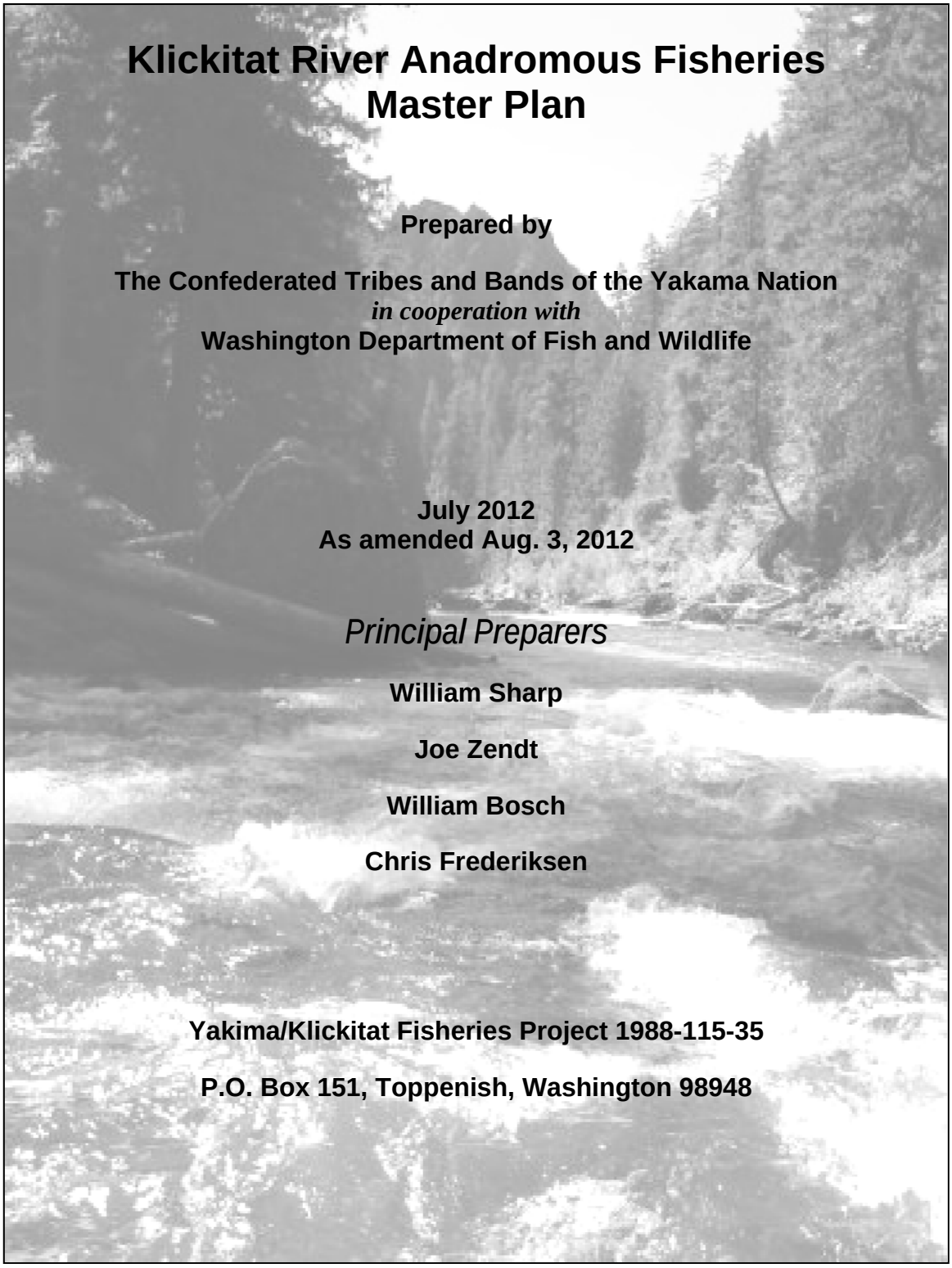

Klickitat River Anadromous Fisheries Master Plan

Prepared by

The Confederated Tribes and Bands of the Yakama Nation
in cooperation with
Washington Department of Fish and Wildlife

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KLICKITAT RIVER ANADROMOUS FISHERIES MASTER PLAN

EXECUTIVE SUMMARY

Introduction

The Klickitat River Anadromous Fisheries Master Plan is submitted to the Northwest Power and Conservation Council by the Yakama Nation in fulfillment of Step 2 requirements for major projects. This document was preceded by drafts submitted in April 2004 and March 2008. This revision has been updated to reflect accomplishments and changes since the March 2008 plan was submitted, and to respond to the ISRP's review of the March 2008 plan. The majority of the changes were to Chapters 5 through 9 and Appendix C.

The Yakama Nation proposes to construct improvements to the existing Klickitat Hatchery near Glenwood, Washington. In addition, it is proposed to build a hatchery and acclimation facility at Wahkiacus (RM 17; Rkm 27). Improvements to the Lyle Falls Fishway and broodstock collection facility, and the Castile Falls Fishway and escapement monitoring facility were completed in earlier phases of the project. These facilities are needed to support programs for spring Chinook, fall Chinook, steelhead, and coho. The location of the Wahkiacus facility will allow release of hatchery coho and fall Chinook to the lower river which will limit adverse impacts to native fish species. In addition, an acclimation site has been identified for McCreedy Creek. These facilities will be used for summer steelhead and will be built only if steelhead are unable to naturally re-colonize stream habitat above Castile Falls. Habitat improvements occurring in conjunction with the proposed project are expected to benefit bull trout and Pacific lamprey as well as steelhead and spring Chinook.

Anadromous fish populations have declined in the Klickitat Subbasin through a combination of habitat degradation, harvest in ocean and freshwater fisheries, and blockages to fish passage. As the human population grows, pressure continues to grow on already depressed fish stocks. The Yakama Nation wants to ensure an adequate and sustainable supply of anadromous fish to satisfy ceremonial, subsistence, commercial, and sport needs. The projects covered by this master plan are part of this effort.

The Klickitat Hatchery began operations in 1952 (construction was not complete until 1954). At that time, the science and art of artificial production was relatively rudimentary. Within the past 50 years, scientific inquiry has lead to new thinking about how and why to engage in artificial production. New approaches view artificial production as supplementation of natural populations rather than as substitutes for them. This Master Plan incorporates new approaches to artificial production.

The existing Klickitat Hatchery facilities are in need of improvement to bring them up to current standards. In addition, a new hatchery is proposed at Wahkiacus Creek and an acclimation facility may be needed at McCreedy Creek to support the proposed new programs.

Spring Chinook, which are native to the Klickitat Subbasin, supported a significant Tribal fishery prior to 1920. The run size has declined greatly since that time. Since 1977, the run size has ranged from 500 to 5,300 fish with most of the fish being of hatchery origin. Natural escapement has averaged about 300 fish since 1977.

The Klickitat Subbasin supports runs of summer and winter steelhead, both of which are native to the system. Both runs are part of the Mid-Columbia Evolutionary Significant Unit (ESU) and are listed as "threatened" under the federal Endangered Species Act.

Fall Chinook were not abundant historically in the Klickitat Subbasin due to natural low water conditions that generally prevail during the late summer and early fall. These conditions made passage at Lyle Falls difficult. The Klickitat Hatchery began releasing fall Chinook in 1952.

Coho were not present historically in the Klickitat Subbasin. Management agencies introduced coho to the Subbasin in the late 20th century to provide fish for Tribal and recreational fishers.

Bull trout and Pacific lamprey are both culturally important to the Yakama Nation. It appears that there are very few bull trout in the lower- to mid-Klickitat drainage. Bull trout appear to be more abundant in the upper drainage where habitat conditions are more favorable. The lamprey population is most likely lower than historic levels due to habitat degradation. Lamprey have also suffered from fish passage problems at hydroelectric dams.

Project History

The Yakama Nation has actively managed fish and wildlife on their Tribal lands for more than 50 years. During this time, wild and artificially produced spring Chinook (*Oncorynchus tshawytscha*), fall Chinook (*O . tshawytscha*), coho (*O. kisutch*), and steelhead (*O. mykiss*) in the Klickitat Subbasin have been managed to ensure their long-term existence and provide fishing opportunities in an effort to mitigate for the loss of fisheries due to construction of the Columbia River hydroelectric dams.

Fishing opportunities for Tribal members are guaranteed by the Treaty of 1855 (12 Stat. 951) between the Yakama Nation and the United States of America. Indian fishing rights were confirmed by a federal court in *U.S. v Oregon* in 1969.

The Klickitat Hatchery, Lyle Falls Fishway, and Castile Falls Fishway were built as part of an effort to mitigate for lost fishing opportunities. The ownership and operation of the three facilities transferred from the Washington Department of Fish and Wildlife to the Yakama Nation in December 2005. They are operated under the Yakima/Klickitat Fisheries Project. The YKFP uses artificial production to re-establish, supplement, and/or increase natural production of anadromous salmonids and harvest opportunities while maintaining long-term fitness of the target populations and minimizing or avoiding impacts on non-target species.

Goals and Objectives of the Proposed Klickitat Programs

The proposed Klickitat programs have as their primary goal an increase in the number and distribution of steelhead and spring Chinook within the Klickitat Subbasin while maintaining or increasing present harvest of all species including fall Chinook and coho. In addition, habitat improvements resulting from the proposed programs are expected to benefit listed bull trout, lamprey, and other non-listed species. The Master Plan establishes biological goals, objectives, and strategies designed to achieve the primary goal. The biological goals, which are consistent with the NPCC Fish and Wildlife Program (NPCC 2000), are designed to achieve both the biological performance of the target species and improve environmental conditions to allow sustainable populations.

Steelhead

Conservation: reduce the 5% extinction probability from a moderate risk rating to a very low risk rating using the Interior Columbia Technical Recovery Team (ICTRT) criteria (NOAA-Fisheries 2009) (Section 6.1.3)

Harvest: maintain or exceed the current harvest opportunities for the Terminal Treaty and Sport fisheries, without substantially impacting the viability of the wild component of the composite run (Section 6.1.3)

Habitat: improve steelhead habitat quality and quantity throughout the Klickitat River Subbasin (Section 6.1.5)

Spring Chinook

Conservation: 1) increase population viability by ensuring that the adaptation of the population is driven by the natural environment, and 2) ensure that population size remains large enough to allow the population to maintain itself (Sections 6.2.1 and 6.2.3)

Harvest: 1) meet or exceed Treaty harvest obligations consistently and on a long-term sustainable basis, 2) maintain or increase recreational fisheries on a long-term sustainable basis (Section 6.2.3)

Habitat: increase the quantity and quality of Klickitat River mainstem and tributary habitat that currently or historically supported spring Chinook (Section 6.2.5)

Coho

Conservation: no conservation goal has been set; the sole conservation objective is to establish a locally adapted, segregated hatchery population to meet harvest goals (Section 6.3.3)

Harvest: provide the fish necessary to support Tribal fisheries mandated by federal court orders and the Treaty of 1855 (Section 6.3.3)

Habitat: prevent further degradation of those sections of the river (RKm 0 to RKm 27) used by coho smolts released from the hatchery (Section 6.3.5)

Fall Chinook

Conservation: no conservation goal has been set; the only conservation objective is to establish a locally adapted, segregated hatchery population designed to provide fish for harvest (Section 6.4.3)

Harvest: provide the fish necessary to support Tribal fisheries mandated by federal court orders and the Treaty of 1855 (Section 6.4.3)

Habitat: no habitat objective has been set; improved habitat conditions for steelhead will benefit fall Chinook as well (Section 6.4.5)

Pacific Lamprey

Conservation: increase species abundance over time (Section 6.5.3)

Harvest: increase the population size to a level that can support some harvest for Tribal fishers (Section 6.5.3)

Habitat: no habitat objectives have been set for Pacific lamprey (Section 6.5.5); it is assumed that actions designed to restore steelhead and spring Chinook will also benefit this species

Bull Trout

Conservation: 1) maintain current distribution of bull trout and restore distribution in previously occupied areas within the Lower Columbia Recovery Unit, 2) maintain stable or 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 opportunity for genetic exchange (Section 6.6.3)

Harvest: increase population size to a level that can support a catch-and-release sport fishery as well as incidental harvest in Tribal fisheries (Section 6.6.3)

Habitat: no specific habitat objectives have been set; it is thought that actions implemented for steelhead will also benefit bull trout (Section 6.6.5, Tables 6-17 and 6-18).

In addition to the goals listed above, the proposed project's primary habitat goal is to move habitat 40% closer to historical conditions.

NPCC Three-Step Review, Context and Rationale of the Proposed Project

The Major Project Review was established by the NPCC as a means to systematically review large capital projects recommended to the Bonneville Power Administration for

funding through the Columbia River Basin Fish and Wildlife Program. The review is also known as the "Three Step Review". Its goal is to consider funding only for projects that have successfully completed the planning process. The review links environmental reviews and funding to specific phases of project development and planning, i.e. concept, progress review, and detailed or final. Each phase must fulfill certain requirements before the project is allowed to progress to the next phase.

The Step requirements are based on the Eight Scientific Principles contained in the Fish and Wildlife Program. An applicant must demonstrate that all aspects of the project including location, magnitude, goals and objectives, environmental effects, operations and maintenance and costs over a period of 10 years. Chapter 3.0 of the Master Plan explains in detail how the proposed programs have been designed to be consistent with the principles and the Step 1 requirements.

Chapter 4.0 presents the local and regional context of the proposed project. The proposed project is located in the Klickitat Subbasin in southcentral Washington State within the NPCC's Columbia River Gorge Province. The area is lightly populated and is typical of the arid and semi-arid country on the east slope of the Cascade Mountains. The proposed project is cognizant of and consistent with a number of other recent and on-going planning efforts in the area including the Klickitat Subbasin Plan, NOAA-Fisheries Recovery Plan, Washington State Watershed Planning Process, and the Washington State Salmon Recovery Planning Process.

The Proposed Programs

The Master Plan recognizes that to be successful, actions must be integrated across what the region refers to as the "4 Hs" (Hatcheries, Habitat, Harvest, and Hydro). The Master Plan focuses primarily on Habitat, Hatcheries, and Harvest because there are no hydroelectric facilities on the Klickitat River. However, the effect mainstem Columbia River dams (Hydro) have on the survival of fish populations originating in the Klickitat River was taken into consideration when setting hatchery release numbers, adult escapement, and harvest goals.

The YN reviewed multiple strategies and approaches for achieving fisheries objectives in the Klickitat River. Chapter 5.0 provides the historical, human, legal, and political context within which the Klickitat Master Plan was developed and will be implemented. Rationale and justification for the objectives and strategies described in the Master Plan relate directly to this context. Increasing the number of sustainable anadromous fish populations within the Klickitat Subbasin can be supported from multiple standpoints. As discussed in Chapter 6.0, many alternatives were considered. Some strategies would not achieve the goals defined for the program and were rejected. The preferred alternatives describe those strategies which proponents believe will most effectively contribute to meeting federal treaty trust, mitigation, and restoration obligations arising from the context described in Chapter 5.0.

