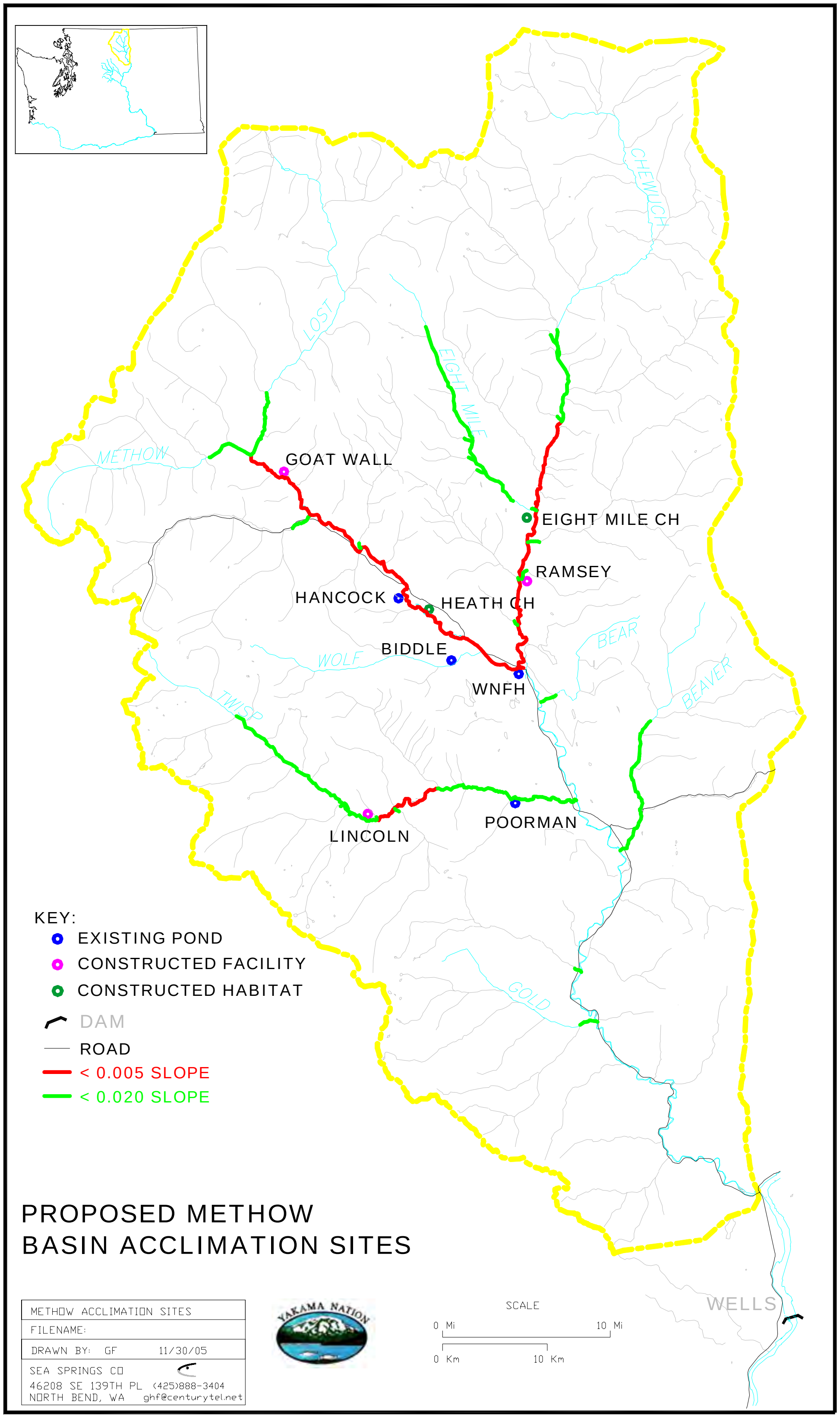

Figure 1. Site Map

II. *SITE DESCRIPTIONS*

A. General Information

Information about the location of the sites, their purpose, their type, their accessibility, and the presence of utilities is summarized in Table 1. In the location section, the tributary column lists the stream into which the acclimation ponds drain. River miles and elevation give a rough indication of the migratory difficulty for each proposed site.

The purpose section of the table provides some information about the proximity to habitat and about the main purpose of the site. Some locations function to release smolts so that returning adults are imprinted on spawning habitat that is located near the release site, some sites are used mainly for broodstock development, with returning adults collected at downstream locations; some sites are intended to spread adults widely within the targeted stream. The slope data for approximately one mile of stream below the release point is a rough approximation of the quality of nearby habitat. Slopes less than 0.5% have been identified on watershed maps as roughly approximating low-gradient habitat which is generally characterized as good for coho.

The site type section indicates whether ponds currently exist or must be constructed and the type of facility proposed. In all the following tables, the sites in red require significant amounts of construction, including construction of ponds and water supply systems at Lincoln and construction of both ponds and water systems at Goat Wall.

Table 1. General Information

	LOCATION						PURPOSE				SITE TYPE					OTHER	
	MAIN TRIBUTARY	RM TO MOUTH OF METHOW	TOWNSHIP	RANGE	SECTION	ELEVATION	LOCAL SPAWNING	BROOD DEVELOPMENT	WIDE ADULT DISTRIBUTION	DOWNSTREAM SLOPE (%)	WINTER USE	EXISTING NATURAL POND	EXISTING MANMADE POND	CONSTRUCTED POND	CONSTRUCTED HABITAT	PLOWED ACCESS	UTILITIES
Ramsey	Chewuck	57	35	21	11	1930			✓	0.57			✓			✓	✓
Poorman	Twisp	44	33	21	10	1730			✓	0.67	✓		✓			✓	✓
Lincoln	Twisp	56	33	20	16	2310	✓		✓	0.57	✓	✓				✓	✓
Biddle	Wolf	54	35	21	32	1920	✓	✓		2.40			✓			✓	✓
Hancock	Methow	59	35	20	15	1920	✓		✓	0.49	✓	✓				✓	
Goat Wall	Methow	68	34	17	7	2258	✓		✓	2.25	✓	✓				✓	

B. Water and Space

Minimum water requirements were calculated using a value of 6 pounds of fish per gallon/minute of flow, with an average release size of 18 fish per pound (see Appendix A Fish culture Guidelines, for more detail and references). This is an average minimum value based on approximate spring-time water temperatures and assumes saturated inflow. Flow rates should be higher than values indicated to provide a safety margin. Space requirements were calculated using 0.3 pounds of fish per cubic foot of water at sites with 24-hour security and 0.1 lbs/cft at other sites. The land requirement assumes that the water surface covers half of the site.

In Table 2, the section on the water supplies describes the type of water source and provides some flow data. These are preliminary measurements; more flow data will be collected in the future. In general, locations that have either gravity or pumped ground water supplies are capable of operating through the winter. Sites with intakes require a high degree of security to insure continuous water flow to the ponds.

Table 2. Water and Space

	REQUIREMENTS									WATER SUPPLY							SPACE
	PROPOSED RELEASE NUMBER	CURRENT CAPACITY	WATER NEEDED (CFS)	REARING SPACE RQRT (CFT)	WATER SURFACE RQRT (ACRES)	Number of Ponds	POND LENGTH	POND WIDTH	LAND SURFACE RQRT (ACRES)	WATER SOURCE	APRIL FLOW	GRAVITY, GROUND	GRAVITY, SURFACE	INTAKE REQUIRED	PUMPED, GROUND	PUMPED SURFACE	EXISTING POND SIZE (CFT)
Ramsey	125,000	185,000	2.6	23,000	0.2					Ramsey			✓				
Poorman	137,500	100,000	2.8	25,000	0.2					Ground		✓					
Lincoln	137,500		2.8	25,000	0.2					Twisp	Large		✓	✓		✓	36,000
Biddle	50,000	75,000	1.0	9,000	0.1					Wolf	2		✓	✓			10,000
Hancock	100,000	200,000	2.1	19,000	0.1					Springs	9	✓					
Goat Wall	50,000		1.0	9,000	0.1	1.0	94.9	31.6	0.1	Springs	Large	✓		✓		✓	

C. Environmental Conditions

Table 3 shows land use designations, ESA-listed fish species that might be near the sites, and other potential development risks for proposed Methow basin sites. These and other impacts will be evaluated in more detail during permit and decision processes, including the National Environmental Policy Act (NEPA) analysis.

Okanogan County zoning designations are defined as follows: RR, rural residential; VF, valley floor; MD, Methow review district. Riverine wetlands are associated with adjacent river systems and paulstrine are associated with small streams and marshes.

Check marks under the species listed in the Impacts column indicate that they are likely to be present near the intake or pond. The main impact to listed fish is barriers or intakes which impede migration around or through acclimation sites. Sites are designed to minimize these impacts, wherever possible.

The Development Risks section list some of the major issues that may prevent construction and/or operation of the sites and affect the facility development process. Development Risks include: local opposition during construction permit application; low flow volumes; water rights issues; waste discharge addressed through the National Pollutant Discharge Elimination System (NPDES) process; the availability (lease, purchase, or use agreement) of land; and access. A check mark in these columns signifies problematic issues identified during the preliminary analysis.

Table 3. Environmental Conditions

	LAND USE						ENV. IMPACTS				DEV. RISKS					
	ZONING	WETLAND DESIGNATION	FLOOD DESIGNATION	COMPREHENSIVE PLAN LAND USE	LAND USE	OWNERSHIP	MINIMAL FISH IMPACTS	BULL TROUT LIKELY	STEELHEAD LIKELY	SPRING CHINOOK LIKELY	LOCAL OPPOSITION	FLOW QUANTITIES	WATER RIGHTS	DISCHARGE IMPACTS	LAND OWNERSHIP	ACCESS
Ramsey	VF	Paulstrine	100 Yr	Ag	Rural residential	Private		✓	✓	✓	✓			✓	✓	
Poorman	VF	Paulstrine	100 Yr	Ag	Rural residential	Private	✓				✓			✓	✓	
Lincoln	VF	Riverine	100 Yr	None	Rural residential	Private		✓	✓	✓		✓	✓	✓		
Biddle	RR	None	None	Ag	Rural residential	Private	✓							✓		
Hancock	RR	Paulstrine	None	State	Pasture	Private		✓	✓	✓	✓			✓	✓	
Goat Wall	RR	Paulstrine	98 Yr	None	Rural residential	Private		✓	✓	✓	✓	✓	✓	✓	✓	

D. Additional Site Information

Water effluent treatment systems that are separate from acclimation ponds are not planned. Relatively small numbers of fish will be held at low densities in large ponds. The minimum retention time will be 2.5 hours and in most cases will be several times longer than this. Fish wastes 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. Most acclimation ponds developed for other species in the region do not include off-line effluent treatment systems.

Avian and mammalian predation is a major consideration for remote acclimation sites. At some locations, chain link fences and overhead bird netting will be installed. At other sites, electric fences and overhead wires could be used. Deterrence of predation through human presence has been used effectively at sites currently operated by the MCCRP as well as federal and state hatcheries and will be employed at locations where no structures are possible.

Many of the ponds at proposed sites could become inundated during floods, which normally occur in the spring during coho acclimation/migration periods. For that reason, the program would not prevent the unplanned release of fish due to flooding.

1. Existing Sites

- *Ramsey*. This large pond on private land is fed by Ramsey Creek water. The site is located in the middle of the low-gradient section of the Chewuch.
- *Poorman*. Large ponds are fed by spring water. Although parts freeze over, the site is likely to be functional in winter. This site will introduce smolts into the lower Twisp.
- *Hancock*. Recent Yakama Nation restoration projects have replaced a road culvert, improved fencing, added woody debris, and improved flow conditions in the spring channel. It is now much more accessible to salmonids and has habitat that should be very attractive to spawning coho. Fry that migrate out of the spring can rear in the Methow mainstem. Net enclosures in the existing ponds would allow the site to be used by other species during coho acclimation.
- *Biddle*. This site has been used in the past by the MCCRP. It has an intake and off-line pond. The intake needs to be improved to minimize impacts to other salmonids in Wolf Creek.

2. New Facilities

- *Lincoln*. Ponds currently exist on the Lincoln property. The ponds are adjacent to the Twisp River. An unscreened culvert provides river water to the ponds. The culvert elevation allows water flow only at moderate to high discharge.. A new intake that meets National Marine Fisheries Service (NMFS)/Washington Department of Fish and Wildlife (WDFW) screen criteria is required. Development of a pumped groundwater supply will provide water supply security and will allow winter operation. Existing vegetation will make placement of predator control fences difficult, but overhead nets can limit bird problems. This site puts coho into the upper portion of the low-gradient section of the Twisp.
- *Goat Wall*. A series of small ponds on private property are fed by springs at the base of Goat Wall. The ponds are valuable habitat and are not large enough to acclimate coho. As a result, it is proposed that a portion of the spring water be diverted into constructed ponds and that a new well be built to supplement the spring water. Adults produced from Goat Wall releases must migrate through a reach of the Methow River that frequently dewaters in late summer or early fall. However, releases from this site may encourage coho, when flow conditions allow, to return to the upper Methow above the dewatered area where quality coho habitat exists. Adult coho frequently migrate upstream during fall freshets which would provide passage in most years.

E. Conceptual Design Drawings

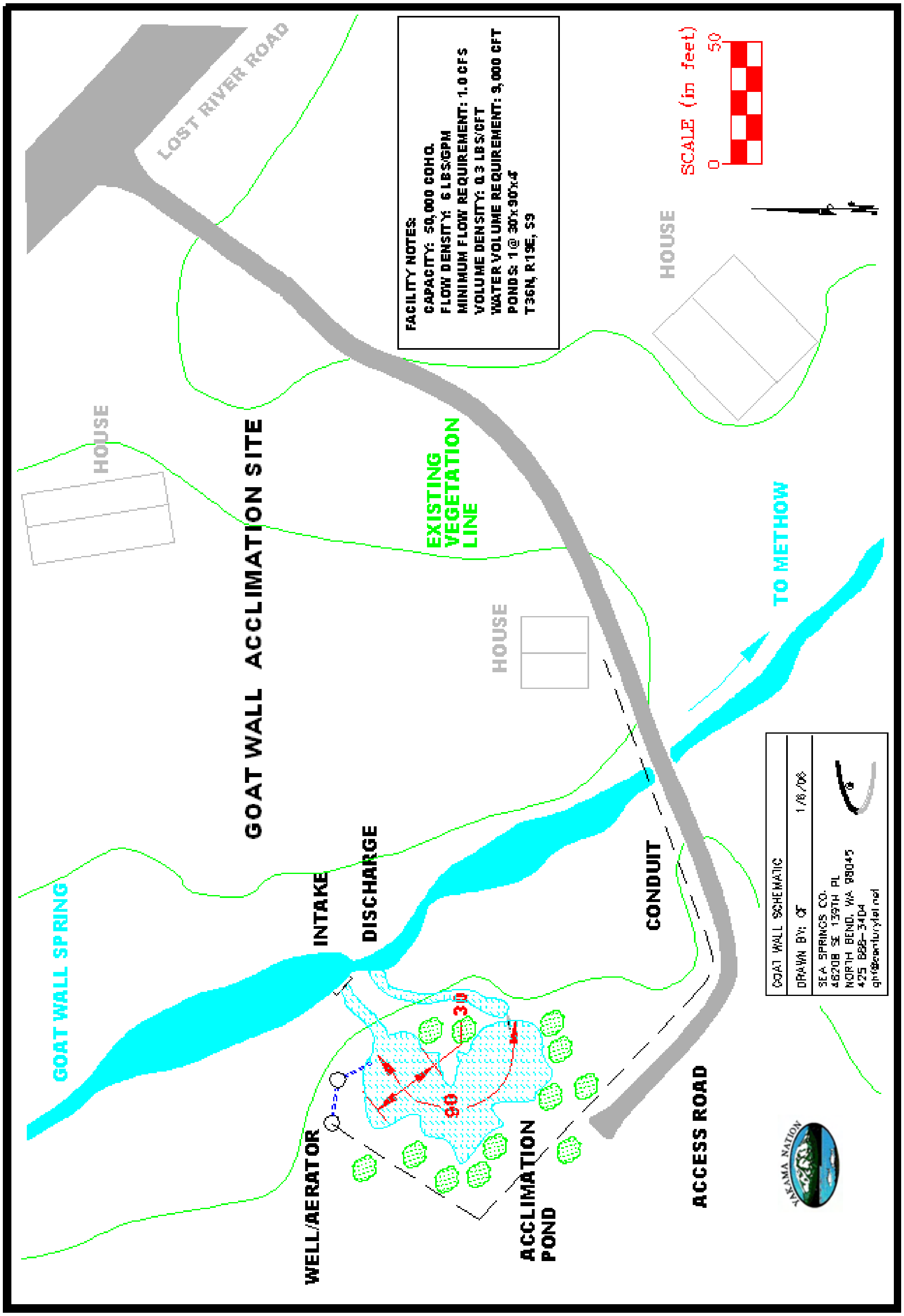

Figure 2. Goat Wall Conceptual Design

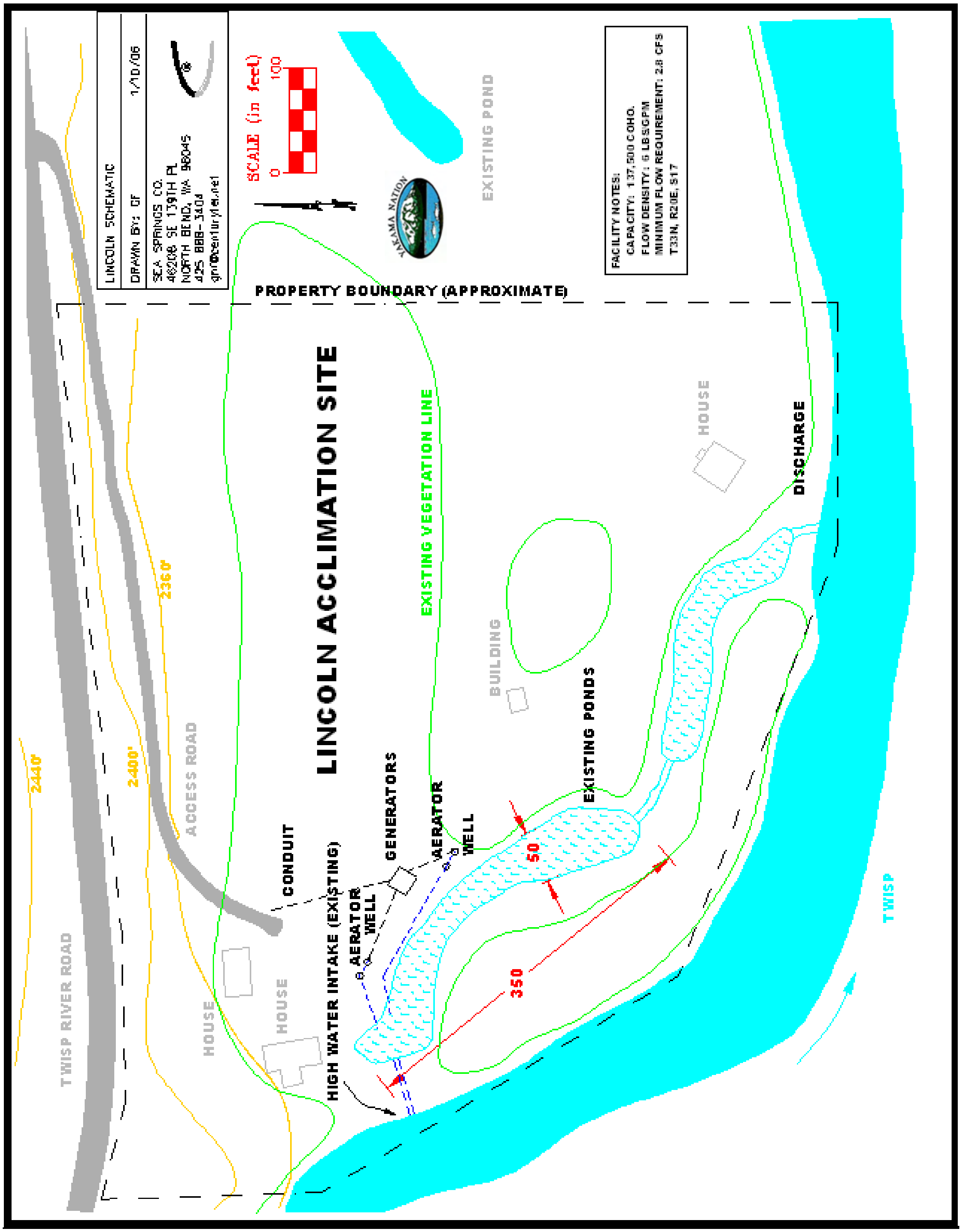

Figure 3. Lincoln Conceptual Design

III. *FACILITY CAPITAL COSTS*

Following are construction, capital equipment, permitting, and land purchase costs for the proposed acclimation sites. Table 4 summarizes these costs. All prices are 2005 dollars. Sales taxes and delivery are included in the estimated values.

Table 4. Methow Acclimation Site Capital Cost Summary

	Construction	Capital Equipment	Land Cost	Total
Lincoln	$254,183	$98,793	$0	$352,976
Goat Wall	$246,317	$25,242	$290,500	$562,060
Existing	$30,680	$0	$0	$30,680
TOTAL	**$531,180**	**$124,035**	**$290,500**	**$945,715**

A. Existing Sites

Relatively minor capital improvements are proposed for sites with existing ponds. Plans include new barrier nets for 3 sites, some road construction at the Hancock site, and improvements to the existing water intake at Biddle. Predator control measures at all the sites include stringing overhead wires and electric fences where possible. None of these existing sites will require land purchase or significant construction.

Table 5. Existing Methow Acclimation Site Capital Costs

	Net barriers	Roads ($18/ft)	Water intake	Predator Control	Fencing ($24/ft)	Unlisted items allowance (30%)	TOTAL
Ramsey	$1,000	$0	$0	$3,000	$0	$1,200	**$5,200**
Poorman	$1,000	$0	$0	$3,000	$0	$1,200	**$5,200**
Biddle	$0	$0	$5,000	$3,000	$0	$2,400	**$10,400**
Hancock	$1,000	$3,600	$0	$3,000	$0	$2,280	**$9,880**
TOTAL	**$3,000**	**$3,600**	**$5,000**	**$12,000**	**$0**	**$7,080**	**$30,680**

B. New Facilities

Table 6. Lincoln Capital Costs

LINCOLN	Description	Quan.	Units	Unit Cost	Cost	Totals
CONSTRUCTION						
SITE WORK						$ 13,390
Mobilization/demobilization	Equipment delivery, removal	1	ea	$ 10,000	$ 10,000	
Roads	Gravel access roads	190	lft	$ 18	$ 3,390	
GROUND WATER SUPPLY		2.8	cfs			$ 67,110
Well	8" diameter, 100' deep	2	ea	$ 25,000	$ 50,000	
Aeration towers	Packed columns	2	ea	$ 2,000	$ 4,000	
Piping	18" PVC SDR35, sand bedding, fittings	190	ft	$ 69	$ 13,110	
ELECTRICAL/GENERATORS						$ 24,400
Power delivery	Poles, lines to delivery power to site	1,000	ft	$ 4.90	$ 4,900	
Site electrical	Water pumps, generators, service drop, alarms	1	ls	$ 10,000	$ 10,000	
Conduit	To well	300	lft	$ 15	$ 4,500	
Alarm system	Alarms, conduit, autodialer	1	ls	$ 5,000	$ 5,000	
PONDS						$ 9,000
Outlet structures	Pre-fabricated steel, with screens	2	ea	$ 2,000	$ 4,000	
Predator net system	Supports with nets	1	ls	$5,000.00	$ 5,000	
MISC						$ 48,000
Site building	Generators, storage	400	sft	$ 120	$ 48,000	
CONSTRUCTION SUBTOTAL						**$ 161,900**
Unlisted item allowance	Contingencies	30%				$ 48,570
Contractor overhead	Construction management, profit	20%				$ 32,380
Sales tax		7.0%				$ 11,333
CONSTRUCTION SUBTOTAL						**$ 254,183**
CAPITAL EQUIPMENT						
Trailer	Office, storage, living quarters	1	ea	$ 15,000	$ 15,000	
Ground water pump, controls	Well pump, 9 hp each, sequential start, overloads	2	ea	$ 5,000	$ 10,000	
Generators	30 Kw, 48 hour fuel tank	2	ea	$ 28,000	$ 56,000	
Sales tax		7.0%			$ 17,793	
CAPITAL EQUIPMENT SUBTOTAL						**$ 98,793**
TOTAL						**$ 352,976**

KEY: LS = Lump Sum, EA = Each, LFT = Linear Feet, SFT = square feet, CFT = cubic feet, CY = Cubic Yards, MO = month, HRS = hours

Table 7. Goat Wall Capital Costs

GOAT WALL	Description	Quan.	Units	Unit Cost	Cost	Totals
CONSTRUCTION						
SITE WORK		1.0	acres			$ 33,550
Mobilization/demobilization	Equipment delivery, removal	1	ea	$ 15,000	$ 15,000	
Roads	Gravel access roads	560	lft	$ 18	$ 10,050	
Erosion Control	Silt fences, vegetation mats	1	ls	$3,500.00	$ 3,500	
Earthwork	Grub, clear, grade site	1.0	acre	$ 5,000	$ 5,000	
SURFACE WATER SUPPLY		1.0	cfs			$ 50,000
Intake screen structure	Precast concrete screen base, screens	1	ea	$ 20,000	$ 10,000	
Intake installation	Sheet pile, dewatering, structure placement	1	ea	$ 50,000	$ 40,000	
GROUND WATER SUPPLY		1.0	cfs			$ 29,440
Well	8" diameter, 100' deep	1	ea	$ 25,000	$ 25,000	
Aeration towers	Packed columns	1	ea	$ 2,000	$ 2,000	
Piping	10" PVC SDR35, sand bedding, fittings	40	ft	$ 61	$ 2,440	
ELECTRICAL/GENERATORS						$ 28,500
Site electrical	Water pumps, generators, service drop, alarms	1	ls	$ 10,000	$ 10,000	
Conduit	To surface water intake and well	900	lft	$ 15	$ 13,500	
Alarm system	Alarms, conduit, autodialer	1	ls	$ 5,000	$ 5,000	
PONDS		417	cy			$ 11,750
Pond construction	Excavate, form berms	417	cy	$ 6.60	$ 2,750	
Outlet structures	Pre-fabricated steel, with screens	2	ea	$ 2,000	$ 4,000	
Predator net system	Supports with nets	1	ls	$5,000.00	$ 5,000	
MISC						$ 3,650
Water discharge channel	Channel construction, rock	250	cy	$ 7	$ 1,750	
Overhead cover	Tree plantings	30	ea	$ 30	$ 900	
Site revegetation		1.0	acres	$ 1,000	$ 1,000	
CONSTRUCTION SUBTOTAL						**$ 156,890**
Unlisted item allowance	Contingencies	30%				$ 47,067
Contractor overhead	Construction management, profit	20%				$ 31,378
Sales tax		7.0%				$ 10,982
CONSTRUCTION SUBTOTAL						**$ 246,317**
CAPITAL EQUIPMENT						
Ground water pump, controls	Well pump, 8 hp, sequential start, overloads	1	ea	$ 5,000	$ 5,000	
Oxygen back-up system	DO sensors, liquid oxygen tank, valves, airstones	1	ea	$ 3,000	$ 3,000	
Sales tax		7.0%			$ 17,242	
CAPITAL EQUIPMENT SUBTOTAL						**$ 25,242**
LAND PURCHASE						
Real estate appraisal		1	ea	$ 5,000	$ 5,000	
Land audit	Environmental appraisal	1	ea	$ 3,000	$ 3,000	
Land purchase	Purchase from private owner	5	acre	$ 50,000	$ 250,000	
Real estate tax		13%			$ 32,500	
LAND PURCHASE SUBTOTAL						**$ 290,500**
TOTAL						**$ 562,059**

KEY: LS = Lump Sum, EA = Each, LFT = Linear Feet, SFT = square feet, CFT = cubic feet, CY = Cubic Yards, MO = month, HRS = hours

C. Basis for the Cost Estimates

In as many cases as possible, estimates for capital equipment and construction costs are based on the actual costs for recent fish facility projects completed by the MCCRP and Yakama Nation coho programs. These projects are listed in Appendix C1. In addition, the 2006 Heavy Construction Costs Estimating Software was used to confirm these costs and to produce estimates where needed.

Land costs were based on a review of recent real estate listings of property for sale in the area. Averages of values for comparable property were used to estimate the Goat Wall land costs.

IV. *PHOTOS*

Biddle.jpg

Hancock.jpg

Lincoln.jpg

Poorman.jpg

Figure 4. Group 1 Photos

APPENDIX D. PROJECT SCHEDULES AND COSTS

Yakama Nation Fisheries Resource Management

CONTENTS

List of Tables

I. *SUMMARY*

This appendix summarizes project schedules and estimated costs for all the program elements. They are based on a fish release plan that is expected to last until 2026 as shown in the table below. Timetables for facility development and the monitoring and evaluation plan are also developed based on program objectives.

	2006	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*	*2025*	*2026*
Wenatchee																					
Broodstock Dev																					
Natural Production																					
Methow																					
Broodstock Dev																					
Natural Production																					

Estimates of the capital and operating costs cover the project's lifetime. Capital cost estimates for the proposed fish facilities system include: program planning; preliminary and final designs; project-level (such as National Environmental Policy Act [NEPA] and Endangered Species Act [ESA]) evaluations; facility development permits; land purchase; construction; and capital equipment. To minimize costs, the proposed facility plan for the Mid-Columbia Coho Reintroduction project makes extensive use of existing facilities—brood capture, rearing, and acclimation—in the region. Alternative locations have been identified for all proposed sites. It is expected that if these alternatives are used, costs will not be significantly different than those for the proposed program.

TOTAL MCCRP CAPITAL COSTS

Planning and Design	$1,040,975
Permits	$875,355
Capital Equipment	$1,280,130
Multi-Function Facilities	$3,473,294
Acclimation Facilities	$3,252,439
TOTAL	**$9,922,193**

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 will change over time. Expenses during years when release numbers and operating costs are at their maximum are estimated to be:

PEAK ANNUAL OPERATING EXPENSES (2012)

Operation and Maintenance	$2,282,110
Monitoring and Evaluation	$1,255,476
Tagging	$653,417
General and Administrative	$428,620
SUBTOTAL	**$4,619,623**
Cost Share	$1,211,200
TOTAL	**$3,408,423**

The proposed program currently shares rearing costs with National Oceanic and Atmospheric Administration (NOAA) through the Mitchell Act and monitoring and evaluation costs with Washington Department of Fish and Wildlife (WDFW) and the region's Public Utility Districts (PUD). Additional funding support may be available in the future through these agencies and others in the region.

II. *INTRODUCTION*

The B and C Appendices include facility descriptions, construction capital cost details, and operating cost estimates for rearing. Other project expenses, such the *PLANNING, DESIGN, AND PERMITS* capital costs and the *OTHER OPERATION AND MAINTENANCE* operating costs are detailed in Chapter IV. Following is a list of master plan facility appendices, with this appendix highlighted.

A. FISH CULTURE GUIDELINES
B. ALTERNATIVE AND PROPOSED PLAN EVALUATIONS
    B.1 REARING FACILITIES
    B.2 ACCLIMATION FACILITIES
C. PROPOSED PLAN SITE DESCRIPTIONS AND CAPITAL COSTS
    C.1 WENATCHEE REARING FACILITIES
    C.2. METHOW REARING FACILITIES
    C.3. WENATCHEE ACCLIMATION FACILITIES
    C.4. METHOW ACCLIMATION FACILITIES
D. PROJECT SCHEDULE AND COSTS

III. *PROJECT SCHEDULES*

Design, permitting and construction activities are scheduled to meet the requirements of the fish release plan. New facilities are not required in the Broodstock Development phases. Natural Production Phases start in 2011 in the Wenatchee and 2012 in the Methow. New facilities will need to be operational by these dates.

The general schedule shown in Table 1 displays how each of the program facility development elements are structured within the NPCC step review process. Facility construction can begin after the Step 3 review in 2009, allowing facilities to be in use by the required dates.

Table 1. Planning, Design, Permit, and Construction Schedule

	2006				2007				2008				2009				2010			
	JFM	*AMJ*	*JAS*	*OND*	*JFM*	*AMJ*	*JAS*	*OND*	*JFM*	*AMJ*	*JAS*	*OND*	*JFM*	*AMJ*	*JAS*	*OND*	*JFM*	*AMJ*	*JAS*	*OND*
NPPC STEP REVIEW																				
PLANNING																				
DESIGN																				
PERMITS																				
NEPA																				
ESA																				
Facility																				
CONSTRUCTION																				
Wenatchee																				
Methow																				

Key: Step 1 Step 2 step 3

A. SMOLT RELEASE

The release plan details shown below guide the calculation of program capital and operating costs.

Table 2. Release Plan Details
(in numbers of smolts released /1,000,000)

	2006	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*	*2025*	*2026*
Wenatchee																					
Broodstock Dev																					
Phase I																					
Phase II	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**																
Natural Production																					
Implementation						**1.16**	**1.16**	**1.16**													
Support Phase I									**0.81**	**0.81**	**0.81**	**0.81**	**0.81**	**0.81**							
Support Phase II															**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	
Methow																					
Broodstock Dev																					
Phase I	**0.50**	**0.50**	**0.50**																		
Phase II				**0.50**	**0.50**	**0.50**															
Natural Production																					
Implementation							**1.00**	**1.00**	**1.00**												
Support Phase I										**0.70**	**0.70**	**0.70**	**0.70**	**0.70**	**0.70**						
Support Phase II																**0.35**	**0.35**	**0.35**	**0.35**	**0.35**	**0.35**
TOTAL	**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**1.66**	**2.16**	**2.16**	**1.81**	**1.51**	**1.51**	**1.51**	**1.51**	**1.51**	**1.10**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.35**

B. FACILITY DEVELOPMENT

Development of the project requires that several evaluation processes be conducted, that designs be completed, and that permits be obtained for new facilities. These new facilities include a small adult holding and incubation site, two constructed habitats, and five acclimation sites involving varying degrees of construction.

Table 3 shows the planned schedule for each of the facility development elements and tasks that support the completion of those elements. The tasks are described in more detail in Chapter IV.A.1 of this Appendix.

Table 3. Planning, Design, Permit, and Construction Detailed Schedule

ELEMENTS	2006				2007				2008				2009				2010			
Tasks	*JFM*	*AMJ*	*JAS*	*OND*	*JFM*	*AMJ*	*JAS*	*OND*	*JFM*	*AMJ*	*JAS*	*OND*	*JFM*	*AMJ*	*JAS*	*OND*	*JFM*	*AMJ*	*JAS*	*OND*
NPPC STEP REVIEW																				
Step 1	1	1	1	1																
Step 2											2									
Step 3																3				
PLANNING																				
Master Plan Support	1	1	1	1																
Site Data Collection					2	2	2	2	2	2										
FACILITY DESIGN																				
Preliminary																				
Wenatchee					2	2	2	2	2	2										
Methow					2	2	2	2	2	2										
Final																				
Wenatchee												3	3	3	3					
Methow												3	3	3	3					
PERMITS																				
Surveys, Studies																				
Cultural Resources						2	2													
Wetlands, Plants						2	2													
Flood						2	2													
Ground Water						2	2													
Surface Water						2	2													
Listed Species					2	2	2	2	2	2										
Other Species					2	2	2	2	2	2										
Discharge Impacts					2	2	2	2	2	2										
NEPA																				
Scoping, SOW					2															
Draft EIS						2	2	2												
Final EIS, ROD									2	2										
ESA																				
Edit HGMP, BA					2	2	2													
Public, Agency Review							2	2	2											
Facility																				
Water Rights					2	2	2	2	2	2	2	3	3	3	3					
JARPA												3	3	3	3					
Critical Areas												3	3	3	3					
Construction												3	3	3	3					
CONSTRUCTION																				
Real Estate Appraisals																	■			
Environ. Land Audits																	■			
Land Purchase																	■			
Wenatchee Con.																	■	■		
Methow Con.																				■

Key: Step 1 (1) Step 2 (2) step 3 (3)

This is an aggressive schedule that assumes that the Step 1 review of the Master Plan will be completed by the end of December, 2006; that the NEPA and ESA permit processes are completed in 18 months from completion of the STEP 1 review; that the Step 2 review process takes 3 months; and that the Step 3 review can be completed in the third quarter of 2009. To meet this timetable, it is expected that fast track planning and design procedures will be used. For example, facility permitting time periods can be shortened by submitting water rights applications prior to preliminary designs being completed and land purchase can be expedited by conducting preliminary discussions with land owners at proposed facility locations prior to a Step 3 decision.

C. MONITORING AND EVALUATION

Table 4 shows the planned schedule for the monitoring and evaluation tasks. The tasks are described in detail in Chapter 7 of the master plan.

Table 4. Monitoring and Evaluation Detailed Schedule

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
PROJECT PERFORMANCE INDICATORS																					
Smolt Survival																					
In-Pond Survival																					
Pre-Rel. Fish Cond.																					
Run Timing																					
Spawn Esc and Dist.																					
Natural Smolt Prod.																					
Egg to Emig. Surv.																					
Adult to Adult Prod.																					
Harvest Rates																					
SPECIES INTERACTIONS																					
NTTOC Status																					
Size Structure																					
Abund. and Surv.																					
Distribution																					
Mech. Of Interaction.																					
Competition																					
Predation																					
GENETIC ADAPTABILITY																					
Morphometrics																					
Genetic Monitoring																					
Sperm Cryopres.																					