A detailed discussion of the actions and objectives aimed at accomplishing the goals of the Master Plan for steelhead, spring Chinook, coho, and fall Chinook is presented in

Chapter 6.0. The following are the major actions proposed for Habitat, Hatcheries, and Harvest.

Habitat: Protecting existing high quality stream habitat and restoring degraded habitat is essential if ESA-listed populations of steelhead and bull trout are to be recovered in the Subbasin. The Master Plan identifies the major habitat factors limiting fish production and relies on the strategies and actions proposed in the Klickitat River Basin Salmon Recovery Plan to improve habitat quality and quantity. The habitat strategies are targeted primarily at Major Spawning Areas for ESA-listed steelhead, but are expected to provide benefits to other resident and anadromous fish species inhabiting these same portions of the Subbasin. Additionally, fish passage at both Lyle Falls and Castile Falls will be improved to create better migration conditions for all native fish species. The habitat strategy is expected to result in an 85% and 26% relative increase in ESA-listed steelhead abundance and productivity, respectively. Habitat actions will also provide substantial benefits to native spring Chinook as well as ESA-listed bull trout and pacific lamprey.

Hatcheries: The YN recognizes that current hatchery practices need to be changed to reflect recent scientific advances and to avoid negative effects hatchery fish may have on naturally spawning salmon populations including listed species. Because hatchery fish may interbreed with, compete with, and prey on native fish populations, the following actions are proposed to reduce these impacts:

1. Coho hatchery releases in the Subbasin will be reduced from approximately 3.7 million to as few as 1.0 million juveniles.

2. A new hatchery and acclimation facility (Wahkiacus) will be constructed at RKm 27 so that hatchery coho and fall Chinook may be released lower in the Subbasin, thereby reducing impacts to native fish species.

3. Hatchery steelhead will not be released above Castile Falls until it is determined that wild fish cannot re-colonize this habitat on their own.

4. Hatchery adult spring Chinook will be collected at Lyle Falls or the Klickitat River Hatchery, then transported and released into suitable habitat above Castile Falls in an effort to re-supply marine derived nutrients and to re-establish spring Chinook production in the upper Klickitat River.

5. If wild steelhead do not naturally re-colonize stream habitat above Castile Falls, a hatchery program would commence and a new juvenile acclimation facility would be constructed at McCreedy Creek. The hatchery program may use both anadromous and resident rainbow trout as broodstock depending on additional literature review and results from ongoing genetic research in this and other basins. The use of resident trout for broodstock would reduce mining of anadromous adults, take advantage of local genetics, and contribute to regional research data needs on this topic.

6. Volitional release strategies will be implemented for all cultured species.

7. The coho and fall Chinook programs will begin shifting to the use of local origin broodstock.

8. Hatchery programs for steelhead and spring Chinook will be monitored against specific objectives for natural escapement and production. Adaptive management measures are specified and will be implemented as necessary to assure that the hatchery programs minimize impacts to natural populations.

9. Out-of-Subbasin transfers of hatchery coho and fall Chinook into the Klickitat River Subbasin will be phased out over time to the extent possible with a goal of completing all hatchery culture phases within the Subbasin.

10. The long-term goal for the preferred alternative is to be consistent with hatchery reform guidelines for the composition of hatchery and natural origin steelhead and spring Chinook spawners used for hatchery broodstock and escaping to the natural spawning grounds.

11. Hatchery releases above Castile Falls will be terminated once steelhead population goals are achieved in this portion of the Subbasin.

12. Hatchery programs will be operated in compliance with Tribal and federal environmental regulations, including requirements to maintain water quality, water quantity, and fish passage. These actions will assure that hatchery operations will not reduce the productivity and capacity of a watershed to support natural stocks.

Harvest: A major goal of the Master Plan is to provide harvest to Tribal members as required by treaty obligations and for sport fishing, while at the same time protecting naturally spawning populations and contributing to the recovery of ESA-listed steelhead and bull trout. Because hatchery fish provide most of the harvestable fish in the Subbasin, the Master Plan is structured to balance potential hatchery impacts to listed species with the harvest benefits they provide. This balance will be achieved by experimenting with reduced hatchery production while at the same time implementing measures that increase hatchery fish survival. The goal is to provide greater harvest benefits from fewer hatchery smolts. If successful, the average number of fish harvested in all fisheries is expected to be:

Coho	14,000
Fall Chinook	18,000
Spring Chinook	4,000
Steelhead	2,000

Additional harvest actions that will be implemented to better meet harvest goals or protect listed fish species include:

1. Marking hatchery fish released in the Subbasin so they can be distinguished from natural origin fish in the hatchery broodstock, on the spawning grounds, and in fisheries.

2. Utilizing harvest practices that improve spawning escapement of natural-origin steelhead and spring Chinook while fully harvesting hatchery-origin fish.

Klickitat River sport fishery regulations require that all steelhead caught with an intact adipose fin must be released. In Tribal fisheries, fishermen generally retain all fish captured at traditional fishing areas. The goal under the Master Plan is to increase average annual wild steelhead escapement to 2,500 adults.

The programmatic goals for steelhead, spring Chinook, coho, and fall Chinook consist of distinct and separate goals for conservation and harvest. The conservation goals for steelhead and spring Chinook are distilled into separate, measurable goals for the VSP parameters that define a viable salmonid population. Harvest goals are expressed as a mean number of fish caught annually in the terminal fisheries for commercial, Tribal, and sport fishers.

Steelhead

The primary steelhead conservation objective is to reduce the 5% extinction probability from a moderate risk rating to a very low risk rating using the ICTRT criteria outlined in the Klickitat Subbasin Recovery Plan (NOAA-Fisheries 2009). When this is achieved, the population would be considered a highly viable population able to withstand natural environmental perturbations with a high level of resiliency.

The steelhead (winter and summer) abundance objective is to achieve a minimum and average escapement of 500 and 1,500 adults respectively in the short term (about 10 years). The long-term objective (more than 10 years) is to increase average adult abundance to 2,500 adults. These abundance objectives were based primarily on the expected improvement in fish performance from the implementation of habitat strategies and actions described in Appendix A to the Master Plan. The habitat actions are also hypothesized to increase productivity from 4.2 to 5.3; which therefore becomes the steelhead productivity objective for this plan.

The spatial structure objective is to have adult steelhead spawning throughout their historical range.

As long as hatchery steelhead are released and spawn in the Klickitat River, the Master Plan has an objective of maintaining the proportion of juvenile production from hatchery-origin spawners at less than or equal to 5% consistent with recommendations of the HSRG for segregated hatchery programs (HSRG 2005).

The primary harvest objective for Klickitat River hatchery steelhead is to maintain or exceed the current harvest opportunities for the Terminal Treaty and Sport fisheries, without substantially impacting the viability of the wild component of the composite run. Popular fisheries have been established for both fisheries due to the unique fishing

opportunities offered by the Klickitat River's landscape. Harvest of hatchery steelhead in the Treaty and Sport fisheries has averaged about 873 and 1,483 fish respectively since 1986.

The Master Plan proposes a not-to-exceed 15% harvest standard on wild summer and winter steelhead captured in terminal fisheries. This guideline will be re-evaluated periodically to ensure consistency with *U.S. v Oregon* principles and objectives.

The proposed hatchery program is designed to benefit conservation and recovery of Klickitat River steelhead while sustaining harvest opportunities for treaty and non-treaty fisheries. The program has the following components:

1. Continue Skamania program until Klickitat Hatchery upgrades are implemented.
   - Mark all releases to allow live detection of adult returns at Lyle

2. When Klickitat Hatchery upgrades are implemented, convert Skamania program to the following:
   - Collect local HOR fish for brood at Lyle
   - Spawn, rear using spring water, acclimate, and release at Klickitat Hatchery
   - Cull diseased fish

3. Current data suggest that <5% of natural smolt production is the progeny of hatchery-origin fish (Narum et al. 2006). Continue to monitor. If this increases to >5% for 3 consecutive years or more than 5 years in 10, then options are:
   - Discontinue program if all parties/stakeholders agree
   - Change the hatchery program to an integrated program using NOR brood stock

   Note that the 5% introgression threshold is based on recommendations published by the Hatchery Scientific Review Group (2005). This threshold may be modified consistent with the project's adaptive management protocols, based on additional literature review and future M&E findings from this or other Columbia Basin steelhead programs.

4. By 2020 (2-3 fish generations from 2005 when passage improvements above Castile first became operational), if passage at Castile Falls has not exceeded 150 fish (20% of estimated 750 fish capacity) in at least 1 year, or if the mean passage at Castile Falls from 2012-2019 is less than 80% of the 150 fish goal (< 120 fish), then:
   - Implement an integrated NOR program at McCreedy Hatchery
   - Base the program size (number of smolts released) on a maximum 25% collection rate of NOR passage at Castile for brood stock. The maximum size of the program would be sufficient brood collection to release 70,000 smolts.

The option also calls for implementing habitat actions to improve steelhead habitat quality and quantity throughout the Klickitat River Subbasin. Habitat actions are

expected to increase steelhead abundance and productivity by 85% and 26%, respectively.[1]

Long-term implementation and adaptive management of the program will be guided by ongoing M&E activities targeting viable salmon population (VSP) parameters affected by the hatchery and habitat programs (Chapter 7). This work will be conducted as part of the Klickitat Subbasin Recovery Plan (NOAA-Fisheries 2009).

Steelhead Habitat Plan

The plan for steelhead habitat involves implementation of a suite of actions that address the limiting factors identified for each MaSA and MiSA. The limiting factors strategies and proposed actions for each area were developed as part of steelhead recovery planning by NOAA (NOAA-Fisheries 2009).

The six strategies that will be used to address limiting factors in key areas of the Subbasin are shown in Table 1. Each strategy will be accomplished through a suite of actions.

Table 1: Relationship between steelhead habitat strategies and key geographic areas in the Klickitat River Subbasin

Strategy	Areas For Implementation
Strategy 1: Protect Stream Corridor Structure and Function	Mainstem Klickitat and throughout MaSA watersheds
Strategy 2: Restore Passage and Connectivity between Habitat Areas	Piscoe Creek, McCreedy Creek, White Creek and tributaries, Little Klickitat tributaries, upper Klickitat mainstem, West Fork Klickitat, Trout Creek
Strategy 3: Restore Floodplain Function and Channel Migration Processes	All areas
Strategy 4: Restore Riparian Condition	Trout Creek, Upper Little Klickitat, Lower Little Klickitat, Klickitat Canyon, Swale Creek, Lower Klickitat, Middle Klickitat, White Creek, Upper Klickitat
Strategy 5: Restore Normative Flow Regimes	Lower Klickitat, Middle Klickitat, Lower Little Klickitat, Upper Little Klickitat, White Creek, Trout Creek, Swale Creek
Strategy 6: Restore Degraded Water Quality, including Water Temperatures	All areas

Steelhead Hatchery Plan

The program has both harvest and conservation components.

[1] The level improvement is based on the combined results of passage improvement and the 40% habitat restoration scenario.

Harvest Component

The harvest component will consist of a target annual release of 90,000 juveniles from the Klickitat hatchery. The program will continue to be operated as a Segregated Harvest program using Skamania steelhead. If monitoring indicates that the percentage of natural juvenile production from hatchery-origin parents increases to more than 5% for three consecutive years or more than 5% for 5 years in a 10-year period, then we will seek to improve the segregated program by moving to a local brood program, collecting hatchery-origin steelhead returning to the Klickitat Subbasin at Lyle Falls. If the rate of hatchery-origin contribution to natural smolt production increases to greater than 10%, then the harvest program could be eliminated by agreement of the parties to *U.S. v Oregon* or converted to an integrated program using local, natural-origin brood stock collected at Lyle Falls. The goal of the program is to provide harvest benefits while, at the same time, minimizing adverse impacts to the natural spawning population by implementing hatchery reform recommendations relative to limit the contribution of hatchery-origin fish to the natural population if monitoring suggests this contribution is increasing.

If a local brood (either hatchery-origin or natural-origin) program is determined to be necessary, the program will require from 70 to 80 adults to produce the target release of 90,000 age-1 steelhead[2]. Releases would be 100% marked with an adipose-fin clip. Broodstock for the harvest program would be distinguished by the absence (hatchery-origin; segregated program) or presence (natural-origin; integrated program) of an adipose fin. Harvest and homing strategies will be used to limit the proportion of hatchery-origin fish on the natural spawning grounds to a rate less than or equal to about 5%. In addition to spawning ground surveys and run reconstruction, we will also monitor this parameter by evaluating juvenile production for the rate of hatchery contribution. The HSRG has concluded that genetic and reproductive risks to wild fish from hatchery fish spawning in the wild are low as long as hatchery fish make up less than 5% of the total spawning population (HSRG, WDFW, and Northwest Indian Fisheries Commission 2004b).

Conservation Component

Analysis of steelhead production potential by the ICTRT and YN indicate that habitat above Castile Falls may support 750 steelhead. Prior versions of the Master Plan called for delaying action for 9 years to see if wild steelhead were able to re-colonize this habitat without human assistance. If by 2020 (2-3 fish generations from 2005 when passage was fully restored above Castile Falls) steelhead escapement above Castile Falls has not reached 150 adults in at least one year or if the mean passage above Castile Falls from 2012-2019 is less than 120 fish (<16% of estimated capacity), hatchery supplementation will be used as a tool to accelerate the re-colonization process[3].

[2] Variability in fecundity over time may alter the number of fish collected for broodstock each year.
[3] The decision to proceed with a supplementation program may also be based on the health of the lower Klickitat River populations and the status of the ESU. The decision to proceed with the program will be made through consultations with NMFS and the WDFW.

Broodstock for the conservation program will be collected at Castile Falls Fishway. The number of adults collected will be dependent on run size and will never exceed 25% of total natural-origin returns. The size and duration of the program will be dependent on the number of anadromous and resident adults available for broodstock, the ability of the resident life history to contribute to anadromous production, and the re-colonization rate after the program has been implemented. The program will be kept small in order to minimize broodstock mining rates and avoid homogenizing or reducing the genetic diversity of the upper Subbasin *O. mykiss* population. Critical M&E activities will be put into place prior to and during the program's implementation stages in order to adequately assess the natural re-colonization and/or contribution of the conservation hatchery program to re-colonization of the upper Klickitat watershed.

Steelhead Harvest Plan

Steelhead harvest will be managed to maximize the exploitation of all adipose fin-clipped hatchery fish while minimizing impacts to wild summer and winter steelhead. Wild steelhead will not be targeted for harvest. A harvest rate standard of not-to-exceed 15% of the total number of natural/wild steelhead adults entering the Klickitat River will be used to manage the fishery. Current regulations for treaty and sport fisheries will provide the basis for future regulations. In-season harvest modifications, i.e. reductions, will be implemented if minimum wild steelhead escapement targets are not likely to be achieved. Fishing for steelhead above Castile Falls will not be allowed until the annual escapement goal of 500 fish is exceeded for at least 3 consecutive years.

Spring Chinook

The Klickitat spring Chinook population is currently not listed under the ESA. On average, the Klickitat spring Chinook run to the Subbasin is approximately 75% hatchery and 25% natural fish. Both conservation and harvest goals are proposed for Klickitat spring Chinook.

The main conservation objectives are to: 1) increase population viability by ensuring that the adaptation of the population is driven by the natural environment, and 2) ensure that the population size remains large enough to allow the population to maintain itself. For natural/hatchery composite programs, the influence of the hatchery and natural environments on the adaptation of the composite population is dependent on the proportion of natural-origin broodstock in the hatchery (pNOB) and the proportion of hatchery-origin fish in the natural spawning escapement (pHOS). The conservation objectives for spring Chinook are found in Table 2.

Table 2: Conservation Goals for Klickitat River Spring Chinook

Parameter	Objective
Productivity	Recruits/Spawner > 7.0[a]
Abundance	Average Adult Escapement > 700 per year Minimum Escapement > 400
Spatial Structure	Spawning Throughout Historical Range
PNI	0.67

[a] see Appendix C.

Note: the R/S value is based on a theoretical intrinsic productivity estimate for future habitat conditions. Measured R/S values for spring Chinook are currently estimated at 3.69 (Table 6-9).

The primary harvest objective for spring Chinook is to meet or exceed Treaty harvest obligations consistently and on a long-term basis. The secondary objective is to maintain or increase recreational fisheries on a long-term sustainable basis. It is mandatory that all harvest objectives must be attainable while still meeting the conservation objectives. The harvest objectives for spring Chinook are shown in Table 3.

Table 3: Harvest objectives for Klickitat River Spring Chinook

Fishery	Objective
Mainstem Columbia River- Tribal	600
Mainstem Columbia River- Non-Tribal	400
Klickitat River Terminal- Tribal	1,800
Klickitat River Terminal- Sport	1,200
Total Harvest	4,000

The alternative strategies considered for spring Chinook were: 1) maintain the existing hatchery program and 2) eliminate the hatchery program and improve habitat. These strategies did not meet the harvest goals and presented many hatchery-related problems. They were rejected in favor of the preferred option: develop an integrated hatchery program and improve habitat.

Spring Chinook Habitat Plan

The habitat objective is to increase the quantity and quality of habitat in the Klickitat River mainstem and tributaries that historically supported spring Chinook. The habitat actions proposed (Table 4) are expected to result in 132% improvement in spring Chinook abundance and 24% increase in productivity.

Table 4: Relationship between spring Chinook habitat strategies and key geographic areas in the Klickitat River Subbasin

Strategy	Areas For Implementation
Strategy 1: Protect Stream Corridor Structure and Function	Mainstem Klickitat
Strategy 2: Restore Passage and Connectivity between Habitat Areas	Lyle Falls and Castile Falls

Strategy 3: Restore Floodplain Function and Channel Migration Processes	Entire Klickitat Mainstem and Swale Creek
Strategy 4: Restore Riparian Condition	Swale Creek, Lower Klickitat, Lower Little Klickitat, Middle Klickitat, Upper Klickitat
Strategy 5: Restore Normative Flow Regimes	Lower Klickitat, Middle Klickitat, Lower Little Klickitat, Swale Creek
Strategy 6: Restore Degraded Water Quality, including Water Temperatures	Entire Klickitat Mainstem

Spring Chinook Hatchery Plan

The hatchery plan involves conversion of the existing segregated harvest program to an integrated harvest program. The program is designed to increase the viability of the natural population while simultaneously producing the adults needed to meet the 4,000 fish harvest objective for all fisheries combined. To achieve these objectives, it is estimated that the hatchery program should release 800,000 yearling spring Chinook annually.

An additional possible objective of the hatchery program is to provide spring Chinook for reintroduction into the White Salmon River following Condit Dam removal and fish passage and return monitoring. Fishery managers have identified wild Klickitat spring Chinook as a possible brood source for spring Chinook reintroduction into the Big White Salmon River. A robust integrated hatchery program that maximizes Klickitat spring Chinook natural production may provide surplus adults which can be made available to aid the Big White Salmon reintroduction effort.

The hatchery program will be converted from segregated to an integrated conservation/harvest program by incorporating an increasing proportion of NOR Klickitat River spring Chinook into the broodstock over time. The pace of broodstock conversion will depend on the size of the natural-origin spring Chinook run which is expected to vary annually. To reduce impacts to the natural-origin spring Chinook population, no more than 1 of every 2 NOR fish passing upstream through the Lyle Falls facility will be taken for brood stock. Present data indicate that 20-50% (averaging about 30%) of the return passes upstream using the ladder at Lyle. Therefore, taking at most 1 of every 2 of these fish will limit NOR brood collection to at most 10-25% (averaging about 15%) of the total run's natural-origin component taken for the integrated hatchery program in any year. The 800,000 fish targeted for release will be incubated, reared, and released volitionally at the Klickitat River Hatchery. Released fish will be differentially marked to denote parental origin (hatchery, natural, or mixed). Broodstock may be collected at Lyle Falls, the Klickitat River Hatchery, and Castile Falls.

Spring Chinook Harvest Plan

Harvest management provisions will be designed to maximize harvest of adipose-clipped hatchery-origin fish while reducing harvest on the natural component of the population. To achieve the objectives, bag limit and season adjustments will be enacted and the

collection location for the majority of broodstock will be shifted to the Lyle Falls Fishway. Surplus fish escaping the fisheries to the Klickitat River Hatchery will be distributed to Tribal members for subsistence and ceremonial purposes; they will not be returned to the river.

Coho

Coho are not native to the Klickitat River Subbasin, but were introduced in 1952 to achieve harvest obligations. Current coho returns are from smolts produced by lower Columbia River hatcheries and released in the Klickitat River Subbasin. Since 1987, the YN estimates that the number of coho returning to the Subbasin has averaged 8,000 fish annually. The combined annual harvest of Klickitat River coho in all fisheries is estimated to average 21,400 fish between 1987 and 2010. The YN estimates that 85-95% of all adults returning to the Klickitat Subbasin are harvested in terminal fisheries.

There is no natural production goal for Klickitat River coho because this species is not native to the Subbasin. There are no plans to establish a viable naturally spawning population. The goal is, however, to establish a locally adapted, segregated hatchery population while minimizing potential negative impacts to native fish species.

Coho Harvest Plan

The primary objective of the coho program is to provide fish necessary to support Tribal fisheries mandated by federal court orders and treaties. The objective is to produce a total of 14,000 coho for harvest in all fisheries, with the majority of the harvest to occur in Tribal fisheries in Zone 6 and the Klickitat River.

Three options were considered for accomplishing the objectives: 1) maintain the existing program, 2) eliminate hatchery production, and 3) reduce hatchery smolt production and convert to local broodstock. Options 1 and 2 did not accomplish the objectives and were rejected. Option 3 appeared to offer the best way to avoid the potential problems associated with a non-native species while achieving the program objectives.

Habitat Actions for Coho

The YN recognizes that the quality and quantity of waters into which fish are released are important to the survival of hatchery fish. Therefore, the habitat goal for coho is to prevent further degradation of the river sections used by coho smolts released from the hatchery.

Hatchery Strategy for Coho

The hatchery strategy calls for the implementation of a segregated harvest program that uses coho returning to the Klickitat River as broodstock. The hatchery strategy will be implemented adaptively over time to determine if the conservation and harvest goals identified for coho can be achieved with the following suite of actions:

- Reduce hatchery production from 3.7 to as few as 1.0 million juveniles

- Eliminate all out-of-Subbasin coho transfers over time
- Convert to the use of locally adapted broodstock
- Eliminate the direct planting of Washougal River origin coho to the mainstem Klickitat River
- Develop the Wahkiacus Hatchery and Acclimation Facility to allow for the implementation of acclimation and volitional release strategies

The plan will be implemented in 3 phases. In Phase 1, hatchery production for the ~1.0m on-station release will be converted from Washougal brood source to local brood source collected at Lyle Falls, then reared and released from Klickitat Hatchery. In Phase 2, hatchery production for the ~1.0m on-station release will be collected at Lyle Falls, then reared and released from the Wahkiacus Acclimation Facility. In Phase 3, when the Wahkiacus facility is fully completed, all broodstock collection, incubation, and rearing will occur at the Wahkiacus Hatchery and Acclimation Facility for the ~1.0m portion of the program. Throughout all three phases, we will continue to investigate alternatives for the ~2.5m direct stream releases including program reduction, local brood source, and alternative rearing and release locations; when acceptable alternatives are identified they will be implemented.

The harvest strategy includes operating fisheries in a manner that ensures that the 750 hatchery adult escapement target (for the local broodstock program) is met each year. To reduce effects on fisheries, the escapement target may also be achieved through the manipulation of river flow passing through the updated Lyle Falls Fishway. By controlling the amount of flow passing through this fishway, managers may be able to attract and capture more adults for use as broodstock. Fishing regulations will be developed that best fit the overall implementation strategy. Selective fisheries for coho are not expected to be necessary as the program does not call for establishment of a self-sustaining run of coho in the Subbasin.

Fall Chinook

Fall Chinook are not indigenous to the Klickitat River Subbasin above Lyle Falls, most likely due to low water conditions that occur historically in the Subbasin in late summer and fall. Currently, fall Chinook returning to the Klickitat River are hatchery-origin URB stock imported from Priest Rapids Hatchery reared and released from the Klickitat River Hatchery.

The average annual harvest of fall Chinook from Klickitat River releases in combined ocean, Columbia River, and Klickitat River fisheries is estimated to exceed 19,000 fish. Sport and Tribal fall Chinook fisheries in the Klickitat River harvested an average of about 6,100 fish annually since 2000. Estimates of fall Chinook escaping the fisheries and spawning naturally in the Klickitat River have averaged about 6,500 (range 2,500 to 25,000) fish annually from 1989 to 2010.

No conservation goal has been established for Klickitat fall Chinook because this race of Chinook is not native to the Subbasin. There are no plans to establish a viable, naturally reproducing population of fall Chinook in the Subbasin in the foreseeable future. The goal is to establish a locally adapted, segregated hatchery population designed to provide fish for harvest. The harvest will support Tribal fisheries mandated by federal court orders and treaties. The objective is production of 18,000 fall Chinook for harvest in all fisheries, with the majority occurring in Tribal fisheries in Zone 6 and the Klickitat River.

The YN considered five options for managing Klickitat River fall Chinook.

1. Maintain existing program
2. Transition to fully integrated hatchery program
3. Eliminate hatchery production
4. Restore the natural fall Chinook spawning habitat eliminated by the construction of The Dalles and John Day dams
5. Convert existing program to local broodstock

Option 5, which relies on local broodstock, best meets the goals identified by YN for fall Chinook. This option may pose risks to native spring Chinook; therefore, the primary objective is to select habitat, hatchery, and harvest measures that reduce these risks while still allowing the YN to meet the fall Chinook harvest objective.

Habitat Strategy for Fall Chinook

The YN will not implement habitat actions designed to establish a self-sustaining population of fall Chinook. The habitat strategies designed to improve steelhead and spring Chinook production in the mainstem Klickitat will most likely improve migration conditions for juvenile hatchery fall Chinook releases. Better migration conditions should increase survival of hatchery fish and result in higher returns of adult fall Chinook.

Hatchery Strategy for Fall Chinook

The hatchery strategy involves implementation of a segregated harvest program that uses fall Chinook returning to the Klickitat River as its broodstock. This will be accomplished through: 1) elimination of eyed-egg transfers from Priest Rapids Hatchery, 2) development of locally adapted broodstock, 3) construction of the Wahkiacus Hatchery, 4) marking all juvenile fall Chinook, and 5) releasing 4 million fall Chinook subyearlings at 50 to 80 fish per pound annually.

Harvest Strategy for Fall Chinook

Fisheries will be managed to consistently meet hatchery broodstock needs and to ensure that the number of fall Chinook adults spawning naturally in stream reaches upstream of

Lyle Falls is minimized. Harvest seasons are expected to be similar to those currently existing.

Pacific Lamprey

The historic and present distribution and abundance of Pacific Lamprey in the Klickitat Subbasin is, for the most part, unknown, though the species is known to occur here. The Columbia River Treaty Tribes recently developed a "Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin" (CRITFC 2011).

The primary biological goal for Pacific lamprey is to rebuild populations to a level that sustains the population over time, but still allows for harvest by Tribal fishers. Currently, data are insufficient on Pacific lamprey abundance and distribution to allow establishment of numeric or spatial structure objectives. Until this information is available, the conservation objective remains broad: increase species abundance over time. The long-term the harvest objective for Pacific lamprey is to increase the population size to a level that can support some harvest for Tribal fishers.

A strategy focused on habitat restoration for Pacific lamprey was the only alternative considered for implementation at this time. Hatchery rearing techniques for Pacific lamprey are still being developed. A future production program for Pacific lamprey in the Klickitat River basin may be developed pursuant to the Tribal Lamprey Restoration Plan. The habitat actions described for steelhead are expected to provide benefits to Pacific lamprey. Specific habitat actions targeted to Pacific lamprey will be developed over time as more information is gathered on species distribution and abundance. The information will be gathered in cooperation with CRITFC, WDFW and the USFWS.

Bull Trout

Klickitat River bull trout are listed as threatened by USFWS under the ESA and are included in the Lower Columbia Recovery Unit. Data collected in the Subbasin indicate that bull trout are found in the mainstem Klickitat River and the West Fork Klickitat River and its tributaries. Portions of the West Fork watershed drain the Primitive Area of the Yakama Reservation and have some of the best stream habitat remaining in the Subbasin. Klickitat River bull trout mainly exhibit a resident life history form. Bull trout abundance in the Subbasin is not currently known, but is assumed by the USFWS to be below 1,000 adults. Studies are on-going to better estimate the abundance and distribution of this species in the Subbasin.

There is no regulated sport or Tribal fishery that targets bull trout in the Klickitat River Subbasin. WDFW regulations state that sport fishers must return all bull trout unharmed to the stream.

The primary bull trout goal is "to ensure the long-term persistence of self-sustaining, complex, interacting groups of bull trout distributed throughout the species' native range, so that the species can be de-listed" (USFWS 2002).

Conservation Objectives for Bull Trout

The following objectives identified by the USFWS for bull trout have been included in this Master Plan.