Wenatchee Broodstock Dev. Phases
Wenatchee Broodstock Nat. Prod. Phases
Methow Broodstock Dev. Phases
Methow Broodstock Nat. Prod. Phases
No PIT tags

IV. *PROJECT COSTS*

The estimating procedures used for Construction and Capital Equipment are detailed in the B and C Appendices. The capital cost element, *Planning, Design, and Permits*, and all the operating cost elements, which include *Operating and Maintenance*, *Monitoring and Evaluation*, and *General and Administrative*, have estimating procedures described in the sections below. The methods used produce an accuracy higher than +/- 35% to 50%, the level suggested in the 3 Step review process description (NPPC 2001). That document states that for the conceptual level proposals required of a master plan, "Cost estimates are general and often are based on costs from previous projects and comparable construction costs." For both capital cost elements, *Planning Design, and Permits* and *Facilities and Capital Equipment*, average values for similar facility projects were compared with site-specific cost estimates to improve accuracy.

Operating cost estimates also have a high degree of accuracy. They are based on the actual costs of operating the feasibility phase of the MCCRP. The cost structure of all the elements of operation are well defined through these current project budgets and are adjusted to predict future costs.

Estimated expense totals are shown in the following tables both with and without cost sharing amounts. Project support currently being provided (detailed in the following sections) is expected to continue in future years and is shown in red in the tables. In addition, there may be other funding contributions that are not listed. For example, land purchase funds for sites that have high value as habitat may be provided by resource agencies and groups. Also, the Grant, Chelan and Douglas County PUDs are obligated to support the coho reintroduction program as part of their Hatchery Compensation Plan (HCP) mitigation responsibility when this program receives the authority and funding from Northwest Power and Conservation Council (NPPC) and Bonneville Power Administration (BPA) to continue its operation, resulting in additional cost-sharing.

A. CAPITAL COSTS

The conceptual design for the natural production phases proposes that lower river hatcheries rear 85% of the program fish and that two new constructed habitats on the Methow would rear the remaining 15%. A spawning and early incubation facility is proposed near Dryden in the Wenatchee basin.

The acclimation system features multiple sites, with emphasis placed on the use of existing ponds that have gravity flow, and surface water supplies. In both Wenatchee and Methow basins, 9 release sites form the recommended natural production acclimation system for a project total of 18 sites. Two of these sites are the constructed habitats; of the other 16, 7 exist and have previously been used by the MCCRP.

The total estimated project capital cost is $9,922,000. Planning, design, and permitting make up $1,916,000 of this total and facility construction, land purchase, and capital equipment the remaining $8,006,000.

1. Planning, Design, and Permits

Table 5 summarizes the costs of the planning, design, and permitting element of the proposed program by task, by NPCC step, and by year. Table 6 details these costs and their timing. Yakama Nation personnel will be major contributors to these efforts; their costs are included under *Operating Costs*, *General and Administrative*.

Table 5. Planning, Design and Permits Cost Summary

SUMMARY BY TASK		
PLANNING	$	388,000
DESIGN	$	652,975
PERMITS	$	875,355
SUMMARY BY STEP		
STEP 1	$	40,000
STEP 2	$	1,325,840
STEP 3	$	550,490
SUMMARY BY YEAR		
2006	$	40,000
2007	$	993,590
2008	$	469,872
2009	$	412,867
TOTAL	**$**	**1,916,330**

Table 6. Planning, Design, and Permits Detailed Cost Schedule
(in Dollars /1,000)

	2006				2007				2008				2009			
	JFM	*AMJ*	*JAS*	*OND*	*JFM*	*AMJ*	*JAS*	*OND*	*JFM*	*AMJ*	*JAS*	*OND*	*JFM*	*AMJ*	*JAS*	*OND*
PLANNING																
Coordinate Step Process	10.0	10.0	10.0	10.0	13.3	13.3	13.3	13.3	13.3	13.3		7.0	7.0	7.0	7.0	
Site Data Collection					40.0	40.0	40.0	40.0	40.0	40.0						
FACILITY DESIGN																
Preliminary																
Wenatchee					24.6	24.6	24.6	24.6	24.6	24.6						
Methow					11.7	11.7	11.7	11.7	11.7	11.7						
Final																
Wenatchee												73.8	73.8	73.8	73.8	
Methow												35.0	35.0	35.0	35.0	
TOTAL PLAN. & DESIGN	**10.0**	**10.0**	**10.0**	**10.0**	**89.6**	**89.6**	**89.6**	**89.6**	**89.6**	**89.6**	**0.0**	**115.8**	**115.8**	**115.8**	**115.8**	**0.0**
PERMITS																
Surveys, Studies																
Cultural Resources						6.0	6.0									
Wetlands, Plants						6.0	6.0									
Flood						10.0	10.0									
Ground Water Withdrawal						10.0	10.0									
Surface Water Withdrawal						12.5	12.5									
Listed Species					3.3	3.3	3.3	3.3	3.3	3.3						
Survey and Manage Species					3.3	3.3	3.3	3.3	3.3	3.3						
Discharge Impacts					3.3	3.3	3.3	3.3	3.3	3.3						
NEPA																
Scoping, SOW					50.0											
Draft EIS						100.3	100.3	100.3								
Final EIS, Record of Decision								110.0	110.0							
ESA																
Edit HGMP, BA					6.7	6.7	6.7									
Public, Agency Review								3.3	3.3	3.3						
Facility																
Water Rights					5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	
JARPA												6.0	6.0	6.0	6.0	
Critical Areas												5.1	5.1	5.1	5.1	
Construction												5.3	5.3	5.3	5.3	
TOTAL PERMITS	**0.0**	**0.0**	**0.0**	**0.0**	**72.1**	**167.0**	**167.0**	**229.1**	**128.8**	**18.8**	**5.5**	**21.8**	**21.8**	**21.8**	**21.8**	**0.0**
TOTAL PLAN, DESIGN, PERMITS	**10.0**	**10.0**	**10.0**	**10.0**	**161.7**	**256.6**	**256.6**	**318.7**	**218.4**	**108.4**	**5.5**	**137.6**	**137.6**	**137.6**	**137.6**	**0.0**

Key: Step 1 Step 2 Step 3

Following are notes on the *Planning, Design, and Permits* tasks:

PLANNING

- Coordinate Step Process - these are the costs for subcontractors to support completion of the master plan, preliminary design, NEPA and ESA evaluations, and final design.
- Site Data Collection - data (listed in the C. appendices) will be collected during the preliminary design phase. These costs are derived from similar costs for developing the current MCCRP facilities.

FACILITY DESIGN

- Preliminary - Preliminary and final design costs are estimated at 15% of construction costs. Of the 15%, preliminary design will be one-third of this amount.
- Final - these costs include preparation of engineering designs, value engineering reviews, bid documents, and management of the contractor bid process.

PERMITS

A full list of fish facility permits is shown in Attachment 2 of this document. Every permit listed will not be required for each site due to differing levels of development and local conditions. NEPA and ESA work will be done concurrently. Much of the effort will be interrelated, with listed species impacts forming an important part of NEPA analyses.

Many of the permit and study costs are derived from similar projects completed by the MCCRP and Yakama Nation in the recent past. These include: ground water withdrawal impact studies, well construction and water rights applications for the MCCRP Rohlfing and Two Rivers sites; flood studies, groundwater studies, and facilities permit applications for the YKFP (Yakama Klickitat Fisheries Project) Wahkiacus

Hatchery and Acclimation Facility; acclimation discharge impact study done on the MCCRP Rohlfing, Butcher, and Beaver sites; cultural resources, plant, and wetland evaluations done for several potential acclimation sites in the Wenatchee watershed; floodplain and wetland assessments, Joint Aquatic Resources Permit Application (JARPA) and environmental checklist applications submitted for the MCCRP Two Rivers and Rohlfing sites; and JARPA applications submitted for the MCCRP Beaver Creek and Mountain Home sites.

Environmental review cost estimates were provided by Nancy Weintraub (BPA, Team Lead for Fish and Wildlife Environmental Review). The BPA estimate of $750,000 includes NEPA and ESA reviews, and the surveys and studies listed in Table 6.

Permit task descriptions:

- Surveys, Studies
    - Cultural Resources — 3 separate surveys of multiple sites are assumed.
    - Wetlands, Plants — 3 separate surveys of multiple sites are assumed.
    - Flood — 3 separate surveys of multiple sites are assumed.
    - Ground Water Withdrawal — 4 of the sites require ground water withdrawal studies. These include the digging of test pits, as well as evaluating potential yields and impacts on both the environment and other users of the planned withdrawal. Well construction is included under *Capital Costs*.
    - Surface Water Withdrawal — 5 sites plan on new surface water withdrawals. These impacts on stream flow will need to be studied.
    - Listed Species — to determine the presence of ESA-listed species at or near the facilities and the potential impacts from construction and operation.
    - Other Species — work on non-listed species will be done in conjunction with listed species.
    - Discharge Impacts — the effect of feeding coho in existing natural ponds will be investigated.
- NEPA
    - Scoping, SOW — this first step in the NEPA process includes preparing a Notice of Intent and a Statement of Work, meeting with cooperating agencies, and holding scoping meetings.
    - Draft Environmental Impact Statement (EIS) — prior to drafting the EIS, scoping comments will be reviewed, issues identified, and public and agency input evaluated. Results from surveys and studies will be included in the draft EIS.
    - Final EIS, Record of Decision — comments received from public review of the draft EIS are evaluated during production of the final EIS.
- ESA
    - Prepare a Hatchery and Genetics Management Plan (HGMP) and Biological Assessments (BAs) — the MCCRP HGMP will need to be rewritten to reflect program changes; assessments of the impacts of the proposed master plan facilities and activities impacting listed species will need to be prepared.
    - Public and Agency Review
- Facility.
    - Water Rights — results from the completion of the ground water and surface water withdrawal studies will be used to support the water rights applications.
    - JARPA — the Joint Aquatic Resources Permit Application includes several separate permits (see Attachment 2).
    - Critical Areas — the proposed facilities are near water, requiring shorelines and critical areas permits.
    - Construction — local grading and building approvals are required.

As a check of these estimates, a comparison of permit costs with other projects can made. The permit total for the MCCRP is estimated to be $875,000 (see Table 5). Costs for other projects are:

- NE Oregon Hatchery Project: Approximately $1,000,000 (personal communication Mickey Carter, Supervisory Environmental Protection Specialist, BPA)
- Average EIS costs of a wide range of Department of Energy (DOE) projects completed in 2005 (DOE 2005): $1,434,000.

The MCCRP permit costs are expected to be lower than these values because significant amounts of environmental evaluation have been completed during the feasibility phase of this project. Impacts on listed fish have been studied for several years by the MCCRP monitoring and evaluation program in coordination with the project's Technical Work Group (TWG), members of which helped guide study designs and reviewed results. Also, work done during master plan development will be applied to permitting, further reducing costs.

2. Facilities and Capital Equipment

This cost element includes land purchase, facility construction, and capital equipment used in the operation of the sites. Two estimating methods were used. One is based on the average values of similar projects and is detailed in Appendices B.1 and B.2. The other is based on site-specific facility designs and is shown in Appendices C.1, C.2, C.3, and C.4. The averaging method uses actual facility costs, reducing variations that result from site properties that are not known until preliminary design studies are completed (such as ground water depths, soil conditions, etc.). The site-specific cost estimates take into account unique features of sites that are known, such as access road lengths, piping distances, etc. The site specific costs were used in the capital cost estimates in Table 7; the average values provide a comparison.

Land purchases totaling $1,789,500 are included in these capital costs. Purchases are planned at 5 sites: Dryden, Tall Timber,Chikamin, Goat Wall, and Heath Ranch. Because most of these sites are in areas that have important habitat for coho and other species, other agencies such as WDFW may be willing to share costs of land purchases. All other sites (acclimation) are either on private land that will be leased or on federal/state land where land use agreements will be obtained.

a. Construction and Land

Table 7. Facility Construction Cost Schedule

	2009	2010	2011	2012
MULTI-FUNCTION				
Dryden		$ 1,897,072		
Eightmile			$ 1,024,571	
Heath			$ 551,651	
ACCLIMATION				
Tall Timber		$ 1,144,508		
Chikamin		$ 733,047		
Chiwawa		$ 459,603		
Misc Wenatchee		$ 93,600		
Lincoln			$ 254,183	
Goat Wall			$ 536,817	
Misc Methow			$ 30,680	
TOTAL		**$ 4,327,830**	**$ 2,397,902**	

Several proposed facilities have multiple functions: the adult holding, spawning, and incubation facility near Dryden in the Wenatchee basin (see Appendix C.1 for design and cost details) and two constructed habitats proposed as rearing/acclimation sites in the Methow (see Appendix C.2) Existing hatcheries that have no associated capital cost will provide the bulk of pre-smolt production.

These multi function sites have the following design features:

- Dryden – an incubation building, spawning shed, and 3 concrete adult holding raceways supplied by water from a constructed infiltration gallery.
- Eightmile – a constructed habitat supplied with a surface water intake on Eightmile Creek and ground water from existing and new wells.
- Heath – an existing habitat with a new outlet structure for controlling and monitoring fish passage.

Like other aspects of the proposed program, acclimation also relies on existing sites with little capital cost. The 5 new facilities (see Appendices C.3 and C.4 for design and cost details) have low costs relative to other acclimation sites in the region due to their use of constructed or existing natural ponds and water supplies where available.

The acclimation sites that require major construction have the following design features:

- Tall Timber — this is planned to be a fully constructed acclimation site, with two ponds supplied by pumped surface and ground water.
- Chiwawa — second-use or excess water from the existing acclimation site will operate two new coho acclimation ponds.
- Chikamin — a new large pond and a gravity flow water intake will be constructed.
- Lincoln — existing ponds will be supplied by new wells.
- Goat Wall — a small well and an existing spring will supply a new acclimation pond.

b. Capital Equipment

Capital equipment is assumed to have a 10 year average life. Replacements at this interval are included in the cost schedule below.

Table 8. Capital Equipment Cost Schedule
(in Dollars /1,000,000)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
CAPITAL EQUIPMENT																					
M&E Equipment		0.02										0.02									
O&M Equipment		0.01	0.02									0.01	0.02								
Multi-Function Fac.					0.20	0.13									0.20	0.13					
Acclimation Fac.					0.13	0.12									0.13	0.12					
TOTAL	**0.00**	**0.04**	**0.02**	**0.00**	**0.33**	**0.25**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.04**	**0.02**	**0.00**	**0.33**	**0.25**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Capital Equipment costs include the following:

- M&E Equipment – the main capital purchases for the Monitoring and Evaluation program are two rotary smolt traps and electrofishing gear.
- O&M Equipment – fish transport tanks and CWT detection systems are needed for broodstock collection.
- Multi-Function Facility Equipment – major equipment to be used at the adult holding and incubation facility and the constructed habitats includes chillers, pumps, generators, and trailers.
- Acclimation Facility Equipment - capital equipment needed at the acclimation sites includes pumps, generators, and trailers.

B. OPERATING COSTS

1. Operation and Maintenance

a. Rearing

The rearing costs estimated here are for production of fish to pre-smolt size while in hatcheries. Transportation of these smolts is included, as is adult holding, spawning, and incubation of Methow brood under contract with the U.S. Fish and Wildlife Service (USWFS). Wenatchee brood and egg handling will be done by Yakama Nation personnel when the Dryden facility is completed and is included in section B1.b (Other O&M).

Hatchery rearing cost estimating procedures are detailed in Appendix B.1. They are based on the average operating costs of five existing Columbia River hatcheries. A formula was developed using these data that allows predictions to be made for the cost of producing various numbers of fish.

340,000[.4+ 0.6*[(number of fish produced)/1,000,000]*

Reference comparisons on the accuracy of this formula reveal that it matches the current operating costs for full hatcheries, and it also compares closely with the amounts currently being paid by the MCCRP.

This same formula is applied to existing hatcheries, with the exception of Willard, and to the constructed habitats. The Willard costs are independent of the number of fish produced since the entire hatchery is dedicated to MCCRP coho production. The habitats will have lower culturing costs than hatcheries due to natural management approaches; however, predator control methods that have been effective at existing acclimation sites include non-lethal hazing by personnel. This will increase overall operating cost back to levels that are similar to conventional hatcheries.

The last cost element in the table below is cost sharing. This is the amount of contribution being made by fishery agencies to the MCCRP for hatchery operations. NOAA, through the Mitchell Act, supports operation of the Willard ($128,000 per year) and Cascade ($277,000 per year) hatcheries. The USFWS also contributes a portion (assumed to be 10% of the total, or $31,400 per year) of the maintenance fees for operating the Leavenworth, Entiat, and Winthrop hatcheries.

Table 9. Rearing Cost Detail
(in Dollars /1,000,000)

	2006	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*	*2025*	*2026*
HATCHERIES																					
Cascade	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.27	0.22	0.22	0.22	0.22	0.22	0.13
Willard	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32							
Winthrop	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Hauling	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Adult Hold., Spawn	0.29	0.29	0.29	0.29	0.29	0.31	0.40	0.40	0.34	0.29	0.29	0.29	0.29	0.29	0.22	0.16	0.16	0.16	0.16	0.16	0.09
CONSTRUCTED HABITATS																					
Eightmile							0.18	0.18	0.18	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.15	0.15
Heath Ranch							0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.14	0.14
SUBTOTAL	**1.10**	**1.09**	**1.09**	**1.09**	**1.09**	**1.12**	**1.55**	**1.55**	**1.48**	**1.41**	**1.41**	**1.41**	**1.41**	**1.41**	**1.00**	**0.87**	**0.87**	**0.87**	**0.87**	**0.87**	**0.71**
COST SHARING																					
Rearing	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.42	0.38	0.38	0.38	0.38	0.38	0.29
TOTAL	**0.66**	**0.66**	**0.66**	**0.66**	**0.66**	**0.68**	**1.11**	**1.11**	**1.05**	**0.97**	**0.97**	**0.97**	**0.97**	**0.97**	**0.58**	**0.49**	**0.49**	**0.49**	**0.49**	**0.49**	**0.42**

b. Other O&M

This cost element covers all the facility operating and maintenance costs except rearing. These include the expenses of operating acclimation, brood collection, spawning, and incubation facilities. Estimates are based on recent MCCRP expenses. The 2006 budget was used as the basis for predicting the costs of future program phases. Adjustments were made to reflect changes in the number of facilities operated and numbers of fish handled. This total does not include: rearing, planning or design costs, monitoring and evaluation, or general and administrative costs.

During the Broodstock Development Phases (BDP1and 2), Methow costs will be lower than in the Wenatchee. During BDP1, four acclimation sites will operate in the Wenatchee and one in the Methow. During BDP2, six are planned for the Wenatchee and three in the Methow. During the natural production phases, coho will be released from 9 sites in both the Wenatchee and Methow basins. As release numbers are reduced in future natural production phase years, the number of acclimation sites used will also be reduced.

Table 10. Operation and Maintenance Cost Detail
(in Dollars /1,000,000)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Acclimation																					
Personnel	0.17	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Operating Supplies	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01
Vehicles	0.02	0.03	0.03	0.03	0.03	0.04	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.03
Land Agreements	0.01	0.01	0.01	0.01	0.02	0.02	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.02
Broodstock Collection																					
Personnel	0.16	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Operating Supplies	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Vehicles	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.05	0.03	0.03	0.03	0.03	0.03	0.02
Spawning																					
Personnel	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.01
Operating Supplies	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Vehicles	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Incubation																					
Personnel	0.05	0.06	0.06	0.06	0.07	0.08	0.08	0.08	0.08	0.07	0.07	0.05	0.05	0.05	0.06	0.05	0.05	0.05	0.05	0.05	0.01
Operating Supplies	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Vehicles	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
TOTAL	**0.52**	**0.59**	**0.59**	**0.59**	**0.64**	**0.67**	**0.74**	**0.74**	**0.74**	**0.73**	**0.72**	**0.66**	**0.66**	**0.66**	**0.69**	**0.63**	**0.63**	**0.63**	**0.63**	**0.63**	**0.47**

2. Monitoring and Evaluation

Estimates of the program costs for the monitoring and evaluation program element are based on current MCCRP expenses. The 2006 monitoring and evaluation budget, with tagging excluded, is $290,000. This budget was divided by task, and the cost for each was extended to future years. Estimates were made for tasks that will not begin until after 2006. Coded wire tagging costs were changed proportionate to the numbers of fish released per year. PIT tags are expected to remain approximately the same, independent of total release numbers.

Monitoring & Evaluation (M&E) costs are shared with WDFW, the HCP hatchery compensation M&E plan, and BPA project number 2003-017-00. Smolt traps at Monitor, Chiwawa, White, Upper Wenatchee, Methow, and Twisp, currently funded through alternate sources, are an integral part of the proposed M&E plan; they would provide data to monitor natural coho production and Non-Target Taxa Of Concern (NTTOC) status. The total on the last line of Table 11 shows the estimated yearly sum for M&E with these cost-share amounts provided by other agencies removed (shown in red).

Table 11. Monitoring and Evaluation Cost Detail
(in Dollars /1,000,000)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
PROJECT PERFORMANCE INDICATORS																					
Smolt Survival	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	-	0.04	-	-	0.04	-	-	0.04	-	-	0.04	-	-
In-Pond Survival	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.00
Pre-Rel. Fish Cond.	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Run Timing	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.00
Spawn Esc and Dist.	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Natural Smolt Prod.	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.01
Egg to Emig. Surv.	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.01
Adult to Adult Prod.	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01
Harvest Rates	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
SPECIES INTERACTIONS																					
NTTOC Status																					
Size Structure	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-	-	-	-	-	-	-	-	-	-
Abund. and Surv.	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-	-	-	-	-	-	-	-	-	-
Distribution	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-	-	-	-	-	-	-	-	-	-
Mech. Of Interaction.																					
Competition	-	-	-	-	-	0.02	0.02	0.02	0.02	0.02	0.02	-	-	-	-	-	-	-	-	-	-
Predation	-	-	-	-	-	0.03	0.03	0.03	0.03	0.03	0.03	-	-	-	-	-	-	-	-	-	-
GENETIC ADAPTABILITY																					
Morphometrics	-	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.01
Genetic Monitoring	0.06	-	-	0.06	-	-	0.06	-	-	0.06	-	-	0.06	-	-	0.06	-	-	0.06	-	-
Sperm Cryopres.	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02	0.02	0.02	-
SMOLT TRAPS																					
Operation and Maint.	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
SUBTOTAL	1.01	1.17	1.17	1.21	1.15	1.19	1.26	1.19	1.13	1.26	1.13	0.94	1.06	0.94	0.94	1.06	0.94	0.95	1.07	0.95	0.86
COST SHARING																					
Smolt Trap	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
TOTAL	0.24	0.39	0.39	0.44	0.38	0.42	0.48	0.42	0.36	0.48	0.36	0.16	0.28	0.16	0.16	0.28	0.16	0.18	0.30	0.18	0.08

3. General and Administrative

The general and administrative cost element covers expenses that are spread over all project functions. These include: program administration; support for planning and design; indirect services; and running project offices. Numbers are based on current MCCRP expenses.

Table 12. General and Administrative Cost Detail
(in Dollars /1,000,000)

	2006	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*	*2025*	*2026*
G&A																					
Administration	0.09	0.09	0.09	0.09	0.10	0.10	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.11	0.10	0.10	0.10	0.10	0.10	0.07
Office, Facility Maint.	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.05
Indirect	0.20	0.20	0.20	0.20	0.21	0.22	0.24	0.24	0.24	0.24	0.24	0.22	0.22	0.22	0.23	0.21	0.21	0.21	0.21	0.21	0.16
TOTAL	0.34	0.34	0.34	0.34	0.37	0.39	0.43	0.43	0.43	0.42	0.42	0.39	0.39	0.39	0.40	0.37	0.37	0.37	0.37	0.37	0.27

C. TOTAL PROJECT COST SCHEDULE

The yearly cost for all project elements is shown in the Table below, for the 20-year project lifetime. The values on the last line show the estimated total yearly project sum with cost-share amounts provided by other agencies removed (shown in red).

Table 13. MCCRP Total Project Cost Schedule
(in Dollars /1,000,000)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
CAPITAL																					
Plan, Design, Per.	0.04	0.99	0.47	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Construction	0.00	0.00	0.00	0.00	4.33	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Capital Equipment	0.00	0.04	0.02	0.00	0.33	0.25	0.00	0.00	0.00	0.00	0.00	0.04	0.02	0.00	0.33	0.25	0.00	0.00	0.00	0.00	0.00
TOTAL CAPITAL	**0.04**	**1.03**	**0.49**	**0.41**	**4.66**	**2.65**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.04**	**0.02**	**0.00**	**0.33**	**0.25**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
OPERATING																					
Rearing	1.10	1.09	1.09	1.09	1.09	1.12	1.55	1.55	1.48	1.41	1.41	1.41	1.41	1.41	1.00	0.87	0.87	0.87	0.87	0.87	0.71
Other O&M	0.52	0.59	0.59	0.59	0.64	0.67	0.74	0.74	0.74	0.73	0.72	0.66	0.66	0.66	0.69	0.63	0.63	0.63	0.63	0.63	0.47
M&E	1.01	1.17	1.17	1.21	1.15	1.19	1.26	1.19	1.13	1.26	1.13	0.94	1.06	0.94	0.94	1.06	0.94	0.95	1.07	0.95	0.86
Tagging	0.48	0.48	0.48	0.48	0.48	0.52	0.65	0.65	0.48	0.48	0.40	0.40	0.48	0.40	0.29	0.28	0.20	0.20	0.28	0.20	0.09
G&A	0.34	0.34	0.34	0.34	0.37	0.39	0.43	0.43	0.43	0.42	0.42	0.39	0.39	0.39	0.40	0.37	0.37	0.37	0.37	0.37	0.27
TOTAL OP.	**3.46**	**3.67**	**3.67**	**3.71**	**3.74**	**3.89**	**4.62**	**4.56**	**4.26**	**4.29**	**4.09**	**3.80**	**4.00**	**3.80**	**3.33**	**3.21**	**3.01**	**3.02**	**3.22**	**3.02**	**2.40**
TOTAL COST	**3.50**	**4.70**	**4.16**	**4.13**	**8.4**	**6.5**	**4.62**	**4.56**	**4.26**	**4.29**	**4.09**	**3.83**	**4.02**	**3.80**	**3.67**	**3.46**	**3.01**	**3.02**	**3.22**	**3.02**	**2.40**
Rear. Cost Share	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.42	0.38	0.38	0.38	0.38	0.38	0.29
M&E Cost Share	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
TOTAL COST	**2.29**	**3.49**	**2.95**	**2.92**	**7.19**	**5.33**	**3.41**	**3.35**	**3.05**	**3.08**	**2.88**	**2.62**	**2.81**	**2.58**	**2.47**	**2.31**	**1.86**	**1.87**	**2.07**	**1.87**	**1.33**

Notes:

- Abbreviations used in the table: O&M — Operation and Maintenance; G&A — General and Administrative; M&E — Monitoring and Evaluation.
- Capital construction costs are assumed to be incurred one year before site operation begins.
- Cost sharing support for the project is removed from the total to produce the values in the last row.
- M&E cost-share represents only current cost share opportunities and does not include HCP coho mitigation.
- Capital costs do not include depreciation. All amounts are in 2005 dollars and are not inflated.

V. *ATTACHMENTS*

1. REFERENCES

DOE (U.S. Department of Energy) 2005. Office of Environment, Safety, and Health. NEPA Quarterly Report. June 1, 2005; Issue No.43.

(NPPC) Northwest Power Planning Council. 2001. Three-Step Review Process as approved by Northwest Power Planning Council on October 18, 2001.

Murdoch, K.G, C.M. Kamphaus and S.A. Prevatte. 2004. Mid-Columbia Coho Reintroduction Feasibility Study: 2002 Annual Monitoring and Evaluation Report. *Prepared For:* Bonneville Power Administration. Project Number 1996-040-00. Portland, OR.

MCCRP (Mid-Columbia Coho Reintroduction Program) 2005. Mid Columbia Coho Budget, Project No.1996-040-00 Intergovernmental Contract No. 00016988, February 1, 2006 to January 31, 2007.

2. PERMIT SUMMARY

NAME	AGENCY	COMMENTS
SEPA and NEPA		
ENVIRONMENTAL CHECKLIST (SEPA)	Lead Agency	Agency makes Determination of Significance (DS) decision based on checklist. DS (forces an EIS), Mitigated DNS, or DNS issued
DRAFT EIS	Lead Agency	Scoping helps determine the content of the EIS
FINAL EIS	Lead Agency	Addresses comments received during 45-day draft EIS comment period
ROD	Lead Agency	Record of Decision
JARPA - Joint Aquatic Resource Permits Application		
HYDRAULIC PROJECT APPROVAL (HPA)	WDFW	Use, divert, obstruct, or change natural flow Screens: 0.4 fps, 1.75mm bar, 2.4mm perf plate, 2.2mm wire mesh
SHORELINES SUBSTANTIAL DEVELOPMENT	Local Govt	In 100-yr. floodplain or within 200 ft. of high water > $2,500
COMPLIANCE WITH CRITICAL AREAS STANDARDS	Local Govt	Critical areas are designated by local governments
FLOODPLAIN MANAGEMENT	Local Govt	
401 WATER QUALITY CERT.	WDOE	Applicant for Fed license or permit for filling or exc. in water or wetlands
EXCEEDANCE OF WATER QUALITY STANDARDS	WDOE	Temporary exceedance (may not be included in new JARPA)
SECTION 404 PERMIT	US ACE	Locating structures, filling, or excavating in water or wetlands
OTHER STATE PERMITS		
ARCHAEOLOGICAL EXCAVATION	Ofc of Arch. & Historic Pres.	Fed projects require section 106 review
NPDES - GENERAL PERMIT FOR UPLAND HATCHERIES	WDOE	May not be needed for <20,000lbs. fish/yr. or <5,000lbs of feed/mo.
PRELIMINARY WATER RIGHT PERMIT	WDOE	Required for drilling and testing
CERT. OF WATER RIGHT	WDOE	Water use permit is the original application
CHANGE OF WATER RIGHT	WDOE	Location or use changes require permit
FISH/EGG TRANSPORT	WDFW	Main tool for WDFW to control movement of fish
OTHER LOCAL PERMITS		
CONSTRUCTION	Local govt	Building permits (including grading), vary by county
CONDITIONAL USE	Local govt	Activities use subject to public hearings
ZONING CODE VARIANCE	Local govt	
ESA RELATED PERMITS		
BIOLOGICAL EVALUATION (BE or BA)	USFWS, NMFS	Consultation used to show minimal impacts; if services agree, a concurrence letter is written
BIOLOGICAL OPINION (BO)	USFWS, NMFS	Issued after formal consultation
HATCHERY & GENETICS MGMT PLAN (HGMP)	NMFS	Replaces the BE for NMFS purposes
OTHER		
WETLAND AND FLOODPLAIN ASSESSMENT	BPA	Normally part of the NEPA document; requirement for federally funded projects
ENVIRONMENTAL LAND AUDIT	BPA	

Appendix E: Coho Juvenile Capacity Estimates for Select Methow River Tributaries

Capacity estimates were determined from EDT (Mobrand 1997) and Zillges (1977)

Capacity estimates formed the basis for NPIP release numbers (maximum value)

Stream Name	RKm	Est Smolt Capacity	Mean egg-emigrant survival [1]	Fecundity[2]	Pre-spawn Mortality Rate	Females	Sex Ratio	Adult Escapement to seed habitat	Adjusted Adult Escapement	Smolt to adult hatchery survival rate[5]	Max NPIP Release Number
Chewuch River	0.0-19.11	127,269	0.094	2600	0.1	579	0.43	1346	1346	0.004	336,396
Total for Chewuch River		**127,269**				**579**			**1346**		**336,396**
Early Winters Creek	0.0-3.06	13,763	0.094	2600	0.1	63	0.43	146	146	0.004	36,378
Total for Early Winters Creek		**13,763**				**63**			**146**		**36,378**
Gold Creek	0.0-5.3	14,946	0.0964	2600	0.1	66	0.43	154	154	0.004	38,522
Total for Gold Creek		**14,946**				**66**			**154**		**38,522**
Lost River	0.0-8.68	26,118	0.094	2600	0.1	119	0.43	276	276	0.004	69,035
Total for Lost River		**26,118**				**119**			**276**		**69,035**
Methow River	0.0-64.7	195,278	0.094	2600	0.1	888	0.43	2065	2065	0.004	516,156
Total for Methow River		**195,278**				**888**			**2065**		**516,156**
Twisp River	0.0-8.52	98,509	0.094	2600	0.1	448	0.43	1042	1042	0.004	260,378
Total for Twisp River		**98,509**				**448**			**1042**		**260,378**
Wolf Creek	0.0-2.41	10,592	0.094	2600	0.1	48	0.43	112	112	0.004	27,995
Total for Wolf Creek		**10,592**				**48**			**112**		**27,995**
Beaver Creek	0.0-14.15	16,718	0.0964	2600	0.1	74	0.43	172	172	0.004	43,089
		16,718				**74**			**172**		**43,089**
Methow River Est. Coho Carry Capacity (smolt)		**503,193**									
Spawning Escapement		**5,312**									

[2] Mean fecundity for Bys 2000-2003

[3] Sex ratio for coho observed at Dryden Dam for Brood years 2000-2003

[4] Hatchery domestication factor to adjust for potentially lower spawning success of domesticated coho stocks used in the reintroduction effort

[5] Smolt to Adult survival rate for 2003 return (2000 BY), may need to be adjusted as more data is collected, broodstock development progresses, or ocean conditions change.

Appendix E: Coho Juvenile Capacity Estimates for Select Wenatchee River Tributaries

Capacity estimates were determined from EDT (Mobrand 1997) and Zillges (1977)

Capacity estimates formed the basis for NPIP release numbers (maximum value)

Stream Name	Estimated Smolt Capacity	Mean egg-emigrant survival [1]	Fecundity[2]	Pre-spawn Mortality Rate	Females	Sex Ratio	Adult Escapement to seed habitat	Smolt to adult hatchery survival rate[5]	0% Nat. Prod. Returns
Nason Ck.	59,067	0.094	2600	0.1	269	0.43	625	0.004	156,125
Total for Nason Creek	**59,067**				**269**				**156,125**
Chiwawa	125,341	0.094	2600	0.1	570	0.43	1325	0.004	331,300
Total for Chiwawa River	**125,341**				**570**				**331,300**
Little Wenatchee	35,459	0.0964	2600	0.1	157	0.43	366	0.004	91,391
Total for Little Wenatchee	**35,459**				**157**				**91,391**
White River	59,730	0.094	2600	0.1	272	0.43	632	0.004	157,878
Total for White River	**59,730**				**272**				**157,878**
Icicle Creek not blocked at hatchery	11,726	0.094	2600	0.1	53	0.43	124	0.004	30,994
Total for Icicle Creek	**11,726**				**53**				**30,994**
Peshastin Creek	27,761	0.094	2600	0.1	126	0.43	294	0.004	73,378
Total	**27,761**				**126**				**73,378**
Mission Creek	22,907	0.094	2600	0.1	104	0.43	242	0.004	60,547
Total	**22,907**				**104**				**60,547**
Wenatchee River	44,500	0.0964	2600	0.1	197	0.43	459	0.004	114,693
Total	**44,500**				**197**				**114,693**
Wen. River Est. Coho Carry Capacity (smolt)	**386,491**								
Spawning Escapement: Females	**1,748**								
Spawning Escapement: Total	**4,065**								

[2] Mean fecundity for Bys 2000-2003

[3] Sex ratio for coho observed at Dryden Dam for Brood years 2000-2003

[4] Hatchery domestication factor to adjust for potentially lower spawning success of domesticated coho stocks used in the reintroduction effort

[5] Smolt to Adult survival rate for 2003 return (2000 BY), may need to be adjusted as more data is collected, broodstock development progresses, or ocean conditions change.