- Maintain current distribution of bull trout and restore distribution in previously occupied areas within the Lower Columbia Recovery Unit
- Maintain stable or increasing trends in abundance of bull trout
- Restore and maintain suitable habitat conditions for all bull trout life history stages and strategies
- Conserve genetic diversity and provide opportunity for genetic exchange

Until bull trout recovery objectives are finalized by the USFWS, the Master Plan has set an abundance target of 1,000 adults, distributed in the West Fork, its tributaries, and mainstem Klickitat River.

The long-term harvest objective is to increase population size to a level that can support a catch-and-release sport fishery as well as incidental harvest in Tribal fisheries.

The habitat plan for bull trout assumes that factors limiting steelhead production in the Subbasin are likely reducing bull trout abundance as well. Therefore, a number of habitat actions aimed at protecting and restoring the mainstem Klickitat and West Fork Klickitat are proposed. No analysis has been performed on expected improvement in bull trout abundance and survival from the implementation of these habitat strategies. The results of on-going and future research will be used to adjust the strategies and to estimate resulting bull trout response.

Monitoring and Evaluation

The proposed monitoring and evaluation program deals with hatchery, harvest, and habitat components of the Master Plan. Habitat action effectiveness monitoring is discussed but not described in great detail here; it will be conducted using a combination of methods including the Columbia Habitat Monitoring Program (CHaMP), the YKFP-developed Rapid Aquatic Habitat Assessment Protocol (RAHAP), and more focused studies in selected areas. It will also be addressed through regional efforts such as the Coordinated Assessments project, subbasin recovery planning, and the Yakama Nation Status and Trends Report (STAR) project.

YKFP's data collection protocols for M&E will be consistent with the Columbia River Basin regional strategies including Monitoring, Evaluation, Research, and Reporting (MERR); Anadromous Salmonid Monitoring Strategy (ASMS); Collaborative Systemwide Monitoring and Evaluation Project (CSMEP), and Pacific Northwest Aquatic Monitoring Partnership (PNAMP). The results of the M&E activities will be presented in annual reports and at annual workshops. Data and information will be stored

on the web at www.ykfp.org. Data will also continue to be presented in PISCES status reports and in peer-reviewed scientific publications.

Chapter 7.0 presents a detailed discussion of monitoring and evaluation activities with a focus on determining the success of the hatchery programs, the effects each program has on native stocks, and collecting information regarding the critical uncertainties identified in the Columbia River Research Plan (NPCC 2006). Hatchery monitoring and evaluation is intended to address at least to some extent all of the critical uncertainties. Objectives, approaches and strategies are listed for all of the following monitoring and evaluation categories:

- Hatchery performance including: adult collection, holding, spawning, rearing, mark rates, release, juvenile migration, and smolt-to-adult survival. The origin and stock of salmon and steelhead used for broodstock will be documented as well as changes in the phenotypic and genotypic characteristics of fish used at Klickitat Hatchery complex. Smolt development of hatchery and natural juveniles will be determined by measuring gill Na+, K+-ATPase activity over time. Information will be used to refine the hatchery rearing practices and release schedule.

- Harvest monitoring will be focused on sampling subsistence fisheries at Cascade Locks, The Dalles Dam, and John Day Dam on the mainstem Columbia River and on sampling all Tribal fisheries on the Klickitat River. The Regional Mark Information System (RMIS) will be monitored to evaluate the extent to which Klickitat hatchery complex releases are harvested in ocean or Columbia River mainstem commercial and sport fisheries. *U.S. v Oregon* Technical Advisory Committee (TAC) reports will also be monitored to evaluate the extent to which Klickitat hatchery complex releases are harvested in commercial and sport fisheries in the Columbia River mainstem and sport fisheries in the Klickitat River.

- Escapement: The composition and abundance of natural and hatchery-origin fish returning to the mouth of the Klickitat River and to the natural spawning grounds will be monitored.

- Juvenile and adult-to-adult productivity will be monitored. Migration timing and travel time will also be monitored.

- Predation: To determine if hatchery releases of coho, spring Chinook, and steelhead could result in high rates of predation on native juvenile steelhead and spring Chinook, a study will be undertaken to develop a predation index for hatchery fish. The study will involve PIT or acoustic tagging to determine the amount of time hatchery fish spend in the Klickitat River following release from facilities and stomach analyses to estimate the number, size, and species of juvenile fish consumed by hatchery juveniles.

- Ecological Interactions: YN staff will use information from the literature as well as in-basin demographic and migratory data collected from other M&E tasks to evaluate potential bottlenecks to survival or productivity.

- Disease: YN staff will work with USFWS fish health specialists to implement disease management protocols and monitor hatchery operations for specific fish pathogens in accordance with the Washington Co-Managers Salmonid Disease Control Policy and the USFWS Fish Health Policy and Implementation Guidelines. Protocols are designed to minimize potential disease transmission within and outside of the hatchery, assuring that fish reared at the Klickitat Hatchery have high survival rates with little chance of pathogen transmission to naturally-rearing fishes and aquatic organisms.

- Genetics: Gain a thorough understanding of the genetic make-up of target stocks in order to maintain long term genetic variability and minimize the impacts of domestication on supplemented stocks (spring Chinook and summer steelhead). YN staff will collect genetic samples from adult and juvenile steelhead and salmon. Analysis of genetic markers will be used to evaluate the relationship of steelhead and Chinook populations in the Klickitat River relative to others in the Columbia River Basin and estimate subbasin origin of stray fish found in the Klickitat River. The influence of hatchery programs will be evaluated for each species. Subpopulation structure within the Klickitat subbasin will also be evaluated.

- Habitat: YN staff will conduct surveys of physical habitat conditions, stream temperature, water quality, and streamflow to monitor and evaluate status and trends in these parameters in the mainstem Klickitat River and selected anadromous fish-bearing tributary watersheds.

Conceptual Designs of Proposed Facilities

Improvements and changes are proposed for the existing Klickitat Hatchery. In addition, it is proposed to build a hatchery and acclimation facility at Wahkiacus. Acclimation ponds may also be built at McCreedy Creek if a need for them is demonstrated over time.

The existing Klickitat Hatchery was completed in 1954 and is no longer adequate to accommodate programs based on the latest scientific thinking. Many of the facilities need repair and do not meet current building codes. It is proposed to remodel the main hatchery building and facilities, build 2 or 3 new houses for hatchery personnel, modify existing raceways, and remove an abandoned adult capture in-river concrete sill.

The proposed Wahkiacus Hatchery and Acclimation Facilities are new construction. Components to be built on-site include rearing and holding ponds, raceways, a settling basin, a hatchery building, two or three residences, a water intake on the Klickitat River, and acclimation ponds.

McCreedy Creek has been identified as a potential water source for a juvenile fish acclimation site. Further studies will be conducted over the next ten years to determine its suitability and whether it is needed. The acclimation site would include up to 20 portable raceways used to rear steelhead.

Project Costs

Project costs are based on the proposed programs (Chapters 6.0 and 7.0) and the conceptual designs (Chapter 8.0). Costs are developed to the 30% conceptual design level required by NPCC and include cost estimates for finalization of facility planning and design, capital construction, operations and maintenance, and monitoring and evaluation. Estimates for operations and maintenance as well as monitoring and evaluation are extended to ten years. Cost estimates will be refined further at the NPCC Step III level (final design).

Capital Construction Cost Estimates

Predicting construction costs requires careful consideration of current cost for labor, material, and equipment. The capital construction costs (Table 5) were supplied by Harbor Consulting Engineers of Seattle, use standard sources, and were evaluated with direct costs quoted by materials suppliers. They are also based on local project costs and vendor locations.

Klickitat Hatchery assumed the following:

- December 2010 dollars
- 10% estimating contingency
- Three phases of construction with winter shutdowns
- 2.5% annual escalation

Wahkiacus Hatchery & Acclimation Facility assumed the following:

- December 2010 dollars
- 10% estimating contingency
- No winter stoppage once construction commences
- 2.5% annual escalation

The current estimate for capital construction includes new facilities as well as modification of existing facilities. Due to the level of certainty a 10% contingency is applied to the overall cost.

The Yakama Nation has established a priority for implementing the proposed capital projects:

1. Klickitat Hatchery upgrade
2. Wahkiacus Hatchery and rearing facilities
3. McCreedy Creek Acclimation Facilities

Table 5: Capital construction estimated costs by fiscal year

Capital Construction Cost Estimate	Current Design Status	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	TOTAL
Klickitat Hatchery Design, Permitting & Const Mgmt (13.5% of Construction)	30% Conceptual	$560,948	$600,000	$1,182,000	$1,470,000	$374,000		$4,186,948
Klickitat Hatchery Construction & Upgrades			$2,500,000	$10,000,000	$15,000,000	$3,514,945		$31,014,945
Wahkiacus Hatchery Design, Permitting & Const Mgmt (20%)	30 % Conceptual		$1,100,260	$2,503,900	$360,000	$160,000	$154,361	$4,278,521
Wahkiacus Hatchery Construction					$10,000,000	$9,000,000	$2,392,605	$21,392,605
McCreedy Cr. Mobile Acc. Design, Permitting, & Const Mgmt (20%)	Preliminary						$175,000	$175,000
McCreedy Cr. Fabrication and install/construction							$875,000	$875,000
Annual Estimate		*$560,948*	*$4,200,260*	*$13,685,900*	*$26,830,000*	*$13,048,945*	*$3,596,966*	*$61,923,019*

Operations and Maintenance

Operations, maintenance, and monitoring and evaluation estimates are based on FY11 salary, operating, and equipment costs.

Table 6: Operation and Maintenance (O&M) Cost Estimates

Operation & Maintenance Costs	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021
Castile Falls Fishway	121,100	124,128	127,231	130,411	133,672	137,014	140,439	143,950	147,549	151,237
Lyle Falls Fishway	242,130	248,183	254,388	260,748	267,266	273,948	280,797	287,816	295,012	302,387
Klickitat Hatchery		94,922	215,551	310,000	504,090	516,692	529,610	542,850	556,421	570,332
Wahkiacus Hatchery				200,559	335,000	343,375	351,959	360,758	369,777	379,022
Klickitat Field Office	37,972	38,921	39,894	40,892	41,914	42,962	44,036	45,137	46,265	47,422
McCreedy Creek Acclimation						78,731	80,699	82,717	84,784	86,904
Annual Total	$401,202	$506,154	$637,064	$942,610	$1,281,942	$1,392,721	$1,427,539	$1,463,228	$1,499,808	$1,537,303

Monitoring and Evaluation

M&E cost estimates are from 2012-2017 identify Accord budgets. Operational costs post-2017 reflect an inflation rate of 2.5% per year. The expanded M&E costs include increased staffing required to effectively monitor the proposed Castile Falls and Lyle Falls counting and trapping facilities and other specific tasks identified in Chapter 7.0. The new staff members will conduct daily M&E activities such as escapement monitoring, biodata collection, video trap reading, and data entry.

On-going M&E activities include continuing existing efforts to monitor status and trends and to gather information on abundance, distribution, demographics, life history, and habitat of Klickitat spring Chinook salmon, steelhead, and other species of interest. The effectiveness of hatchery and habitat actions are also on-going. Expanded M&E activities are being implemented and are aimed at accurately assessing the hatchery reform measures. Monitoring will involve the following activities:

- Spawning ground surveys (redd counts)
- Adult salmonid monitoring at Lyle Falls Fishway
- Juvenile outmigration monitoring
- Juvenile and resident salmonid population surveys
- Scale analysis
- Sediment monitoring
- Water quality monitoring
- Habitat surveys
- Pathogen sampling
- Genetic data collection, analysis, and synthesis
- Brood stock composition
- Juvenile and adult-to-adult survival
- Spring Chinook and steelhead PIT tagging

Table 7 presents a summary of on-going and expanded monitoring and evaluation costs. Table 8 provides a 10-year summary of estimated costs for all project areas. Note that operational costs are from 2012-2017 identify Accord budgets. Operational costs post-2017 reflect an inflation rate of 2.5% per year.

Table 7: Summary of expanded M&E cost estimates

Task		FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY2017	FY2018	FY2019	FY2020	FY2021
7.1	Hatchery Operations	$227,026	$232,702	$238,519	$244,482	$250,594	$256,859	$263,281	$269,863	$276,609	$283,524
7.2	Harvest[a]										
7.3	Escapement	$340,538	$349,051	$357,778	$366,722	$375,890	$385,287	$394,920	$404,793	$414,912	$425,285
7.4	Productivity	$340,538	$349,051	$357,778	$366,722	$375,890	$385,287	$394,920	$404,793	$414,912	$425,285
7.5	Predation	$113,513	$116,351	$119,260	$122,241	$125,297	$128,430	$131,640	$134,931	$138,305	$141,762
7.6	Ecological Interactions	$113,513	$116,351	$119,260	$122,241	$125,297	$128,430	$131,640	$134,931	$138,305	$141,762
7.7	Disease[b]	$5,551	$5,690	$5,832	$5,978	$6,127	$6,280	$6,437	$6,598	$6,763	$6,932
7.8	Genetics	$97,138	$99,566	$102,056	$104,607	$107,222	$109,903	$112,650	$115,467	$118,353	$121,312
7.9	Habitat	$152,646	$156,462	$160,374	$164,383	$168,493	$172,705	$177,023	$181,448	$185,984	$190,634
	Total	$1,390,463	$1,425,225	$1,460,855	$1,497,377	$1,534,811	$1,573,181	$1,612,511	$1,652,824	$1,694,144	$1,736,498

Costs should be considered as conceptual
Costs provided by Yakama Nation
[a] Harvest monitoring is covered under contract with the Bureau of Indian Affairs.
[b] A Mitchell Act contract provides additional funding for fish health services with the USFWS.

Table 8: Ten-Year summary of future costs

Cost Area	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021
A. Capital Construction, Design and Permitting	$560,948	$4,200,260	$13,685,900	$26,830,000	$13,048,945	$3,596,966				
B. Operations and Maintenance Costs	$401,202	$506,154	$637,064	$942,610	$1,281,942	$1,392,721	$1,427,539	$1,463,228	$1,499,808	$1,537,303
C. Monitoring and Evaluation Costs	$1,390,463	$1,425,225	$1,460,855	$1,497,377	$1,534,811	$1,573,181	$1,612,511	$1,652,824	$1,694,144	$1,736,498
Total Estimated Costs	$2,352,613	$6,131,639	$15,783,819	$29,269,987	$15,865,698	$6,562,868	$3,040,050	$3,116,052	$3,193,952	$3,273,801
Capital Total	$560,948	$4,200,260	$13,685,900	$26,830,000	$13,048,945	$3,596,966	$0	$0	$0	$0
O &M and M&E Total	$1,791,665	$1,931,379	$2,097,919	$2,439,987	$2,816,753	$2,965,902	$3,040,050	$3,116,052	$3,193,952	$3,273,801

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GLOSSARY

Anadromous	Fish which hatch and rear in fresh water, migrate to the ocean to grow and mature, and return to fresh water to spawn
Acclimation	The process by which hatchery fish are accustomed to the natural waters into which they will be released
Attraction Water	Water that is released at the downstream opening of a fish ladder to allow fish to use the ladder for their upstream migration. The volume of water must be sufficient to selection by upstream migrants.
ATPase	ATPases are a class of enzymes that catalyze the decomposition of adenosine triphosphate (ATP) into adenosine diphosphate (ADP) and a free phosphate ion. This dephosphorylation reaction releases large amounts of energy which are used for many biochemical processes including muscle contraction and the metabolism of sugar.
Broodstock	Adult fish used by hatcheries to propagate the next generation of fish
Denil ladder	A stepped flume-type fishway constructed with side and bottom vanes which cause the water to back on itself, thus dissipating energy and allowing adult fish to easily pass up the flume
Eye elastomer tag	A tagging method that consists of injecting a plastic (elastomer) tag into the eye of a fish in order to identify it when it is caught, returns to the river from the sea, and/or is observed on the spawning grounds
Habitat Unit	A discrete area of a stream such as a pool, riffle, or glide
Head cutting	An in-stream fracture where an unstable stream substrate exists due to flows being in disequilibrium with the existing channel gradient
Introgression	Infiltration of the genes of one species into the gene pool of another through repeated backcrossing of an interspecific hybrid with one of its parents
Mini-jack	A juvenile anadromous fish that returns the same year it was released from the hatchery; this generally occurs when fish are released from the hatchery at a size that is too large

Neotropical	Birds that migrate between North America and the subtropical and tropical portions of South America
Outplants	Hatchery fish that are released into a stream or lake
Reach	An extended portion of a river along its length
Smoltification	The physiological, morphological, and behavioral changes, including loss of parr marks and development of the silvery color of adults and a tolerance for saltwater, that take place in juvenile salmon (parr) as they prepare to migrate downstream and enter the sea
Stop Log	A wooden plank placed within metal guides to stop or regulate water flow within a fishway or dam
Supplementation	Using hatchery-bred fish to augment fish populations in rivers and streams

ACRONYMS AND ABBREVIATIONS

Af	Anadromous female
AHA	All "H" Analyzer
Am	Anadromous male
AER	Adult Equivalent Run
A2R	Age 2 Recruits
ASR	All Species Review
ATPase	Adenosine triphosphate
BKD	Bacterial Kidney Disease
BPA	Bonneville Power Administration
C+E	Catch plus Escapement
CFR	Code of Federal Regulations
cfs	cubic feet per second
CMP	Culvert-multiplate
CMU	Concrete Masonry Unit
CRITFC	Columbia River Inter-Tribal Fish Commission
CSMEP	Collaborative Systemwide Monitoring and Evaluation Project
CWT	Coded wire tag
DPS	Distinct Population Segment
EA	Environmental Assessment
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ESU	Ecologically Significant Unit
fpp	Fish per pound
FWP	Columbia Basin Fish and Wildlife Program
HGMP	Hatchery Genetics Management Program
HOR	Hatchery Origin
HOS	Hatchery Origin Spawners
HSRG	Hatchery Scientific Review Group
HVAC	Heating, ventilation, and air conditioning
ICTRT	Interior Columbia Technical Recovery Team
IFWF	Idaho Fish and Wildlife Foundation
IHN	Infectious haematopoetic necrosis
ISAB	Independent Scientific Advisory Board
ISRP	Independent Scientific Review Panel
K	Potassium
LCR	Lower Columbia River
LWD	large woody debris

MaSA	Major Spawning Area
MCFEG	Mid-Columbia Fisheries Enhancement Group
M&E	Monitoring and evaluation
MiSA	Minor Spawning Area
Na	Sodium
NFH	National Fish Hatchery
NMFS	National Marine Fisheries Service
NOAA Fisheries	National Oceanic and Atmospheric Administration – Fisheries
NOR	Natural origin
NPCC	Northwest Power and Conservation Council
ODFW	Oregon Department of Fish and Wildlife
pHOS	Proportion of hatchery fish present on the spawning grounds
PIT	Passive Integrated Transponder
PNAMP	Pacific Northwest Aquatic Monitoring Program
PNI	Proportion of Natural Influence
pNOB	Proportion of Natural Origin Broodstock
RASP	Regional Assessment of Supplementation of Projects
RCW	Regulatory Code of Washington
Rkm	River kilometer
Rm	River mile
R/S	Recruit per spawner
SAR	Smolt-to-adult (SAR survival rate is measured from the point where a juvenile fish is released or captured to their return to the same point as an adult)
TAC	Technical Advisory Committee
TRT	Technical Review Team
URB	Upriver Bright
USFWS	U.S Fish and Wildlife Service
VSP	Viable Salmon Population
WDFW	Washington Department of Fish and Wildlife
WHAF	Wahkiacus Hatchery and Acclimation Facility
YKFP	Yakima/Klickitat Fisheries Project
YN	Yakama Nation

CHAPTER 1.0 INTRODUCTION

The Klickitat Subbasin Fishery Master Plan is submitted by the Yakama Nation (YN) to the Northwest Power and Conservation Council (NPCC) in fulfillment of Council requirements. NPCC requires all organizations and entities seeking funding for major projects related to fish and wildlife to fulfill the stipulations outlined in the "Step" process (Sections 1.5 and 3.1).

1.1 Description of the Current Project Proposal

Improvements to the Lyle Falls Fishway and broodstock collection facility, and to the Castile Falls Fishway and escapement monitoring facility (Figures 1-1 and 1-2) have now been completed. The Yakama Nation proposes to construct improvements to the existing Klickitat Hatchery near Glenwood, Washington and to build a hatchery and acclimation facility at Wahkiacus (RM 17; Rkm 27) (Figure 1-2). These facilities are needed to support programs for spring Chinook salmon, fall Chinook, steelhead, and coho salmon. The location of the Wahkiacus facility would allow release of hatchery coho and fall Chinook salmon in the lower river which would limit adverse impacts to native fish species. An acclimation site has been identified for McCreedy Creek. This facility would be used for summer steelhead and would be built only if steelhead are unable to naturally re-colonize stream habitat above Castile Falls. Habitat improvements occurring concurrent with the proposed project are expected to also benefit bull trout and Pacific lamprey.

1.2 Document Organization

Chapter 1.0 introduces the project and Chapter 2.0 presents the goals and objectives of the proposed fishery programs. Consistency with NPCC Step 1 requirements is discussed in Chapter 3.0; Chapter 4.0 presents the project context. The project rationale is presented in Chapter 5.0. The proposed programs and monitoring and evaluation activities are discussed in chapters 6.0 and 7.0. Concept designs are presented in Chapter 8.0 and cost estimates are presented in Chapter 9.0. This document has been updated to reflect accomplishments and changes since the March 2008 plan was submitted, and to respond to the ISRP's review of the March 2008 plan.

In addition to material contained in the body of the document, detailed information supporting the text is found in the appendices. The appendices contain Hatchery Genetic Management Plans for steelhead, spring and fall Chinook, and coho; modeling results; proposed habitat actions; and updated conceptual designs for the proposed Klickitat and Wahkiaucus Hatchery facilities. Hyperlinks found throughout the text guide the reader to additional supporting information.

It should be noted that, in this Master Plan the term "Subbasin" refers to the Klickitat Subbasin; "subbasin" refers to the watersheds of individual Klickitat tributaries. "Basin" denotes the Columbia River Basin.

Figure 1-1: Location of Project

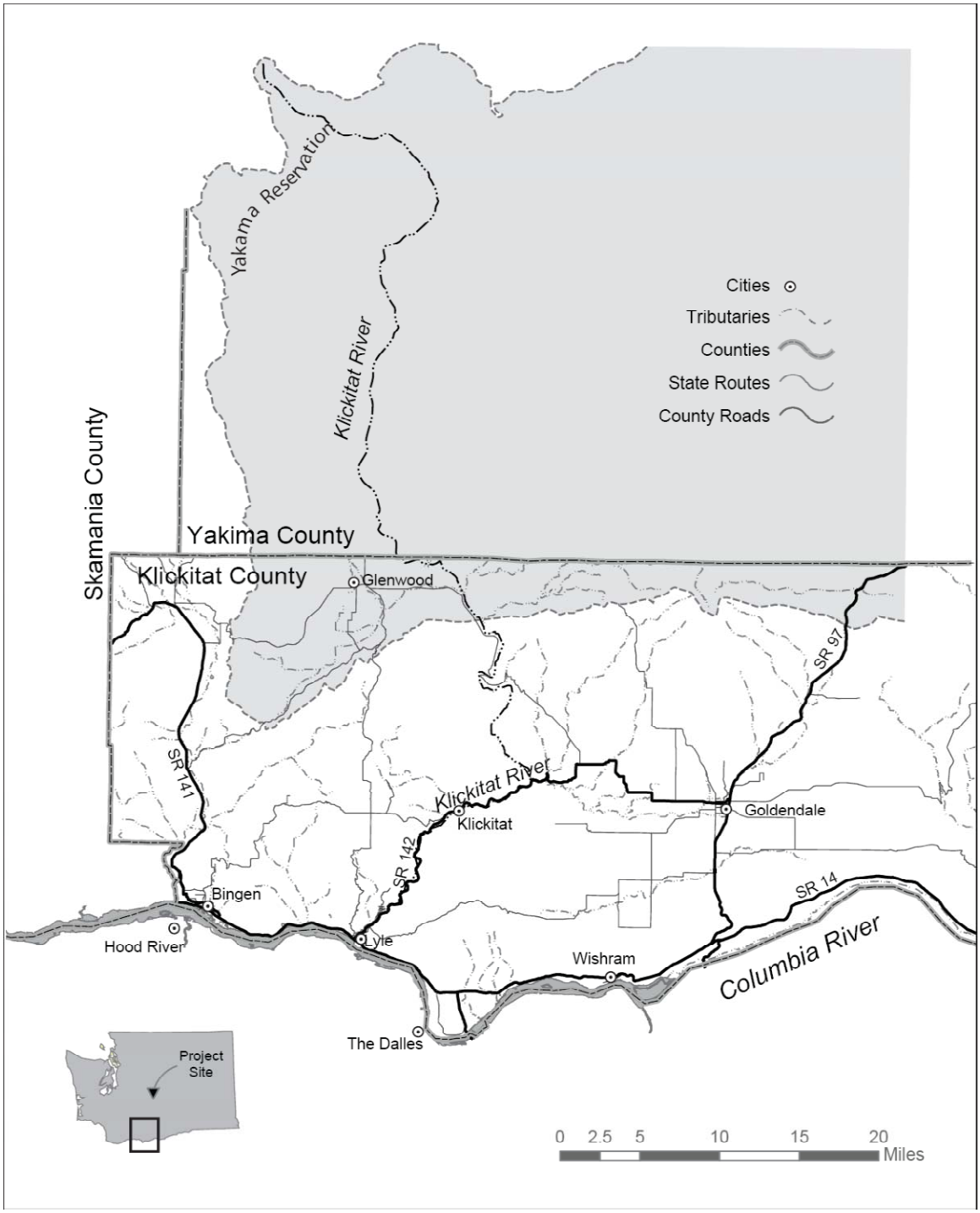
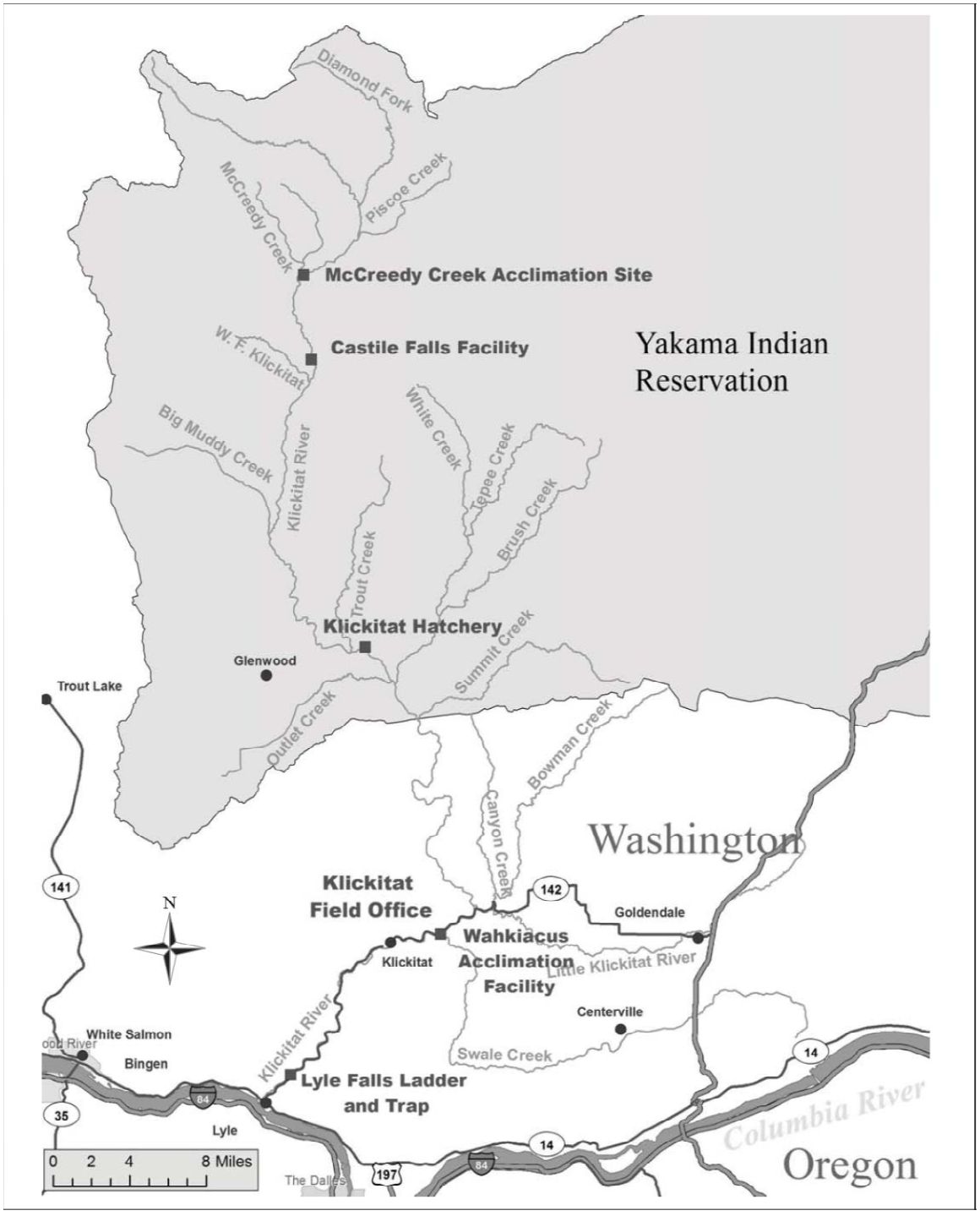


Figure 1-2: Location of Project Facilities



1.3 Need for the Project

Anadromous fish populations have declined in the Klickitat Subbasin, as well as the entire Columbia River Basin, through a combination of habitat degradation, overfishing, and blockages to fish passage. At the same time, the human population has continued to grow, placing more pressure on already depressed fish stocks. The Yakama Nation wants to ensure an adequate and sustainable supply of anadromous fish to satisfy ceremonial, subsistence, commercial, and sport needs. The proposed Klickitat project is part of this effort.