Appendix E: NPIP Smolt release numbers needed for spawning escapement and continued hatchery supplementation

Location	Hatchery Release to reach capacity	Broodstock No. for release size to seed habitat	Total Run Size (escp + broodstock)	Release Size needed for Total Return
Chewuch River	**336,396**	425	1771	590,182
Early Winters	**36,378**	46	191	63,823
Gold Creek	**38,522**	49	203	67,583
Lost River	**69,035**	87	363	121,116
Methow River	**516,156**	652	2717	905,558
Twisp River	**260,378**	329	1370	456,813
Wolf Creek	**27,995**	35	147	49,116
Beaver Creek	**43,089**	54	227	75,596

Location	Hatchery Release to achieve carry capacity goals	Broodstock No. for release size to seed habitat	Total Run Size to Nason Creek (escp + broodstock)	Release Size needed for Total Return to Nason Ck*
Nason Creek	**156,125**	197	822	205,432
Chiwawa River	**331,300**	419	1744	435,931
Little Wenatchee River	**91,391**	115	481	120,255
White River	**157,878**	199	831	207,738
Icicle Creek	**30,994**	39	163	40,783
Peshastin Creek	**73,378**	93	386	96,552
Mission Creek	**60,547**	76	319	79,670
Wenatchee River	**114,693**	145	604	150,916

Table 1. AHA model results for the upper Wenatchee River natural production phases

Upper Wenatchee River		Natural Production Implementation			Natural Production Support (I)			Natural Production Support (F)			Long-term (PFC)		
Hab	[EDT] Prod. | Capacity	1.41		504	1.41		504	1.61		550	1.90		600
Hab	Min NOR Escape | %Kelt	1			1			1			1		
Hab	Smolt Prod. | Capacity	123		44,000	123		44,000	141		48,035	166		52,402
Hydro	SAR [Mar.|Total] Vary? (Y/N)	0.030	0.011	y	0.030	0.011	y	0.030	0.011	y	0.025	0.011	y
Hydro	Passage Surv [Juv.|Adult]	0.45		0.85	0.45		0.85	0.45		0.85	0.54		0.85
Hydro	Adj. Prod. | Adj. Capacity	1.40		503	1.40		503	1.61		549	1.90		601
Harv	Harv -Mixed Stock	0.100		0.100	0.100		0.100	0.100		0.100	0.100		0.100
Harv	Harv-Mainstem [NORs|HORs]			0.050			0.050			0.050	0.100		0.050
Harv	Harv -Terminal										0.050		
Harv	Total Exploitation Rate	0.100		0.15	0.10		0.15	0.10		0.15	0.23		0.15
		pNOB		pHOS	pNOB		pHOS	pNOB		pHOS	pNOB		pHOS
pNOB-Goal	pHOS-Goal	10%		90%	35%		70%	80%		60%			
pNOB-Realized	pHOS-Realized	11%		76%	35%		70%	80%		46%			
	[Int /Seg /None]	Local	Import	Int	Local	Import	Int	Local	Import	Int	Local	Import	Int
Local | Imported	Smolt Release	121		100,000	85		70,000	42		35,000			
Exported Brood	% Marked			100%			100%						
% to Hatchery	% to Nat. Spawn.	35%		65%	35%		65%	10%		90%			
Recruits/Spwnr	Fitness? [Y / N]	3.6		y	3.6		y	3.6		y	4.0		y

Table 2. AHA model results for the Chiwawa River natural production phases

Chiwawa River		Natural Production Implementation			Natural Production Support (I)			Natural Production Support (F)			Long-term (PFC)		
Hab	[EDT] Prod. | Capacity	1.52		1,435	1.52		1,435	1.75		1,435	2.10		1,435
	Min NOR Escape | %Kelt	1			1			1			1		
	Smolt Prod. | Capacity	133		125,341	133		125,341	153		125,341	183		125,328
Hydr	SAR [Mar. |Total] Vary? (Y/N)	0.030	0.011	y	0.030	0.011	y	0.030	0.011	y	0.025	0.011	y
	Passage Surv [Juv. | Adult]	0.45		0.85	0.45		0.85	0.45		0.85	0.54		0.85
	Adj. Prod. | Adj. Capacity	1.52		1,431	1.52		1,431	1.75		1,431	2.10		1,437
Harv	Harv -Mixed Stock	0.100		0.100	0.100		0.100	0.100		0.100	0.100		0.100
	Harv-Mainstem [NORs|HORs]			0.050			0.050			0.050	0.100		0.050
	Harv -Terminal										0.050		
	Total Exploitation Rate	0.100		0.15	0.10		0.15	0.10		0.15	0.23		0.15
		pNOB		pHOS	pNOB		pHOS	pNOB		pHOS	pNOB		pHOS
pNOB-Goal	pHOS-Goal	10%		90%	35%		70%	80%		60%			
pNOB-Realized	pHOS-Realized	11%		81%	35%		77%	80%		60%			
	[Int /Seg /None]	Local	Import	Int	Local	Import	Int	Local	Import	Int	Local	Import	Int
Local | Imported	Smolt Release	532		440,000	372		308,000	186		154,000			
Exported Brood	% Marked			100%			100%						
% to Hatchery	% to Nat. Spawn.	35%		65%	35%		65%	10%		90%			
Recruits/Spwnr	Fitness? [Y / N]	3.6		y	3.6		y	3.6		y	4.0		y

Table 3. AHA model results for the White River natural production phases

White River			Natural Production Implementation		Natural Production Support (I)		Natural Production Support (F)		Long-term (PFC)	
Hab		[EDT] Prod. | Capacity	1.63	717	1.63	717	1.75	717	2.20	1,077
		Min NOR Escape | %Kelt	1		1		1		1	
		Smolt Prod. | Capacity	135	59,730	135	59,730	146	59,730	183	89,750
Hydro	SAR [Mar.|Total]	Vary? (Y/N)	0.032 / 0.012	y	0.032 / 0.012	y	0.031 / 0.012	y	0.026 / 0.012	y
	Passage Surv	[Juv. | Adult]	0.45	0.85	0.45	0.85	0.45	0.85	0.54	0.85
		Adj. Prod. | Adj. Capacity	1.63	721	1.63	721	1.75	719	2.20	1,078
Harv	Harv -Mixed Stock		0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
	Harv-Mainstem	[NORs|HORs]		0.050 / 0.050		0.050		0.050	0.100	0.050
	Harv -Terminal								0.050	0.050
	Total Exploitation Rate		0.100	0.15	0.10	0.15	0.10	0.15	0.23	0.19
			pNOB	pHOS	pNOB	pHOS	pNOB	pHOS	pNOB	pHOS
pNOB-Goal		pHOS-Goal	10%	90%	35%	75%	80%	60%		
pNOB-Realized		pHOS-Realized	11%	78%	35%	73%	80%	57%		
		[Int /Seg /None]	Local / Import	Int	Local / Import	Int	Local / Import	Int	Local / Import	Int
Local	Imported	Smolt Release	254 /	210,000	178 /	147,000	89 /	73,500	/	-
Exported Brood		% Marked		100%		100%				
% to Hatchery		% to Nat. Spawn.	35%	65%	35%	65%	10%	90%		
Recruits/Spwnr		Fitness? [Y / N]	3.6	y	3.6	y	3.6	y	4.0	y

Table 4. AHA model results for Nason Creek natural production phases

Nason Creek		Natural Production Implementation		Natural Production Support (I)		Natural Production Support (F)		Long-term (PFC)	
Hab	[EDT] Prod. | **Capacity**	1.13	709	1.13	709	1.50	709	2.10	900
	Min NOR Escape | **%Kelt**	1		1		1		1	
	Smolt Prod. | **Capacity**	94	59,067	94	59,067	125	59,067	175	75,000
Hydro	SAR [Mar.|Total] **Vary? (Y/N)**	0.031 | 0.012	y	0.031 | 0.012	y	0.031 | 0.012	y	0.026 | 0.012	y
	Passage Surv [Juv. | **Adult**]	0.45	0.85	0.45	0.85	0.45	0.85	0.54	0.85
	Adj. Prod. | **Adj. Capacity**	1.13	706	1.13	706	1.50	707	2.10	901
Harv	Harv -Mixed Stock	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
	Harv-Mainstem [NORs|HORs]		0.05 0.05		0.050		0.050	0.100	0.050
	Harv -Terminal							0.050	0.050
	Total Exploitation Rate	0.100	0.15	0.10	0.15	0.10	0.15	0.23	0.19
		pNOB	pHOS	pNOB	pHOS	pNOB	pHOS	pNOB	pHOS
pNOB-Goal	**pHOS-Goal**	10%	90%	35%	75%	80%	60%		
pNOB-Realized	**pHOS-Realized**	11%	84%	35%	83%	80%	64%		
	[Int /Seg /None]	Local | Import	Int	Local | Import	Int	Local | Import	Int	Local | Import	Int
Local | Imported	**Smolt Release**	254 |	210,000	178 |	147,000	89 |	73,500	|	-
Exported Brood	% Marked		100%		100%				
% to Hatchery	% to Nat. Spawn.	35%	65%	35%	65%	10%	90%		
Recruits/Spwnr	**Fitness? [Y / N]**	3.6	y	3.6	y	3.6	y	4.0	y

Table 5. AHA model results for Little Wenatchee River natural production phases

Little Wenatchee River		Natural Production Implementation		Natural Production Support (I)		Natural Production Support (F)		Long-term (PFC)	
Hab	[EDT] Prod. | Capacity	1.50	447	1.50	447	1.65	447	2.10	633
	Min NOR Escape | %Kelt	1		1		1		1	
	Smolt Prod. | Capacity	119	35,459	119	35,459	131	35,459	167	50,238
Hydro	SAR [Mar.|Total] Vary? (Y/N)	0.032 | 0.012	y	0.032 | 0.012	y	0.033 | 0.013	y	0.028 | 0.013	y
	Passage Surv [Juv. | Adult]	0.45	0.85	0.45	0.85	0.45	0.85	0.54	0.85
	Adj. Prod. | Adj. Capacity	1.44	428	1.44	428	1.65	447	2.10	633
Harv	Harv -Mixed Stock	0.100	0.100	0.100	0.100	0.100	0.100	0.100	
	Harv-Mainstem [NORs|HORs]		0.05 0.05		0.050		0.050	0.100	
	Harv -Terminal							0.050	
	Total Exploitation Rate	0.100	0.15	0.10	0.15	0.10	0.15	0.23	
		pNOB	pHOS	pNOB	pHOS	pNOB	pHOS	pNOB	pHOS
pNOB-Goal	pHOS-Goal	10%	90%	35%	75%	80%	60%		
pNOB-Realized	pHOS-Realized	11%	80%	35%	75%	80%	56%		
	[Int /Seg /None]	Local | Import	Int	Local | Import	Int	Local | Import	Int	Local | Import	Int
Local | Imported	Smolt Release	145 |	120,000	102 |	84,000	51 |	42,000	|	-
Exported Brood	% Marked		100%		100%				
% to Hatchery	% to Nat. Spawn.	35%	65%	35%	65%	10%	90%		
Recruits/Spwnr	Fitness? [Y / N]	3.6	y	3.6	y	3.6	y	4.0	y

Table 6. AHA model results for the Mid-and Upper Methow River natural production phases

	Mid and Upper Methow		Natural Production Implementation			Natural Production Support (I)			Natural Production Support (F)			Long-term (PFC)		
Hab		[EDT] Prod. | Capacity	1.19		1,836	1.19		1,836	1.35		1,836	1.69		2,000
		Min NOR Escape | %Kelt	1			1			1			1		
		Smolt Prod. | Capacity	105		161,302	105		161,302	119		161,302	149		175,747
Hydro	SAR [Mar. |Total]	Vary? (Y/N)	0.030	0.011	y	0.030	0.011	y	0.030	0.011	y	0.025	0.011	y
	Passage Surv	[Juv. | Adult]	0.45		0.85	0.45		0.85	0.45		0.85	0.54		0.85
		Adj. Prod. | Adj. Capacity	1.19		1,830	1.19		1,830	1.35		1,830	1.69		1,999
Harv	Harv -Mixed Stock		0.100		0.100	0.100		0.100	0.100		0.100	0.100		
	Harv-Mainstem	[NORs|HORs]			0.050			0.050			0.050	0.100		
	Harv -Terminal											0.050		
	Total Exploitation Rate		0.100		0.15	0.10		0.15	0.10		0.15	0.23		
			pNOB		pHOS	pNOB		pHOS	pNOB		pHOS	pNOB		pHOS
	pNOB-Goal	pHOS-Goal	10%		90%	35%		80%	80%		25%			
	pNOB-Realized	pHOS-Realized	11%		81%	35%		77%	80%		57%			
		[Int /Seg /None]	Local	Import	Int	Local	Import	Int	Local	Import	Int	Local	Import	Int
	Local | Imported	Smolt Release	423		350,000	296		245,000	148		122,500			
	Exported Brood	% Marked			100%			100%			100%			
	% to Hatchery	% to Nat. Spawn.	35%		65%	35%		65%	10%		90%			
	Recruits/Spwnr	Fitness? [Y / N]	3.6		y	3.6		y	3.6		y	4.0		y

Table 7. AHA model results for the Chewuch River natural production phases

Chewuch River Coho		Natural Production Implementation			Natural Production Support (I)			Natural Production Support (F)			Long-term (PFC)		
Hab	[EDT] Prod. | Capacity	1.10		1,415	1.10		1,415	1.45		1,415	1.79		1,500
Hab	Min NOR Escape | %Kelt	1			1			1			1		
Hab	Smolt Prod. | Capacity	99		127,269	99		127,269	130		127,269	161		134,892
Hydro	SAR [Mar. |Total] Vary? (Y/N)	0.029	0.011	y	0.029	0.011	y	0.029	0.011	y	0.024	0.011	y
Hydro	Passage Surv [Juv.|Adult]	0.45		0.85	0.45		0.85	0.45		0.85	0.54		0.85
Hydro	Adj. Prod. | Adj. Capacity	1.10		1,414	1.10		1,414	1.45		1,414	1.79		1,504
Harv	Harv -Mixed Stock	0.100		0.100	0.100		0.100	0.100		0.100	0.100		
Harv	Harv-Mainstem [NORs|HORs]			0.05 0.05			0.050			0.050	0.010		
Harv	Harv -Terminal										0.050		
Harv	Total Exploitation Rate	0.100		0.15	0.10		0.15	0.10		0.15	0.15		
		pNOB		pHOS	pNOB		pHOS	pNOB		pHOS	pNOB		pHOS
pNOB-Goal	pHOS-Goal	10%		90%	35%		80%	80%		60%			
pNOB-Realized	pHOS-Realized	11%		83%	35%		82%	80%		59%			
	[Int /Seg /None]	Local	Import	Int	Local	Import	Int	Local	Import	Int	Local	Import	Int
Local | Imported	Smolt Release	393		325,000	275		227,500	138		113,750			-
Exported Brood	% Marked			100%			100%						
% to Hatchery	% to Nat. Spawn.	35%		65%	35%		65%	13%		87%			
Recruits/Spwnr	Fitness? [Y / N]	3.6		y	3.6		y	3.6		y	4.0		y

Table 8. AHA model results for the Twisp River natural production phases

Twisp River Coho		Natural Production Implementation		Natural Production Support (I)		Natural Production Support (F)		Long-term (PFC)	
Hab	[EDT] Prod. | Capacity	1.32	926	1.32	926	1.45	926	1.64	1,200
	Min NOR Escape | %Kelt	1		1		1		1	
	Smolt Prod. | Capacity	140	98,509	140	98,509	154	98,509	174	127,660
Hydro	SAR [Mar.| Total] Vary? (Y/N)	0.025 | 0.009	y	0.025 | 0.009	y	0.025 | 0.009	y	0.021 | 0.009	y
	Passage Surv [Juv. | Adult]	0.45	0.85	0.45	0.85	0.45	0.85	0.54	0.85
	Adj. Prod. | Adj. Capacity	1.32	925	1.32	925	1.45	925	1.64	1,201
Harv	Harv -Mixed Stock	0.100	0.100	0.100	0.100	0.100	0.100	0.100	
	Harv-Mainstem [NORs|HORs]		0.05 0.05		0.050		0.050	0.100	
	Harv -Terminal							0.050	
	Total Exploitation Rate	0.100	0.15	0.10	0.15	0.10	0.15	0.23	
		pNOB	pHOS	pNOB	pHOS	pNOB	pHOS	pNOB	pHOS
pNOB-Goal	pHOS-Goal	10%	90%	35%	75%	80%	60%		
pNOB-Realized	pHOS-Realized	11%	82%	35%	80%	80%	66%		
	[Int /Seg /None]	Local | Import	Int	Local | Import	Int	Local | Import	Int	Local | Import	Int
Local | Imported	Smolt Release	332	275,000	233	192,500	116	96,250		-
Exported Brood	% Marked		100%		100%				
% to Hatchery	% to Nat. Spawn.	35%	65%	35%	65%	13%	87%		
Recruits/Spwnr	Fitness? [Y / N]	3.6	y	3.6	y	3.6	y	4.0	y

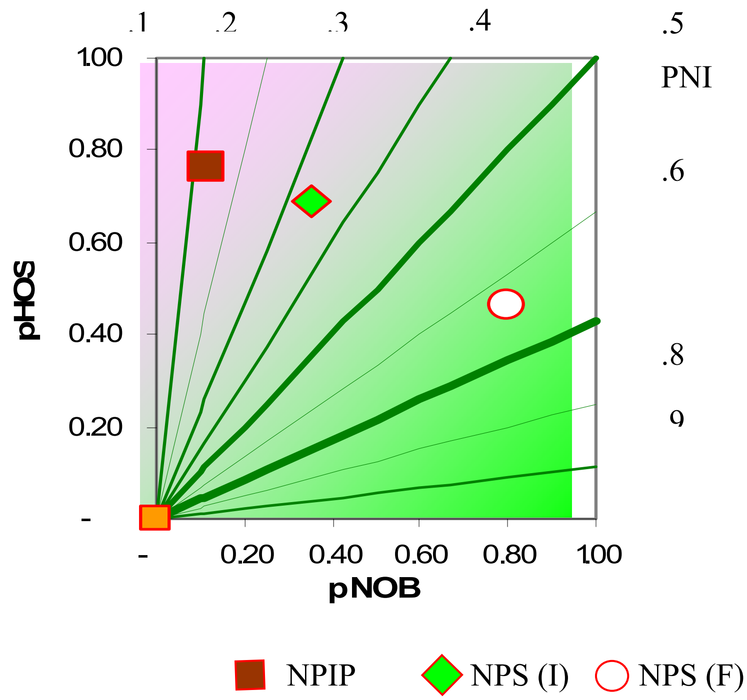

Figure 1. Proportion Natural Influence (PNI) Predicted for the Upper Wenatchee River Natural Production Phases

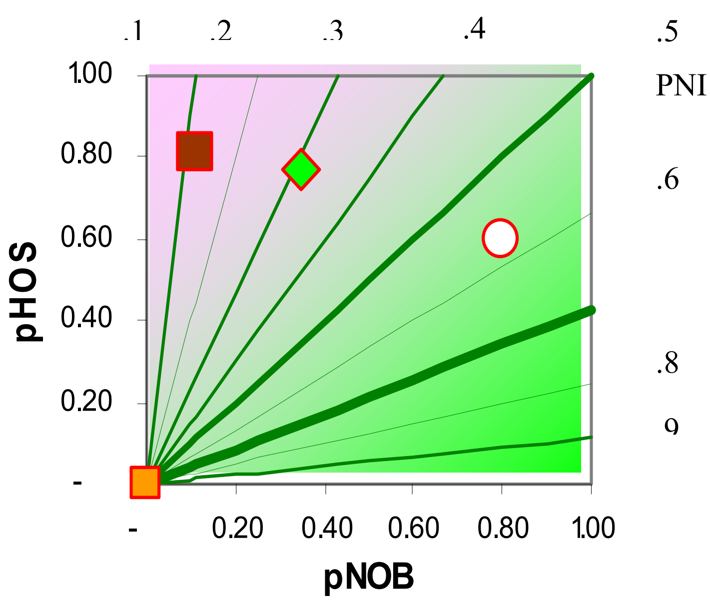

Figure 2. Proportion Natural Influence (PNI) Predicted for Chiwawa River Natural Production Phases

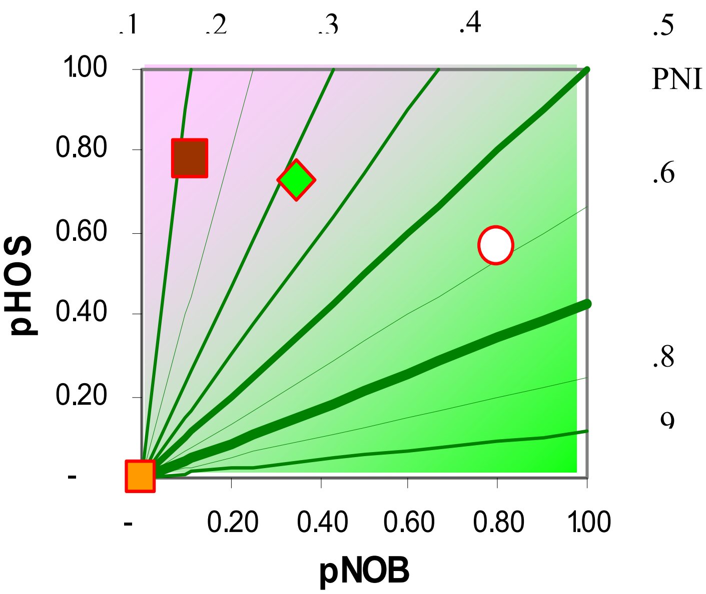

Figure 3. Proportion Natural Influence (PNI) Predicted for White River Natural Production Phases

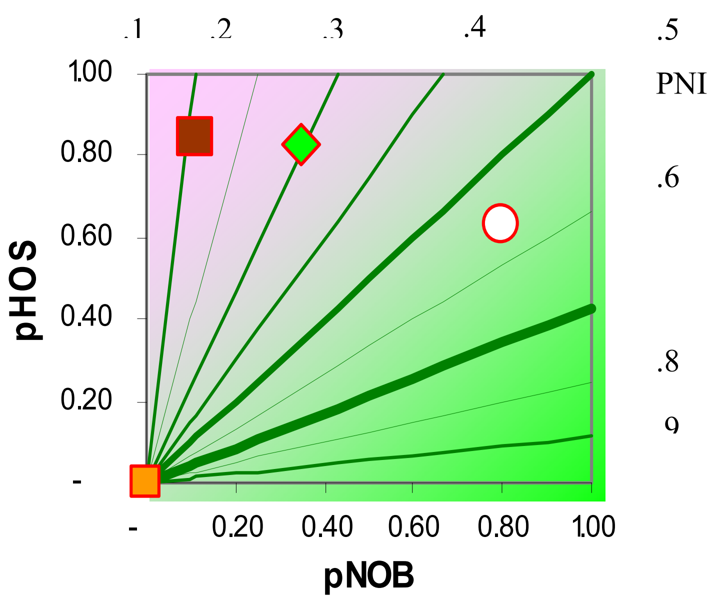

Figure 4. Proportion Natural Influence (PNI) Predicted for Nason Creek Natural Production Phases

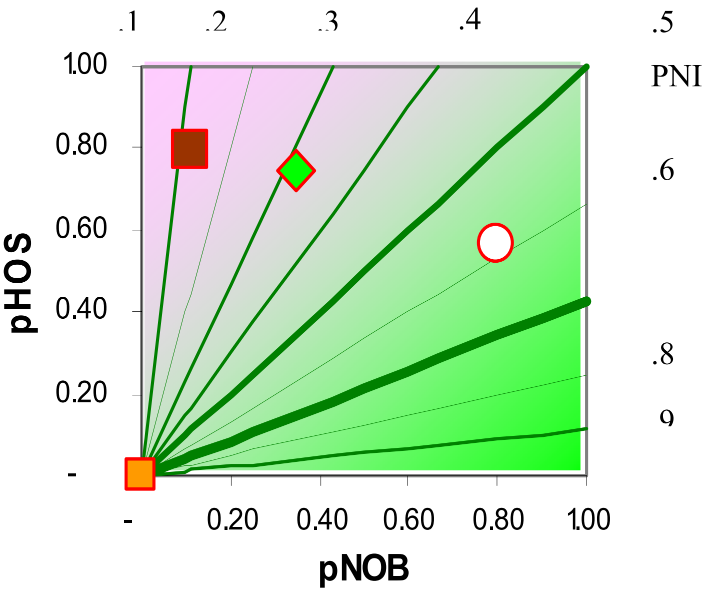

Figure 5. Proportion Natural Influence (PNI) Predicted for Little Wenatchee River Natural Production Phases

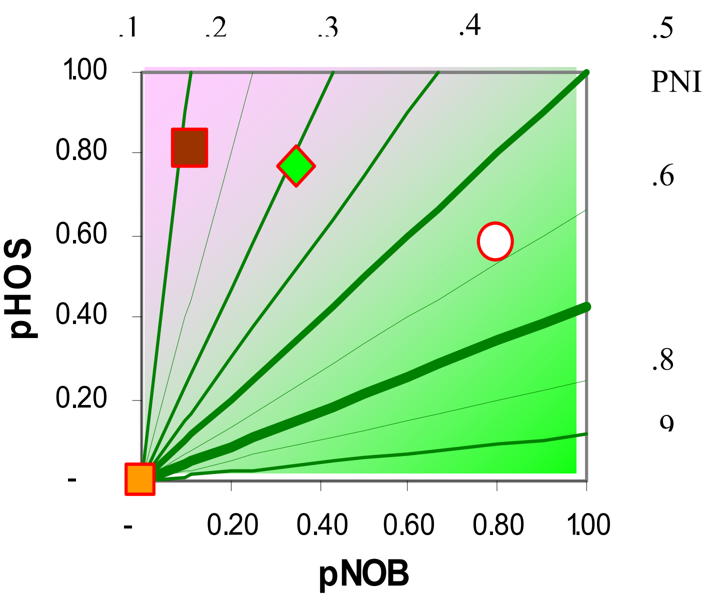

Figure 6. Proportion Natural Influence (PNI) Predicted for the mid-and upper Methow River Natural Production Phases

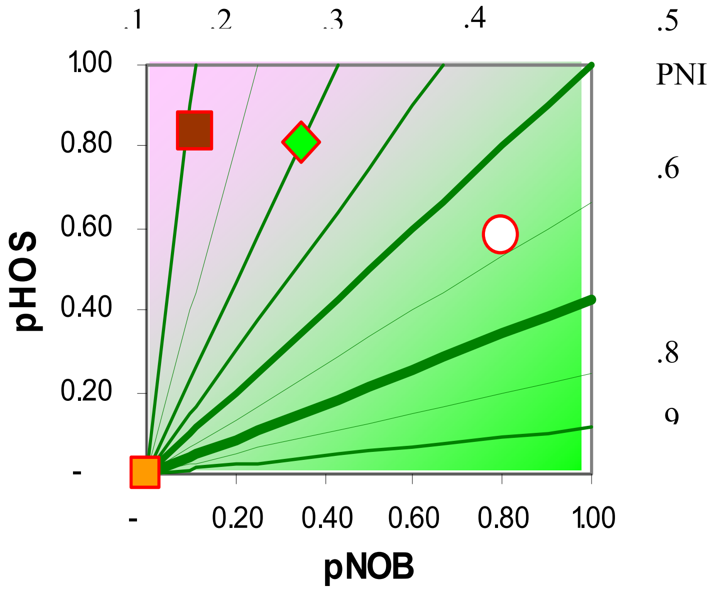

Figure 7. Proportion Natural Influence (PNI) predicted for Chewuch River Natural Production Phases

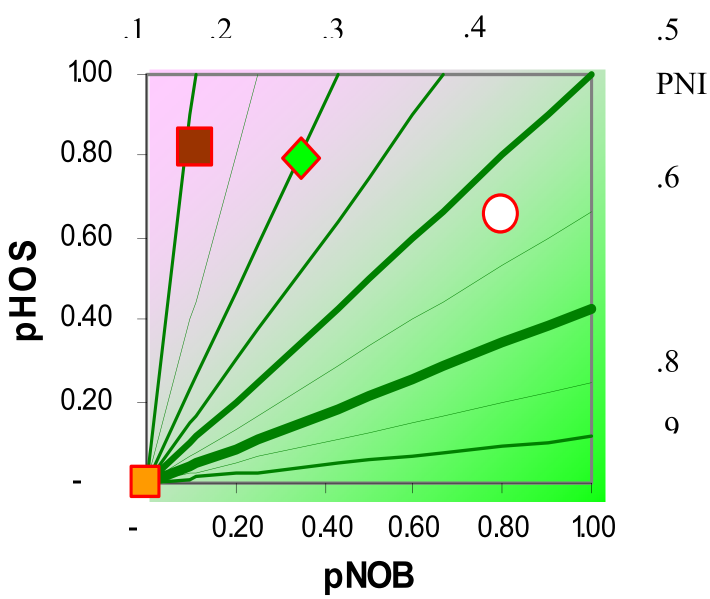

Figure 8. Proportion Natural Influence (PNI) predicted for Chewuch River Natural Production Phases

Table 9. Documentation of AHA model input values

Management Intent		Initiate natural producing in key habitat areas. NOR Escapement >600	Begin development of locally adapted fully integrated stock. NOR escapement >700	Realization of locally adapted fully integrated stock. NOR escarpment > 900	Self-sustaining naturally reproducing population. NOR escapement > 1500. Terminal and mainstem harvest in most years
Management Strategy		Release basin specific broodstock in areas predicted by EDT to be most productive for coho salmon. Begin local adaptation process.	Begin conversion to integrated hatchery program to move towards PNI>0.5 (i.e. pNOB > pHOS). Protect and restore habitat.	Full conversion to integrated hatchery program. Realization of PNI>0.5 (i.e. pNOB > pHOS). Protect and restore habitat.	Habitat protection and restoration. Harvest according to matrix schedule. Periodic hatchery supplementation as needed to prevent extirpation and achieve harvest goals (per matrix), subject to condition that PNI>.5 (pNOB>pHOS).
		Natural Production Implementation	**Natural Production Support (I)**	**Natural Production Support (F)**	**Fully Restored Population**
Habitat Data	Data Source(s)	EDT	EDT	EDT	EDT
	Quality Rating	2	2	2	2
	Administrator	Casey Baldwin	Casey Baldwin	Casey Baldwin	Casey Baldwin
Hydro Data	Data Source(s)	Survival values taken from 2004 FCRPS Biological Opinion. Values include D and transportation. Mid-Columbia values for non-FCRPS projects calculated from reported McNary value. Downstream survival values have current, intermediate and long-term values for the Current, Short-Term and Long-Term values as default.	Survival values taken from 2004 FCRPS Biological Opinion. Values include D and transportation. Mid-Columbia values for non-FCRPS projects calculated from reported McNary value. Downstream survival values have current, intermediate and long-term values for the Current, Short-Term and Long-Term values as default.	Survival values taken from 2004 FCRPS Biological Opinion. Values include D and transportation. Mid-Columbia values for non-FCRPS projects calculated from reported McNary value. Downstream survival values have current, intermediate and long-term values for the Current, Short-Term and Long-Term values as default.	Survival values taken from 2004 FCRPS Biological Opinion. Values include D and transportation. Mid-Columbia values for non-FCRPS projects calculated from reported McNary value. Downstream survival values have current, intermediate and long-term values for the Current, Short-Term and Long-Term values as default.
	Quality Rating	3	3	3	3
Harvest Data	Data Source(s)	Mixed Harv:	Mixed Harv:	Mixed Harv:	Mixed Harv:
	Quality Rating	3	3	3	3
Hatchery Data	Data Source(s)	Data was obtained from BPA Project # 1996-040-00 years 2000 through 2005. The following values were used: Fecundity - 2700, prespawn survival - 0.1. Egg to smolt survival - 75. Smolt-to-Adult survival 0.40%	Data was obtained from BPA Project # 1996-040-00 years 2000 through 2005. The following values were used: Fecundity - 2700, prespawn survival - 0.1. Egg to smolt survival - 75. Smolt-to-Adult survival 0.40%	Data was obtained from BPA Project # 1996-040-00 years 2000 through 2005. The following values were used: Fecundity - 2700, prespawn survival - 0.1. Egg to smolt survival - 75. Smolt-to-Adult survival 0.40%	Data was obtained from BPA Project # 1996-040-00 years 2000 through 2005. The following values were used: Fecundity - 2700, prespawn survival - 0.1. Egg to smolt survival - 75. Smolt-to-Adult survival 0.40%
	Quality Rating	3	3	3	3
	Administrator	Keely Murdoch	Keely Murdoch	Keely Murdoch	Keely Murdoch
	Notes	Capacity is the median value between EDT and Zillges (1977)	Capacity is the median value between EDT and Zillges (1977)	Capacity is the median value between EDT and Zillges (1977)	Productivity Value assumes habitat improvement projects have been implemented

Appendix G

HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Mid-Columbia Coho Reintroduction Feasibility Project
Species or Hatchery Stock:	Coho salmon (*Oncorhynchus kisutch*)
Agency/Operator:	Yakama Nation/Washington Department of Fish and Wildlife
Watershed and Region:	Wenatchee, Methow, Entiat basins
Date Submitted:	December, 2002
Date Last Updated:	December 1999

HATCHERY AND GENETICS MANAGEMENT PLAN

MID-COLUMBIA COHO REINTRODUCTION FEASIBILITY PROJECT

December 2002

Contributors: T. Scribner, K. Murdoch, J. Dunnigan (YN); G. Ferguson (Sea Springs Co. for YN); Chris Pasley, Mark Ahrens, Julie Collins, Marc Jackson, Loren Jensen (USFWS); Robert Becker (ODFW); Nancy Weintraub (BPA); and members of the Technical Work Group

Editor: Judith Woodward

Yakama Nation   Washington Department of Fish & Wildlife   Bonneville Power Administration

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SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of Program: Mid-Columbia Coho Reintroduction Feasibility Project (Project #9604000)

1.2) Population (or stock) and species: Coho Salmon *(Oncorhynchus kisutch),* currently extirpated in mid-Columbia basins.

1.3) Responsible organizations and individuals:

Co-managers:

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Other organizations involved, and extent of involvement in the program:

Technical Work Group (TWG) Members:

- Bonneville Power Administration (BPA) (also is primary funding agency)
- Confederated Tribes of the Colville Indian Reservation
- National Marine Fisheries Service (NMFS) (NOAA Fisheries) (also has decision responsibilities for listed species)
- Northwest Power Planning Council (NPPC) (also makes Fish and Wildlife Program decisions under the Northwest Power Act)
- U.S. Fish and Wildlife Service (USFWS) (also has decision responsibilities for listed species)
- U.S. Forest Service (USFS) (also has decision responsibilities for facilities located on USFS land)
- Chelan Public Utility District (also owns and funds operation of some facilities used by the project)

1.4) Funding source: Bonneville Power Administration

Staffing level: 14 FTEs

Annual hatchery program operational costs: $802,000 (does not include planning/design, construction, or monitoring/evaluation)

Entire project budget: $2,200,000

1.5) Location(s) of hatchery and associated facilities:

Location of program: Feasibility phase (what this HGMP covers—see section 1.7.2): Wenatchee, Methow, and Entiat river basins in Washington State. See Figure 1.

Facilities that would be used (see figures 1-3):

This project is a feasibility study (see section 1.7) As such, it must rely on existing or temporary facilities. Most existing facilities are programmed for other species as their first priority. As a result, when needs change in the priority program, the coho feasibility project must find another site. Since the coho program's inception in 1996, sites for most activities have changed, often several times. Until feasibility has been demonstrated and a long-term program is approved (see section 1.11.2), sites likely will continue to change. Listed below are facilities approved or formally proposed as of spring 2002.

1. Broodstock collection: Tumwater, Dryden, or Wells dams; Winthrop National Fish Hatchery (NFH) or Leavenworth NFH (fish ladder or Dam 5); mainstem dams above Priest Rapids; or Prosser Dam on the Yakima River.

2. Adult holding/spawning: Winthrop NFH will be used for adults returning to the Methow basin. In the Wenatchee basin, the Chiwawa Ponds were used to hold adult coho in 2000 and 2001; the Entiat NFH will be used to hold adult coho in 2002 and beyond.

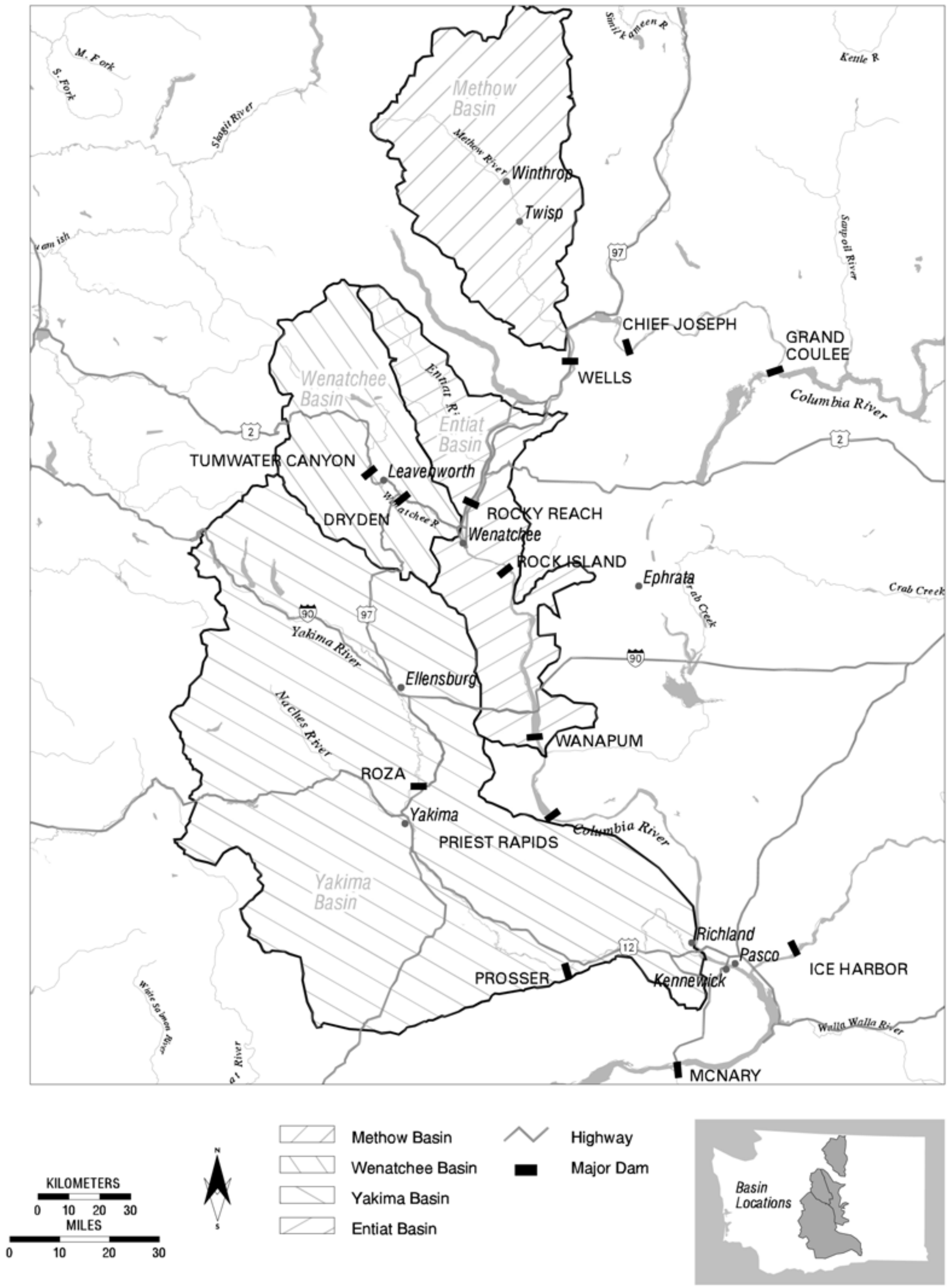
3. **Incubation/Early Rearing:**

<u>Incubation</u> sites include the following locations in the mid-Columbia region: Peshastin incubation facility, Entiat NFH, Leavenworth NFH, and Winthrop NFH. In the lower Columbia, Cascade Hatchery (ODFW) and Willard NFH are used.

<u>Rearing</u> sites include the following locations: Cascade Hatchery, Willard NFH, and Winthrop NFH. In-basin smolt production could be proposed in the future at an as-yet undetermined location. Options currently identified include Chiwawa, White River, Two Rivers (Little Wenatchee), Leavenworth NFH, Entiat NFH, and Dryden Dam, but others could be identified in the future.

4. Acclimation/release: Figures 2 and 3 show potential locations in the Wenatchee and Methow basins. Some sites shown on the maps, and others that may be proposed in the future, would be reviewed by the TWG and various regulatory agencies, and would be subject to environmental analysis of site-specific impacts. The project might not use every site identified. While specific sites in the Entiat basin have not yet been proposed or identified for this phase of the program, potential streams have (the Entiat and Mad rivers). Section 10 provides further details on sites in the Wenatchee and Methow basins.

FIGURE 1 MID - COLUMBIA COHO SALMON STUDY - LOCATION MAP



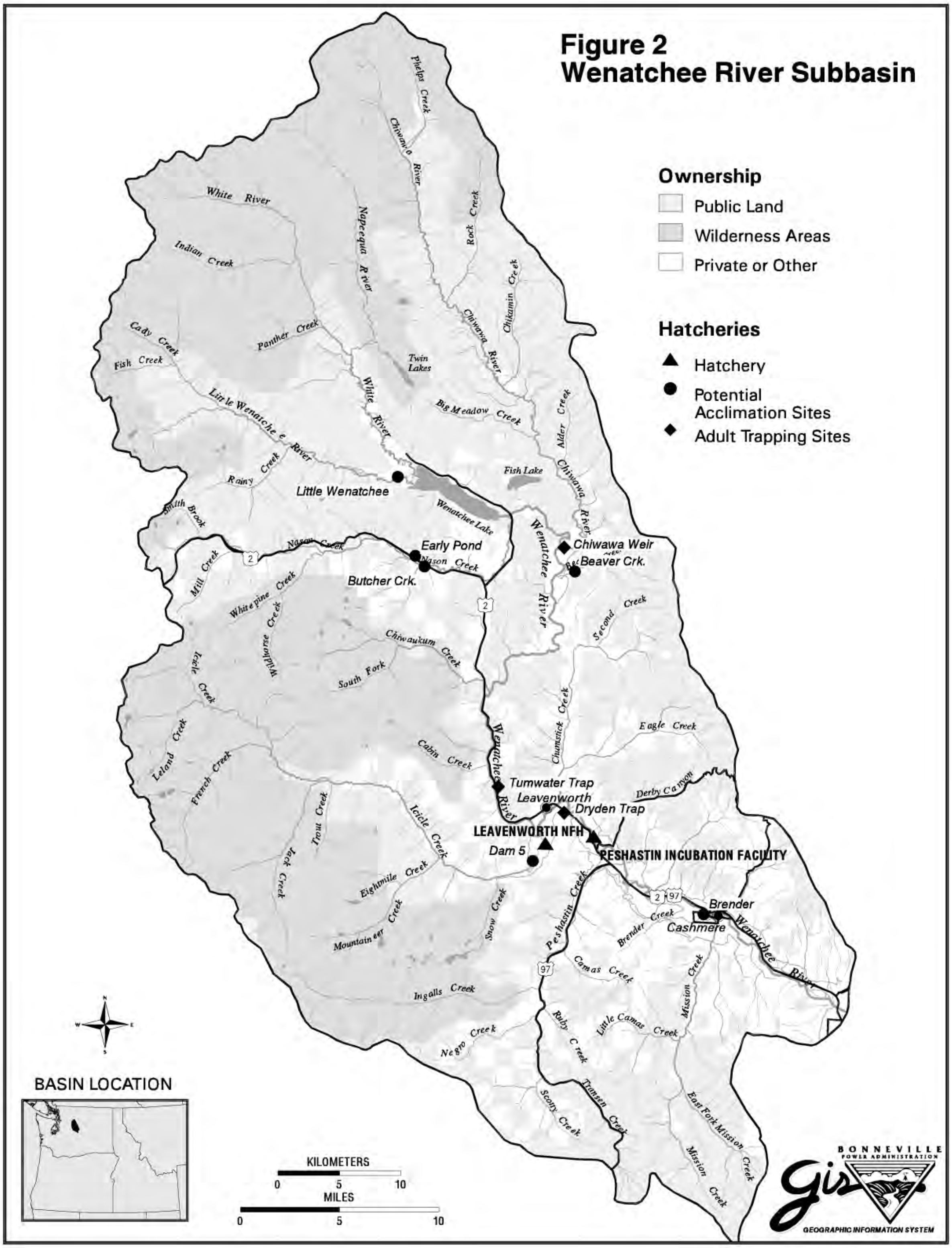


Figure 2
Wenatchee River Subbasin

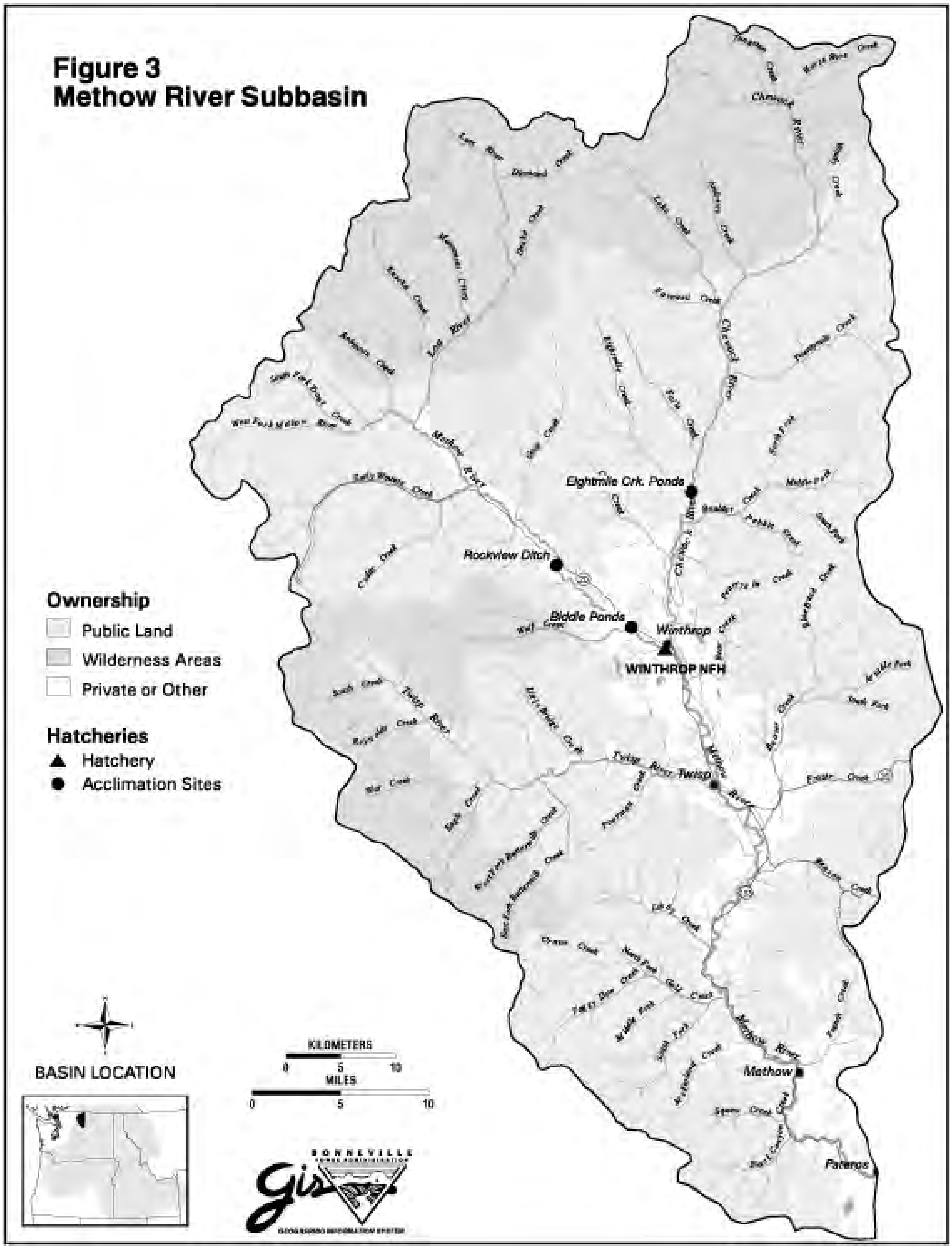


Figure 3
Methow River Subbasin

5. Other: Monitoring. Locations of various types of monitoring activities are identified briefly below. Section 11 describes the activities in detail.

Wenatchee basin:

- Juvenile out-migration and predation would be monitored using rotary traps located near the mouth of Nason Creek (predation on spring chinook) and at the Lake Wenatchee outfall (predation on sockeye). Weirs could be used on smaller tributaries such as Chumstick, Brender, and Beaver creeks. Alternatively, beach seining, tow-netting, or fyke nets could also be used to collect coho to analyze predation on sockeye.
- Juvenile distribution and abundance would be monitored using systematic snorkel surveys upstream, and especially downstream, of all release sites.
- Juvenile coho in Lake Wenatchee may be radio-tagged to determine their potential overlap with sockeye.
- Surveys using hydro-acoustic, beach seining, trawling, and/or purse seining gear would collect information on age-specific sockeye rearing distribution in Lake Wenatchee.
- If necessary, electro-fishing and/or snorkeling would be done in the following places:

  1) for spring chinook and bull trout just below the release site near Lake Wenatchee (Two Rivers); and

  2) for spring chinook, steelhead, and naturally spawned coho in Nason Creek.
- PIT tag detection of juvenile coho mainstem survival would be done at existing facilities at Rock Island, McNary, John Day, The Dalles, and Bonneville dams.
- Coded wire tags (CWTs) would be collected from spawned broodstock and from carcasses found during spawning surveys, to estimate smolt-to-adult survival by release group.
- Adults will be monitored at Priest Rapids and Rock Island dams on the Columbia River, at Tumwater and Dryden dams on the Wenatchee, and at the adult broodstock weir on the Chiwawa River. Remote underwater video camera monitoring systems could be installed at some sites.
- Foot/boat redd surveys will be conducted to determine spatial distribution of returning coho adults in potential natural spawning areas including Nason Creek, Beaver Creek, Chumstick Creek, Brender Creek, and the Wenatchee and Little Wenatchee rivers. On smaller tributaries such as Chumstick, Brender, and Beaver creeks, weirs could be used to monitor adult returns.
- Radio telemetry and video monitoring will be used to determine distribution of coho adults returning to the Wenatchee River basin. They could be trapped and radio-tagged at Priest Rapids, Dryden, and/or Tumwater dams.

Methow basin:

- PIT tag detection would be done at the same locations as for Wenatchee fish, with the addition of Rocky Reach Dam.

- Adult monitoring would be done at Wells and Rocky Reach dams to determine conversion rates between dams.
- Juvenile distribution/abundance monitoring would be done using systematic snorkel surveys at all release sites.
- Foot/boat redd surveys along with radio-telemetry techniques may be used to determine the spawning distribution of coho returning to the Methow River basin.

Entiat basin: Locations not proposed at this time.

1.6) Type of program: Integrated Recovery

1.7) Purpose (Goal) of program:

The Mid-Columbia Coho Reintroduction Program encompasses a vision of an optimistic future that may take many years to achieve, as well as short-term goals that will provide information to enable decision-makers to assess whether the vision is achievable. This section has been divided into two parts to describe both long- and short-term (feasibility phase) goals. However, **the remainder of this plan focuses on tasks and impacts related to the short-term goals**. The long-term vision is provided to help reviewers understand the plan's overall context.

1.7.1) Long-term Vision

The long-term vision for this program is to reestablish naturally reproducing coho salmon populations in mid-Columbia river basins, with numbers at or near carrying capacity, that provide opportunities for significant harvest for Tribal and non-Tribal fishers.

The Yakama Nation believes that achieving this vision will be possible only with continued regional efforts to improve habitat for all anadromous species. Until significant improvements are made in conditions such as mainstem passage or agricultural water use, the mid-Columbia coho program, like other salmon programs in the Columbia basin, probably will need to supplement a locally adapted population for many years.

The vision is closely tied to the vision for reintroduction of coho to the Yakima basin and to other areas from which the species has been eliminated. Mid-Columbia coho reintroduction is identified as a priority in the *Wy-Kan-Ush-Mi-Wa-Kish-Wit* document (Tribal Restoration Plan) by the four Columbia River Treaty Tribes, and has been affirmed as a priority by the Northwest Power Planning Council (see section 3.2).

Mid-Columbia basins historically occupied by coho include the Wenatchee, Methow, Entiat, and Okanogan basins. Mullan (1983) estimated historical mid-Columbia River adult coho populations as follows:

- Wenatchee—6,000 - 7,000
- Methow—23,000 - 31,000
- Entiat—9,000-13,000
- Okanogan—Numbers were not identified, although their presence was documented

The ideal would be to restore coho populations in these basins to their historical levels. Due to 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.

1.7.2) Goals of Feasibility Phase

This phase, which is expected to last at least through 2004, has two primary goals:

- to continue existing studies and to initiate new ones (adapting to changing needs, new information, and concerns of project participants) to 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; and
- to 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.

Studies done in this phase will inform future decisions about whether the long-term vision described in 1.7.1 can be achieved.

1.8) Justification for the program

The Mid-Columbia Coho Program is a phased approach to a “Restoration” program as defined in Part II.C of the NPPC’s *Artificial Production Review* (NPPC 1999). This section states: “An extreme case of a restoration production program is where the natural population has been eliminated, and fish are reintroduced by artificial production when the problem causing the extirpation is removed. A restoration program is a temporary measure that will be withdrawn once the natural population is rebuilt or a determination is made that restoration is not possible.” (NPPC 1999, p. 14)

Because there are listed species in this basin that, unlike coho, have not been extirpated, and because barriers to natural production have been reduced (not eliminated), this project is taking a phased approach to restoration by testing the feasibility of developing a naturally reproducing broodstock as well as testing the risks to other species, before implementing a full-scale restoration program.

1.9) Program “Performance Standards”

Specific objective(s) of program (at least through 2004):

Experience with the project so far has shown that trying to define specific numeric goals for such an experimental project is unrealistic. Too little is known at this stage about the possibilities and risks of an attempt to re-establish a new population of formerly extirpated coho. The project has grappled annually with the study results to determine the significance of survival, interactions, and overall program feasibility and has found that annual agreements with the TWG on release numbers and other program specifics are most effective at meeting feasibility study needs. The list below identifies the feasibility study’s objectives.

- Determine whether hatchery adults from lower Columbia River broodstock return in increasing numbers to the Wenatchee and Methow basins so that their progeny may be expected to reach replacement, thus significantly limiting the infusion of the Lower River hatchery stock, with the long-term goal of eliminating use of the Lower River stock altogether.
- Continue to develop a locally adapted broodstock in the Methow and Wenatchee basins.
- Continue coho smolt releases in areas where coho adults will be allowed to return to spawn naturally. These areas currently are expected to be in the Wenatchee basin in

Nason, Beaver, Chumstick, and Brender creeks; and in the lower Wenatchee and Little Wenatchee rivers.

- Evaluate rearing and release procedures within the constraints of hatchery operations that maximize adult survival and the creation of naturally spawning populations.
- Study interactions among coho and listed and sensitive species, particularly spring chinook and sockeye salmon, steelhead, and bull trout. Such studies have required, and could continue to require, coho releases in habitat of sensitive species.
- Minimize potential negative interactions among coho and listed and sensitive species while also conducting necessary interaction studies.
- Annually evaluate project performance with TWG and resource managers and expand or adapt studies as data indicate are necessary or appropriate.
- Monitor hatcheries that raise program coho for compliance with IHOT guidelines.

1.10) List of Performance Indicators designated by "benefits" and "risks"

Monitoring studies of these performance indicators are described in detail in section 11.

1.10.1) Benefits to coho

- Trends in survival of hatchery coho as measured by PIT tags (smolt-to-smolt), and by counts at dams/facilities and CWTs (smolt-to-adult).
- Spatial distribution of returning adults in potential natural spawning areas as identified from radio telemetry, foot/boat redd surveys, and weirs.
- Reproductive success (initial evaluations only) of naturally reproducing coho using redd counts, redd capping, and smolt production estimates.
- Changes made by out-of-basin stock, using genetic monitoring of neutral allelic frequencies; and physical and behavioral traits such as fecundity, body morphometry, maturation timing, and straying and homing to acclimation sites.

Risks to other listed species

- Predation on other species by program fish as indicated by stomach content analyses.
- Superimposition of spring chinook redds by spawning coho as measured by superimposition studies.
- Competition for food and habitat during freshwater rearing of naturally produced coho juveniles as measured through micro-habitat use and growth evaluations.
- Other potential ecological interactions as indicated by residualism studies or by F2 evaluations.

1.11) Expected size of program

1.11.1) Program size for the feasibility stage (this plan)

Table 1 shows smolt release numbers, broodstock requirements, and production so far. Total release numbers in the Wenatchee and Methow basins are defined under agreements as part of *U.S. v. Oregon*. Feasibility studies will identify ecological risks, broodstock requirements, and survival of out-of-basin stocks. Current plans are to release only smolts. In the future, however, if the Technical Work Group determines that study objectives would be better served—for example, in interaction studies—another life stage could be used. Total numbers released in each basin are not expected to change for the feasibility phase, although release sites in each basin could change. Release numbers at each site are evaluated and discussed among TWG members annually as study needs require and as facility availability changes.

1.11.2) Program size in the long term

Before implementation of the long-term vision described in section 1.7.1 can begin, a variety of decision processes must be completed, using the results of the feasibility studies. These processes most likely would include, at a minimum, a National Environmental Policy Act (NEPA) document if federal funding is involved, and a Step Two and Three review by the NPPC. Then, if the decision-making entities agree to continue the project, it is expected that release numbers would be calculated taking into account carrying capacity (see section 3.5.1), survival estimates of hatchery produced and naturally produced coho, harvest goals, and any reductions necessary to limit risks to other species. It is possible, however, that future coho releases would be less than the number required to fully seed the habitat, in order to limit interactions with listed species.

1.12) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data.

Program performance is shown in Table 1.

1.13) Date program started: Research into feasibility began in 1996.

1.14) Expected duration of program:

Program staff expect that results from feasibility studies could be sufficient by 2004 to allow managers to recommend options for the long term. While it is likely that some form of long-term program will be recommended, a number of options will need to be developed and considered in a variety of decision processes that could take several years to complete. Coho releases are unlikely to be suspended while these decision processes continue, and some feasibility studies are expected to continue beyond 2004. Such studies could contribute, for example, to NEPA or ESA analyses that would help resource managers determine specifics of a long-term program. Full-scale implementation could begin formally only after the following three conditions are met: a) initial feasibility and evaluation of the most important critical uncertainties related to coho re-introduction have been determined, b) the project co-managers propose such a program, and c) an Environmental Impact Statement (EIS), the NPPC Step Two and Three reviews, and other decision processes are completed, currently expected in approximately 2008.

Table 1. Summary of Coho Releases and Broodstock Development

Table 1a. Methow Basin Coho Program

Smolt Releases

Smolt Release Year	**Winthrop**	**Total**
1998	341,000	341,000
1999	0	0
2000	200,000	200,000
2001	180,000	180,000
2002	200,000	200,000
2003	250,000	250,000
2004	250,000	250,000
2005	250,000	250,000

All progeny derived from adults returning to the Methow will be released into the Methow basin unless the Wenatchee basin is short of local brood fish. In that case, Winthrop production would be released in the Wenatchee basin. See section 10.4 for detailed guidelines on source of releases.

Winthrop Adult Returns					**Smolt Production from Methow Returns**				
Adult Return Year	Adult Re-turns***	Prespawn Mortality	Broodstock	Natural Spawn-ing****	Females	Spawning Year	Eggs	Smolts	Outplant Year
1999	0*	0	0	0	0	1999	204,000	145,000	2001
2000	0*	0	0	0	0	2000	0	0	2002
2001	536*	54	334	202	93	2001	239,000	165,000	2003
2002**	209	21	130	58	0	2002	175,000	124,000	2004
2003-2005	TBD	TBD	TBD	TBD	TBD	2003	TBD	TBD	2005

* Actual observed numbers

** Adjusted for relatively poor downstream survival rates (9.9%) in 2001

*** Smolt-adult survival for 2001 (only year so far with returns): 0.17 – 0.27% (TWG meeting notes, 1/29/02)

**** This natural spawning is predicted as a result of capture efficiency at Wells and straying

Table 1b. Wenatchee Basin Coho Program

Smolt Releases

Smolt Release Year	Nason Cr. (TBD)	Early Pond	Butcher Cr.	Beaver Cr.	Little Wenat-chee	Chumstick Cr.	Brender Cr.	Leaven -worth	Total
1999			75,000					450,000	525,000
2000			75,000					925,000	1,000,000
2001			145,000					855,000	1,000,000
2002		23,500	150,000	75,000				751,500	1,000,000
2003	155,900*	0	150,100	75,000	100,800		37,500	453,100	1,000,000
2004	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	1,000,000
2005	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	1,000,000

Wenatchee Adult Returns					Smolt Production from Adult Returns				
Adult Re-turn Year	Adult Re-turns**	Pres-pawn Mort.	Brood-stock	Natural Spawn-ing	Females	Spawning Year	Eggs	Smolts	Outplant Year
2000	1,113***	111	919	83	407	2000	1,100,000	650,000	2002
2001	1,773****	177	1,219	377	499	2001	1,3000,000	835,000	2003
2002	1,773	177	1,350	246	608	2002	1,640,000	1,000,000	2004
2003	TBD	TBD	TBD	TBD	TBD	2003	TBD	TBD	2005
2004	TBD	TBD	TBD	TBD	TBD	2004	TBD	TBD	2006
2005	TBD	TBD	TBD	TBD	TBD	2005	TBD	TBD	2007

Source of Wenatchee Outplants

Smolt Release Year	Lower River	Wenatchee Production	Methow Production	Total
1999	1,000,000	0	0	1,000,000
2000	1,000,000	0	0	1,000,000
2001	856,000	0	144,000	1,000,000
2002	400,000	600,000	0	1,000,000
2003	0*****	837,000	163,000	1,000,000
2004	0*****	1,000,000	0	1,000,000
2005	0*****	1,000,000	0	1,000,000

* Includes fry plants and several sites in Nason Creek watershed
** Smolt-adult survival in 2001: 0.16%
*** Actual observed numbers
**** Expanded for the days we weren't trapping
***** Only if localized stock production is sufficient to meet total release numbers. See section 10.4 for guidelines.

1.15) Watersheds targeted by the program:

Short-term (this plan)

Wenatchee: Nason Creek, Wenatchee River, Little Wenatchee River, Icicle Creek, Chumstick Creek, Brender Creek, Beaver Creek

Methow: Methow River. In the first few years of this project, we released fish from sites on the Chewuch River (Eightmile and Fulton Ditch) and Wolf Creek (Biddle Pond).

Longer-term vision

Ideally, coho would be re-established into all suitable habitat in mid-Columbia basins and tributaries. Likely areas include:

Wenatchee: All streams targeted in the feasibility phase, plus White River, Chiwawa River, Peshastin Creek

Methow: In addition to Methow River, Chewuch River, Wolf Creek, Twisp River, Eight Mile Creek

Entiat: Entiat River, Mad River

Okanogan: Okanogan River and tributaries

1.16) Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.

When BPA evaluated the proposed feasibility studies in its Environmental Assessment (EA) (USDOE BPA 1999b), it considered three alternatives to the program proposed by the Yakama Nation (the "Tribal Alternative"). The three alternatives to the proposal were: "Phased Study Alternative," which would have funded research in the Wenatchee basin only; "Hatchery Releases Alternative," in which the only question studied would have been whether adult coho could return in sufficient numbers to replace themselves, with no predation studies, and no acclimation or spawning in natural habitat; and "No Action Alternative," which anticipated continued releases of coho in the mid-Columbia region under *U.S. v. Oregon* but without BPA funding and with little or no research. The "Tribal Alternative" was selected as the proposed action because it best met the needs and purposes outlined in the EA (USDOE BPA 1999b, sections 1.1 and 1.2) and was found to have no significant environmental impacts. The December 1999 HGMP outlined the Tribal Alternative in as much detail as was possible at the time. Since then, the program has been modified in certain details, which are presented in this update, but the fundamental goals have not changed.

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS

2.1) List all ESA permits or authorizations in hand for the hatchery program.

- NMFS Biological Opinion, April 27, 1999 specifies terms and conditions for project studies for one year. This Opinion required preparation of a long-term management plan, which resulted in the 1999 HGMP (NMFS 1999(b)).
- USFWS Biological Opinion 01-F-E0231, May 18, 2001 specifies terms and conditions to minimize incidental take of bull trout, including requirements for electro-fishing (USDI, FWS 2001).
- WDFW Section 10 Permit #1094. Coho broodstock collection is done in conjunction with WDFW steelhead broodstock collection under this permit. Under Modification 2 of this permit, radio tagging coho adults at Priest Rapids Dam is done in conjunction with WDFW adult steelhead radio tagging (NMFS 1998(b)).
- WDFW Section 10 Permit #1203. Coho smolt trapping for predation studies in the Wenatchee basin is done in conjunction with WDFW juvenile salmonid research under this permit.

2.2) Provide descriptions, status, and projected take actions and levels for ESA-listed natural populations in the target area.

2.2.1) Description of ESA-listed salmonid population(s) affected by the program.

- Identify the ESA-listed population(s) that will be directly affected by the program.
(Includes listed fish used in supplementation programs or other programs that involve integration of a listed natural population.)
No listed species will be directly affected by the program. The program's target species is coho salmon, which has been extirpated from mid-Columbia basins and is not listed under ESA.

- Identify the ESA-listed population(s) that may be incidentally affected by the program.
(Includes ESA-listed fish in target hatchery fish release, adult return, and broodstock collection areas).
Information in this section includes status of species and potential impacts in the Entiat basin, as well as in the Wenatchee and Methow basins, although the project does not propose coho releases in the Entiat at this time. The information is offered to give reviewers a context for the long-term plans and to show similarities and differences among the basins in this region. As well, the information could be useful should adaptive management reviews suggest that studies or other work be undertaken in a basin other than those currently proposed.

Table 2. ESA-Listed Fish Species in the Wenatchee and Methow Basins

Common Name	Endangered Species Act	Washington Species Criteria
Spring chinook salmon (Upper Columbia River)	Endangered	Vulnerable/Species of Importance
Steelhead trout (Upper Columbia River)	Endangered	Species of Importance
Bull trout	Threatened	Vulnerable/Species of Importance

Table 3 lists spawning areas for listed species that are within 8 km (5 mi) of potential coho acclimation sites in the Wenatchee and Methow basins. Although not ESA-listed, sockeye and summer chinook are included in the tables and some of the analyses. Lake Wenatchee sockeye are one of only two sockeye populations remaining in the Columbia River system, and summer chinook are important because, though presently healthy, only a few historically numerous populations still exist in the Columbia River basin. Please see figures 2 and 3 for approved or proposed acclimation site locations as of spring 2002. Other known spawning areas in the two basins that are more than 8 km from acclimation sites are listed by species and stream below the table. Specific acclimation/release sites have not yet been proposed for the Entiat basin.

Table 3. Spawning Areas for Sensitive Anadromous Species Near Potential Coho Acclimation/Release Sites*

Basin/Water Body	Spring chinook	Summer chinook	Sockeye	Steelhead	Bull trout
Wenatchee					
Nason Cr.	**X**			**X**	**U**
Little Wenatchee R.	**X**		**X**	**X**	**U**
Wenatchee R. mainstem	**X**	**X**		**X**	
White R.	**X**		**X**	**X**	**X**
Chiwawa R.	**X**			**X**	**X**
Icicle Cr.				**X**	**U**
Beaver Cr.				**X**	
Brender Cr.				**X**	
Chumstick Cr.				**X**	
Methow					
Upper Methow R.	**X**			**X**	**U**
Methow R. mainstem	**X**			**X**	
Twisp R.	**X**			**X**	**U**
Chewuch R.	**X**			**X**	**U**
Wolf Cr.	**X**			**X**	**U**
Goat Cr.				**U**	

*Legend: X = spawning area overlaps with coho acclimation site

U = spawning area is no further than 8 km (5 mi) upstream of acclimation site

The following lists known spawning areas for listed species in addition to the streams listed in Table 3; they are all more than 8 km (5 mi) from coho acclimation and release sites evaluated for this project.

- **Spring chinook**: Methow basin—Lost River
- **Steelhead:** Wenatchee basin—Mission Creek, Peshastin Creek

  Methow basin—Gold Creek, Libby Creek, Beaver Creek, Early Winters Creek, Lost River
- **Bull trout:** Wenatchee basin—Ingalls Creek, Chiwaukum Creek, Mill Creek (tributary to Nason), White River, Panther Creek (tributary to White R.), Chickamin Creek, Rock Creek, Phelps Creek, Icicle Creek (resident population)

  Methow basin—Foggy Dew Creek, Crater Creek, Buttermilk Creek, Reynolds Creek, Blue Buck Creek, Lake Creek, Goat Creek, Early Winters Creek, Cedar Creek, West Fork Methow River, Monument Creek, Lost River

Although potential acclimation and release sites have not been proposed in the Entiat basin, streams most likely to be targeted initially for coho reintroduction (should the long-term vision be implemented) would be the Entiat and Mad rivers. These streams are known to contain the following listed species (USDA FS 1996):

- **Spring chinook:** Lower Entiat, Lower-Mid Entiat (stronghold*), Upper-Mid Entiat, Lower and Middle Mad rivers.
- **Steelhead:** All of the Entiat except Upper; and Middle Mad rivers.
- **Bull trout:** Lower Entiat, Lower-Mid Entiat, Upper-Mid Entiat (stronghold*), all Mad River (stronghold).
- **Late-run chinook:** Lower Entiat, Lower-Mid Entiat (stronghold*), Upper-Mid Entiat.

* (as indicated in USDA FS 1996)

Table 4 shows the temporal overlap of life-history stages for species in these basins. Adult steelhead migrate at similar times to coho. They, like coho, are collected for broodstock at Dryden and Tumwater dams in the Wenatchee basin and at Wells Dam on the mainstem Columbia River. They may migrate up Icicle Creek to Leavenworth NFH, although none have been observed at the trap. Adult bull trout also could be in these broodstock collection areas. Spring chinook would not be affected at trapping sites because they pass these areas in May and June.

Table 4. Life History Timing of Methow and Wenatchee Salmonids

Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chinook (Spring)	Adult Immigration					■	■	■	■				
	Adult Holding						■	■	■				
	Spawning								■	■			
	Incubation	■							■	■	■	■	■
	Emergence		■	■									
	Rearing	■	■	■	■	■	■	■	■	■	■	■	■
	Juvenile Emigration				■	■	■						
Species	**Life Stage**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Chinook (Summer)	Adult Immigration							■	■	■			
	Adult Holding								■	■	■		
	Spawning									■	■	■	
	Incubation									■	■	■	■
	Emergence	■	■	■	■								
	Rearing	■	■	■									
	Juvenile Emigration				■	■	■	■	■	■	■		
Species	**Life Stage**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Chinook (Fall)	Adult Immigration										■	■	
	Adult Holding										■	■	
	Spawning											■	
	Incubation	■	■									■	■
	Emergence		■	■									
	Rearing			■	■	■	■						
	Juvenile Emigration						■						
Species	**Life Stage**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Sockeye	Adult Immigration							■	■	■	■		
	Adult Holding								■	■	■		
	Spawning									■	■	■	
	Incubation	■	■	■	■					■	■	■	■
	Emergence				■	■							
	Rearing	■	■	■	■	■	■	■	■	■	■	■	■
	Juvenile Emigration				■	■							
Species	**Life Stage**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Coho	Adult Immigration									■	■	■	■
	Adult Holding									■	■	■	■
	Spawning										■	■	■
	Incubation	■	■	■								■	■
	Emergence		■	■	■								
	Rearing	■	■	■	■	■	■	■	■	■	■	■	■
	Juvenile Emigration				■	■	■						
Species	**Life Stage**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Steelhead (Summer)	Adult Immigration	■	■	■	■	■			■	■	■	■	■
	Adult Holding	■	■	■					■	■	■	■	■
	Spawning			■	■	■	■						
	Incubation						■	■	■				
	Emergence								■	■			
	Rearing	■	■	■	■	■	■	■	■	■	■	■	■
	Juvenile Emigration				■	■							
Species	**Life Stage**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Bull Trout	Spawning									■	■	■	
	Incubation	■	■	■							■	■	■
	Emergence	■	■	■	■								
	Rearing	■	■	■	■	■	■	■	■	■	■	■	■

2.2.2) Status of ESA-listed salmonid population(s) affected by the program.

- Describe the status of the listed natural population(s) relative to "critical" and "viable" population thresholds (*see definitions in "Attachment 1").*

- Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.

- Provide the most recent 12 year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.

- Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

The following is a brief review of listed fish status in each basin, based on material already published, as noted. WDFW is developing HGMPs for all listed fish in mid-Columbia basins under the jurisdiction of the Mid-Columbia Habitat Conservation Plan (part of the re-licensing process for the mid-Columbia public utility districts). When completed, those documents will have the most up-to-date status of and plans for the listed fish.

UCR Spring Chinook

In general, recent total abundance of Upper Columbia River spring chinook has been quite low (NMFS 1999(a)). Spring chinook run estimates 1986 – 1998 for the Wenatchee, Methow, and Entiat basins are shown in tables 5 – 7 below.

Table 5. Run Estimates, Wenatchee River Spring Chinook

Year	Rock Island Dam Count	Rocky Reach Dam Count	Wenatchee Redd Counts
1986	21,001	4,138	441
1987	18,883	3,480	545
1988	16,212	4,823	491
1989	10,690	3,168	493
1990	7,721	1,909	446
1991	5,781	1,323	251
1992	15,634	2,714	491
1993	19,943	4,128	536
1994	2,041	349	125
1995	887	256	23
1996	2,150	569	72
1997	6,205	1,866	175
1998	3,324	842	78

Source: NMFS 1999(a)

Table 6. Run Estimates, Methow River Spring Chinook

Year	Wells Dam Count	Methow River System Redd Counts
1986	2,896	186
1987	2,272	673
1988	3,024	733
1989	1,633	517
1990	967	482
1991	687	250
1992	1,542	738
1993	2,601	647
1994	258	133
1995	82	15
1996	387	0*
1997	971	145
1998	406	0*

*All fish collected at Wells Dam.
Source: NMFS 1999(a)

Table 7. Run Estimates, Entiat River Spring Chinook

Year	Rocky Reach Dam Count	Wells Dam Count	Wenatchee Redd Counts
1986	4,138	2,896	105
1987	3,480	2,272	64
1988	4,823	3,024	67
1989	3,168	1,633	37
1990	1,909	967	83
1991	1,323	687	32
1992	2,714	1,542	42
1993	4,128	2,601	100
1994	349	258	24
1995	256	82	1
1996	569	387	8
1997	1,866	971	20
1998	842	406	15

Source: NMFS 1999(a)

UCR Steelhead

The following information on UCR steelhead is taken entirely from NMFS 1999(a).

The life history of this ESU is similar to other inland steelhead ESUs. However, smolt ages are some of the oldest on the west coast (up to 7 years old), likely as a result of the ubiquitous cold water temperatures (Mullan et al. 1992). Adults of this ESU spawn later than most downstream populations. Adults of Wenatchee and Entiat River populations return after one year in the ocean, those from the Methow River primarily after two years of ocean life. Adults remain in fresh water up to a year before spawning.

The entire ESU has been heavily hatchery-influenced, with a thorough mixing of stocks as a result of the Grand Coulee Fish Maintenance Project beginning in the 1940s (Fish and Hanavan 1948; Mullan et al. 1992). Until recently, hatchery releases composed of a composite of basin stocks continued. The Wells Hatchery stock is included in the listing. Currently, efforts are underway to develop hatchery programs from more locally adapted stocks, using naturally spawning fish.