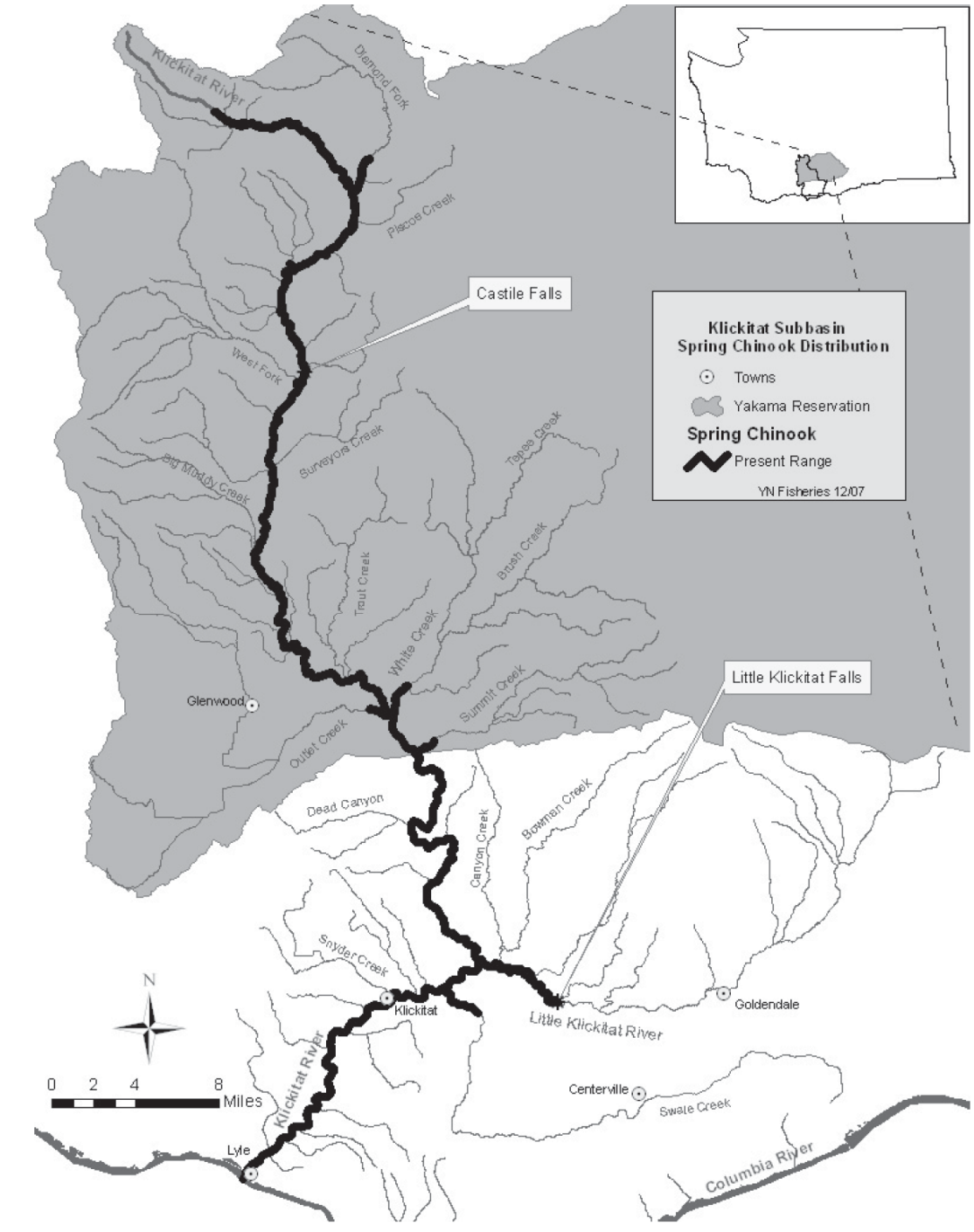
Habitat enhancement alone cannot increase fish populations to needed levels. The YN, therefore, proposes to combine preservation and restoration of fish habitat with supplementation from hatcheries. The proposed project relies upon the most current scientific research to design a project that will assure abundant fish while fulfilling federal treaty trust responsibilities as well as other Tribal needs. The proposed project draws on information gained through the Yakima/Klickitat Fisheries Project's (YKFP) Cle Elum Supplementation and Research Facility and the Hatchery Scientific Review Group (HSRG). The existing Klickitat hatchery has not consistently met the need. Hatchery reform and habitat restoration actions proposed in the Master Plan have a high degree of likelihood of meeting current and future demands on the fisheries resources.

The Klickitat Hatchery began operations in 1952 (construction was not complete until 1954). At that time, the science and art of artificial production was relatively rudimentary. Within the past 50 years, scientific inquiry has lead to new thinking about how and why to engage in artificial production. New approaches view artificial production as supplementation of natural populations rather than as substitutes for them.

The existing facilities (Klickitat Hatchery, Lyle Falls Fishway, and Castile Falls Fishway) were in need of improvement to bring them up to current standards. Necessary modifications at Lyle and Castile Falls were completed in Step 2. In the case of the Castile Falls Fishway, the facility had never been effective, and recent changes to the weirs improved their operation. In addition, a new hatchery is proposed at Wahkiacus Creek and an acclimation facility may be needed at McCreedy Creek to support the proposed summer steelhead program.

Spring Chinook are native to the Klickitat River Subbasin (Figure 1-3). Large natural runs supported a significant Tribal fishery at Lyle Falls prior to 1920. By 1951, the annual spring Chinook run ranged between 1,000 and 5,000 fish annually. The run size averaged about 2,500 fish by 1959. Since 1977, the run size has ranged between 500 and 5,300 fish with an average of 1,900 fish. Most of the returning fish are of hatchery origin; natural escapement has ranged from 100 to about 1,100 fish and has averaged about 300 fish annually since 1977.

Figure 1-3: Distribution of Spring Chinook in the Klickitat Subbasin



Several factors are believed to have adversely affected natural production of spring Chinook in the Klickitat River.

- It is believed that hatchery operations have contributed to a shortened run, smaller body size and fish that cannot negotiate Castile Falls as a wild stock. The native wild stocks were presumed to be larger fish able to produce more offspring and thus, would be able to better exploit available habitat.

- "Improvements" in the 1960s to the Castile Falls Fishway were not successful and resulted in reduced fish passage.

- Degradation due to livestock grazing, logging, and road construction has negatively affected salmonid habitat in the Klickitat Subbasin.

The Klickitat Subbasin supports runs of summer and winter steelhead (Figure 1-4), both of which are native to the system. Both runs are part of the Mid-Columbia Evolutionary Significant Unit (ESU) and are listed as "threatened" under the federal Endangered Species Act (ESA).

Fall Chinook (Figure 1-5) were not historically abundant in the Klickitat Subbasin due to the natural low water conditions that generally prevail during the late summer and early fall, making passage at Lyle Falls difficult. In addition, glacial sediment from Big Muddy Creek is thought to contribute to low egg survival. Hatchery fish from outside the Subbasin were first introduced in 1946 and releases from the Klickitat Hatchery began in 1952. Originally, tule stock were used, but Upriver Bright (URB) stock has been used since 1986.

Coho were introduced to the Klickitat Subbasin by management agencies in the 20th century to provide fish for harvest by Tribal and recreational fishers. Coho had not been present historically in the system.

Both bull trout (*Salvelinus confluentus*) (Figure 1-6) and Pacific lamprey (*Lampetra tridentate*) are species culturally important to the YN. Recent evidence indicates both resident and adfluvial bull trout are present in the Subbasin. Bull trout that are most likely adfluvial have been reported in the mainstem Klickitat River from the mouth up to the area below Castile Falls. Resident populations have been documented in the West Fork Klickitat River, Fish Lake Stream, Little Muddy Creek, Trappers Creek, Clearwater Creek, Two Lakes Stream, and an unnamed tributary to Fish Lake Stream (all within the West Fork Klickitat watershed). Insufficient data exists to make an assessment of bull trout abundance in the Klickitat River. However, it appears that there are very few bull trout in the lower- to mid-Klickitat drainage. Bull trout appear to be more abundant in the upper drainage where habitat conditions are more favorable (Appendix B).

Figure 1-4: Distribution of Summer and Winter Steelhead in the Klickitat Subbasin

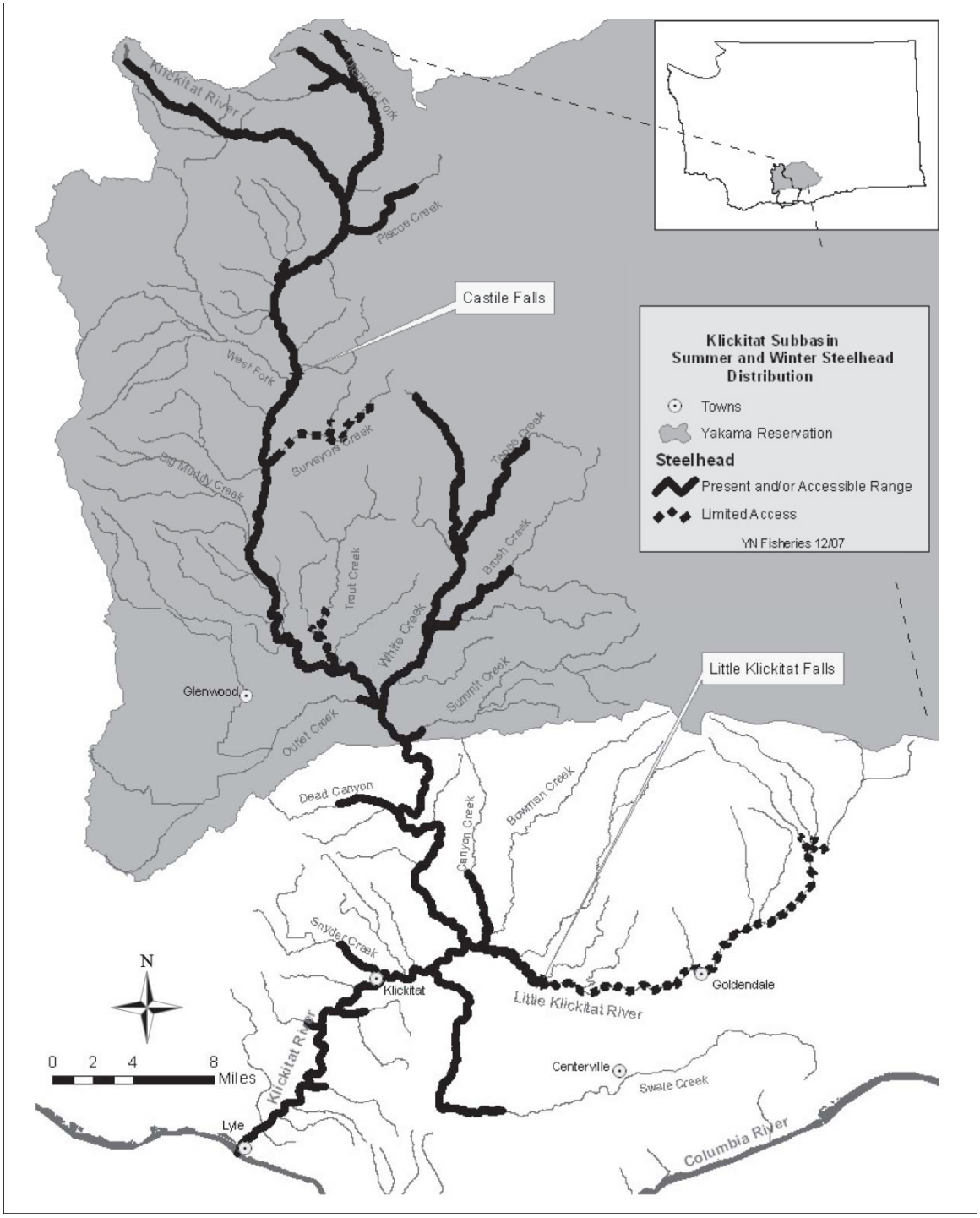


Figure 1-5: Distribution of Fall Chinook in the Klickitat Subbasin

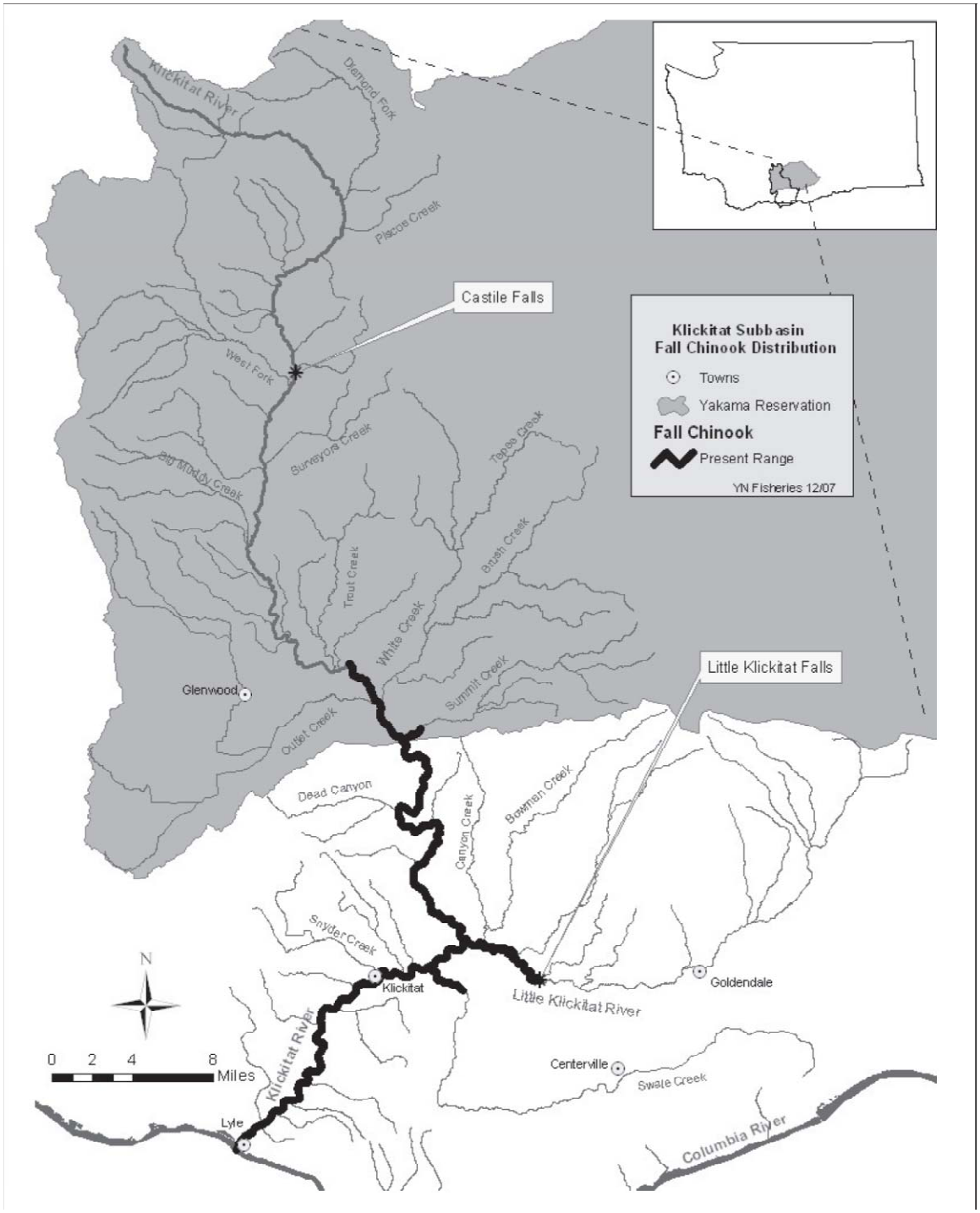
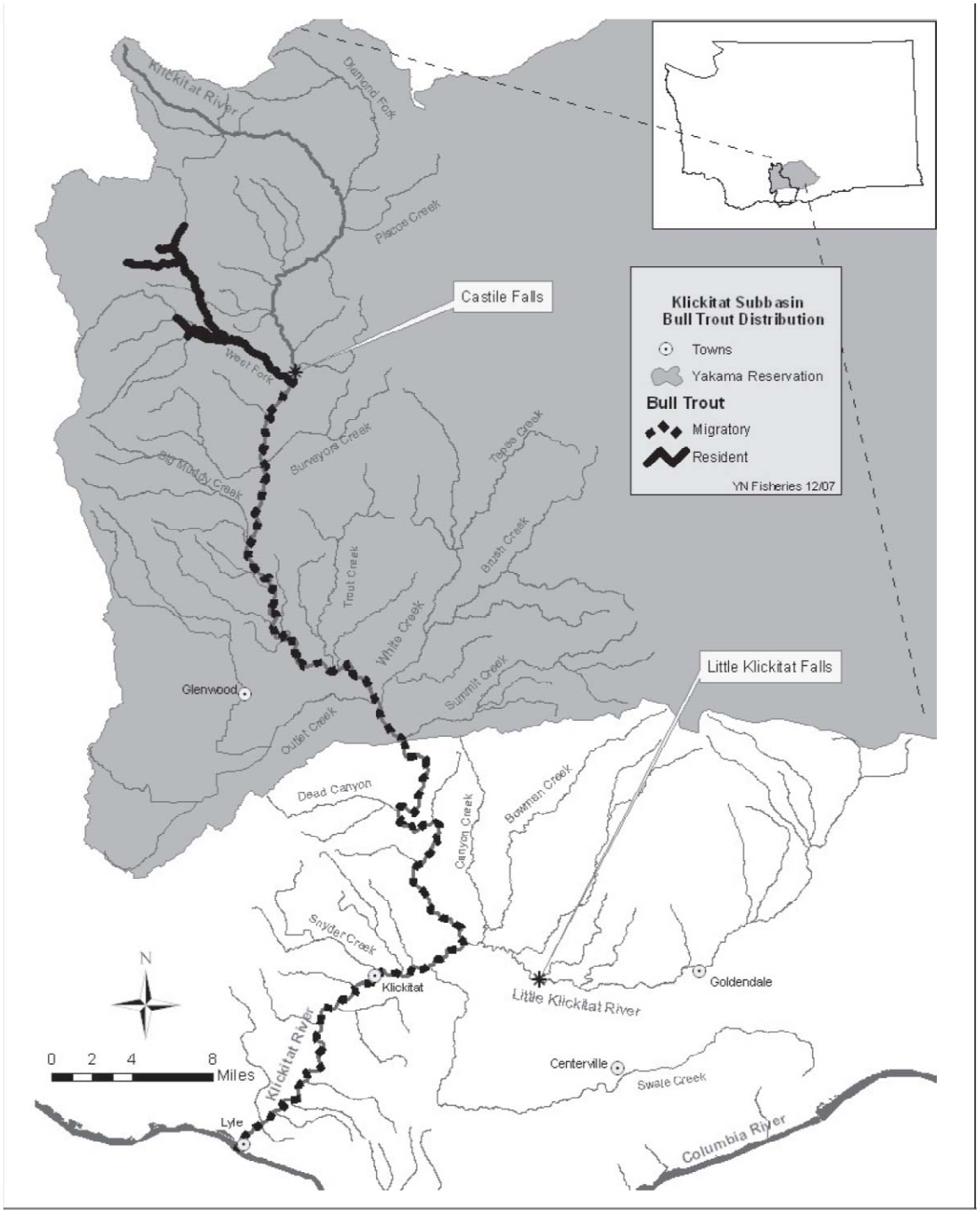


Figure 1-6: Distribution of Bull Trout in the Klickitat Subbasin



The lamprey population is most likely lower than historic levels due to habitat degradation. Lamprey have also suffered from fish passage problems at hydroelectric dams. Data on the abundance and distribution of lamprey are limited. Recent research efforts have been aimed at filling this information gap.

The ecological, historical, and legal rationale for the proposed project is discussed further in Chapter 5.0.

1.4 Project History

The Yakama Nation has actively managed fish and wildlife on their Tribal lands for more than 50 years. During this time, wild and artificially produced spring Chinook (*Oncorynchus tshawytscha*), fall Chinook (*O . tshawytscha*), coho (*O. kisutch*), and steelhead (*O. mykiss*) in the Klickitat Basin have been managed to ensure their long-term existence and provide fishing opportunities in an effort to mitigate for the loss of fisheries due to construction of the Columbia River hydroelectric dams.

Fishing opportunities for Tribal members are guaranteed by the Treaty of 1855 (12 Stat. 951) between the Yakama Nation and the United States of America which states "that the exclusive right of taking fish in the streams running through and bordering said reservation is hereby secured to said Indians; and at all other usual and accustomed stations, in common with the citizens of the United States . . . .". The rights secured by this Treaty were impaired by the loss of fisheries resources following construction of the Columbia River mainstem hydroelectric dams as well as by other causes. Non-treaty fishing opportunities have also eroded with the dwindling populations of salmon and steelhead.

Indian fishing rights were confirmed by a federal court in *U.S. v Oregon*[4] in 1969 (http://www.ccrh.org/comm/river/legal/sojudge.htm). This case was a landmark decision in establishing Columbia River treaty tribes' rights to traditional fishing areas and fish.

The Klickitat Hatchery and Lyle Falls Fishway were constructed between 1950 and 1954 as part of an effort to mitigate for lost fishing opportunities. Fishways were developed at Castile Falls during the 1950s to facilitate spring Chinook access to upriver habitats. The hatchery was previously operated by the Washington Department of Fish and Wildlife (WDFW). The ownership and operation of the hatchery, as well as Lyle Falls and Castile Falls fishways, was transferred to the Yakama Nation in December 2005 and will be operated under the YKFP.

The YKFP uses artificial production to re-establish, supplement, and/or increase natural production of anadromous salmonids and harvest opportunities while maintaining the long-term fitness of the target populations and minimizing or avoiding impacts on non-target species (Bonneville Power Administration 1996). Planning, implementation, and evaluation of YKFP programs are guided by the Regional Assessment of Supplementation Project (RASP 1992). YKFP is also aimed at the experimental aspects

[4] 302 F. Supp. (Dist. Oregon 1969)

of determining the effect of supplementation on natural production of anadromous salmonids.

The Klickitat River Anadromous Fisheries project grew out of the Klickitat Salmon and Steelhead Hatchery preliminary design effort (R.W. Beck and Associates, et al. 1990). A technical work group comprising representatives of BPA, Yakama Nation, WDF, WDW, as well as R.W. Beck and Associates and Fish Management Consultants was formed to design a hatchery for steelhead and spring Chinook in order to "test the hypothesis that new artificial propagation in the basin can be used to increase harvest and enhance natural production while maintaining genetic resources of wild stock fishes." The proposed hatchery was to be located downstream from the existing Klickitat hatchery which was, at that time, owned and operated by WDF.

The emphasis then shifted to the Yakima Subbasin and the Cle Elum Supplementation and Research Facility which was used to test the concept of supplementation on spring Chinook. Cle Elum released its first fish in 1999 and supplementation in that system has increased adult returns and redd abundance while generally keeping risks from ecological interactions within proscribed limits (http://ykfp.org/publications/pubjumpmenu.htm). Focus then returned to the Klickitat Subbasin.

It was decided at that point to concentrate on upgrading the facilities at the existing Klickitat hatchery rather than construct an entirely new hatchery as outlined in the 1990 technical working group document (R.W. Beck and Associates et al. 1990). The scope was widened to include facilities at Lyle Falls and Castile Falls and to include fall Chinook and coho in addition to spring Chinook and steelhead to have all stocks benefit from the current scientific approaches to hatchery management.

As thinking on the project progressed, the need for another hatchery in the Klickitat Subbasin was identified. Segregation of the two endemic stocks of Klickitat spring Chinook and summer steelhead from the production stocks of fall Chinook and coho was needed. The Wahkiacus Hatchery, which is part of this Master Plan, was proposed. The Wahkiacus Hatchery allows geographic segregation (26 river miles) of the stocks from one another, minimizing potentially adverse interactions.

Once the scope of the proposed Klickitat River Anadromous Fisheries Project was defined, preliminary planning and design work began. A draft Master Plan was submitted to the NPCC in 2004. The NPCC review raised a number of issues which were addressed in a revised Master Plan issued March 2008. The revised plan incorporated guidelines for hatchery reform issued by the HSRG (2005) and used the AHA modeling tool to conduct more comprehensive analyses of proposed production programs. The Klickitat Hatchery Complex draft environmental impact statement (DEIS; based on the March 2008 Master Plan) was completed July 2011. Public review of the DEIS concluded October 2011. A final EIS with a record of decision is expected in the autumn of 2012. This revision of the Master Plan has been updated to incorporate information gained through all of these prior reviews.

1.5 NPCC Three-Step Review

The Major Project Review was established by the NPCC as a means to systematically review large capital projects recommended to the Bonneville Power Administration (BPA) for funding through the Columbia River Basin Fish and Wildlife Program. The premise is that only proposed projects that are targeted to meet a need within the Columbia River Basin and which are clearly defined in terms of biological benefits will be eligible for funding. Project proponents must think carefully about what they want to achieve and how they want to achieve it. Projects must also be designed to be as economical as possible. The long-term implications of proposed projects as well as the short-term gains must also be considered. The goal of the Major Project Review, known as the Three-Step Review, is to consider funding only for projects that have successfully completed the planning process from project concept to final design. As stated in the NPCC's Major Project Review document (NPCC 2001), "Any new project funded through the Council's Columbia River Basin Fish and Wildlife Program must be thoroughly reviewed in advance to ensure its design, construction and proposed operations are compatible with the environment and consistent with financial planning for the subbasin where it is located and the Columbia Basin as a whole."

The Three-Step Review links environmental reviews and funding to specific phases of project development and planning. The first step is development of a plan at the conceptual level. This is considered the preliminary or feasibility stage and "is important in identifying all major components and elements" as well as showing the initial layout of components at the proposed site and/or within the proposed plan. Concept designs are expected to have a variance (contingency) of plus or minus 35% to 50%. The concept of the proposed project is contained in a master plan which is submitted to the NPCC for review. Approval of the master plan by the NPCC is accompanied by a notice to proceed to Step 2.

In Step 2, the proposed project is further refined and is submitted for environmental review—usually an environmental impact statement (EIS) or environmental assessment (EA). Step 2 is also known as the "progress review phase." Any major difficulties in the design and proposal are identified in this phase. More details are presented to assure that the project is economically viable and financially responsible and meets "the intent and scope of the previous decision." Expected variance is plus or minus 25% to 35%. At this stage, any changes to the proposed project between steps 2 and 3 are expected to be minor. Approval of this phase allows the project proponent to proceed with Step 3.

Step 3 is "detailed/final" design phase. Final designs are formulated for all facilities and programs and cost estimates are refined accordingly. Expected variances will be plus or minus 10% to 15%. A detailed "and exhaustive review has been carried out" and cost estimates represent "the best available estimate of construction costs for the project." Program operations, research, and monitoring and evaluation (M&E) costs are also presented as final estimates.

NPCC reviews proposed projects according to elements based on the Eight Scientific Principles presented in the Columbia River Basin Fish and Wildlife Program (NPCC

2000). These principles and the Step 1 review elements are discussed in more detail in Chapter 3.0.

CHAPTER 2.0 GOALS AND OBJECTIVES OF THE PROPOSED KLICKITAT PROGRAMS

The basis of any planning effort is the establishment of goals and objectives. All decisions made about facilities and programs must be aimed at accomplishment of the goals and objectives. The proposed Klickitat programs have as their primary goal an increase in the number and distribution of several fish species within the Klickitat Subbasin. An increase in number and distribution of fish is desirable for both social and biological reasons. From the social standpoint, more fish means that YN members can continue to participate in traditional activities. Larger numbers of fish can also benefit the YN from the economic standpoint by increasing the opportunity for commercial and sport harvests. Finally, the ecological benefits cannot be overstated. The proposed Klickitat programs will aid in increasing steelhead populations currently listed under the ESA. In addition, habitat improvements are expected to benefit the listed bull trout and non-listed species, resulting in healthier stream systems within the Subbasin and benefiting the Columbia Basin as a whole.

This Master Plan has established a number of biological goals and objectives that will contribute to accomplishment of the overall goal of increasing fish numbers and distribution within the Subbasin. Biological objectives are defined by the NPCC Fish and Wildlife Program (NPCC 2000) which contains the following language.

> *Biological objectives have two components: 1) biological performance, describing responses of populations to habitat conditions, described in terms of capacity, abundance, productivity and life history diversity, and 2) environmental characteristics, which describe the environmental conditions or changes sought to achieve the desired population characteristics. Where possible, biological objectives are intended to be empirically measurable and based on an explicit scientific rationale.*

The biological objectives established for this Master Plan are designed to achieve both biological performance of the target species and improve environmental conditions to allow sustainable populations. Quantifiable goals have been established for spring Chinook, fall Chinook, steelhead, and coho. Bull trout and Pacific lamprey are not specifically targeted by the proposed programs, but are expected to benefit from proposed habitat improvements and fish passage facilities. The biological goals established for this proposed project are shown below and are also discussed further in Chapter 6.0.