Most natural production occurs in the Wenatchee River watershed and in the Methow/Okanogan river systems, with a small run returning to the Entiat River. A majority of fish spawning in natural production areas are of hatchery origin. Indications are that natural populations in the Wenatchee, Methow/Okanogan, and Entiat rivers are not currently self-sustaining.

In recent years it was determined that steelhead habitat in the upper Columbia region was over-seeded, primarily due to the presence of hatchery fish; on the average, hatchery seeding was nearly 110% of the level of production the habitat could support. In addition, it was estimated that the proportion of hatchery-origin steelhead in spawning escapements was 65% in the Wenatchee River and 81% in the Okanogan, and Methow rivers (Busby et al. 1996), a level much higher than that NMFS believes is acceptable to minimize adverse genetic effects to natural populations. This is likely a partial explanation for the low natural replacement rates estimated for the area; populations in the Wenatchee River have a recent Natural Cohort Replacement Rate of 0.3, while those in the Entiat River are no greater that 0.25 (Bugert 1997).

Table 8 shows steelhead counts at mid-Columbia dams. Table 9 shows seeding levels relative to capacity for the Wenatchee, Methow, and Entiat basins.

Table 8. Steelhead Counts at Mid-Columbia Dams

Year	Priest Rapids Dam Count	Priest Rapids Dam Wild Origin	Rock Island Dam Count	Rocky Reach Dam Count	Wells Dam Count
1986	22,382	2,342	22,867	15,193	13,234
1987	14,265	4,058	12,706	7,172	5,195
1988	10,208	2,670	9,358	5,678	4,415
1989	10,667	2,685	9,351	6.119	4,608
1990	7,830	1,585	6,936	5,014	3,819
1991	14,027	2,799	11,018	7,741	7,715
1992	14,208	1,618	12,398	7,457	7,120
1993	5,455	890	4,591	2,815	2,400
1994	6,707	855	5,618	2,823	2,138
1995	4,373	993	4,070	1,719	946
1996	8,376	843	7,305	5,774	4,127

1997	8,948	785	7,726	7,726	4,107
1998	5,790	919	4,810	4,265	2,482

Source: NMFS 1999(a)

Table 9. Estimated Steelhead Smolt Production Capacities

Watershed	Smolt Production Capacity	Recent Ten-Year Seeding Levels	Seeding Levels' Percent of Production Capacity
Wenatchee	62,167	73,371	118.2%
Methow	58,552	65,586	112.0%
Entiat	12,739	10,728	84.2%
Total	**133,458**	**149,685**	

Source: NMFS 1999(a)

Bull Trout

The following information is taken entirely from USDI FWS 2001.

The mid-Columbia River region includes watersheds of four major tributaries of the Columbia River in Washington. USFWS identified 16 bull trout subpopulations in the four watersheds (number of subpopulations in each watershed)—Yakima River (8), Wenatchee River (3), Methow River (4), Entiat River (1) (USDI FWS 2001).

Bull trout in this region are most abundant in Rimrock Lake of the Yakima River basin and Lake Wenatchee of the Wenatchee River basin. Both subpopulations are considered "strong" and increasing or stable. The remaining 14 subpopulations are relatively low in abundance, exhibit "depressed" or unknown trends, and primarily have a single life-history form. USFWS considers 10 of the 16 subpopulations at risk of extirpation because of naturally occurring events due to isolation, single life-history form and spawning area, and low abundance (USDI FWS 1998).

Wenatchee River basin. USFWS identified three bull trout subpopulations in the Wenatchee River basin: 1) Lake Wenatchee, 2) Icicle Creek, and 3) Ingalls Creek. In 1995, the Chelan County Public Utility District video-recorded 15 bull trout ascending Tumwater Dam. Although migratory (fluvial) and possibly resident bull trout are present, USFWS believes that the majority of bull trout upstream of Tumwater are migratory (adfluvial) and use Lake Wenatchee.

Of the three subpopulations, the Lake Wenatchee subpopulation has the greatest number of fish in the Wenatchee basin (Brown 1992; K. Williams, WDFW, *in litt*. 1996; A. Murdoch, WDFW, *in litt*. 1997). Anecdotal accounts indicate that the Little Wenatchee River and tributaries to Lake Wenatchee once supported a popular bull trout fishery (WDFW 1997). The bull trout spawning in the Little Wenatchee River basin was last recorded in 1984, and this stock may be extirpated (WDFW 1997). Bull trout have been extirpated from the Napecqua River, a tributary to Lake Wenatchee (WDFW 1997). Four distinct spawning stream reaches remain in this subpopulation (K. MacDonald, USFS, *in litt.* 1996).

The Icicle Creek subpopulation consists of resident bull trout isolated above the Leavenworth NFH dam. A total of 11 bull trout were observed in surveys in 1994 and 1995 (Ringel 1997). Migratory bull trout are observed occasionally below the dam and are believed to originate from the subpopulation upstream (K. MacDonald, USFS, *in litt.* 1996). The Ingalls Creek subpopulation is composed primarily of resident fish. Eight bull trout were observed during snorkel surveys of the creek in 1995 (Ringel 1997). USFWS considers the Icicle and Ingalls creeks subpopulations to be at risk of stochastic extirpation due to their inability to be re-founded, their single life-history form and spawning area, and their low numbers.

Methow River basin. USFWS identified four bull trout subpopulations in the Methow River basin: 1) Methow River, 2) Lost River, 3) Goat Creek, and 4) upper Early Winters (K. Williams, WDFW, *in litt*. 1996*)*.

The Methow River subpopulation is composed primarily of migratory (fluvial) fish. In the mainstem Methow River, up to 79 percent of the average flow is removed from a 40-mile reach, occasionally stranding and killing bull trout. Due primarily to temperature constraints in partially dewatered tributaries to the Methow River, 60 percent of the total spawning and rearing area for bull trout has been lost (Mullan et al. 1992). There appears to be sufficient connectivity to allow bull trout access to spawn in various reaches of seven tributaries (Gold, Wolf, and lower Early Winters creeks, and Twisp, West Fork Methow, lower Lost, and Chewack rivers) (WDFW 1997). The number of redds observed at 21 transects in the 7 streams was 0 to 27, with an overall mean of 9.4 per stream (K. Williams, WDFW, *in litt.* 1996).

The Lost River subpopulation is isolated in the upper portion of the watershed, which is considered to be a “stronghold” for bull trout. The subpopulation is composed primarily of resident bull trout, which in 1993 was estimated at over 1,000 resident and migratory fish (K. Williams, WDFW, *in litt.* 1996).

The Goat Creek subpopulation consists of low numbers of resident bull trout that are believed to be genetically distinct (WDFW 1997). They are isolated upstream by a culvert 6.8 miles from the confluence and, in dry years from July through October, by low flows across an alluvial fan at the confluence with the Methow River.

The upper Early Winters Creek subpopulation, also resident, is isolated above a waterfall 7.9 miles from the confluence with the Methow River. USFWS considers the Goat Creek and upper Early Winters Creek subpopulations at risk of stochastic extirpation due to their inability to be re-founded, their single life-history form and spawning area, and their low numbers.

2.2.3) <u>Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of listed fish in the target area, and provide estimated annual levels of take</u>.

- Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.

- Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish.

- Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).

- Broodstock collection between early September and early December could take steelhead adults and, less likely, bull trout adults, by handling and delaying migration. (Spring chinook do not migrate when the trap is operating.)
- Trapping for predation studies between March and June at the mouth of Nason Creek could take spring chinook, steelhead, and bull trout juveniles, either by exposing them to greater risk of predation while in the live box, or by handling.
- Weirs in small tributaries such as Chumstick, Brender, and Beaver creeks, could take juvenile or adult steelhead while monitoring juvenile coho emigration or adult returns.
- Tow-net sampling in Lake Wenatchee could take bull trout juveniles through injury or handling stress. A low potential exists for lethal take.
- Electro-fishing for carrying capacity and condition surveys could take bull trout, chinook and steelhead. Adverse effects could be caused by extra handling, or fish could be killed if improper shocking procedures are used.
- Trapping of returning coho adults at Priest Rapids and Tumwater dams for a radio telemetry study could encounter steelhead (and bull trout at Tumwater), causing minimal handling and migration delay.
- Snorkeling surveys could encounter all ages and species of listed fish. A very low potential exists for harassment.
- Juvenile trapping at the outlet to Lake Wenatchee and broodstock collection at Wells Dam would be done within the limits of existing permits, so those activities would not lead to additional take of listed species beyond what already occurs.
- Broodstock at Winthrop NFH are taken from coho that swim into the hatchery, so listed fish would not be affected.

Numbers of listed fish that might be taken during each activity are shown in the “take tables” in Appendix A. Details of the activities and potential take are described below. The risk of adverse ecological interactions between listed fish and coho smolts in the natural environment is discussed in section 3.5.

Wenatchee Basin

- Dryden Dam: The Dryden Dam trap is operated five days per week from July 1 to November 14 each year for steelhead broodstock collection under WDFW's Section 10 permit (#1094). The coho broodstock collection program has been operating within the parameters of that permit. In order to collect coho broodstock throughout the entire run, however, YN requested and was granted an extension of the trapping period from November 14 to December 7.

  Extending the trapping period an additional three weeks (November 14 – December 7) will result in additional handling of an unknown number of Upper Columbia River steelhead. WDFW's 2001 steelhead trapping at Dryden Dam terminated on November 9th and never extends beyond November 14th. Therefore, no data exist to project steelhead captures during the November 14 - December 7 period. During the six trapping days from November 1 – 9, 2001, 10 steelhead were observed, for an average of 1.66 steelhead per day of trapping. If this capture rate were indicative of the expected rate during the requested extension period (approximately 15 trapping days), an estimated 25 additional adult steelhead may be trapped, handled and released as a result of the trapping extension. If the steelhead passage timing observed during 2001 is indicative of a "normal year," then the lengthened trapping period would account for a relatively small proportion of the total steelhead migration. In fact, the low-flow conditions of 2001 delayed steelhead migration, so that in a normal year, even fewer would be encountered during coho trapping. In any event, we do not expect additional steelhead mortality, as no mortality has been observed during the existing trapping period.

  The trap is checked daily to identify captured steelhead as natural or hatchery origin. A Denil ladder is operated up to three hours per day to ensure upstream passage of fish released from the trap (NMFS 1998(b)).

  Bull trout are unlikely to be captured in the Dryden trap. Although USFWS estimated an annual lethal take of one adult bull trout and take by trapping of five adults for all broodstock collection activities (USDI FWS 2001), based on our experience, we expect no lethal take and only two captured and released, with minimal delay in their migration.

- Tumwater Dam: Coho broodstock collection at Tumwater Dam also has operated according to the parameters of the existing WDFW Section 10 permit (#1094) for steelhead broodstock collection. The trap currently operates three days a week, 8 hours a day (although we understand that it is permitted to operate 16 hours a day), and trapping ends in mid-November. YN requested and was granted an extension of the trapping period until December 7. The extension will allow broodstock collection, if necessary, over the entire run. In addition, it will allow more complete enumeration of "natural" adult coho returns to the upper Wenatchee and more opportunity to radio tag adult coho to help identify spawning locations. Recent modifications allow Tumwater, like Dryden Dam, to be operated passively.

  Extending the trapping period an additional three weeks (same time period as Dryden) may result in capture, handling and release of additional upper Columbia River steelhead from that which would have occurred under the existing trapping protocol. During the proposed trapping extension period (November 15 – December 7), 21, 0, 1, and 107 steelhead were observed passing Tumwater Dam in 1998 through 2001, respectively (K.

Peterson, NOAA Fisheries, personal communication, September 2002). We do not anticipate any additional mortality as a direct result of the extended trapping operation, as no mortality has been observed during the existing trapping period.

Bull trout are fall spawners, typically in September and October for most populations (Pratt 1992). Video counts at Tumwater show that bull trout rarely migrate past the dam during September and October. Operation of the trap during the period of bull trout spawning is therefore not likely to impact their seasonal movement, since most likely will be spawning in headwater tributaries during this period. Any bull trout caught in the trap would be removed and released immediately. USFWS estimated an annual lethal take of one adult bull trout and take by trapping of five adults for all broodstock collection activities (USDI FWS2001); however, in our experience, bull trout have not been trapped, and there has been no lethal take.

- Leavenworth NFH: Coho would be trapped at Dam 5 or at the fish ladder, using both the right and left bank ladder traps. There is a very low potential to trap bull trout and steelhead while collecting coho broodstock. Steelhead in Icicle Creek are thought to be remnants of an old USFWS program. An average of 15-20 steelhead adults return per spawning season, most during March and April. The odds of catching one in the coho traps in the fall are extremely low (D. Carie, personal communication, 12/10/99). Bull trout spawn in the fall, but earlier than coho. The potential for catching one in a trap during the coho broodstock collection period is greater than for steelhead, but still low. Traps will be checked daily and any listed species released immediately.
- Nason Creek Smolt Trap: The rotary trap operated at RM 2 on Nason Creek probably will capture some spring chinook, bull trout, and steelhead juveniles. Take tables in Appendix A show numbers of chinook juveniles and eggs/fry expected to be taken for both the hatchery smolt predation and naturalized coho (fry plants) studies. During the 2001 study of coho smolt predation on spring chinook (see section 3.5.3), YN trapped and handled 133 spring chinook smolts and 126 spring chinook fry. Spring chinook runs past a WDFW smolt trap on the Chiwawa River as well as the Monitor trap showed that the spring chinook smolt migration peaked prior to the coho release and start of the predation study. As a result, only a limited number of spring chinook actually encountered our trap. All juvenile spring chinook captured were released and passed downstream within an hour. We observed no spring chinook mortality caused by the trap.

  However, by beginning the trap operation in March rather than May for the naturalized coho predation study, we likely will encounter the peak spring chinook out-migration. For this reason, the take tables in Appendix A show higher numbers of spring chinook encountered than would be indicated by our past experience with this trap.

  During a one-month period, the trap captured 8 juvenile bull trout and 303 juvenile steelhead, with no observed mortality. We estimate an annual incidental lethal take of one juvenile bull trout and the capture, handling, and release of 25 juvenile bull trout annually; and the capture, handling, and release of 500 juvenile steelhead, with a potential for an annual incidental lethal take of 10 steelhead juveniles (Appendix A).
- Tributary weir traps: Weirs might be set up to monitor juvenile emigration or adult returns at smaller tributaries, such as Chumstick, Brender, and Beaver creeks, where

natural spawning is expected in the future. Such traps have not yet been used for the project, so we cannot report actual experience with take. Take tables in Appendix A predict potential steelhead take, including a maximum potential unintentional lethal take of 5 juveniles. Listed spring chinook and bull trout are not expected to be encountered in these tributaries.

- Tow-net sampling: The tow nets proposed for this study (see section 11.1.1) are designed to capture sockeye fry. With the type of nets and the speed at which they would be towed (under 7 mph), bull trout older than one year are unlikely to be captured due to their size and ability to maneuver away from the nets (USDI FWS 2001). In addition, bull trout rear in tributary streams and typically do not migrate to the lake until they are larger than the size fish the nets are designed for (K. Murdoch, pers. comm. 2002).

  While the net is designed to create a safe reservoir for entrained fish, and all listed fish are removed after a 10-minute deployment, USFWS estimated an incidental lethal take of 5 juvenile bull trout and a trapping take of 15 juvenile bull trout (USDI FWS 2001).

  During 2002 YN staff captured only sockeye fry and sockeye smolts. All smolts were released uninjured (no descaling or visible injury). We encountered no bull trout or spring chinook in 2001 or 2002. If spring chinook are present in the lake, they are not pelagic and will not be found in the center as sockeye are (where we are tow netting). Spring chinook would be found only near the lake edges. Therefore, we estimate no take of spring chinook or bull trout from tow netting.

- Electro-fishing: Electro-fishing has the potential to injure fish. Although most, if not all stunned adult and juvenile fish appear to recover sufficiently to swim away, long-term effects or effects that do not result in immediate mortality are not well understood (USDI FWS 2001). During research in the Columbia River basin, an electro-shocking injury level for incidentally shocked juvenile salmon has been estimated at 10 percent (M. Schuck, fishery biologist, Washington Department of Fisheries, pers. comm. *in* Scholz 1992). Barton and Dwyer (1997) found that, for juvenile bull trout, electro-shock resulted in increased plasma glucose and plasma cortisol levels indicative of acute stress (*in* USDI FWS 2001).

  We estimate that 150 spring chinook juveniles and 150 steelhead juveniles could be captured and released during electro-fishing, with the potential for an unintended lethal take of 15 of each species annually. In its Biological Opinion on the coho feasibility studies, the USFWS assumed that all take of bull trout would be lethal take, to avoid underestimating the level of take, and estimated an annual lethal take of 3 adult and 10 juvenile bull trout; however, to date, we have not encountered bull trout in our electro-fishing activities. To reduce the potential for fish mortality, USFWS required that YN and BPA use the NMFS electro-fishing guidelines (NMFS 1998(a)) *and* guidelines found in Fredenberg (1992).

- Snorkeling surveys: Snorkeling surveys for coho juveniles and adults would be done near release sites. It is possible that a snorkeler could frighten a fish from its hiding place, causing it to be caught and eaten by a predator. However, the low number of surveys per year on any particular stream (up to three on Nason Creek), the short amount of time a snorkeler would spend in any reach, and the snorkeler's training to observe only, make it unlikely that the surveys would cause injury to or significantly disrupt normal behavior of listed fish as described in the NMFS definition of "harass" (NMFS 1996).

Methow Basin

Broodstock collection and snorkeling surveys could encounter listed fish (bull trout and steelhead) in the Methow basin. The effect of snorkeling surveys would be similar to that described for the Wenatchee basin.

Peak adult steelhead migration occurs in September and October, and extends from August through November (L. Brown, WDFW, personal communication, 1999). Wild steelhead adults destined for the Methow basin overwinter in the Wells pool on the Columbia River and spawn in April and May. During the coho broodstock collection period, there is an overlap in adult steelhead and adult coho migration timing past the upper mainstem projects. The overlap is most prevalent in late October and extends into November.

- Wells Dam: Beginning in fall of 1999, coho adults returning to the Methow basin were trapped at Wells Dam on the Columbia River. The dam is equipped with traps to collect adult fish. WDFW currently operates the traps to collect steelhead adults, which return at similar times to coho. The current steelhead protocol is to operate the trap for 3 days a week, up to 16 hours a day. If runs are large enough, we do not trap at Wells but rather allow the coho adults to swim to the WNFH. If the runs are predicted to be less than 150 fish for the Methow, we would trap at Wells as often as WDFW's permit (#1094) allows. We will be trapping at Wells in fall 2002. There has been no steelhead mortality associated with this trap.

  Adult bull trout distribution in the mainstem Columbia River near Wells Dam is unknown. In recent years, no bull trout have been observed via video monitoring at Wells Dam between September 15 and November 7 (R. Klinge, Douglas County Public Utility District, personal communication), probably due to temperature constraints in the mainstem Columbia River during that period. We do not anticipate handling any bull trout at Wells Dam during coho broodstock collection.

  Any listed fish caught in the trap will be released immediately.

- Winthrop NFH: Coho would swim directly into the hatchery, so listed species would not be affected. Because this is the only release site for coho smolts in the Methow basin, the coho are expected to be well-imprinted on the hatchery, resulting in good collection rates.

Priest Rapids Dam

The project is proposing to radio tag up to 400 adults over the next 4 or 5 years at Priest Rapids Dam in order to study homing and straying of coho adults. WDFW currently operates a trap at the dam for stock assessment. The coho project would trap during part of WDFW's trapping period, but also has requested an extension of the trapping date to November 21st from the current ending date of October 14th so that a statistically significant number of adult coho can be trapped and radio tagged. The number of days per week would remain at two.

When WDFW is not trapping for their purposes, steelhead will be incidentally collected in the adult trap at the dam. Tribal or WDFW personnel will be present to sort and handle the fish while the trap is collecting coho adults. There is no off-ladder holding area at the trap. Therefore, when listed steelhead are incidentally trapped, they will be returned immediately back to the fish ladder upstream of the trap. We expect the impacts to steelhead to be minor, with minimal migration delay and no increased mortality. The 50 adult steelhead shown in the take table in Appendix A indicates the number that might be captured during the trapping extension only.

- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.

While YN does not anticipate exceeding any prescribed take levels during any M&E or broodstock collection activities, if they should happen to do so, they will cease the activity, immediately notify the proper regulatory agency, and proceed based on their decision. Options might include reducing trapping days or using other sites.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. *Hood Canal Summer Chum Conservation Initiative*) or other regionally accepted policies (e.g. the NPPC *Annual* [sic] *Production Review* Report and Recommendations - NPPC document 99-15). Explain any proposed deviations from the plan or policies.

There is no ESU-wide hatchery plan for these basins. The *Biological Assessment and Management Plan, Mid-Columbia River Hatchery Program* (NMFS et al. 1998) identifies actions in mid-Columbia basins to address needs of several listed species. Although coho were included in general policy statements, specific actions were not identified for that species. The coho program is consistent with policies addressing restoration projects in NPPC document 99-15, although its phased approach to coho reintroduction is more conservative than the guidelines outlined in the *Artificial Production Review* (NPPC 1999).

3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.
Since the 1990s, various entities in the Pacific Northwest have renewed the region's focus on reintroduction of coho to mid-Columbia tributaries.

The four Columbia River Treaty Tribes (Nez Perce, Umatilla, Warm Springs, and Yakama) identified coho reintroduction in the mid-Columbia as a priority in the *Wy-Kan-Ush-Mi-Wa-Kish-Wit* document, commonly referred to as the Tribal Restoration Plan (TRP) (CRITFC 1995).

It is a comprehensive plan put forward by the Tribes to restore the Columbia River fisheries. This project is the initial phase necessary to determine the feasibility of implementing that long-term vision in the mid-Columbia region.

In 1996, the Northwest Power Planning Council (NPPC) recommended the tribal mid-Columbia reintroduction project for funding by BPA, which has responsibilities under the Northwest Electric Power Planning and Conservation Act of 1980 to protect, mitigate, and enhance fish and wildlife that have been affected by the construction and operation of the Federal Columbia River Power System. It was identified as one of fifteen high-priority projects for the Columbia River basin, and was incorporated into the NPPC's Fish and Wildlife Program (program measures 7.1H, 7.4A, 7.4F, and 7.4O) (as documented in NPPC 1994). The project received a partial Step-Two review by the Council in August 2000 and will be subject to full Step-Two and Step-Three reviews once the feasibility phase is completed and the time is ripe to consider full implementation of the long-term vision.

The release of coho from lower Columbia hatcheries into mid-Columbia tributaries is also recognized in the Columbia River Fish Management Plan, a court-mandated plan under the jurisdiction of *U.S. v. Oregon*, involving Federal, state and tribal fish managers in the Columbia basin (CTWSR et al. 1988). While this project is not mandated under that court order, fish produced under that plan supply the project.

The *Biological Assessment and Management Plan, Mid-Columbia River Hatchery Program* (NMFS et al. 1998) also recognizes the potential for coho reintroduction in mid-Columbia basins, although coho-specific plans and analyses were outside the scope of that document.

Plans for the initial feasibility research phase of this project were outlined, revised, and analyzed in several documents, primarily *Mid-Columbia Coho Salmon Study Plan* 11/25/98 (YIN 1998); *Mid-Columbia Coho Reintroduction Feasibility Project Final Environmental Assessment* (USDOE BPA 1999(b)) and *Supplement Analyses* (USDOE/BPA 2001(b) and USDOE/BPA 2001(d)); *Biological Opinion: 1999 Coho Salmon Releases in the Wenatchee River Basin by the Yakama Indian Nation and the Bonneville Power Administration* (NMFS 1999(b)); and *Biological Opinion: Mid-Columbia Coho Reintroduction Feasibility Project, FWS Reference: 01-F-E0231* (USDI FWS 2001). In addition, a Biological Assessment was prepared by BPA on the proposal to dredge the area behind Dam 5 at Leavenworth Hatchery (USDOE/BPA 2001(c); its findings received concurrence from NMFS in a letter dated September 28, 2001 and from USFWS in a letter dated November 16, 2001.

The U.S. District Court ruled on March 22, 1974 that the Yakama Nation and Washington Department of Fish and Wildlife co-manage fish resources in Washington state. This decision is commonly referred to as the Boldt Decision.

A Memorandum of Understanding, dated 12/27/93, stipulates that the Wenatchee National Forest (WNF) and the YN will cooperatively manage fish resources on the Wenatchee National Forest.

This HGMP is consistent with all these plans, analyses, agreements, memoranda, and court orders.

3.3) Relationship to harvest objectives

3.3.1) Describe fisheries benefiting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available.

The long-term vision of the Tribes is to re-establish coho in sufficient numbers to provide significant harvest opportunities for Tribal and non-Tribal fishers in mid-Columbia tributary basins. For the period covered by this plan, however, the numbers of returning coho are not expected to be high enough to justify establishing a fishery in the mid-Columbia basins. Harvest levels of all existing Columbia River and ocean fisheries (Tribal and non-Tribal) could be adjusted once escapement goals for upriver coho are agreed to by all parties. Without a coho fishery in the target basins, listed species in those basins would not be at risk.

The marking protocol for program fish has changed from that outlined in the original HGMP (see Tables 19-21, section 11.1.1). The most significant change is a commitment to internally identify or mark with a coded wire tag 100% of the hatchery fish released in both the Methow and Wenatchee basins by 2002 (a year sooner than originally indicated in the HGMP); however, they will not be adipose-clipped, in order to limit their harvest in selective fisheries that target adipose-clipped hatchery coho. This change, combined with current monitoring practices in the relevant fisheries, means that the effect of harvest on survival of program coho will be accurately and effectively assessed.

3.3.1.1) Description of existing fisheries

During their life cycle, this project's research coho might be in waters that are subject to the following fisheries: ocean commercial troll fisheries, ocean recreational fisheries, Buoy 10 recreational fisheries, lower Columbia River commercial fisheries, lower Columbia River recreational fisheries, Zone 6 (Bonneville to McNary) Treaty Indian commercial fisheries, and above Bonneville Dam recreational fisheries.

Ocean fishing seasons and regulations are adopted annually by the Pacific Fisheries Management Council (PFMC). Ocean fisheries for coho are managed on a quota or total allowable catch basis pursuant to objectives in the PFMC's fishery management plan. Because of weak stock constraints, non-Indian commercial troll fisheries targeting coho (especially in areas where Columbia River coho are present) have been very limited since 1994. However, recreational coho fisheries have continued. In 1998, the PFMC adopted the first selective fisheries for coho in recreational fisheries off the mouth of the Columbia River. The states of Washington and Oregon also adopted selective fishery regulations for the popular Buoy 10 fishery in the Columbia River estuary. Washington and Oregon began mass marking (removing adipose fins from) hatchery coho in 1995. Selective fishery regulations required all retained coho to have a healed adipose fin clip. These fisheries generally begin in early August and run through late August to late September.

Mainstem Columbia River sport fisheries typically begin August 1, but generally target chinook and steelhead with minimal harvest of coho. Mainstem commercial fisheries in the lower Columbia River generally occur from mid-September through October. Treaty commercial fisheries in Zone 6 generally occur from late August through early October. Some coho (mostly late stock) are harvested in the latter part of this fishery.

Fisheries may also occur in tributary areas. The Yakama Nation regularly conducts fisheries in the Yakima and Klickitat rivers in the late fall (October to December) targeting fall chinook and coho. The state of Washington also reinitiated a late fall fishery in the Yakima River in 1998 which is expected to continue. The Yakama Nation and/or state of Washington may choose to adopt similar late fall fishing seasons in upper Columbia areas once coho populations are reestablished to levels which would support a fishery; however, adult returns are not expected in sufficient numbers in the next 5-6 years to support a coho fishery in the target basins.

3.3.1.2) Expected harvest rates

Upper Columbia River coho adult returns are a sub-component of the Columbia upriver early stock coho return. Average harvest rates in non-Indian ocean and Columbia River fisheries for marked and unmarked Columbia upriver coho can be estimated using data provided in 1999 by the joint staffs of the Oregon and Washington departments of fish and wildlife. Data include release locations, marking levels, and 1998 selective fishery surveys. Total harvest rates for upriver early coho average about 20% in ocean fisheries and 15% in mainstem Columbia River fisheries for a total harvest rate of about 35% on upriver early-stock coho. Harvest rates on marked (hatchery-released coho) are estimated to average about 30% in ocean fisheries and 20% in river fisheries for a total harvest rate on marked upriver early-stock coho of 50%. Harvest rates on unmarked coho are estimated to average about 12% in ocean fisheries and 11% in river fisheries, for a total harvest rate on unmarked upriver early-stock coho of 23%. Currently non-Indian fisheries are managed to assure that at least 50% of the total upriver coho return (combined early and late stocks) escapes above Bonneville Dam.

Harvest rates of 10% or more on upriver coho stocks in combined Treaty Indian Zone 6 and tributary area fisheries could also occur. Harvest rates for all ocean and Columbia River fisheries (Treaty Indian and non-Indian fisheries) would adjust annually to be consistent with escapement goals for upriver coho once these goals are established and agreed upon by all the parties.

In sum, the total harvest rate on non-adipose-fin-clipped coho is likely to be 20 – 25% due to the selective fisheries that are likely to remain in place for many years as a result of ESA constraints (Mid-Columbia Coho Reintroduction Feasibility Project, Responses to ISRP Comments on Partial Step-Two Review, August 2000).

3.4) Relationship to habitat protection and recovery strategies.

Mid-Columbia coho salmon populations were decimated in the early 1900s by impassable dams 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 and fire management also contributed to destruction of salmon habitat.

Mullan (1983) estimated historical mid-Columbia River adult coho populations as follows:

- Wenatchee—6,000 - 7,000
- Methow—23,000 - 31,000
- Entiat—9,000-13,000

- Okanogan—Presence documented but no numbers specified

Indigenous natural coho salmon no longer occupy the mid-Columbia river basins. Since Priest Rapids Dam was completed in 1960, the peak escapement of adult coho upstream of the dam was probably never greater than 10,000 coho and has not exceeded 1,300 since 1974 (WDFW/ODFW 1998). From 1988 to 1997, adult counts at Priest Rapids Dam averaged only 16 coho, probably a result of releases from Turtle Rock Hatchery, which annually released about 600,000 coho smolts, until the program was terminated in 1994 (WDFW/ODFW 1995).

For several reasons, self-sustaining coho populations were not 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:

- The construction and operation of mainstem Columbia River hydropower projects were detrimental to mid-Columbia River salmonid populations because of the number of dams and reservoirs through which they had to pass, leading to deaths from turbines, gas bubble trauma, and so forth.
- 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 PUD. The coho program was terminated due to poor adult returns, thought to be caused in part by 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. These species currently constitute the program at Turtle Rock. The last coho releases were in 1994.

Since that time, conditions and practices have changed 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, mining has ended, and grazing practices have been improved. A few specific examples of projects designed to improve conditions for fish in the target basins include:

Wenatchee Basin:

- improvements in fish passage at Tumwater and Dryden dams
- fish screens at Dryden Dam
- replacement of Chumstick Creek culverts

Methow Basin:

- improvements to the Methow Valley Irrigation District system
- restoration of salmonid habitat in Early Winters and Goat creeks

Similar improvements have been made on the mainstem Columbia.

Another significant change in regional conditions is that the ESA listings of several salmonid species that migrate through the lower Columbia River have curtailed coho fisheries that once over-harvested the mid-Columbia stocks of coho. These fisheries restrictions are likely to be in effect for a number of years.

Recent improvements in artificial production methodology may also improve efforts aimed at supporting natural production. Supplementation techniques, featuring refined genetic objectives, the production of “natural-like” hatchery smolts, and acclimation/release in wild habitat, are being developed.

Because of these changed conditions, feasibility studies into restoring coho to these basins are consistent with guidance in NPPC’s document 99-15 (NPPC 1999).

3.5) Ecological interactions

One of the primary goals of the coho feasibility studies is to assess interactions with other species and to minimize any adverse effects identified. The NEPA document prepared on the feasibility studies (USDOE/BPA 1999(b)) assessed potential interactions based on information available at the time. Subsequent residualism and predation studies showed little or no adverse effect of hatchery coho smolt releases. Additional predation and F2 interactions studies are ongoing or planned. Results of existing assessments are summarized in the following sections.

Because many negative impacts of ecological interactions among species are density-dependent, the estimated carrying capacities of selected Mid-Columbia rivers and streams (if the habitat were to be "fully seeded") are shown in Table 10 as an aid to assessing the near-term risks to other species. These carrying capacity estimates should be considered minimum for the basins, because they include only the main tributaries listed; the majority of fisheries experts agree that, in natural conditions, coho use small creeks in their early life history. Based on the following analysis, and on other discussions with the Mid-Columbia Technical Work Group, we expect that the numbers of hatchery coho released in the Wenatchee or Methow basins are unlikely to result in returning adults sufficient to produce natural origin juveniles in numbers that would exceed the carrying capacity of the tributaries/reaches near the release locations.

The method used to calculate the carrying capacities is presented below. Other methods used by Technical Work Group members have resulted in similar ranges of numbers.

3.5.1) Method for Estimating Carrying Capacities:

We compiled and summarized existing physical habitat inventory for the largest tributaries of the Wenatchee (Little Wenatchee, Nason Creek, White and Chiwawa rivers) and Methow (upper Methow, Chewuch and Twisp rivers) basins. We did not develop estimates for smaller tributaries, so these estimates likely underestimate the potential available habitat and therefore the coho smolt carrying capacity within these watersheds. The U.S. Forest Service collected the data using the Hankin and Reeves (1988) methodology. For each tributary of interest, we tabulated the total stream area by habitat type (pool, glide, riffle, side channel, etc.). We used summer stocking densities presented by Reeves et al. (1989) to estimate the total potential summer standing crop of coho parr within each tributary. In order to estimate adult coho escapement required to fully seed the habitat at these levels, we needed estimates of adult coho sex ratio (D. Dysart, personal communication), life-stage-specific survival rates, and coho fecundity (Yakama Nation, unpublished data). Life-stage-specific survival rates (L. Lestelle personal communication) were partitioned into the egg-to-emergent fry, emergent fry colonization, and summer and winter parr survival. These survival rates are considered to be near optimal and therefore likely overestimate survival within these watersheds.

Female escapement (FE) and adult coho escapement (AE) required to achieve coho smolt carrying capacities (CC) were estimated using the following formula:

$$FE = \frac{CC}{F \times EFS \times FCS \times SPS \times WPS}$$

$$AE = \frac{FE}{SR}$$

Where F = average fecundity (2750 eggs/female)
EFS = egg-to-emergent fry survival (60%),
FCS = emergent fry colonization survival (80%),
SPS = summer parr survival (75%),
WPS = winter parr survival to spring smolt (50%), and
SR = female sex ratio (percent females: 50%)

Assumptions

- Methodology presented by Reeves et al. (1989) accurately estimates potential natural coho summer parr stocking densities within these watersheds.
- Fecundity, sex ratios, and survival rates are realistic.
- Coho survival at life stages earlier than spring smolt will not limit spring smolt production.

Table 10. Estimated Coho Carrying Capacity of Selected Mid-Columbia Basins

Wenatchee	Summer Natural Stocking Capacity	Spring Smolt Natural Stocking Capacity	Female Escapement	Adult Escapement
Nason Creek	845,676	422,838	854	1,708
White River	681,656	340,828	689	1,377
Chiwawa River	887,348	443,674	896	1,793
Little Wenatchee	157,592	78,796	159	318
Total	2,572,272	1,286,136	2,598	5,196
Methow	**Summer Natural Stocking Capacity**	**Spring Smolt Natural Stocking Capacity**	**Female Escapement**	**Adult Escapement**
Methow River	2,638,180	1,319,090	2,665	5,330
Chewuch River	1,119,008	559,504	1,130	2,261
Twisp River	709,108	354,554	716	1,433
Total	4,466,296	2,233,148	4,511	9,024

Assumptions
1. Reeves et al. (1989) accurately estimates natural coho summer parr stocking densities
2. Fecundity = 2750 eggs/female
3. Egg to fry survival = 60%
4. Fry dispersal survival = 80%
5. Fry to summer parr survival = 75%
6. Over-winter survival = 50%
7. Adult sex ratio (female) = 50%
8. Estimates are minimum because they include only the mainstem tributaries listed

Sources
1. Physical habitat inventory for each tributary Hankin and Reeves (1988) collected by USFS
2. Sex ratio (Doug Dysart, personal communication)
3. Survival rates (Larry Lestelle, personal communication)
4. Fecundity estimates (Yakama Nation, unpublished information)
5. Coho summer stocking density estimates (Reeves et al. 1989)

3.5.2) Species that could negatively impact the success of the program:

Historically, bull trout and northern pikeminnow (*Ptychocheilus oregonensis*) were probably the most significant fish predators within the Methow, Wenatchee, and Entiat basins. Today bull trout abundance in most parts of these three basins is low and would not be expected to limit project success. However, Lake Wenatchee is a stronghold for the local bull trout population. Predation rates by bull trout on coho smolts released into the Little Wenatchee or White River could be significant.

Although little information exists about the abundance of northern pikeminnow for the mainstem Methow, Wenatchee or Entiat basins, the abundance of this species is assumed to be relatively low and probably accounts for a small portion of juvenile mortality in freshwater. Several non-endemic centrarchid and ictalurid species are present in the mainstem Columbia River, but the potential impact of these species on project success is unknown.

River otters, mergansers, and bald eagles, among other non-fish predators, are known to eat coho smolts acclimating in uncovered, natural-style ponds, but exact numbers are unknown. Project staff are examining non-toxic, non-lethal methods to control predation by such species.

Project activities are not expected to appreciably change the functional or numeric response or the long-term abundance of predators within the Methow, Wenatchee, or Entiat basins, or in the mainstem Columbia River. This is due to the relatively large number of all species of hatchery fish that currently rear and/or migrate within these areas.

3.5.3) Species that could be negatively impacted by this program:

Ecological interaction risks include predation by coho on other species of concern, competition between coho and other species, residualism, straying, and transfer of disease.

In this section, analysis of ecological interactions focuses on those that could occur within the Wenatchee and Methow river basins, as these basins are where releases are most likely during the time period of this plan. The nature of the impacts in the Entiat basin, should coho be released there, would for the most part be similar to those expected in the Methow and Wenatchee. The species within each basin that potentially could be adversely affected by the project would be the same for F_2 and hatchery fish and are listed in section 2.2.1.

In addition to listed species in mid-Columbia basins, coho smolts encounter other listed stocks and species while migrating in the Columbia River and its estuary. The potential for adverse interactions between coho and other listed species in the mainstem is discussed at the end of this section.

Predation

Predation effects can be direct or indirect and are related to the release of hatchery smolts into the natural environment. For this analysis, direct predation refers to coho consumption of another species. Indirect predation refers to either the increased or reduced levels of predation on other species as a result of the release of large numbers of coho smolts. These indirect effects are being studied in the Yakima basin with inconclusive results so far (YN YKFP 2000). There is no evidence to suggest that an indirect predation risk exists in mid-Columbia basins.

Although the impact of predation on an individual prey animal is unambiguous, the impact on a population of prey 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 relative impacts of predation on a prey population are determined by partitioning the sources of freshwater mortality and comparing the relative magnitude of each source. Size of hatchery fish appears to be relevant to whether or not the supplemented species will prey significantly on other fish species (Hillman and Mullan 1989).

Coho salmon have been shown to prey on several species of salmonids including sockeye salmon (*O. nerka)* fry (Ricker 1941; Foerster and Ricker 1953; Ruggerone and Rogers 1992); pink (*O. gorbuscha*) and chum (*O. keta*) salmon fry (Hunter 1959); spring chinook fry (Dunnigan and Hubble 1998); and fall chinook salmon (Thompson 1966; Dunnigan and Hubble 1998).

In the mid-Columbia basins, the species most at risk for direct predation is spring chinook; sockeye salmon could be at risk in certain parts of the Wenatchee basin, especially downstream of any acclimation site above Lake Wenatchee. Spring chinook spawn in higher reaches of the watershed and emerge from the gravel later than summer/fall chinook, due to the colder water; and young-of-the-year spring chinook are smaller than coho when coho begin migrating. Sockeye emerge at about the same time as coho and rear in habitat proposed for coho acclimation in the Wenatchee basin. Summer/fall chinook spawn lower in the watershed, and emerge sooner than coho. They are smaller than coho, and there has been concern that summer/fall chinook would be prey for coho. However, studies in the Yakima basin, as discussed below, have shown that coho predation on fall chinook is very low. Most resident trout and steelhead are not considered to be at risk because these species generally emerge from the gravel after coho have migrated downstream, or, as in the case of bull trout, spawn in upper reaches of tributaries. See section 2.2.1.

The potential for impact to each listed or sensitive species is discussed in more detail below. We include summaries of research that studied coho predation on non-listed species because their findings are relevant to the feasibility questions in these basins.

Coho Salmon Predation on Fall Chinook

Studies of coho predation on fall chinook were conducted in the Yakima basin at the Chandler Juvenile Monitoring Facility (CJMF) in 1997 and 1998. They indicate that coho predation on fall chinook was 0.1% of all fall chinook smolts produced above Prosser, or the equivalent of 3.7 fall chinook adults. However, researchers believe that the artificial conditions associated with

CJMF create abnormal opportunities for predation (the fish are at unnaturally high densities in unnatural habitat with no cover against predators, and fish are potentially held several hours in the livebox before being examined) (Dunnigan and Hubble 1998).

Coho predation studies were also conducted in 1997 and 1998 in the open Yakima River (Dunnigan and Hubble 1998). There the observed rate of coho predation on fall chinook was zero: none of the coho sampled in either year contained remains of fall chinook. Calculations were then made, using two different methods, to estimate what total coho predation on fall chinook in the Yakima River might have been. Because the 1997 sample size was small, calculations made from it were not precise and the estimates ranged to absurd numbers. However, despite the small sample size, it seems likely that sampling reflected actual consumption rates in the river during the 1997 coho outmigration (Dunnigan and Hubble 1998). Conditions were not conducive for sight-feeding predators such as coho to be highly successful. Flows were extremely high and the water was turbid. Coho salmon migrated rapidly during this period (averaging 160 kilometers [100 miles] in 3 days) so the potential time for predation was limited. Predation rates on fall chinook by other sight-feeding predators such as smallmouth bass and northern pikeminnow were also relatively low during this period in 1997. It also seems highly unlikely that impacts in the river during 1997 would have been high given that coho predation at CJMF in 1997 was low and CJMF is perhaps the worst-case scenario for fall chinook predation (see above) (Dunnigan and Hubble 1998).

Sample sizes in 1998 allowed for more precise estimates of the total number of fall chinook consumed in the open river. Statistical analysis shows that, given an observed predation rate of 0% and a sample size of 462 coho, there was a 5% chance of observing a predation rate equivalent to the consumption of no more than 349 smolts (or approximately 3.5 adult fall chinook) (Dunnigan and Hubble 1998).

Coho Salmon Predation on Spring Chinook

Yakima River Basin

In 1997, YN snorkeling surveys in the Methow basin generally found emergent spring chinook fry in association with shallow (less than 12 inches), low-velocity backwater and spring brook channels, or close to large woody debris along shallow stream margins (Dunnigan and Hubble 1998). Wild coho juveniles progress through a series of preferred habitat types beginning with back eddies, then moving to log jams, undercut banks, open bank areas, and finally to fast water habitat (Lister and Genoe 1970). Dunnigan and Hubble's observations generally agree with Lister and Genoe's (1970), in that coho prefer deeper and faster water conditions than do spring chinook fry. Minimal spatial overlap tends to indicate limited opportunity for direct predation or competition. However, more definitive studies were required.

In 1998 and 1999, the YN studied coho predation on spring chinook, analyzing the stomach contents of coho sampled at a rotary trap in the Easton reach of the upper Yakima River. In 1998, five coho among the 981 sampled had consumed fish. Two of the prey items were identified as *Oncorhynchus* spp, consumed by a single coho. In 1999, only two of the 1,757 coho smolts sampled had consumed fish, neither of which was *Oncorhynchus* spp. Based on fry consumption estimates using the He and Wurtsbaugh (1993) gut evacuation model, researchers estimate that the total number of adult spring chinook equivalents consumed by coho was no higher than 7 (or 0.38% of the potential number of adult chinook returning to the study reach), assuming a 0.14% egg-to-adult survival rate (Fast et al. 1986) (Dunnigan 1999).

Although data collected in the Yakima basin seem to indicate that direct predation by coho is not a significant risk to spring or fall chinook, because the studies were done in a different basin and results were limited, additional predation studies were done in the Wenatchee basin.

Wenatchee River Basin

In 2001, the YN studied coho predation on spring chinook, analyzing the stomach contents of coho sampled at a rotary trap located at river mile 0.8 on Nason Creek. As reported in Murdoch and LaRue (2002), a total of 4,309 coho smolts were trapped during the study. Of these, a random sample from throughout the run of 1,094 fish were retained for stomach content analysis. Two coho, collected on the same date, had consumed spring chinook fry. This indicates a 0.18% incidence of predation. Using the generic model of gut evacuation rates presented by He and Wurtsbaugh (1993), and the mean residence time of 15.8 days, researchers estimated that the total number of spring chinook fry consumed during the outmigration was 2,436. This number likely is an overestimate because the mean residence time was calculated from the time the barrier nets in the acclimation pond were removed to the time each fish was captured in the smolt trap. However, fish remained in the pond up to three weeks after the net was removed. The actual time each fish spent in Nason Creek after leaving the pond until capture in the trap is unknown, but in most cases it probably was less than the mean residence time used in the calculations.

One hundred spring chinook redds were counted in Nason Creek in 2000, the highest density of spring chinook redds observed within the previous six years. Similar high numbers were observed throughout the region and are thought to be due to exceptionally favorable ocean conditions the previous year. Assuming an average fecundity of 4,200 and egg-to-fry survival rate of 60.0% (Fast et.al. 1986), the estimated number of spring chinook fry consumed by coho during the 2001 smolt migration was less than 1% (0.97%) of the spring chinook fry population in Nason Creek. This study may represent a worst-case scenario for coho smolt predation on spring chinook fry in Nason Creek due to the known over-estimate of residence time and the unusually high density of spring chinook, which is not expected to recur every year (Murdoch and LaRue 2002).

Other factors will further limit the risk of coho predation on spring chinook. In the Wenatchee basin,

1) in the near term, most returning coho adults will be captured for broodstock; and

2) planned natural coho spawning either will be limited to less sensitive areas for spring chinook, like Icicle Creek, or will be carefully monitored to determine the risk of negative interactions with chinook (see section 11.1.1).

In the Methow,

1) a large proportion of adult spring chinook are being collected for an adult-based supplementation program; and

2) most coho adults would be collected for broodstock.

Consequently, the opportunities for predation by naturally spawning progeny of these released fish would be minimal.

Coho Salmon Predation on Summer Chinook

The Yakama Nation, in cooperation with WDFW, evaluated coho predation on summer chinook in the Wenatchee basin during the 2000 smolt out-migration. The study was similar to studies conducted in the Yakima basin on spring and fall chinook. Hatchery coho smolts released from acclimation sites on Icicle Creek and Nason Creek in the spring of 2000 were recaptured in a WDFW-operated 8-foot rotary smolt trap. The trap was located on the Wenatchee River at river mile (RM) 7.1, near the town of Monitor. The study results described below are taken from the annual report by Murdoch and Dunnigan (2001).

During spring 2000, 12,243 coho smolts and 69,239 summer chinook fry were captured in the Monitor smolt trap. Of the 12,243 coho caught, 837 were retained for stomach content analysis. Protocol for the study required that the trap's live box be emptied of fish hourly. Unfortunately, this protocol was violated during the latter part of the study (after May 27th) and the live box was emptied once every three hours. During the study, coho predation of fish generally was uncommon. Between the release date and May 27th, four coho in the sample (0.6%) had consumed summer chinook. This compares to 17 coho that had consumed fish (9.8%) after the protocol had been violated (Table 11). When all samples are grouped, the incidence of predation was 2.5%.

Table 11. Incidence of Predation on Summer Chinook

Time Period	Number of coho sampled	Number of samples containing fish	Incidence of predation
Release to May 27	663	4	0.0060
May 28 to June 18	174	17	0.0977
Release to June 18	837	21	0.0250

We believe that this study represents the worst case scenario for the 2000 out-migration. The study reach contained the highest density of summer chinook redds in the Wenatchee River basin. All hatchery coho released from the Icicle Creek and Butcher Creek acclimation sites passed through this stretch of river. Additionally, data collected from the trap indicated that approximately 10.2 million summer chinook fry migrated past the trap during 2000 (T. Miller, WDFW pers. comm.), so fry were abundant and available for predation during the study.

Researchers measured a random sample of summer chinook fry captured in the trap and compared their lengths to those of summer chinook consumed by coho. Summer chinook fry consumed by coho were significantly smaller than summer chinook fry trapped in the live box. Results also indicated that the chinook fry consumed by coho were significantly smaller than the population of coho migrating past the Monitor smolt trap, implying that only the smallest of the fry, rather than the entire population, are vulnerable to predation by hatchery coho smolts.

Coho Salmon Predation on Sockeye Salmon

The risks of coho predation on sockeye salmon could be similar to spring chinook. Sockeye spawn upstream of most of the proposed release areas in the Wenatchee basin, but a significant number rear in Lake Wenatchee and would be present at times when coho smolts, if released above the lake as proposed, would be migrating through Lake Wenatchee (see Figure 2). Although not listed under ESA, sockeye in this area are considered a vulnerable species because they are one of only two populations remaining in the Columbia River system (the other is in Lake Osoyoos [Okanogan River]) (Ken MacDonald, USFS, personal communication, 1999). Sockeye are considered to be introduced in the Entiat basin (USDA FS 1996), most likely wanderers from the Okanogan (NMFS et al. 1998).

Before significant numbers of coho are released upstream of Lake Wenatchee, YN is investigating the risks. The first task is to determine the spatial and temporal distribution of juvenile sockeye within Lake Wenatchee, in order to assess the potential for interaction with hatchery coho smolts during the coho out-migration. The distribution of sockeye fry within the lake is determined by beach seining, snorkeling in the littoral zone, and tow-netting within the limnetic or pelagic zone. The route hatchery coho take through Lake Wenatchee and the amount of time they take to do so are being analyzed using radio-telemetry. A study of coho smolt predation on sockeye follows these baseline studies.

Studies began in 2001, with limited results. They are expected to continue through 2003. See section 11.1.1.

Coho Salmon Predation on Bull Trout

Potential for coho predation on young-of-the-year bull trout would be limited due to the lack of geographic overlap between bull trout spawning and rearing areas in the Wenatchee and Methow basins and proposed coho acclimation and release sites (Table 3). All proposed acclimation sites in the Wenatchee and Methow are lacustrine-type habitats that generally are not used by juvenile bull trout. In any event, bull trout tend to stay on the spawning grounds until they are large enough not to be a prey-sized item for coho smolts. Significant spatial overlap between the two species may occur in the long term if coho return to spawn upstream of their acclimation sites in significant numbers. Conversely, coho might also benefit bull trout in the long run as coho juveniles probably would become prey for adult bull trout.

Specific coho release sites have not been identified in the Entiat basin and studies are not proposed under this plan. If coho reintroduction is eventually initiated in the Entiat basin, two of the three target rivers (Entiat and Mad) contain bull trout (see section 2.2.1). In particular, the Mad River is considered a stronghold for bull trout by the USFS (USDA FS 1996). In the Entiat, the presumed spawning area for bull trout is within a mile of Entiat Falls (WDFW 1998). Downstream of the falls, which is a barrier to fish, lower gradients, higher temperatures and the presence of rainbow trout and chinook salmon suggest that the habitat may be unsuitable for bull trout spawning and initial rearing. In the Mad River, known spawning occurs in the upper middle reach, most above Cougar Creek (WDFW 1998). At this time, the potential for coho predation on bull trout in the Entiat basin is unknown but expected to be minimal, due to limited micro-habitat overlap and late emergence timing of juvenile bull trout. In fact, because bull trout are better predators than coho, it is much more likely that coho (naturally produced and hatchery) will become prey for bull trout, benefiting the bull trout population, rather than the other way around.

In summary, direct predation by coho smolts on other species is expected to be low either because coho would be actively migrating downstream and therefore be moving quickly away from other species' rearing areas; because habitat overlap is minimal; because fish densities in the habitat are low; or because coho would be too small to prey on other species. While some risk to spring chinook needs to be imposed in order to study the potential for long-term risk to sensitive species, implementing the following mitigation measures as appropriate would minimize that risk:

- working with other fish managers to determine release sites and numbers that minimize risk but that also meet research objectives;
- releasing coho smolts in low densities;
- attempting to release fish that more closely resemble sizes of wild coho, which tend to be smaller than hatchery fish[1] (our target size of 20-25 fpp equates to 110 – 120 mm);
- ensuring smolts are ready to actively migrate before volitionally releasing them from acclimation ponds; and
- monitoring predation and adapting feasibility studies and activities as necessary to minimize risks.

Competition

By definition, competition is a situation where the use of a common and limited environmental resource by two individuals or species causes the growth or survival of one individual or species to be reduced due to the shortage of this resource (Whittaker 1975). Direct competition for food and space between hatchery coho and other species can result in displacement of other fish into less preferred areas, which can potentially affect their growth and survival. For competition to have an adverse effect, the same limited resource must be used by more than one species. However, in some instances, competition for space and food may clearly alter patterns of microhabitat utilization while having no effect on productivity or viability (Spaulding et. al 1989). Indeed, the small-scale shifts in use of habitat niches may represent a significant benefit at the community level because environmental resources are used more efficiently (Nilsson 1966).

Juvenile coho salmon are known to be highly aggressive compared to other juvenile salmonids; thus they may compete with hatchery or naturally produced spring and summer/fall chinook, steelhead or rainbow trout, and resident fishes under certain conditions. For example, in a study conducted by Stein et al. (1972) in an artificial stream, coho socially dominated **fall chinook**, and fall chinook grew faster alone than with coho present. However, Lister and Genoe (1970) suggested that coho and fall chinook do not interact in the natural environment because of size-related differences in microhabitat selection. Coho salmon displaced **summer chinook** from preferred microhabitats in the Wenatchee River drainage but did not measurably affect their growth or survival (Spaulding et al. 1989). YN snorkeling surveys, as discussed under "Predation" above, showed that spring chinook and coho use different microhabitats (Dunnigan and Hubble 1998). Groot and Margolis (1991) also suggest that there is little habitat overlap between chinook and other salmonids including coho and sockeye, and that this habitat segregation provides a possible mechanism for reducing ecological interactions between the species.

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[1] Throughout the geographic range of coho salmon, length at smoltification is relatively consistent. Groot and Margolis (1991) reported that mean smolt size in yearling smolts ranged from 75 (Andersen and Narver 1975) to 122 mm fork length (McHenry 1981), and smolt size in Minter Creek, Washington ranged from 95-106 mm (Salo and Bayliff 1958).

Coho salmon have been shown to displace **cutthroat trout** from pool habitat into riffle habitat (Glova 1984; 1986; 1987; Bisson et al. 1988), even though both species preferred pool habitat in the absence of the other species. Tripp and McCart (1983) observed increasing negative impacts on cutthroat trout growth and survival as coho stocking densities increased.

Coho salmon and **rainbow/steelhead trout** are reported to share habitat along the western coast of North America from California to British Columbia (Frasier 1969; Hartman 1965; Johnston 1967; Burns 1971), with both species residing in freshwater for extended periods (Groot and Margolis 1991). However, the reported impacts of the presence of coho salmon on rainbow/steelhead trout are conflicting. Frasier (1969) observed that the survival rate of steelhead living sympatrically with coho salmon declined slightly as coho salmon densities increased. Coho were shown not to affect steelhead growth or habitat use in the Wenatchee River (steelhead occupied different microhabitats than salmon) (Spaulding et al. 1989), and coho affected steelhead habitat use only to a small extent in another Washington stream (Allee 1974, 1981). However, Hartman (1965) concluded that strong habitat selection occurred in the spring and summer as a result of aggressive behaviors which were differentially directed by coho against steelhead in pools and by steelhead against coho in riffle habitats.

Coho salmon may have a competitive advantage over steelhead when they coexist. Juvenile coho salmon tend to emerge from the gravel earlier than steelhead, which allows them to establish territories and reach larger sizes than steelhead of the same age class (Berejikian 1995). Both laboratory and stream studies indicate that these species use different stream microhabitats. In the absence of coho salmon, steelhead use more of the water column and more pool habitat than when coho salmon are present (Hartman 1965, Allee 1974, Bugert and Bjorn 1991). In the presence of coho salmon, age-0 steelhead generally occupy the shallower, faster water of riffles and pool slopes, while coho salmon occupy the deeper water of pools (Bugert et al. 1991).

The segregation of these species appears to be both actively maintained and adaptive (Nilsson 1966). Their habitat segregation is consistent with inter-specific morphological variation: juvenile steelhead are more fusiform in shape than coho salmon and therefore better able to cope with higher water velocities (Bisson et al. 1988). These differences may reduce competition and facilitate partitioning of stream resources during low summer flows in streams when competition is most intense (Hard 1996). Because of their different morphology and habitat use, it is expected that stream characteristics will be primary determinants of interactions between these species: steelhead are expected to thrive better in the presence of coho salmon in streams with higher gradients and velocities, while steelhead are likely to diminish in streams with lower gradients and velocities (Hard 1996); Stelle 1996).

In 1998, the YN conducted field experiments to address the impacts of coho on the growth, abundance, and broad-scale geographical displacement of cutthroat and rainbow/steelhead trout. Researchers found no evidence that coho salmon influenced the abundance of cutthroat or rainbow trout when they compared the abundance of each species at sites where coho were stocked as well as where coho were not stocked. Coho abundance was largely related to stocking location. In addition, they found no evidence that coho affected the growth of cutthroat or rainbow trout when they compared the condition factor of each species in areas with and without coho (Dunnigan and Hubble 1998). These streams were generally characterized as relatively high gradient (2-5%), and ranged from second- to third-order streams.

Researchers were unable to locate any studies that investigated competitive interactions between **bull trout** and coho salmon. However, Underwood et al. (1992) investigated competitive interactions between hatchery steelhead and spring chinook juveniles and juvenile bull trout and concluded that competition between these species of hatchery fish and bull trout was not affecting abundance of bull trout or their use of microhabitats.

Little competitive interaction is expected between bull trout and coho smolts released in the mid-Columbia tributaries. Bull trout typically spawn in tributaries to the Wenatchee and Methow Rivers, or in the middle to upper reaches of the Entiat and Mad rivers. Spawn timing in these tributaries is most likely similar to general patterns observed for the species, is related to water temperature and generally occurs from September to October (Pratt 1992). Spawning and rearing of bull trout is thought to be primarily restricted to relatively pristine and cold streams, often within the headwater reaches (Rieman and McIntyre 1993). The geographic overlap of the juvenile bull trout rearing habitat and the coho migratory path would be minimal for coho releases because the majority of juvenile bull trout rearing habitat is believed to occur upstream of proposed (or likely, in the case of the Entiat River) coho acclimation sites. Sites proposed in the future for the Mad River would take into account known bull trout spawning locations. Any opportunity for interaction with bull trout juveniles would be further limited due to the migratory behavior of coho smolts.

No published studies were found that demonstrated complete competitive exclusion (species extirpation) by coho of any species.

Rapid out-migration of hatchery fish is believed to decrease the risk of ecological interaction to wild fish (Steward and Bjornn 1990). Recent studies in the Yakima basin found that, on average, actively migrating PIT-tagged coho smolts migrated approximately 30.1 km (18.8 miles) per day. The later the fish were released and the higher the volume of water flowing in the river, the faster the fish moved. Migration rates for coho released in the mid-Columbia tributaries are expected to be similar.

Competition that results directly from the release of hatchery coho smolts would likely be negligible due to the fact that coho would be actively migrating downstream and therefore have limited time to interact with individual fish species. Implementing the following mitigation measures (which are similar to those for minimizing predation) as appropriate would minimize the risk further:

- releasing coho smolts in low densities;
- avoiding or delaying releases in habitat for sensitive species (except when the point of the research is to test interactions with a specific species or when YN and the TWG mutually agree such releases would be appropriate);
- attempting to release fish that more closely resemble sizes of wild coho, and
- ensuring smolts are ready to actively migrate before volitionally releasing them from acclimation ponds.

Coho will be released at levels that meet project goals and that will produce naturalized coho at levels consistent with the carrying capacity of the natural habitat (Table 10). From the one million coho smolts proposed to be released into the Wenatchee River basin in the next few years, approximately 1,000 returning adults are expected. Until 2003, a maximum of 380 coho are expected to spawn naturally near release sites; that number is approximately 6% of the historic population (6,000 - 7,000) in the basin.

Current carrying capacity of tributaries in the mid-Columbia is likely lower than historically for all species of salmonids, and therefore, competition between two species might still be severe at densities below the historic carrying capacity of the habitat. However, while estimating current carrying capacity is imprecise at best, estimates provided in Table 10 suggest that the coho escapement proposed under this plan would not threaten other species in the near term. In fact, in 2001, only three coho redds were found in Nason Creek downstream from the release site.

If the project moves beyond feasibility studies and stocking or natural production significantly increases coho densities, the risk of adverse competition effects could increase. Project participants plan studies that will help assess the potential for inter-species competition, beginning with spawning ground surveys in fall 2001; habitat use by sub-yearling coho, spring chinook, and steelhead in summer 2002; and radio-telemetry studies in fall 2002/2003 (see section 11.1.1). It is expected that such studies would inform future decisions on release numbers and escapement goals for the long term. The challenge will be to make competition studies meaningful with the limited numbers of naturally produced coho expected in the near term.

Residualism

The spatial and annual incidence of residualism—the tendency of hatchery smolts to delay or avoid what otherwise would be normal outmigration in the spring—can be variable. When fish residualize, they become a part of the stream-reared fish community; they could potentially compete with resident fish for resources such as food and space and become potential predators (or prey).

To help determine the incidence of coho residualism, YN conducted snorkeling studies in 1999, 2000, and 2001 in Nason Creek; in 2000 in the Wenatchee River; and in 2000 and 2001 in the Methow River. Rates of residualism in Icicle Creek and the Wenatchee and Methow rivers were low. Few residual coho were observed during 1999 snorkel surveys in Nason Creek. During a complete survey (100% sample rate) between Swamp Creek (RM 4.5) and the mouth of Nason Creek, 8 (0.01%) coho were observed (Dunnigan 1999). No coho were observed in Nason Creek in 2000, but it is likely that the numbers of residual coho were too low to be detected with the 20% sample rate used. Similarly, no residual coho were observed in Nason Creek during the 2001 surveys, even though the sample rate was increased to 25%. If the relative abundance of residual coho in Icicle Creek (0.002%) were applied to the 75,000 smolts released into Nason Creek, it would result in approximately 1 to 2 residual coho (Murdoch and Dunnigan 2001).

Based on the 1999 observations and the 2000 estimates in Nason Creek, and previously reported rates of coho residualism in the Yakima River (Dunnigan 1999), we believe that the proportion of hatchery coho that do not migrate during the spring is low. Recent experience with mid-Columbia coho releases shows that when researchers remove the barriers at coho acclimation sites, the fish leave quickly. The incidence of coho residualism is expected to be minimized through acclimation and volitional releases. Based on these results, the Technical Work Group deemed further residualism studies unnecessary.

Straying

At the start of feasibility studies, straying of Lower Columbia fish back to their natal hatchery (thus increasing competition with local populations) was not expected to be an issue. Johnson et al. (1990) found that coho smolts acclimated for similar periods used in our study (up to six weeks) strayed back to their natal hatchery at a rate less than 0.001% when released from another river system. Beginning in 2002, 100% of coho smolts released will be marked, thus allowing lower Columbia River hatchery managers to monitor strays of adult project fish to hatcheries where they were reared.

In the mid-Columbia region, returning coho have been observed spawning in tributaries to the Wenatchee where they were not released (Peshastin and Chiwakum), as well as in the Entiat River and Chelan Falls. YN proposes a radio-telemetry evaluation to collect data on stray rates of project fish in the mid-Columbia (see section 11.1.1).

In sum, broad geographical displacement and reduced survival of other salmonid populations is not expected because:

1) coho released during the period covered by this plan are expected to migrate quickly and therefore limit the risk of competition with other species;
2) studies have shown little residualism among hatchery coho smolts;
3) numbers of naturally spawning and rearing coho are expected to be well below the carrying capacity of the target streams;
4) the incidence straying and the numbers of naturally spawning fish would be monitored as carefully as technology allows; and
5) release numbers or rearing practices would be modified if necessary to limit effects on sensitive species.

Transfer of Disease

In general, artificially propagated fish are more prone to suffer from infectious diseases and parasites than their wild counterparts because they live under unnaturally crowded conditions where transmission of infectious agents is more efficient. In addition, hatchery rearing conditions and artificial diets may result in stress or nutritional imbalances that affect the physical condition of hatchery fish and their resistance to disease organisms. Concerns have been raised in the past that such diseases could be transmitted from hatchery-reared coho to wild fish of other species, thus increasing the incidence of infection among wild stocks.

The presumed risk is from two sources: first from hatchery coho smolts released into these locations and later, from adult fish returning to spawn. Upriver salmonids have been documented holding in the lower reaches of lower Columbia River tributaries where they may become exposed to infectious agents in that sub-basin and later show overt disease when they arrive at their upriver "home." Using genetic "fingerprinting" methods, researchers have documented the movement of strains of infectious agents within the Columbia River basin that are believed to be due to the migration of adult salmonids (Jim Winton, USFS, personal communication, 1999).

Because anadromous fish are already in the subject watersheds and because coho salmon are more resistant than steelhead or chinook salmon to many of the viral and bacterial pathogens of concern, the added risk from this source seems limited. Virtually all of the infectious diseases affecting hatchery coho salmon in the Columbia River basin are thought to occur in wild fish or in the natural environment. Most Columbia basins have or have had the major diseases of concern. For example, BKD is prevalent in essentially all hatchery and wild stocks of salmonids in the Columbia River basin (Jim Winton, USGS, personal communication, 1999).

A literature review by Miller et al. (1990) found that, in spite of the comparatively high incidence of disease among hatchery stocks, there is little evidence that diseases or parasites are routinely transmitted from hatchery to wild fish. This review found a number of studies indicating that bacterial kidney disease was *not* transmitted from infected hatchery outplants.

Among the normal suite of viral, bacterial, fungal and protozoan diseases known to infect salmonids in the Columbia River basin, the most important for coho is coldwater disease. Coldwater disease is a significant risk to coho, particularly in the higher-elevation tributaries of the mid-Columbia basins. Depending on fish life stage and specific rearing conditions, when water temperature in the hatchery cools in the fall and winter, potentially lethal bacterial outbreaks can develop. The disease is treated using antibiotics, but it is not always effective. Because the causative bacterium is already free-living in the watershed, other salmonids in the basin might not be placed at significantly greater risk from this disease due to the presence of coho.

Hatchery-reared fish are prone, through proximity, to contract a variety of fungal, protozoan, and helminth parasites that are relatively easy to diagnose, and chemical treatment of the holding water normally is effective. Any potential risk of transmitting most internal and external parasites of salmonid fish from hatchery to wild situations would be confined to the brief period during outmigration and would therefore be limited.

All phases of broodstock development, fish transfers, and smolt releases would follow the fish health policy documented in *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries* (IHOT 1995(a)). Rigorous sanitation and use of disinfecting procedures combined with optimum husbandry, isolation and quarantine practices and a strong diagnostic and therapeutic program would minimize fish health concerns and reduce any potential for adverse effects from disease transmission by released coho to a low risk.

Migration Corridor/Ocean

Little is known about the effects of hatchery fish on listed fish in the migration corridor and ocean. Studies have shown that a significant portion of all hatchery fish released into the Columbia River basin do not survive the Snake and Columbia River migration corridors, for a variety of possible reasons (NMFS 1999(b)). In an attempt to address potential ecological effects of hatchery fish on listed fish in the migration corridor and ocean, NMFS has recommended an annual production ceiling for the Columbia and Snake rivers. NMFS determined, in its Biological Opinion on the project, that the proposed 1999 coho salmon release was consistent with its Columbia River basin production ceiling and that it would not jeopardize the continued existence of listed salmon and steelhead in migration corridors, the estuary, or the ocean (NMFS 1999(b)). The total release numbers have not changed since 1999, so the 1999 determination is assumed to be still valid.

SECTION 4. WATER SOURCE

To begin to develop a locally adapted coho population, the project is using existing hatcheries that have space available and no conflicts with existing programs. Where possible, these facilities are in mid-Columbia basins. So far, however, capacity in the region is not sufficient to accommodate project needs. Winthrop National Fish Hatchery on the Methow River is being used for part of the broodstock development, but ideally another hatchery in or near the Wenatchee basin is needed to meet broodstock development and egg quality goals. Beginning in 2002, Entiat NFH will be used for adult holding, spawning, and egg eye-up only. Full term rearing is not available at this time but could be an option if resource managers reduce or eliminate Entiat NFH spring chinook production for ESA reasons.

Primary rearing facilities:

Winthrop NFH – Water rights total 29,930 gpm from the Methow River, Spring Branch Spring and two wells. Water use ranges from 8,528 to 27,686 gpm, with the Methow River providing the majority of the flow. All rearing facilities are normally supplied with single-pass water; however, some serial re-use occurs in low-flow years (USDI FWS n.d.). The water supply at Winthrop NFH has frozen in the past. If that were to happen again, any coho at the hatchery would be released into the environment.

Lower Columbia River rearing facilities:

Willard NFH – see USFWS documents for water supply details.

Cascade (ODFW) – see ODFW documents for water supply details.

Adult holding facilities:

Entiat NFH – water rights total 15,340 gpm from three sources: the Entiat River, Packwood Springs, and wells. Approximately 7,786 gpm is available for hatchery use. The Entiat River and wells provide most of this water flow.

Leavenworth NFH – water rights total 25,551 gpm from wells, Icicle Creek, and Snow and Nada lakes. Average flow available to the hatchery is 18,170 gpm. There is insufficient water to operate all rearing facilities. Water from Snow and Nada lakes supplement Icicle Creek during low flow periods.

Chiwawa (WDFW) – see WDFW documents for water supply details.

Approved or proposed acclimation/release sites as of spring 2002:

Dam 5 – Icicle River [not expected to be available after 2003].

Little Wenatchee (Two Rivers) – Pumped ground and/or gravel pit water, discharged to the Little Wenatchee River (revised location since 2001, subject to environmental review).

Butcher Creek – Butcher Creek, tributary to Nason Creek.

Early Pond – Unnamed creek, tributary to Nason Creek.

Whitepine – Unnamed creeks, tributary to Nason Creek (subject to environmental review).

Beaver Creek – Beaver Creek, tributary to the Wenatchee River.

Eightmile Creek – Eightmile Creek, tributary to the Chewuck River.

Biddle Pond – Wolf Creek, tributary to the Methow River.

Other potential sites are being identified and, if proposed, will be subject to various environmental and TWG reviews before being used.

SECTION 5. FACILITIES

Section 1.5 describes the locations of physical facilities required for this feasibility study. No permanent hatchery will be built for these studies. Most facilities proposed for use already exist. The exceptions include some acclimation sites and a potential temporary production facility if existing facilities cannot be used. Impacts of construction and use of currently known acclimation and temporary production facilities are described in the following documents:

- *Mid-Columbia Coho Reintroduction Feasibility Project, Final Environmental Assessment and Finding of No Significant Impact* (USDOE/BPA 1999(b)) and *Supplement Analyses* (USDOE/BPA 2001(b) and USDOE/BPA 2001(d));
- Biological Assessment for Mid-Columbia Coho Reintroduction Feasibility Project, Chelan and Okanogan Counties, Washington (USDOE/BPA 1999(a));
- Biological Assessments prepared for USFWS in March 2001 (USDOE/BPA 2001(a)) and for NMFS and USFWS in August 2001 (USDOE/BPA 2001(c)).

5.1) Broodstock collection facilities (or methods).

Coho returning to the Wenatchee River Basin might be collected at one or more of the following facilities: Dryden Dam, Tumwater Dam, Dam 5 and the ladder at Leavenworth NFH, and Columbia River mainstem dams. For the Methow River, coho will be collected at Wells Dam and at the Winthrop National Fish Hatchery. If insufficient broodstock are trapped in the mid-Columbia sites listed, then Prosser Dam at RM 40 on the Yakima River may be used as an alternative to meet broodstock collection goals, rather than making up deficits with lower Columbia River fish. Prosser Dam is a coho broodstock collection site for the Yakima River coho restoration program. See section 7.2 for more detail.

5.2) Fish transportation equipment (description of pen, tank truck, or container used).

Adult coho are transported in a 930 gallon insulated stainless steel fish transportation tank. The tank is equipped with four microbubble ceramic plate oxygen diffusers and two aerators. In addition to the large transportation tank, a limited number of adult coho may be transported in a 200 gallon insulated fish tote equipped with one or two oxygen diffusers.

Coho smolts typically are hauled from lower Columbia River hatcheries to various acclimation sites in mid-Columbia basins by Oregon Department of Fish and Wildlife (ODFW). Fish are transported in 1,500-5,000 gallon (6,000-19,000 liter) transport tanker trucks. These units are insulated and typically maintain sub-50ºF (<10ºC) hauling temperatures and strive for no more than a 10ºF (6ºC) (<5ºF preferred) variation between tank temperature and release site temperature. Transport tanks are equipped with oxygen injection and water circulation systems. Dissolved oxygen levels are maintained at 9-15 ppm. Oxygen and temperature levels are monitored during transports. Hauling densities are targeted at or below 1 pound of fish per gallon of water. Length of transport ranges from 6-8 hours.

5.3) Broodstock holding and spawning facilities.

All coho collected at Dryden Dam, Tumwater Dam, and on Icicle Creek will be transported by Yakama Nation personnel to Entiat National Fish Hatchery. The adult holding ponds at ENFH will be used as a holding facility until all the fish are spawned. End dates will be determined each year in consultation with facility operators.

Fish collected at Wells Dam will be transported to Winthrop NFH for holding and spawning.

5.4) Incubation facilities.

Leavenworth NFH – Coho eggs are incubated in Marisource stack incubators with 6,000-6,500 eggs per tray. Total incubation capacity for coho at the LNFH is 720,000 eggs. The hatchery uses ground water and effluent is UV-sterilized prior to discharge.

Peshastin incubation facility – Two deep trough incubators were used for brood year 2001. Each trough contained 4 incubation cells. Chilled water was supplied to each incubator. Total incubation capacity at the Peshastin facility (a temporary facility at a former fruit warehouse) was approximately 864,000 eggs.

Entiat NFH – A total of three deep trough incubators supplied with chilled water will incubate coho eggs at the ENFH. Maximum incubation capacity at ENFH will be 1,728,000 green eggs.

Cascade Hatchery (ODFW) – Eyed eggs transported from green egg incubation sites will be hatched in existing facilities.

Willard NFH – Eyed eggs transported from green egg incubation sites will be incubated and hatched in existing facilities.

Winthrop NFH. – Normally eggs are incubated from adults spawned at the hatchery. If there is a shortfall in the target numbers for this hatchery using eggs from adult returns to the Methow, eyed eggs transported from lower river sites will be incubated and hatched here.

5.5) Rearing facilities.

Mid-Columbia brood eyed-eggs not reared in the region will be transported to lower Columbia River fish hatcheries for rearing. These hatcheries may include Cascade FH (ODFW) or Willard NFH. Please refer to HGMPs for these facilities for information on rearing conditions.

5.6) Acclimation/release facilities.

Figures 2 and 3 show locations of existing and known potential acclimation sites, listed below. Currently, coho pre-smolts are acclimated in semi-natural ponds or river side channels behind Dam 5 on Icicle Creek and at Butcher Creek, Beaver Creek, and Early Pond in the Wenatchee basin; and at Winthrop NFH in the Methow basin. Additional sites are proposed in the Wenatchee basin for 2002 and beyond. The program will lose use of the Dam 5 site after 2003.

In the Wenatchee basin, specific acclimation and release sites in Chumstick and Brender creeks, a replacement for acclimation at Dam 5, and additional sites in Nason Creek have not been approved, although some options have been identified. Additional sites in the Methow beyond those identified in the 1999 EA have not been proposed. No specific sites in the Entiat basin are currently proposed. Before new, additional, or replacement sites are developed, they would be subject to NEPA and/or ESA review of site-specific impacts.

Wenatchee basin

- Dam 5 – an impoundment formed in the Icicle River channel by a dam. Fish screens added to the dam confine coho during acclimation.
- LNFH – above-ground temporary metal framed ponds or unused Foster/Lucas cement ponds. Potential replacement for Dam 5.
- Little Wenatchee (Two Rivers) – a proposed site at an operating gravel pit that will require construction of an earthen pond and a pumped water supply.
- Butcher Creek – an existing beaver pond with an outlet barrier added.
- Early Pond – an existing pond formed during construction of Highway 2. An outlet screen is fitted to an existing culvert to confine fish.
- Beaver Creek – an existing pond adjacent to Beaver Creek with inlet and outlet screens added to confine fish and regulate water flow.
- Whitepine – two proposed sites near the Whitepine campground. One is an existing pond on private land that would require a net barrier. The other is an existing beaver pond on USFS land that would need minor road improvements and a net barrier.
- Brender – an existing pond that will require the addition of a downstream barrier.
- Coulter Creek – an existing pond in the Nason Creek watershed proposed for use in 2003, requiring installation of an outlet pipe through a beaver dam and barrier nets.
- Mahar Creek Pond – an existing pond in the Nason Creek watershed proposed for use in 2003, requiring installation and removal of barrier nets.

Methow basin

- Eightmile Creek– an existing series of ponds with fish screens in place.
- Biddle Pond – an existing pond with fish screens in place.

5.7) Describe operational difficulties or disasters that led to significant fish mortality.

Coho reared at Winthrop NFH experienced an unusual botulism problem in 2001, after their rearing location was changed due to the extremely low water that year. The rearing location has been moved to inside the hatchery. There was no reported loss from botulism in natural or hatchery populations of other species. This problem is not expected to recur.

5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.

Coho are not listed in these basins.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

6.1) Source

Because coho salmon have been extirpated in the Wenatchee and Methow basins, the research into the feasibility of reintroducing the species relies on development of a coho broodstock from lower Columbia River populations. No wild stock from the mid-Columbia exists to use, and wild stocks from other areas such as British Columbia currently are unavailable. The domesticated Lower Columbia River stock (which originated from the Toutle River stock, with recent infusions of Sandy River stock) is being used as initial broodstock. These fish would come as smolts from Willard or Cascade hatcheries. In 2000, 700,000 smolts came from Cascade and 400,000 from Eagle Creek, but Eagle Creek is no longer used as a source. The numbers from each hatchery are negotiated annually, but the fish are from essentially the same stock regardless of which of the three lower river hatcheries they come from.

Beginning in 1999, adult coho returning to the mid-Columbia from earlier releases in the Methow basin were collected at Wells Dam and Winthrop NFH for use as broodstock. Other collection points were added in later years (see section 1.5). Projected numbers of returning adults to be collected in 2002 are shown in Tables 14 and 15 (section 7.4). Broodstock collection goals are developed annually. As adult returns increase, the project will rely less on the Lower Columbia River stock.

To maximize the potential for genetic variability and naturalization of the returning population, the project would initially use most of the returning coho for broodstock, collected throughout the run. Hatchery fish that return to the mid-Columbia will have gone through a substantial selection process to survive the long migration and the variety of obstacles they encounter in the journey, which is expected to enhance the trend toward local adaptation.

Ideally, adults collected at Wells Dam would be used to develop a Methow basin broodstock, and adults collected at Dryden or Tumwater dams would be used to develop a Wenatchee basin broodstock. However, the number of adults returning is likely to constrain the program from meeting the ideal for much longer than the scope of this plan. For this period, in general, Wenatchee returns are incubated at Entiat NFH and then at lower river hatcheries and returned to the Wenatchee for acclimation. Methow returns are spawned and reared at Winthrop NFH, to the extent of their capacity. The localized stocks are supplemented with progeny of lower Columbia River hatchery stocks if necessary to meet production numbers. Release guidelines are specified in section 10.4.

6.2) Supporting information

6.2.1) History

The Lower Columbia River stock has been essentially a hatchery stock since the 1960s and is considered domesticated. The original source of the Lower River stock was the Toutle River stock. The LCR stock also has had recent infusions of Sandy River stock.

Ninety Years of Salmon Culture at Little White Salmon National Fish Hatchery (Nelson and Bodle, 1990, pp. 12-18), describes the early history of the Lower River stock. Tables 12 and 13 show more recent history.

> *Initial attempts to rear coho salmon with the native, late-running stock were made in 1919 and 1922. Attempts in 1930 and in the 1950s involved early-running stocks native*

to the Quinault, Quilcene, and Dungeness rivers of Puget Sound, Washington, as well as a native Toutle River stock. The Toutle River stock was considered responsible for establishing a successful run in 1956. In 1957 and 1958, eggs from Little White Salmon NFH were shipped to Willard NFH for incubation, after which the fry were returned for rearing. Additional eggs of the Toutle River stock were received from Eagle Creek NFH in 1962 and Bonneville State Fish Hatchery (SFH) in 1963.

Initially, these fish were released in their first summer; later, they were usually released as yearlings in February or March. Fish reared at Little White Salmon NFH were also shipped to Spring Creek, Eagle Creek, Carson, and Willard NFHs for finishing and distribution; others were released in the Columbia, Snake, Klickitat, and John Day rivers…

By 1965, a dependable run of Toutle River coho salmon stock was established… Increasingly larger numbers of eggs were moved to Willard NFH, until finally the Little White Salmon facility began serving its present function as an egg-taking station for Willard NFH. Eggs were also shipped to Entiat, Winthrop, Leavenworth, Carson, and Coleman NFHs; Washougal SFH; and [to other states and countries].

Table 12. Coho Genetic History at Eagle Creek Hatchery

Originally at hatchery beginning:	
BY '57	400,000 from Sandy River 200,000 from Little White Salmon NFH (Toutle)
BY '58	600,000 from Sandy River 467,000 from Big Creek
Since 1987 (released from ECNFH):	
BY '88	325,000 from Sandy River, released April '90
BY '90	292,000 from Sandy River, released April '92
BY '91	196,000 from Sandy River, released April '93
BY '93	579,000 from Toutle River, released May '95

Table 13. Willard NFH Coho Salmon Fish/Eggs Received From Other Hatcheries 1985-1999

Date	Number	Received From
01/28/94	187,556	Speelyai SFH, WA
12/04/94	589,433	Lower Kalama SFH, WA
12/24/96	883,000	Cascade SFH, OR
02/19/97	886,413	Bonneville SFH, OR
03/17/97	948,592	Klaskanine SFH, OR
06/12/97	268,002	Eagle Creek NFH, OR

6.2.2) Annual size

Broodstock collection of mid-Columbia adults began in 1999 at Wells Dam and Winthrop NFH. Table 1 (section 1.11) shows numbers of fish collected in each basin. In 2000, we estimate that 1,113 coho returned to the Wenatchee River Basin; of these, we trapped 919. We observed a pre-spawn mortality rate of 9.5% (87 fish). Based upon 2001 dam counts (Rock Island minus Rocky Reach), 8,555 adult coho returned to the mid-Columbia River and Wenatchee River Basin. This gives us a 0.86% survival rate. Based on numbers of coho collected further upstream at Dryden Dam and in Icicle Creek, Tumwater Dam video counts, redds in Icicle Creek, and coho carcasses collected in the Wenatchee River, 1,730 coho were known to return to the Wenatchee River basin and spawn, providing a minimum smolt-to-adult survival for the Wenatchee River of 0.16%. We collected 1,240 coho for broodstock in the Wenatchee River Basin in 2001.

Based upon Wells Dam counts, 536 coho returned to the Methow River in 2001. This gives us a 0.27% smolt-to-adult survival for the Methow River. Of the 536 coho counted at Wells Dam, 334 coho returned to the Winthrop National Fish Hatchery; 93 were females. Of the 334, 128 males were returned to the river to spawn naturally.

In future years, if too few adults return to maintain an effective population size, their numbers would be supplemented either by adding Lower River adults to the breeding pairs, by supplementing the next year's releases with Lower River smolts, or a combination of both.

6.2.3) Past and proposed level of natural fish in broodstock.

Currently, there is no natural population from which to collect broodstock. Once naturally reproducing coho salmon are re-established in mid-Columbia tributaries, natural fish will be incorporated into the broodstock, initially in their proportion to hatchery fish. As natural production increases, the percentage of naturally produced fish incorporated into the broodstock would be evaluated on an annual basis.

6.2.4) Genetic or ecological differences

There are no natural stocks of coho in the target area. Genetic studies will monitor divergence of natural spawners from hatchery broodstock if the project is successful at improving adult returns (see section 11.1.1).

6.2.5) Reasons for choosing

The primary reason for choosing Lower River broodstock to begin with is that it is the closest stock available geographically, and it is the only early stock in the Columbia River basin. For at least six years, the broodstock selection process would be entirely random, but as large a proportion as possible of the returning adults will be used in order to incorporate the characteristics that allowed the lower Columbia River fish to return to mid-Columbia basins. While the genetics monitoring program would study returning coho for traits associated with survival and adaptability, any proposal to select for certain traits in developing broodstock would be evaluated in future decision-making processes. See also section 6.1.

6.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.

Because coho are considered extirpated from mid-Columbia basins, introduction of a Lower River stock would not affect a listed population.

SECTION 7. BROODSTOCK COLLECTION

7.1) Life-history stage to be collected (adults, eggs, or juveniles).

Adults.

7.2) Collection or sampling design.

Include information on the location, time, and method of capture (e.g. weir trap, beach seine, etc.) Describe capture efficiency and measures to reduce sources of bias that could lead to a non-representative sample of the desired broodstock source.

Wenatchee River Basin

To maximize genetic diversity we will collect a representative sample of returning coho from throughout the run. Based on experience in 2000 and 2001, we expect the first coho to arrive at Dryden Dam as early as the first week of September and to continue through early December. Migration peaks in mid-October. Weekly broodstock collection goals will be developed on an annual basis based on the average distribution of returning coho (Table 16 [section 7.4]). If, during any week, the broodstock collection goal is not met, the deficit will be carried over to the following week.

If we are unable to meet our weekly broodstock collection goals through trapping efforts at Dryden Dam, adult coho will be trapped concurrently at Tumwater Dam and Leavenworth NFH Dam 5 or ladders on the Icicle River.

- Dryden Dam: Broodstock collection at Dryden Dam will take place daily in coordination with Eastbank Fish Hatchery Complex personnel. Currently, YN provides two people (fisheries biologist and/or fisheries technicians) each day during the trapping period to assist in trap operations. Number of personnel required for trap operation will be re-evaluated with facility operators on an annual basis. If the weekly coho broodstock collection goals are met prior to the end of the week, YN personnel will continue to assist in the operations and collections at Dryden Dam, to include enumerating and passing coho upstream. YN alone will operate the Dryden Dam fish trap after November 14th.

The Dryden Dam fish trapping facility is operated by WDFW and Chelan County Public Utility District (CPUD) personnel from July 5 through mid-November to collect steelhead and summer chinook broodstock. The trap normally is operated 24 hours a day, 5 days a week. BPA has proposed to extend the trapping period to December 7. This will help ensure broodstock are collected throughout the entire run.

To keep transportation stress to a minimum, no more than 65 adult coho will be collected and transported from Dryden Dam on any given day. Any coho in excess of 65 will be passed upstream.

- Tumwater Dam: Trapping efforts at Tumwater Dam will be coordinated with Eastbank Fish Hatchery personnel. Tumwater Dam trap normally is operated 3 days/week, 8 hours/day between July 19 and November 17th (Peterson 2001), although it is permitted to operate up to 16 hours a day. BPA has requested that operations be extended through December 7.
- Leavenworth NFH: If necessary, coho would be trapped at Dam 5 or the fishway, using both the right and left bank ladder traps. The trap could be operated between September 7 and December 7, by either YN or hatchery personnel.

Methow River Basin

Depending on run size, adult coho can either be trapped at Wells Dam and/or allowed to ascend the Methow River on their own. If insufficient numbers return to the Methow River basin, additional broodstock may be taken in the Wenatchee River basin to meet Methow basin project goals.

- Wells Dam: Beginning in fall of 1999, coho adults returning to the Methow basin were trapped at Wells Dam on the Columbia River. The dam is equipped with traps to collect adult fish. The traps are currently being operated by WDFW to collect steelhead adults, which would be returning at the same time as coho. Currently we allow coho adults to swim into Winthrop NFH rather than trap them at Wells. If the runs are predicted to be less than 150 coho for the Methow, we would trap at Wells as often as WDFW's permit (#1094) allows.
- Winthrop NFH: The Winthrop NFH fish ladder is opened on the first of October and allowed to attract and collect fish throughout the run. Coho swim directly into the hatchery. Because this is the only release site for coho smolts in the Methow basin, the coho are expected to be well-imprinted on the hatchery, resulting in good collection rates. Spawning generally begins during the last week of October and continues on a one-day-per-week basis for a period of approximately 5 weeks.

Sources of bias: The sources of bias are low at Tumwater and Wells dams and at Winthrop and Leavenworth hatcheries. The sources of bias at Dryden are unknown. Potential sources of bias may include fish size and ladder efficiency, particularly with regard to river discharge. Dryden is a low-head dam, so fish can jump over it during high flows.

7.3) Identity.

Describe method for identifying (a) target population if more than one population may be present; and (b) hatchery origin fish from naturally spawned fish.

The project will begin marking all hatchery fish with coded wire tags to distinguish them from any naturally produced fish that may return in future years. See section 11.1.1.

7.4) Proposed number to be collected:

7.4.1) Tables 14 and 15 show program goals for the Wenatchee and Methow basins for 2002. They are based on pre-spawn mortality, eye-up, and hatching rates observed during the 2000 and 2001 brood years. The program goals will be re-evaluated on an annual basis if eye-up, mortality rates, or sex ratios change.

Table 14. Wenatchee River Broodstock Collection Goals: 2002

Program Goal (smolts)	Egg-to-smolt survival rate	Green eggs required	Fecundity	Pre-spawn Mortality rate**	Adult Females Required	Total Broodstock Collection ***
1 million	.60	1.6 million	2750	.10	673	1464

* Based on projected egg-to-smolt survival rates observed in 2000 brood
** Observed pre-spawn mortality rate in 2000 and 2001
*** Assumes 54:46 male to female ratio as observed in 2001

Table 15. Methow River Broodstock Collection Goals: 2002

Program Goal (smolts)	Eyed-egg survival rate*	Eggs required	Fecundity	Pre-spawn Mortality rate**	Adult Females Required	Total Broodstock Collection ***
250,000	.70	357,143	2750	.10	144	497

* Based on projected egg to smolt survival rates observed in 2001
** Observed pre-spawn mortality rate in 2000 and 2001
*** Assumes a 71:29 male to female ratio as observed in 2001

Table 16 shows weekly broodstock collection goals for the Wenatchee basin in 2002. Weekly goals will be developed annually. In the Methow, the project captures all possible fish, but at some point might need to develop weekly goals.

Table 16. Weekly Coho Broodstock Collection Goals for Wenatchee Basin: 2002

Week ending	**9/8**	**9/15**	**9/22**	**9/29**	**10/6**	**10/13**	**10/20**	**10/27**	**11/3**	**11/10**	**11/17**	**11/24**	**12/1**	**12/8**	**Total**
Estimated % of run	0.1	1.6	7.2	10.9	12.3	20.2	10.5	9.9	12.8	6.5	3.7	2.0	1.8	.50	100
Broodstock collection goals	2	23	105	160	180	296	154	145	187	95	54	29	27	7	1464

7.4.2) Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:
See Table 1 (section 1.11) and section 6.2.2.

7.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.
Fish collected in excess of broodstock needs at Dryden Dam will be passed upstream.

7.6) Fish transportation and holding methods.
Methow Basin: If adult fish are trapped at Wells Dam, they are transported by a 400-gallon tank truck in groups of 20 or less to the Winthrop NFH adult holding/spawning facility. The trip takes about an hour and a half. Also see section 8.3.

Wenatchee Basin (see tank description in section 5.2): Coho are transported from Dryden to Entiat in a 0.6% salt solution (by weight), and are released directly into the holding pond. The trip takes about 1.25 hours. All broodstock will be treated with a 167 ppm formalin drip as a fungal control measure. Initial treatments begin upon release of fish into the holding pond and will continue for three consecutive days past the last transfer of fish. Thereafter, fish are treated every two to three days or as needed to control fungus.

7.7) Describe fish health maintenance and sanitation procedures applied.
See section 7.6. The fish transportation truck is disinfected weekly.

7.8) Disposition of carcasses.
At Winthrop NFH, spawned carcasses are returned to streams in the upper Methow basin for nutrient enhancement. At Entiat NFH, fish might be injected with an anti-bacterium to keep them disease-free. In those cases, carcasses are buried on the hatchery grounds. Uninjected carcasses are returned to streams.

7.9) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.
Any listed fish caught in the traps would be removed and released immediately.

SECTION 8. MATING

8.1) Selection method.

Spawners will be chosen randomly from ripe fish once a week. Returns from mid-Columbia brood may be selected to mate with returns from Lower Columbia River (LCR) transplants or other mid-Columbia brood to eliminate crossing LCR returns with LCR returns.

8.2) Males.

Eggs will be fertilized with one primary male and one back-up male. Jacks (2-year-old males) will be randomly collected during broodstock collection in the relative proportion that they occur in the run and incorporated into the mating schemes.

8.3) Fertilization.

During fertilization procedures, we will follow a 1:1 mating protocol with a back-up male. In the event that five or fewer females are available for spawning on any single spawn date, the eggs from each female will be divided into 5 clutches, a different male fertilizing each clutch.

- **Leavenworth NFH, Entiat NFH and Peshastin incubation facility:** Green eggs will be transported to the incubation facility where fertilization will occur. After fertilization, Iodophor egg treatments will include a minimum of one 30-minute contact period prior to putting the eggs in the incubation trays.
- **Winthrop NFH:** A minimum of six persons is required to carry out spawning operations at the adult holding/spawning facilities. For actual spawning, two fish killers select and kill males and females from pre-sorted fish. One spawner strips eggs from the females into numbered plastic zip-lock bags, one bucker spawns the males into numbered plastic bags, one egg transporter carries coolers containing gametes to the hatchery building, and one person fertilizes and places the eggs in an Iodophor solution (75ppm) in the isolation incubation buckets. Further details on spawning methods can be found in the Winthrop NFH Fish Culture Manual.

  Personnel from the USFWS Olympia Fish Health Center are present at most or all spawning days to collect viral and bacterial samples from the adults. They coordinate with the spawner and the bucker to get the proper amount of ovarian, blood, kidney, and spleen samples. After spawning, they immediately transport their samples back to the lab.

8.4) Cryopreserved gametes.

The program is cryopreserving gametes for a long-term genetics study. In 5-15 years, the project would use the gametes to determine if changes in genetic characteristics, run timing, or other behaviors result in measurable survival benefits.

8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

The mating scheme will not affect listed natural fish, as coho are not listed in these basins.

SECTION 9. INCUBATION AND REARING

At the outset of the feasibility studies, final incubation and rearing of coho to smolts was done only in lower Columbia River hatcheries. The smolts were then trucked to mid-Columbia acclimation sites.

Beginning in 1999, Winthrop NFH began incubation and rearing of eggs and juveniles from adults returning to the mid-Columbia. They have the capacity to rear up to 250,000 smolts per brood year, with two brood years on station at a time. As stated in section 1.5, additional capacity in the region is needed to maximize the potential to meet program goals for broodstock development and smolt quality. In the Wenatchee basin, initial incubation takes place at the LNFH. LNFH does not have space to incubate the program's entire annual egg requirements; at this time, capacity for coho is limited to approximately 720,000 coho eggs. In 2001, coho eggs in excess of 720,000 were incubated at a temporary facility housed in a fruit warehouse in Peshastin. Beginning in 2002, coho eggs will be incubated at the Entiat NFH and/or at the Peshastin facility, transferred to lower Columbia hatcheries at the eyed egg stage for rearing to pre-smolts, and then returned to mid-Columbia basins for acclimation and release.

Physical characteristics of the rearing environment and fish growth and health in those environments depend on the hatchery. All hatcheries currently involved in this project use appropriate IHOT protocols and standards, including those for health and disease monitoring.

9.1) Incubation:

9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding.

Provide data for the most recent twelve years (1988-99), or for years dependable data are available.

Table 1 in section 1.11 shows eggs taken and survivals since 1999. Tables 14 and 15 in section 7.4 show egg take goals and survival rates expected for 2002. Goals will be adjusted annually (see section 7.4).

9.1.2) Cause for, and disposition of surplus egg takes.

To date, no surplus eggs have been taken.

9.1.3) Loading densities applied during incubation.

Provide egg size data, standard incubator flows, standard loading per Heath tray (or other incubation density parameters).

See 9.1.4 below.

9.1.4) Incubation conditions.

Describe monitoring methods, temperature regimes, minimum dissolved oxygen criteria (influent/effluent), and silt management procedures (if applicable), and any other parameters monitored.

Incubation procedures at all sites will follow IHOT recommendations for flow rates, loading densities, *Saprolegnia* control treatments, and water quality conditions. Incubation will occur at ground water temperatures; however, egg development will be retarded through the use of chillers in some cases. The purpose of this altered temperature regime will be to more closely match natural emergence times and to concentrate the range of time over which fry begin feeding in the hatchery.

Leavenworth NFH: The coho eggs are reared in an isolation unit (10'x 8'x 6') located inside the nursery building. This unit contains 8 Marisource heath incubator stacks with 16 trays per stack. To prevent silt build up, the top tray of each stack is not used, leaving 15 trays per stack for egg rearing. Each tray measures 15.5" x 12.5" x 2". Well water is provided to the incubator trays at a rate of 4 gallons per minute (gpm), with a temperature range of 45-48° F. Loadings are set at 2.5 females per tray, which is approximately 6,000-7,000 eggs. The maximum loading for the isolation unit is 750,000 eggs. Egg development is monitored using Daily Temperature Units (DTUs). The eggs remain in the Heath trays until they reach the eyed stage at approximately 500 DTUs. The eggs are then removed from the trays and shocked by pouring a basket of eggs from a height of 2 to 3 feet into another basket submerged in water. Twenty-four hours after shocking, the eggs are picked with a Jensorter model H egg-picking machine. The following day the eggs are transported to another facility by Yakama Nation fishery staff.

Throughout the incubation period, the eggs are chemically treated to prevent fungus problems. Using a Masterflex peristaltic pump, a daily 15-minute dose of 1667 ppm formalin is pumped through ½ inch PVC pipe to the Heath incubators. Each Heath incubator stack has one micro-irrigation emitter, which is used to disperse the formalin treatment. Additionally, the isolation unit is equipped with an alarm system and a flow-through Ultra-Violet (UV) effluent treatment. The alarm detects any deleterious fluctuations in flow and/or temperature, and the UV system treats all effluent water from the isolation unit.

The LNFH staff maintain the incubators, temperature regime, and flow volumes and keep records on temperature units and egg numbers (eye-up).

Peshastin (2001): Groundwater is used for incubation. It has a CaCO3 hardness of 73, a pH of 7.7, and an average temperature of 52º F. Water temperature is monitored with an onset temperature recorder, which measures temperatures hourly. Temperatures are maintained at approximately 41ºF with a water chiller. The water is passed over a tote filled with bio-rings to ensure that adequate levels of dissolved oxygen and total dissolved gas are maintained prior to entering the incubators. Water is treated with activated charcoal and oyster shell prior to use in the incubators. Four gpm of flow is used per deep trough and the maximum green egg capacity per trough is 500,000.

Entiat NFH (2002 and beyond): Incubation facilities and conditions will be similar to those used in Peshastin in 2001.

Winthrop NFH: The eggs remain in the isolation incubation buckets until eye-up, which occurs approximately one month after spawning, or at 450-540 DTUs. After eggs are eyed, they are shocked and then picked by hand. Buckets containing a high mortality are picked with a mechanical egg picker.

After picking, and after receiving the Enzyme Linked Immunosorbent Assay (ELISA) results for each numbered bucket, the eggs are weighed and sampled on an electronic scale. A 200-500 egg sample is taken, to estimate the number per pound. Since coho salmon are quite resistant to bacterial kidney disease (BKD), eggs with differing ELISA values (lows, highs, and moderates) are tracked throughout incubation and rearing, but they are not isolated. After enumeration, the eyed eggs are placed in the Marisource stack-type incubator, using the 15.5" x 12.5" x 2" trays, 7 trays per stack.

Each tray is loaded with 4,000 eggs. Water flow is maintained at 3-5 gpm. Ground water is the primary incubation source and temperature remains quite constant in the range of 48 - 50º F. Dissolved oxygen levels are also constant at about 9.5 ppm inflow and not less than 8 ppm outflow.

Since fungus (i.e. Saprolegnia sp.) has not been a problem in the incubation of salmon and steelhead eggs at Winthrop NFH, formalin treatments are not required during incubation. Hatching begins after approximately 975 DTUs. Yolk sac mortality can be avoided by keeping incubation flows below 5 gpm. Significant yolk sac mortality has been observed in incubation units where flows exceed 6 gpm.

9.1.5) Ponding.

Ponding will occur after a majority have buttoned up (approximately 1375 temperature units). At ponding the coho will be approximately 1,100 fish per pound and

4 centimeters in length. Ponding will occur in February (Joe Blodgett, YN, personal communication).

9.1.6) Fish health maintenance and monitoring.
Regular iodophore treatments are the current method used to control fungus. Label regulations and recommendations are followed at all incubation locations. Eggs are shocked and picked after eyeing.

9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation.
Because coho are not listed, the primary concern would be disease transfer between coho and listed fish in any of the incubation facilities. There are no listed fish raised at Entiat NFH or Leavenworth NFH. At Winthrop, where spring chinook are raised, coho are kept in separate raceways and water used in coho rearing containers is not used for spring chinook.

9.2) Rearing:

The following information applies to the Winthrop NFH. It is representative of the rearing conditions at Willard, Cascade and additional production facilities that may be used in the future.

9.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years (1988-99), or for years dependable data are available.
Experience is limited at this point. Survival rates based on this limited experience are shown in Tables 14 and 15 (section 7.4).

9.2.2) Density and loading criteria (goals and actual levels).
Table 17 shows rearing facilities at Winthrop NFH.

Table 17. Rearing Facilities at Winthrop National Fish Hatchery

Unit Type	Unit Length (ft)	Unit Width (ft)	Unit Depth (ft)	Unit Volume (cu ft)	Number Units	Total Volume (cu ft)	Construction Material
Brood Ponds	80	40	6	19,200	2	38,400	Concrete
Marisource Incubators					42		Fiberglass
Raceways	80	8		1,300	30	39,000	Concrete
Foster Lucas Raceways	76	17		2,200	16	35,200	Concrete
Raceways	102	12		2,200	16	35,200	Concrete
Starter Tanks	16	3		120	34	4,080	Fiberglass
Troughs	16	1.33	1	21	8	168	Concrete

Swim-up fry are expected to be ready to come out of the stacks with full yolk absorption after 1800 DTU. The nursery is presently equipped with 34 fiberglass tanks. Every tank is thoroughly cleaned and then disinfected with approximately 2 ppm Hyamine between year-classes. The tanks have a total capacity of 100 cubic feet; rearing space per tank is approximately 89 cubic feet. The tanks accommodate a flow of approximately 30 gpm.

Ideally, 15,000 to 20,000 fry should be started per tank. However, at full production, initial loading of tanks may be closer to 30,000 fish per tank. Initial DI (Density Index) in past years has ranged from 0.05 - 0.41, and the FI (Flow Index) has ranged from 0.28 - 1.22. The target densities are similar to those used in steelhead rearing at this facility. The hatchery tries to keep the DI below .30 during early rearing (fry stage) and below .20 during later rearing (fingerling stage to smolt).

Since fry and fingerlings receive better cleaning and feeding, and treatable diseases are more easily observed in the hatchery building, fingerling spring chinook normally remain in the nursery until they are 200 - 300/lb. Coho salmon fry will also remain in the nursery until that size is reached unless space is not available.

9.2.3) Fish rearing conditions

Pond management strategies (e.g., Density Index and Flow Index) are used to help optimize the quality of the aquatic environment and minimize fish stress which can induce infectious and noninfectious diseases. For example, the Density Index is used to estimate the maximum number of fish (of a given length) that can occupy a rearing unit based on the rearing unit's size. The Flow Index is used to estimate the rearing unit's carrying capacity based on water flows.

The following parameters are currently monitored at Winthrop NFH:

- *Total Suspended Solids (TSS)* — 1 to 2 times per month on composite effluent, maximum effluent and influent samples. Once per month on pollution abatement pond influent and effluent samples.
- *Settleable Solids (SS)* — 1 to 2 times per month on effluent and influent samples. Once per week on pollution abatement influent and effluent samples.
- *In-hatchery Water Temperatures* — maximum and minimum daily.
- *In-hatchery Dissolved Oxygen* — as required by stream flow and weather conditions.

9.2.4) Indicate biweekly or monthly fish growth information (average program performance), including length, weight, and condition factor data collected during rearing, if available.

Table 18. Coho Growth Data (Average 1997-2001), Willard NFH

Month	Length Increase (inches)	Food Conversion	Water Temperature (F)
January	0.074	1.60	40.0
February	0.115	2.89	40.4
March	0.306	1.47	40.9
April	0.323	1.19	41.2
May	0.425	1.00	43.3
June	0.487	0.92	43.4
July	0.508	0.97	44.2
August	0.562	0.95	44.2
September	0.458	0.97	43.6
October	0.228	1.79	43.0

November	0.148	3.55	42.1
December	0.059	4.23	40.7

9.2.5) Indicate monthly fish growth rate and energy reserve data (*average program performance*), if available.

Winthrop NFH: At first feeding we generally start out at around 1.5% - 2% body weight per day until most of the fish are actively feeding. Feeding is spread out over 8 feedings each day. Once growth begins accelerating, feeding percentage is gradually decreased. Ground water in the nursery is quite constant at 47-51º F. At these temperatures we expect 50 Monthly TU/inch or about 0.33 inches per month. Once fish leave the nursery and begin rearing in raceways on river water, growth patterns change depending on temperature fluctuations. The following table illustrates average rates of coho growth in the first spring, and in the first and only fall on-station. The table includes averages from brood years 1999 and 2000.

		Average Growth (inches)	Average TUs/inch
Spring	April May June	0.489 0.504 0.341	31.0 31.2 64.9
Fall	October November December	0.364 0.083 0.057	49.3 223.7 339.4

9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (*average program performance*).

Winthrop NFH: Feeds from Moore-Clark are used throughout rearing. Guidelines for matching size of feed with size of fish come from a combination of the manufacturer's recommendations and trial and error, and are as follows:

swim-up - 570/lb	#0 Nutra Starter
570/lb - 300/lb	#1 Nutra Starter
300/lb - 150/lb	#2 Nutra Starter
150/lb - 100/lb	1.2 mm Nutra Fry
150/lb - 90/lb	1.5 mm Clark Fry
100/lb - 50/lb	2.0 mm Clark Fry
50/lb - 20/lb	2.5 mm Clark Fry

9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.

Fish health is monitored by the Winthrop NFH staff. Monthly fish health checks are conducted by Olympia Fish Health Center personnel. All rearing units are cleaned on a regular basis to help prevent environmental fish health problems.

Health monitoring activities that normally take place at Winthrop NFH include the following:

- On at least a monthly basis, both healthy and clinically diseased fish from each fish lot are given a health exam. The sample includes a minimum of 60 fish per lot.
- At spawning, a minimum of 60 ovarian fluids and 60 kidney/spleens are examined for viral pathogens from each species.
- Prior to transfer or release, fish are given a health exam. This exam may be in conjunction with the routine monthly visit. This sample consists of a minimum of 60 fish per lot.
- Whenever abnormal behavior or mortality is observed, the fish health specialist will examine the affected fish, make a diagnosis and recommend the appropriate remedial or preventative measures.
- Reporting and control of specific fish pathogens are conducted in accordance with the Co-Managers Fish Disease Control Policy and the USFWS Fish Health Policy and Implementation Guidelines.

9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable.
When sampling fish at LNFH and Butcher Creek, we estimate the degree of smoltification by classifying pre-smolts as either parr, transitional, or smolt based on physical appearance. ATPase activity is not measured.

9.2.9) Indicate the use of "natural" rearing methods as applied in the program.
At Winthrop NFH, final rearing occurs in outside raceways and ponds. Coho are moved out to C-bank 12' x 100' raceways at 150-400 fish per pound in April or May. The fish occupy two ponds until marking or a DI of .20 is reached, at which time the groups are split to occupy 5 ponds until release—approximately one year after they are moved outside. Release is volitional and generally starts the third week of April and ends the first week of May. The target release size is currently 20 to 22 fish per pound.

Water source during final rearing is primarily river water. Ground water is usually available if needed to clear up disease problems or regulate growth rates. River water temperatures fluctuate according to air temperatures, but normally stay in favorable ranges throughout summer and winter months.

On years when egg take goals are not met, fish are often transported from lower Columbia River coho hatcheries to make up the number for a final release of 250,000 smolts. Successful transfers have taken place in late winter and early spring to allow an adequate acclimation period.

Release strategies may be modified by YN, but in recent years have been volitional type releases directly out of the rearing units. The large drains of C-bank lead under the hatchery grounds to a bypass channel which leads to the river.

Natural rearing conditions are emphasized during the acclimation/release phase (see section 10). Camouflage netting is used to provide semi-natural cover during most of the outdoor rearing cycle. Covers are not used during mid-winter months due to snow load problems. Also, temperature and feeding are manipulated to help match hatchery smolt sizes and growth regimes to those of natural smolts. Other hatchery rearing technologies that produce a more natural-like smolt will be tested in the future. Options being considered include rearing in locations closer to acclimation sites, rearing in natural–style ponds, rearing at low densities, extending the acclimation period to include the second winter prior to smolting, and more culture adjustments to include very rapid growth just prior to release.

9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation.
No listed fish are propagated in this program.

SECTION 10. RELEASE

Describe fish release levels, and release practices applied through the hatchery program.

10.1) Proposed fish release levels.

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Yearling	751,500	19.2 (yr 2000)*	Volitional release, Apr 15 – May 30	Icicle Creek
Yearling	248,500	19.5 (yr 2000, at time of transport to site)*	Volitional release, Apr 15 – May 30	Nason Creek
Yearling	250,000	17.0 (yr 2000)*	Volitional release, Apr 25 – May 15	Methow River

* Source: K. Murdoch 2001

10.2) Specific location(s) of proposed release(s).

The following lists potential or approved release sites as of spring 2002. Others might be added in future years, depending on NEPA, ESA, TWG, and other reviews.

Stream, river, or watercourse: Nason Creek
Release point: Butcher Creek acclimation site, RM 8.2
Major watershed: Wenatchee River
Basin or Region: Mid-Columbia

Stream, river, or watercourse: Nason Creek
Release point: Early Pond acclimation site, RM 8.5
Major watershed: Wenatchee River
Basin or Region: Mid-Columbia

Stream, river, or watercourse: Nason Creek
Release point: Whitepine acclimation site, RM 11.2
Major watershed: Wenatchee River
Basin or Region: Mid-Columbia

Stream, river, or watercourse: Beaver Creek
Release point: Beaver Creek acclimation site, RM 0.5
Major watershed: Wenatchee River
Basin or Region: Mid-Columbia

Stream, river, or watercourse: Icicle Creek
Release point: Leavenworth NFH, Dam 5, RM 2.8
Major watershed: Wenatchee River
Basin or Region: Mid-Columbia

Stream, river, or watercourse: Little Wenatchee R.
Release point: Two Rivers, RM 0.5
Major watershed: Wenatchee River
Basin or Region: Mid-Columbia

Stream, river, or watercourse: Wenatchee R.
Release point: Brender, RM 2
Major watershed: Wenatchee River
Basin or Region: Mid-Columbia

Stream, river, or watercourse: Chumstick Creek
Release point: Uncertain [possible direct stream release]
Major watershed: Wenatchee River
Basin or Region: Mid-Columbia

Stream, river, or watercourse: Methow River
Release point: Winthrop NFH, RM 50.4
Major watershed: Methow River
Basin or Region: Mid-Columbia

10.3) Actual numbers and sizes of fish released by age class through the program.

Leavenworth NFH

Release year	Yearling	Avg size
1996	N/A	
1997	N/A	
1998	N/A	
1999	450,000	
2000	891,845	19.2
2001	855,167	19.5

Release year	Yearling	Avg size
Average	732,337	

Nason Creek

Release year	Yearling	Avg size
1996	N/A	
1997	N/A	
1998	N/A	
1999	50,000	
2000	76,893	19.5
2001	142,291	19.5
Average	89,728	

Methow River

Release year	Yearling	Avg size
1996	335,300	
1997	74,200	
1998	341,146	
1999	0.00	
2000	199,763	17.0
2001	260,319	19.0
Average	201,788	

Source: K. Murdoch, 2001.

10.4) Actual dates of release and description of release protocols.
Table 1 (section 1.11) shows release numbers from each release site in the Wenatchee and Methow basins. All fish were volitionally released as smolts. Release dates in the Methow ranged from April 25 – May 15; release dates in the Wenatchee ranged from April 15 – May 30. In the Wenatchee, snorkel surveys confirmed that all fish had left acclimation sites. The date volitional release begins is determined by observing the migratory behavior of the smolts.

The program ideal is to have sufficient numbers of progeny of local returns to allow progeny of returns to the Methow released in the Methow, and progeny of Wenatchee returns released in the Wenatchee. We have not yet reached that ideal. In the interim, because our data show that smolt-adult survivals are much higher for Wenatchee releases than Methow releases, we propose the following release guidelines, as the way to make the best possible use of the fish that have survived to the mid-Columbia:

1) Progeny of Wenatchee returns are released in the Wenatchee.

2) If there are insufficient smolts from Wenatchee returns to meet the 1 million release number in the Wenatchee, they will be supplemented with progeny of Methow returns. This could leave the Methow with a shortfall, so Methow releases would be supplemented, as necessary, with lower Columbia River stocks.

3) If there are still insufficient numbers to meet the 1 million release numbers in the Wenatchee, even with Methow progeny, they will be supplemented with lower Columbia River juveniles, in which case all releases in the Methow would be lower Columbia River stocks.

4) If there is extra production of Wenatchee progeny and a shortfall in the Methow, the extra Wenatchee fish could be used to make up the shortfall in the Methow.

10.5) Fish transportation procedures, if applicable.

Coho smolts are typically hauled by ODFW from lower Columbia River hatcheries to various acclimation ponds in mid-Columbia basins. Fish are transported in 1,500-5,000 gallon (6,000-19,000 liter) transport tanker trucks. These units are insulated and typically maintain sub-50ºF (<10ºC) hauling temperatures and strive for no more than a 10ºF (6ºC) (<5ºF preferred) variation between tank temperature and release site temperature. Transport tanks are equipped with oxygen injection and water circulation systems. Dissolved oxygen levels are maintained at 9-15 ppm. Oxygen and temperature levels are monitored during transports. Hauling densities are targeted at or below 1 pound of fish per gallon of water. Length of transport ranges from 6 to 8 hours.

10.6) Acclimation procedures (*methods applied and length of time*).

To condition them to the wild, coho smolts are acclimated away from the hatchery whenever possible in a semi-natural rearing environment. These sites use surface water supplies that expose fish to cold water early in the acclimation period and a rising temperature as the release time approaches. Ponds usually have earth and rock bottoms, and surrounding natural vegetation provides some cover. A low level of predation by fish, birds, and mammals will be allowed.

Juvenile coho are typically acclimated for 4-6 weeks prior to liberation, but depending on experimental objectives, could be acclimated from 2 weeks to 6 months. During that period, fish culturists periodically feed the pre-smolts a predetermined amount of fish food. This amount is calculated based on number and size of fish, and on water temperature. Typical fish culture activities include net and screen maintenance; pond cleaning (if applicable); predator control using such methods as nets, non-lethal live traps, propane and other noise emitters; mortality assessments; and growth and fish health measurements.

10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

In 2000, 26,394 of the 925,000 coho released from Icicle Creek were coded wire tagged and adipose-fin-clipped; 26,118 were coded wire tagged with no external mark. No Butcher Creek fish were marked or tagged. Of the 200,000 coho smolts released from Winthrop in 2000, 26,470 were coded wire tagged and fin-clipped. By 2002, 100% of the hatchery population will be internally marked with a coded wire tag. The current marking protocol is outlined in Table 19 (section 11.1.1). Fish marked with CWT are not adipose clipped in order to limit their harvest in selective fisheries that target adipose-clipped coho (see section 3.3). Since the program's emphasis during the feasibility studies is development of a localized coho broodstock, the program will attempt to maximize the number of adults collected, thereby allowing the project to estimate relative survival between mark groups by evaluating tags recovered from fish collected for broodstock. We expect natural coho production to be relatively low since we will attempt to collect a large proportion of the return. However, we will attempt to estimate the number of naturally produced fish by estimating the relative proportion of unmarked juvenile and adult fish, thereby providing a means to estimate the smolt-to-adult rates for both hatchery and naturally produced coho.

10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.

Not applicable. The program has no surpluses at this time.

10.9) Fish health certification procedures applied pre-release.

Fish health experts check the condition of fish prior to removal from the hatcheries (described in 9.2.7). Health checks are not performed at the acclimation sites unless obvious signs of disease are present.

10.10) Emergency release procedures in response to flooding or water system failure.

In the event of flooding, coho would be released early from acclimation ponds. Sites are designed to allow safe fish migration during floods. High-water exit paths are included near stream channels so that if ponds are overtopped during floods, fish can leave volitionally. Premature releases might reduce coho survival if they were not ready to migrate, but high water likely would move them rapidly downstream in turbid water, providing little opportunity for them to prey on other species or to be preyed upon themselves.

In the past, Winthrop NFH's water system has occasionally frozen in winter, requiring release of fish. The hatchery plans to install a new infiltration gallery, reducing the likelihood that coho would be released prematurely; however, unforeseen disasters such as freezing or pump failures could still result in emergency releases of fish (C. Pasley, personal communication, July 2002).

10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.

Most resident trout and steelhead are not considered to be at risk because these species generally emerge from the gravel after coho have migrated downstream, or spawn in upper reaches of tributaries (i.e., bull trout).

Studies in these basins have shown little evidence of hatchery coho predation on spring chinook, possibly because coho smolts migrate rapidly once they are released. However, because of the nature of the project, biologists need to deliberately create some risk to listed or sensitive fish in order to test the degree to which coho predation on other species might occur if coho are reintroduced. These risks are minimized by implementing the following measures as appropriate:

- working with other fish managers to determine release sites and numbers that minimize risk but that also meet research objectives;
- releasing coho smolts in low densities;
- attempting to release fish that more closely resemble sizes of wild coho, which tend to be smaller than hatchery fish[2] (our target size of 20-25 fpp equates to 110 – 120 mm).
- ensuring smolts are ready to migrate before releasing them volitionally; and
- monitoring predation and adapting feasibility studies and activities as necessary to minimize risks.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

The studies listed below would be conducted in the Wenatchee, Methow and Yakima basins. Currently, direct predation studies are proposed only in the Wenatchee basin, although studies likely would be needed in the future in other basins.

Funding for this feasibility project is being provided by Bonneville Power Administration. The research is being implemented by the Yakama Nation, with assistance from other project participants.

11.1.1) Describe plans and methods proposed to collect data necessary to respond to each "Performance Indicator" identified for the program (section 1.10).

Performance Indicator: Trends in survival of hatchery coho as measured by smolt-to-smolt (PIT tags) and smolt-to-adult (counts at dams/facilities) survival.

The smolt-to-smolt and smolt-to-adult survival rates for hatchery coho released in the Wenatchee and Methow basins would be studied in three ways.

- To estimate smolt-to-smolt survival to McNary Dam and other lower Columbia River mainstem projects, a portion of each release group (at least 8,000 fish annually in the Wenatchee, 8,000 every third year in the Methow) would be PIT-tagged (see "Marking" below).
- Smolt-to-adult survival would be monitored for the Wenatchee basin based on Rock Island minus Rocky Reach and/or Dryden Dam adult fish passage counts and redd counts. They would be based on Wells Dam counts for the Methow basin.

[2] Throughout the geographic range of coho salmon, length at smoltification is relatively consistent. Groot and Margolis (1991) reported that mean smolt size in yearling smolts ranged from 75 (Andersen and Narver 1975) to 122 mm fork length (McHenry 1981), and smolt size in Minter Creek, Washington ranged from 95-106 mm (Salo and Bayliff 1958).

- Coded wire tags would be collected from all coho retained for broodstock and from carcasses collected during spawning ground surveys to allow for a comparison in smolt-adult survival rates between acclimation sites and local vs. lower river stocks.

Marking

The marking protocol to estimate the smolt-to-adult survival rate for coho juveniles released in the Wenatchee system is outlined in Table 19. Three internal-mark groups will be identified: lower Columbia River transfers, Wenatchee progeny and Methow returning progeny. Each mark group will receive a differential CWT code. All CWT marks will be snout tags and potentially alternate body tag locations (for example dorsal, anterior fins, cheek, etc.). Adipose fin clips will not accompany CWT marks. In 2001-2002, an unmarked group (Lower River returns) will be identified by subtraction (total returns collected minus marked returns). Beginning in 2002, all three mark groups of juvenile coho released in the Wenatchee will be marked with CWT. If it is determined that selective mating of in-basin vs. Lower River progeny will occur, then body tag locations will be added in order to non-lethally differentiate mark groups. All marks will be retrieved from spawned broodstock and spawning ground carcasses in order to estimate survival by group.

The project will use PIT-tagged juveniles in order to parse out that portion of the smolt-to-adult mortality that is occurring in the freshwater migrant lifestage. Mark groups identified are lower Columbia River transfers, Wenatchee progeny and Methow returning progeny. PIT-tagged juvenile coho were released in the Methow in 2000 and 2001 (Table 20). This will give us two consecutive years of juvenile survival from the Methow for Lower River smolts. PIT tag releases from that point will occur approximately every third year (Table 20), unless mainstem passage conditions change, or other conditions occur to make us suspect survival rates may have changed.

PIT-tagged juveniles will be released in the Wenatchee River every year until at least 2005 (Table 21). The project PIT tagged and released 8,000 fish in 2000 and 2001 in order to establish a baseline juvenile survival rate for Lower River coho smolts. In 2002, the project released 8,000 coho juveniles from the Leavenworth Dam 5 site, in addition to 8,000 Wenatchee progeny from the natural production areas, in order to assess differences in juvenile survival between the two groups. During the period 2004-2005, the project will release 8,000 PIT-tagged Wenatchee progeny in the natural production areas to monitor changes in juvenile survival potentially related to the local adaptation process.

Marking Protocol for the Mid-Columbia Coho Releases

Table 19. CWT Marking Scheme* for Mid-Columbia Coho Smolt Releases

Release Year	Lower River Transfers Methow	Lower River Transfers Wenatchee	Wenatchee Progeny	Methow Progeny
2001	100% (250,000)	0% (826,600 **not** marked)	N/A	100% (146,875)
2002	100% (250,000)	100% (678,524)	N/A	N/A

2003	100% (if used)	100% (if used)	100%**	100%)**
2004	100% (if used)	100% (if used)	100%**	100%**
2005	100% (if used)	100% (if used)	100%**	100**

* Marks will be differential CWT (snout and potentially cheek) with no adipose fin clip.
** Actual numbers will depend on numbers produced, which is unpredictable at this time.

Table 20. PIT Tag Releases of Juvenile Coho from the Methow Basin

Release Year	Lower River Transfers
2000	8000
2001	8000
2002	0
2003	0
2004	8000*
2005	0

*Numbers depend on funding.

Table 21. PIT Tag Releases of Juvenile Coho from the Wenatchee Basin

Release Year	Lower River Transfers	Wenatchee Progeny	Methow Progeny
2000	8000	N/A	N/A
2001	8000	N/A	0
2002	8000	17,000*	0
2003	0**	24,000*	0
2004	0**	24,000*	0
2005	0**	24,000*	0

* Numbers depend on funding.
**A sample will be PIT tagged, if Lower River fish are used.

Performance Indicator: Spatial distribution of returning adults in potential natural spawning areas as identified from radio telemetry and foot/boat redd surveys.

Foot/boat redd surveys are conducted in the Wenatchee basin in several areas where adult coho are expected to spawn naturally (Nason Creek, Icicle Creek, and in the Little Wenatchee and Wenatchee rivers. In some of the smaller streams (Chumstick, Beaver, Brender), we might rely on weirs or traps to determine how many fish are returning to these streams. The Methow River is also surveyed.

Beginning in 2001 and continuing in 2002, the Yakama Nation is conducting a radio-telemetry evaluation to estimate the proportion of coho returning to the Wenatchee River that spawn in Beaver and Nason Creeks. Up to 75 adult coho randomly collected at the Tumwater Dam fish trap are anesthetized, gastrically tagged and released upstream of the dam. Fixed monitoring stations near the mouths of Nason and Beaver creeks determine how many of the tagged fish spawned in each creek. Mobile tracking determines the spawning locations of the tagged fish. Data are corroborated with spawning ground surveys. Video counts are used to estimate the total number of fish spawning above Tumwater Dam (Beaver Creek and Nason Creek). In 2004, the study will include adults spawning in the Little Wenatchee River.

The Yakama Nation conducts weekly spawning ground surveys in Nason Creek and bi-weekly surveys in Icicle Creek to identify the location and distribution of coho redds. Surveys began in fall 2001 and are conducted between about October 15th and December

15th. Surveys may extend beyond December 15th if spawning is not complete and river and weather conditions permit.

In Nason Creek, researchers attempt to count all coho redds. The surveys extend from Whitepine Creek (RM 15.4) to the mouth of Nason Creek (RM 0). The entire length of Icicle Creek below the hatchery (2.8 miles) is also surveyed. Elsewhere, surveys are conducted initially in stream reaches close to the smolt release sites, and branch out from these release sites if redds are not located; or researchers use radio telemetry results to guide them to likely spawning locations. Staffing and funding do not allow the entire basin to be searched for every coho redd.

Each redd identified is marked with a piece of surveyors tape. Locations of each redd are identified and mapped with a portable GPS unit. We also collect spawned coho carcasses during the surveys. From each coho carcass found, fork length and post-orbital hypural length are measured to the nearest millimeter. The sex is identified. The percentage of eggs remaining in each female coho carcass is visually estimated.

Physical data are recorded from a random sample of redds in each sub-basin.

Performance Indicator: Reproductive success (initial evaluations only) of naturally reproducing coho using redd counts, redd capping, and smolt production estimates.

Redd count methods are described in the previous section. The smolt production estimate comes from the Monitor smolt trap, operated by WDFW. Redd capping (placing a fine mesh net over the redd and capturing emerging fry in the cod end) is also done in selected areas.

Performance Indicator: Changes made by out-of-basin stock, using genetic monitoring of neutral allelic frequencies; and recording of such traits as fecundity, body morphometry, maturation timing, and straying/homing rates.

The genetics sampling and adaptation program would study:

- the naturalization of a hatchery fish stock (Lower Columbia River stock);
- allelic frequencies to determine the amount and rate of divergence of the mid-Columbia broodstock from the Lower River stock;
- physical traits and demographic information for introduced coho juveniles and adults and the contribution of those traits and other characteristics to survival.

The main goal driving the genetic and adaptation monitoring and evaluation is to determine the best implementation strategies that result in enhancing the natural production of coho salmon in mid-Columbia rivers. The genetic and adaptation M&E plan focuses on three major categories: 1) are there changes in the frequencies of neutral alleles in the population over time as the program and broodstock develop; 2) is there phenotypic divergence of localized coho and Lower River hatchery coho; and 3) are the introduced fish successful at producing progeny?

The following subsections describe the specific program for each of the genetic and adaptation monitoring studies listed above.

- *Assess changes in out-of-basin stock using genetic monitoring of allelic frequencies.*

The main opportunity of the genetics M&E program is to determine the rate and direction of divergence in neutral allele frequencies of the coho stocks that are used for reintroduction in mid-Columbia rivers.

A sound understanding of the genetic structure of the species of interest is a prerequisite to 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 actions. This can be done by measuring the frequencies of alleles at specific loci through time and in a series of populations (Allendorf and Phelps 1981; Utter 1991; Allendorf 1995). Such a database permits the determination of temporal (and mostly stochastic) and geographic (degree of isolation) variance components. A series of samples will be taken of naturalized coho spawning in the wild (Naches and Upper Yakima Rivers), as well as from the Yakima, Wenatchee, and Methow hatchery broodstocks. An additional number of samples will be used to scale the level of variability within and beyond the Columbia River populations (Umatilla, Clearwater, Klickitat, Lower Columbia, and the Thompson River on the Fraser River system). Microsatellite DNA techniques will be the primary tool. Protein electrophoresis and mtDNA may also be used.

- *Monitor traits such fecundity, body morphometry, and maturation timing.*

Because conditions in the mid-Columbia and Yakima are likely to be different than in the coastal streams and lower Columbia where the coho originate, life history characteristics of the introduced broodstock are likely to change. For one, the migration distance is very much greater into the mid-Columbia than, for example, to Eagle Creek. Optimal maturation rates and timing are likely to be different between these two areas. In order to determine if the stock used has adequate genetic variance and phenotypic plasticity to adapt to local conditions, the life history characteristics of the coho broodstock must be monitored over the length of the program.

An important link to environmental condition is the water temperature profiles in the streams or hatchery setting. The coho stock will be exposed to a water temperature profile that may deviate from the ancestral stream. Although this does not represent a particular problem for controlled conditions (there is generally very little variation in development rate of the eggs, and the genetic variance is additive), it is necessary to determine if the broodstock used has sufficient variance in maturation schedules to match local conditions. A longer-term goal is to select the broodstock from successful wild-spawning fish, thereby enabling the broodstock to progress towards local maturation optima.

For this plan, we will monitor fitness-related phenotypic traits such as fecundity, body morphometry, and maturation timing.

- *Gene flow from program fish into natural populations.*

Monitoring done on mid-Columbia coho will contribute to answering broader questions about the rate of genetic drift when a broodstock is established in a subbasin. A regional sampling effort will collect samples of coho from all reintroduced populations (programs with the intent of establishing wild-spawning, self-recruiting populations) above Bonneville Dam. These samples will be used to extract alleles at a number of nuclear DNA loci. These will be used to estimate parameters of gene flow, diversity, and genetic differentiation.

- *Quantify stray rates and homing to acclimation sites.*

As shown in Table 1b, 1,773 adult coho returned to the Wenatchee basin in 2001. The Fish Passage Center indicates that 10,465 and 1,628 adult coho were counted at Rock Island and Rocky Reach dams, for a difference of 8,837 adults (M. Cooper, USFWS letter, July 1, 2002). Such results raise questions of what happens to the coho between these dams and the smolt release sites to which they would be expected to return.

1) The project will investigate straying and drop-out rates of transferred hatchery coho within the mid-Columbia basin. A sample size of up to 400 adult coho returning to mid-Columbia tributaries will be radio-tagged at Priest Rapid Dam. A combination of fixed sites and mobile tracking will be used to identify spawning areas, drop-out rates, and stray rates. We will also recover CWTs from all carcasses during spawning surveys in order to recover release group information. We will also coordinate with other fisheries agencies within the basin to aid in the recovery of marks to evaluate homing/stray rates.

2) The project also will investigate the rates at which transferred hatchery coho stray back to their natal hatcheries. All fish collected for broodstock at the lower Columbia River hatcheries are examined for the presence of a CWT regardless of the presence or absence of an adipose fin. Spawning surveys conducted by state and federal agencies in the vicinity of lower Columbia River hatcheries also check carcasses for the presence of CWT regardless of the presence of an adipose fin, and enter data into existing regional databases.

Performance Indicator: Predation on other species by program fish as measured by stomach content analyses.

Currently, studies of predation by hatchery coho on sensitive species are planned only for the Wenatchee River basin. Predation studies would not be done in the Methow basin primarily because the opportunities don't exist to study predation on the species of concern—spring chinook, sockeye, and steelhead. All returning spring chinook adults in the Methow are collected and taken to the hatchery to be spawned under an adult-based supplementation program. Studies of hatchery coho predation on steelhead are not planned because steelhead emerge after yearling coho have migrated.

A rotary trap would be placed near two coho acclimation/release sites in the Wenatchee basin to monitor the level of predation on spring chinook and sockeye fry by coho smolts. The stomach contents of up to 3,000 coho would be examined for each of two studies (one of coho predation on spring chinook, the other of coho predation on sockeye) (6,000 fish total).

- *Predation on spring chinook*

Methods are detailed in Mid-Columbia Coho Reintroduction Feasibility Study 2002/2003 F2 Study Plans (prepared by Keely Murdoch, YN):

Hatchery coho smolts released from acclimation sites on Nason Creek and naturally reared coho smolts scatter planted in Nason Creek approximately 9 months prior to the predation evaluation will be recaptured in a 5-foot rotary screw trap located at RK 1.3 on Nason Creek (Nason creek Campground). The trap will be operated between March 15 and June 15. The naturally reared coho will be marked with an adipose fin clip for quick identification.

The rotary smolt trap will be checked and the live box emptied hourly during the study. The frequent removal of coho from the trap is important in minimizing predation on chinook fry within the live box. Up to 1500 hatchery coho smolts and 1500 naturally reared coho smolts will be collected from throughout the run and retained for stomach content analysis, which will use methods similar to those used in previous years and documented in the 2001 annual report for the project (Murdoch and LaRue 2002).

- *Predation on sockeye*

A brief literature review of the life history of sockeye salmon indicates that they vary substantially in age at out-migration, in growth, and in rearing habitats throughout their geographic range (Groot and Margolis 1991). Such variation makes species-wide generalization difficult. Before attempting a study of coho predation on sockeye, life history information specific to Lake Wenatchee must be collected, in order to determine periods and locations that sockeye salmon in Lake Wenatchee are most susceptible to hatchery coho smolt predation. Sockeye life history collection began in 2001, with limited results; methods will be modified in 2002 as described below.

The YN used radio telemetry to estimate hatchery coho smolt spatial distribution within and travel time through Lake Wenatchee. Due to the short tag life of smolt-sized radio-transmitters (10 days), the data we gathered were limited—many of the tags died before the smolts left the lake. Of the fish we were able to track through the lake, mean travel time was 6.85 days. Telemetry technology is changing rapidly. During the 2002 spring emigration, a smolt-sized radio tag will be available with a tag life of approximately one month. This will allow a more complete data set to be collected.

We used snorkel surveys and beach seining to locate sockeye fry within the littoral zone of Lake Wenatchee. The first fry were observed on May 11 and were observed in the littoral zone from this point through the end of the study. Tow nets were used to capture sockeye fry in the limnetic areas of the lake. Only two fry were captured in the limnetic zone, both on May 16th. The size of the tow net may have been limiting. A larger tow net will be used in 2002 to more accurately assess the locations and distribution of sockeye fry during late April and May.

At the end of the data gathering period (2002), we will assess the information and determine potential risk to sockeye from coho predation and also the potential for monitoring success. If it is considered feasible to continue the study and coho are released upstream of the lake, YN would monitor the impact through a predation study similar to those done for spring chinook, possibly using a WDFW rotary trap at the Lake Wenatchee outfall, or beach seining or trawling in Lake Wenatchee.

Performance Indicator: Superimposition of spring chinook redds by spawning coho as measured by superimposition studies.

Due to concerns regarding the number of adult coho spawners returning to Nason Creek in 2001 and 2002, and possible superimposition effects on incubating spring chinook salmon eggs by later spawning coho salmon, the YN is monitoring the locations of spring chinook redds, identified by CPUD, and coho salmon spawning locations to gauge the potential for redd superimposition and associated adverse effects.

In 2001 we measured the exact locations of up to 50 spring chinook redds in each of two study reaches (100 total) in Nason Creek (Table 22). Each study redd was measured by triangulating from the upstream and downstream ends of the redd tailspill with two fixed points on the bank. The width of each study redd was measured at its widest point.

These measurements enabled us to accurately determine superimposition by spawning coho salmon on spring chinook redds. Each redd was relocated during coho spawning ground surveys and the percent of superimposition was visually estimated (0 through 100%).

During the 2001 coho spawning ground surveys, three coho redds were identified in Nason Creek. None was found to superimpose on spring chinook redds.

The studies will be continued in future years.

Table 22. Redd Superimposition Study Reaches

Reach	Location	River Mile	Length	% of 2000 chinook spawning
Butcher Creek	Butcher Creek Pond to Butcher Creek Rd. Bridge	8.3 to 7.1	1.2 RM	14%
Lower Nason	Fishing Pond to Campground	3.4 to 0.8	2.6 RM	16%

Performance Indicator: Competition for food and habitat during freshwater rearing of naturally produced coho juveniles as measured through micro-habitat use and growth evaluations.

To begin to evaluate the potential for naturally produced coho salmon to negatively affect steelhead or spring chinook salmon through competition for space and food, we will assess the distribution, habitat use, growth and abundance of juvenile steelhead and spring chinook in the presence and absence of coho. Potential micro–habitat overlap between sub-yearling coho, spring chinook, and steelhead will be evaluated every two weeks between July 1st and September 15th, beginning in 2002. For the analysis, Nason Creek will be divided into 4 study reaches. Two reaches will be located upstream of the Butcher Creek acclimation site, and two will be located downstream of the site. This division of reaches was selected because the distribution of spring chinook redds identified during spawning ground surveys in 2000 indicated that 52% of the chinook spawned between the Butcher Creek acclimation site and Whitepine Creek, while 48% spawned downstream from the Butcher Creek acclimation site (Mosey and Murphy 2000). Within the four reaches we will snorkel a stratified random sample of habitat to collect information regarding microhabitat use and distribution of chinook, steelhead and coho.

Due to the low number of coho redds in Nason Creek in 2001, hatchery coho parr from mid-Columbia broodstock will be scatter planted into two of four study reaches in 2002 (treatment reaches). The four study reaches are listed in Table 1. While the scatter-planted coho salmon are not naturally produced, we propose to use them as a surrogate, providing information regarding possible interactions between juvenile coho and species of concern.

Prior to scatter planting sub-yearling coho, the current, or baseline, distribution of 0+ spring chinook and steelhead will be evaluated, using the four reaches shown in Table 23. Each reach will be divided into 500 meter sections. We will randomly select 100 meters from each 500-meter section for distribution analysis through underwater observation (20% sample rate). Underwater snorkeling techniques will be conducted as described by Thurow (1994). All salmonids will be enumerated by species and size class. Macrohabitat (pool, riffle, or glide) will be noted and measured. Fish densities and distribution will be reported.

Table 23. Nason Creek Study Reaches

Reach Number	Location	Coho Scatter Plants	River Kilometer
1	Mouth to Kahler Creek Bridge	Yes	0.0 to 6.3
2	Kahler Creek Bridge to Butcher Creek	Yes	6.3 to 13.3
3	Butcher Creek to Merritt Bridge	No	13.3 to 17.9
4	Merritt Bridge to Whitepine Creek	No	17.9 to 24.8

Prior to scatter planting, baseline collections of fish for growth and condition factor information will be collected. Fish growth and condition factor sampling will be repeated once a month for two months.

Within each reach we will collect a sample of up to 25 sub-yearling chinook, steelhead, and coho using a back-pack electrofisher. After collection fish will be anesthetized, measured (fork length in mm), and weighed. Condition factors will be calculated for each fish examined. Micro-habitat variable, abundance and condition factors of spring chinook and steelhead collected in allopatry and sympatry with coho will be compared using analysis of variance.

Comparisons in the change in growth will be made between chinook and steelhead parr in reaches 1 and 2 (sympatric with planted coho [treatment]) with the change in growth and condition factors for chinook and steelhead located in reaches 3 and 4 (allopatric with planted coho [control]).

Performance Indicator: Other potential ecological interactions as indicated by residualism surveys or F2 evaluations.

- *Residualism surveys*

Snorkeling surveys following a stratified random sampling design were done near acclimation/release sites to determine whether and how many coho do not migrate downstream after release. Few residual coho have been found (see section 3.5.3) and no further studies are proposed.

- *Other F2 evaluations*

Additional studies of interactions between naturally produced coho and other fish species—particularly listed fish—are anticipated when and if there are sufficient numbers of coho to allow a meaningful study to be conducted. Methods will be developed in consultation with the TWG.

11.1.2) Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.

Project budgets have been approved by NPPC and BPA through 2005.

11.2) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from monitoring and evaluation activities.

Some risk to sensitive species needs to be imposed in order to study the potential for long-term risk from coho reintroduction. Sections 3.5.3 and 10.11 list mitigation measures that would minimize the risk to listed species from coho releases.

During all monitoring and evaluation activities, any listed fish incidentally caught or handled will be released immediately to the location from which it was caught. During the operation of a rotary smolt trap, risk to listed fish can be minimized by frequent checking and emptying of the trap's live box. Experience has shown little or no mortality from broodstock collection procedures, as listed fish not subject to collection themselves are released upstream immediately. Risk of mortality from electro-shocking is reduced by using properly trained personnel and following NMFS guidelines for electro-shocking (NMFS 1998(a)) and additional guidance in Fredenberg 1992.

SECTION 12. RESEARCH

Because the Mid-Columbia Coho Reintroduction Feasibility Project is by definition a research project, there are no additional studies or descriptions to add to this section beyond what is covered in section 11.

SECTION 13. ATTACHMENTS AND CITATIONS

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SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

"I hereby certify that the foregoing information is complete, true and correct to the best of my knowledge and belief. I understand that the information provided in this HGMP is submitted for the purpose of receiving limits from take prohibitions specified under the Endangered Species Act of 1973 (16 U.S.C.1531-1543) and regulations promulgated thereafter for the proposed hatchery program, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or penalties provided under the Endangered Species Act of 1973."

Name, Title, and Signature of Applicant:

Certified by_____________________________ Date:_____________

APPENDIX A: TAKE TABLES

Listed species affected: Spring Chinook______________ **ESU/Population:**__UCR__________________________________
Activity:__Smolt Trapping____________________

Location of hatchery activity: Nason Creek____________ **Dates of activity:**_3/15 – 6/15____________ **Hatchery program operator:**_________________

Type of Take	**Annual Take of Listed Fish By Life Stage *(Number of Fish)***			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	500	1000		
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)	10	20		
Other Take (specify) h)				

Listed species affected: __Steelhead________________ **ESU/Population:** UCR________________________________ **Activity:**_Smolt Trapping___________________				
Location of hatchery activity:_Nason Creek_________ **Dates of activity:** 3/15 – 6/15_________________**Hatchery program operator:**_________________				
	Annual Take of Listed Fish By Life Stage *(__Number of Fish__)*			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)		500		
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)		10		
Other Take (specify) h)				

Listed species affected: __Bull Trout ________________ **ESU/Population:** UCR___________________________________
Activity:__Smolt Trapping___________________

Location of hatchery activity: Nason Creek___________ **Dates of activity:** 3/15 –6/15________________ **Hatchery program operator:**__________________

Type of Take	Annual Take of Listed Fish By Life Stage (***Number of Fish***)			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)		25		
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)		1		
Other Take (specify) h)				

Listed species affected: _Spring Chinook ____________**ESU/Population**:___UCR________________________________
Activity:__Electrofishing___________________

Location of hatchery activity:___Nason Creek_____________________ **Dates of activity:**___7/1-9/30__________________
Hatchery program operator:_________________

	Annual Take of Listed Fish By Life Stage (***Number of Fish***)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)		150		
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)		15		
Other Take (specify) h)				

Listed species affected: __Steelhead__________________ **ESU/Population:** UCR___________________________________
Activity:_Electro-fishing____________________

Location of hatchery activity:___Nason Creek________ **Dates of activity:**__7/1-9/30___________________ **Hatchery program operator:**_________________

	Annual Take of Listed Fish By Life Stage (***Number of Fish***)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)		150		
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)		15		
Other Take (specify) h)				

Listed species affected: __Bull Trout________________ **ESU/Population:** UCR_________________________________ **Activity:**_Electro-fishing____________________				
Location of hatchery activity:__Nason Creek__________ **Dates of activity:**_7/1-9/30____________________**Hatchery program operator:**_________________				
	Annual Take of Listed Fish By Life Stage *(**Number of Fish**)*			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)		10	3	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)		10	3	
Other Take (specify) h)				

Listed species affected: Steelhead____________________ **ESU/Population**:___UCR_______________________________
Activity:___Broodstock Collection_________________

Location of hatchery activity:_Dryden Dam__________ **Dates of activity**:__9/1-12/7_____________ **Hatchery program operator:**_________________

Type of Take	**Annual Take of Listed Fish By Life Stage (*Number of Fish*)**			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)			30	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: Bull Trout___________________ **ESU/Population**:___UCR______________________________ **Activity:**___Broodstock Collection_________________				
Location of hatchery activity:_Dryden Dam__________ **Dates of activity:**_9/1-12/7__________________**Hatchery program operator:**_________________				
	Annual Take of Listed Fish By Life Stage ***(Number of Fish)***			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)			2	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: _Steelhead___________________ **ESU/Population**: UCR__________________________________
Activity:_Trapping – Radio-telemetry and/or broodstock collection____________________

Location of hatchery activity:___Tumwater Dam______ **Dates of activity:** 9/1/-12/7_____________________ **Hatchery program operator:**_________________

	Annual Take of Listed Fish By Life Stage *(**Number of Fish**)*			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)			30	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: Bull Trout **ESU/Population**: UCR **Activity:** Trapping – Radio-telemetry and/or broodstock collection				
Location of hatchery activity: Tumwater Dam **Dates of activity:** 9/15-12/7 **Hatchery program operator:**				
	Annual Take of Listed Fish By Life Stage ***(Number of Fish)***			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)			2	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: Steelhead___________________ **ESU/Population**:___UCR______________________________
Activity: Trapping-Radio-telemetry_________________

Location of hatchery activity:_Priest Rapids Dam________ **Dates of activity**:_9/15-12/7___________________ **Hatchery program operator:**_________________

Type of Take	**Annual Take of Listed Fish By Life Stage (*Number of Fish*)**			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)			50	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: __Bull Trout__________________ **ESU/Population**:___UCR________________________________
Activity:___Tow-net sampling_________________

Location of hatchery activity:_Lake Wenatchee___ **Dates of activity:**_____________________ **Hatchery program operator:**__________________

Type of Take	**Annual Take of Listed Fish By Life Stage (*Number of Fish*)**			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)				
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: Spring Chinook______________ **ESU/Population:**__UCR__________________________________ **Activity:**__Weir Operation__________________				
Location of hatchery activity: Beaver Creek___________ **Dates of activity:**_3/15 – 6/1; 9/1 – 12/15___________ **Hatchery program operator:**_________________				
	Annual Take of Listed Fish By Life Stage *(**Number of Fish**)*			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	0	0	0	0
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: Steelhead____________ **ESU/Population:**__UCR_______________________________ **Activity:**_Weir Operation_________________				
Location of hatchery activity: Beaver Creek___________ **Dates of activity:**_3/15 – 6/1; 9/1 – 12/15___________ **Hatchery program operator:**_________________				
	Annual Take of Listed Fish By Life Stage ***(Number of Fish)***			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	0	150	15	0
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)	0	5	0	0
Other Take (specify) h)				

Listed species affected: Spring Chinook **ESU/Population:** UCR **Activity:** Weir Operation				
Location of hatchery activity: Brender Creek **Dates of activity:** 3/15 – 6/1; 9/1 – 12/15 **Hatchery program operator:**				
	Annual Take of Listed Fish By Life Stage ***(Number of Fish)***			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	0	0	0	0
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: Steelhead____________ **ESU/Population:**__UCR________________________________
Activity:_Weir Operation_________________

Location of hatchery activity: Brender Creek___________ **Dates of activity:**_3/15 – 6/1; 9/1 – 12/15___________ **Hatchery program operator:**_________________

	Annual Take of Listed Fish By Life Stage (*Number of Fish*)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	0	200	20	0
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)	0	5	0	0
Other Take (specify) h)				

Listed species affected: Spring Chinook **ESU/Population:** UCR
Activity: Weir Operation

Location of hatchery activity: Chumstick Creek **Dates of activity:** 3/15 – 6/1; 9/1 – 12/15 **Hatchery program operator:**

	Annual Take of Listed Fish By Life Stage (***Number of Fish***)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	0	0	0	0
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: Steelhead____________ **ESU/Population:**__UCR________________________________
Activity:_Weir Operation_________________

Location of hatchery activity: Chumstick Creek____________ **Dates of activity:**_3/15 – 6/1; 9/1 – 12/15___________ **Hatchery program operator:**_________________

	Annual Take of Listed Fish By Life Stage *(**Number of Fish**)*			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	0	200	20	0
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)	0	5	0	0
Other Take (specify) h)				