Steelhead

Conservation: reduce the 5% extinction probability from a moderate risk rating to a very low risk rating using the Interior Columbia Technical Recovery Team (ICTRT) criteria (NOAA-Fisheries 2009) (Section 6.1.3)

Harvest: maintain or exceed the current harvest opportunities for the Terminal Treaty and Sport fisheries, without substantially impacting the viability of the wild component of the composite run (Section 6.1.3)

Habitat: improve steelhead habitat quality and quantity throughout the Klickitat River Subbasin (Section 6.1.5)

Spring Chinook

Conservation: 1) increase population viability by ensuring that the adaptation of the population is driven by the natural environment, and 2) ensure that population size remains large enough to allow the population to maintain itself (Sections 6.2.1 and 6.2.3)

Harvest: 1) meet or exceed Treaty harvest obligations consistently and on a long-term sustainable basis, 2) maintain or increase recreational fisheries on a long-term sustainable basis (Section 6.2.3)

Habitat: increase the quantity and quality of Klickitat River mainstem and tributary habitat that currently or historically supported spring Chinook (Section 6.2.5)

Coho

Conservation: no conservation goal has been set; the sole conservation objective is to establish a locally adapted, segregated hatchery population (Section 6.3.3)

Harvest: provide the fish necessary to support Tribal fisheries mandated by federal court orders and the Treaty of 1855 (Section 6.3.3)

Habitat: prevent further degradation of those sections of the river (RKm 0 to RKm 27) used by coho smolts released from the hatchery (Section 6.3.5)

Fall Chinook

Conservation: no conservation goal has been set; the only conservation objective is to establish a locally adapted, segregated hatchery population designed to provide fish for harvest (Section 6.4.3)

Harvest: provide the fish necessary to support Tribal fisheries mandated by federal court orders and the Treaty of 1855 (Section 6.4.3)

Habitat: no habitat objective has been set; improved habitat conditions for steelhead will benefit fall Chinook as well (Section 6.4.5)

Pacific Lamprey

Conservation: increase species abundance over time (Section 6.5.3)

Harvest: increase the population size to a level that can support some harvest for Tribal fishers (Section 6.5.3)

Habitat: no habitat objectives have been set for Pacific lamprey (Section 6.5.5); it is assumed that actions designed to restore steelhead and spring Chinook will also benefit this species

Bull Trout

Conservation: 1) maintain current distribution of bull trout and restore distribution in previously occupied areas within the Lower Columbia Recovery Unit, 2) maintain stable or 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 opportunity for genetic exchange (Section 6.6.3)

Harvest: increase population size to a level that can support a catch-and-release sport fishery as well as incidental harvest in Tribal fisheries (Section 6.6.3)

Habitat: no specific habitat objectives have been set; it is thought that actions implemented for steelhead will also benefit bull trout (Section 6.6.5, Tables 6-17 and 6-18).

In addition to the goals listed above, the proposed project's primary habitat goal is to move habitat 40% closer to historical conditions.

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CHAPTER 3.0 CONSISTENCY WITH NPCC STEP 1 REQUIREMENTS

The NPCC Major Projects (Three Step) Review Process is based on the policies detailed in the 2000 Columbia Basin Fish and Wildlife Program (FWP). The FWP presented eight scientific principles used to shape any fish and/or wildlife project that takes place in the Basin. The eight principles, in turn, were the basis for the requirements contained in the NPCC Major Projects Review document (NPCC 2001). Every project that comes before the NPCC for funding must be consistent with the eight scientific principles and the Major Projects requirements, both in spirit and in fact.

3.1 The Eight Scientific Principles

The YN has made every effort to design the proposed project to conform to the eight scientific principles and the Major Project Review requirements that flow from them. This section presents the principles and discusses how the Master Plan accommodates them.

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

Language from the NPCC Fish and Wildlife Program further amplifies Principle 1:

> *The physical and biological components of ecosystems together produce the diversity, abundance and productivity of plant and animal species, including humans. The combination of suitable habitats and necessary ecological functions forms the ecosystem structure and conditions needed to provide the desired abundance and productivity of specific species.*

The Master Plan recognizes that the aquatic and terrestrial habitats present within and outside of the Klickitat Subbasin determine the abundance, productivity, and diversity of the Subbasin's fish populations. The quality and quantity of habitat within the Subbasin has been evaluated through field surveys and modeling. This has resulted in the identification of habitat factors that are likely limiting fish production in the Subbasin. Strategies and actions have been developed and incorporated into the Master Plan in an effort to improve habitat and associated ecological functions within the historical range of the steelhead and spring Chinook populations (Chapter 6.0).

The biological objectives for the Master Plan are based on an analysis of the entire life cycle of and ecosystem inhabited by each species of interest. The ecosystem of concern for Klickitat River anadromous fish includes the mainstem Columbia River and its estuary and the Pacific Ocean. Though the analysis allowed biologists to explicitly account for the effects that habitat conditions in the mainstem Columbia River, estuary, and ocean have on anadromous fish production in the Klickitat River, it is recognized that improvements in areas outside the Klickitat River Subbasin are not likely to occur in the foreseeable future. Many such actions are outside the influence of the Yakima/Klickitat

Fisheries Program. The Master Plan, therefore, emphasizes improving stream habitat conditions in the Klickitat River.

Harvest is also a "condition" that determines the diversity and abundance of fish. The Master Plan proposes fishing seasons and limitations on the number of fish caught in all fisheries. In addition, fisheries that select for marked hatchery fish will continue in the Subbasin (Chapter 6.0).

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

NPCC Fish and Wildlife Program:

> *Although ecosystems have definable structures and characteristics, their behavior is highly dynamic, changing in response to internal and external factors. The system we see today is the product of its biological, human and geological legacy. Natural disturbance and change are normal ecological processes and are essential to the structure and maintenance of habitats.*

Habitat conditions in the Klickitat River have been degraded over time (Yakama Nation et al. 2004). Human activities such as logging, agriculture, and both urban and rural development have all resulted in a decrease in both habitat quality and quantity. The Master Plan recognizes that this degradation has occurred and proposes substantial habitat protection and improvement actions to return Subbasin habitat more closely to the pre-development condition.

The Master Plan goal is to move habitat conditions 40% closer to historic conditions. To accomplish this goal, the MP proposes habitat actions in both mainstem and tributary habitats across the Subbasin (Chapter 6.0, Appendix A). The proposed habitat actions reflect the habitat restoration and protection actions identified through earlier watershed assessment activities which included both data collection and modeling. The approach will help protect fish populations from catastrophic events as well as smaller scale disruptions. It is recognized that habitat protection and restoration activities that take into account natural processes as well as man-caused changes require a long-term commitment.

Fish population abundance and diversity is expected to increase as existing habitat is improved and new habitat established. As a result, hatchery production will decrease over time as escapement and harvest targets are achieved, especially for ESA-listed steelhead. Habitats and fish populations will be monitored to detect trends in condition and abundance and to assess the extent to which ecosystem productivity and function is being restored. Information gathered through monitoring and evaluation will be used to make changes to the Master Plan (Principle 7 below, Chapter 7.0).

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

NPCC Fish and Wildlife Program:

> *Ecosystems, landscapes, communities and populations are usefully described as hierarchies of nested components distinguished by their appropriate spatial and time scales. Higher-level ecological patterns and processes constrain, and in turn reflect, localized patterns and processes. There is no single, intrinsically correct description of an ecosystem, only one that is useful to management or scientific research. The hierarchy should clarify the higher-level constraints as well as the localized mechanisms behind the problem.*

The Master Plan accounts for the fact that Klickitat River fish populations are important locally and regionally. For example, Klickitat River steelhead are included in the Mid-Columbia ESU. Changes in this population's abundance, productivity, and diversity can impact the overall health of the entire ESU. The Master Plan accounts for this by supporting actions located in those areas of the Subbasin defined by the Technical Review Team (TRT) as needed for the recovery of the ESU.

The environmental conditions within the Subbasin vary by stream. As a result, the life history, abundance, and productivity of fish inhabiting the streams may also be different from one another. It is important to maintain life history diversity in fish populations because it allows the population to take advantage of changing environmental conditions. This may be especially important if global warming effects accelerate. Therefore, while the overall Master Plan goal is to increase fish production within the Klickitat Subbasin, adult escapement targets also have been set for specific areas of the Subbasin (Chapter 6.0). If escapement levels are not likely to be achieved, harvest actions will be adjusted accordingly.

The NPCC Fish and Wildlife Plan notes that there is no intrinsically correct ecosystem. Past fisheries management decisions under the federal Mitchell Act carved out a principle role for the Klickitat Subbasin in mitigating the impacts of dam construction. This resulted in a modification of the pre-development ecosystem. The Master Plan accounts for the needs and Treaty-reserved rights of the Yakama Nation while recognizing that man is part of the environment occupied by fish and that man has been a significant force in the development of the Klickitat Subbasin as it exists today including its fish stock abundance, productivity, and diversity. Tribal members have been fishing in the Klickitat Subbasin for generations and the Klickitat River has high cultural significance to members of the YN. This significance has increased greatly as harvest opportunity has decreased at other traditional fishing sites due to ESA salmon listings. To maintain the Yakama Nation's treaty fishing rights and traditional way of life, the Master Plan continues to support the production of hatchery fish principally for Tribal harvest. Risks to native species from the harvest-oriented programs for coho and fall Chinook will be reduced below former levels by decreasing the impacts of harvest-oriented artificial production on ecosystems that provide excellent habitat for natural production. This will

be accomplished by: 1) moving release locations to the lower river, 2) reducing hatchery release numbers, 3) eliminating out-of-Subbasin fish transfers, and 4) developing new hatchery facilities in the lower river for harvest-oriented production. The monitoring and evaluation program will be used to assist managers in determining the impacts the Plan's programs may be having on wild fish populations.

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

NPCC Fish and Wildlife Program:

> *Habitats are created, altered and maintained by processes that operate over a range of scales. Locally observed conditions often reflect more expansive or non-local processes and influences, including human actions. The presence of essential habitat features created by these processes determines the abundance, productivity and diversity of species and communities. Habitat restoration actions are most effective when undertaken with an understanding and appreciation of the underlying habitat-forming processes.*

Habitat conditions observed in a particular reach may indicate impacts occurring elsewhere in the Subbasin or at a larger scale. For example, changes in the amount and timing of stream flow or sediment input to the channel may be the result of human actions or natural processes occurring in adjacent upland areas or upstream of the reach where the impact is observed. Habitat actions and strategies proposed in the Master Plan are based on earlier watershed assessments and emphasize actions at the watershed (Subbasin) level rather than at the habitat unit scale. Strategies include:

- Protecting stream corridor structure and function
- Restoring passage and connectivity between habitat areas
- Restoring floodplain function and channel migration processes
- Restoring riparian condition
- Restoring normative flow regimes
- Restoring degraded water quality, including water temperature

The Master Plan proposes a variety of actions to implement these strategies, taking into account the limited usefulness of some types of habitat actions as well as the acceptability of some actions to members of the public.

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

NPCC Fish and Wildlife Program:

> *Each species has one or more ecological functions that may be key to the development and maintenance of ecological conditions. Species, in effect, have a distinct job or occupation that is essential to the structure, sustainability and productivity of the ecosystem over time. The existence,*

> *productivity and abundance of specific species depend on these functions. In turn, loss of species and their functions lessens the ability of the ecosystem to withstand disturbance and change.*

One of the key roles anadromous fish play in the Klickitat River is the delivery of marine-derived nutrients back to the Subbasin as their carcasses decompose after spawning. These nutrients increase stream productivity and provide a food source for both terrestrial and aquatic species (Cedarholm et al. 2000).

Past salmon harvest management in the ocean and the Columbia River and habitat degradation have resulted in a decrease in the abundance of some species in the Klickitat Subbasin. This has resulted in a decrease in the amount of nutrients delivered to portions of the Subbasin. However, hatchery production and release of hatchery fall Chinook and coho beginning in the 1950s has increased marine-derived nutrients in the mainstem Klickitat River. Although hatchery production will be decreased under the new plan, increased adult production goals for spring Chinook and steelhead should help alleviate the loss of marine-derived nutrients resulting from hatchery fish spawning naturally in the Subbasin.

The reduction in hatchery production, as well as the elimination of out-of-Subbasin hatchery transfers, signals a change in Subbasin fisheries management. The Master Plan emphasizes the production of native fish stocks in both the natural and hatchery environments. The proposed production and harvest actions are expected to increase the abundance and productivity of native steelhead and spring Chinook, thereby ensuring that the ecological functions provided by these species are maintained into the future.

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

NPCC Fish and Wildlife Program:

> *The diversity of species, traits and life histories within biological communities contributes to ecological stability in the face of disturbance and environmental change. Loss of species and their ecological functions can decrease ecological stability and resilience. It is not simply that more diversity is always good; introduction of non-native species, for example, can increase diversity but disrupt ecological structure. Diversity within a species presents a greater range of possible solutions to environmental variation and change. Maintaining the ability of the ecosystem to express its own species composition and diversity allows the system to remain productive in the face of environmental variation.*

The diversity of fish populations will be ensured primarily through habitat improvement, increased access to suitable habitat, and habitat protection actions across the Subbasin. This Plan documents many habitat actions that are being implemented to protect and restore the native ecology of the Subbasin (see Principle 8 and Chapters 6 and 7). Thus, if environmental conditions result in, for example, the failure of a spawning aggregate in

one portion of the Subbasin, the existence of populations in other parts of the Subbasin will allow production to continue.

It is known that changing ocean and estuary conditions can result in wide swings in fish population abundance. The Master Plan sets a minimum escapement target for steelhead and spring Chinook to account for low survival years as well as higher average escapement targets to take advantage of better survival years. This strategy will help fish populations to rebuild quickly to levels needed to sustain the species over time. To achieve the higher average escapement target, harvest will likely need to be adjusted in some years. Harvest actions will be consistent with the goal of allowing more wild fish to spawn naturally, thereby producing more juveniles in subsequent years.

It is recognized that, while hatchery programs may provide substantial harvest and conservation benefits, they also pose risks to native fish communities. Hatcheries can prevent fish from taking advantage of favorable habitat conditions by decreasing population productivity. To reduce hatchery effects on wild anadromous fish populations, the Master Plan sets performance targets for the proportion of hatchery fish present on the spawning grounds (pHOS), incorporates HSRG recommendations to ensure that the natural environment, rather than the hatchery environment, drives the local adaptation of the composite stock, limits the proportion of the wild population used as hatchery broodstock, and sets minimum and average adult escapement targets. The influence of hatchery populations on natural-origin fish will also be reduced by maximizing harvest opportunities to target hatchery fish and by implementing measures to increase homing fidelity. The objective is to ensure that the natural, rather than the hatchery, environment drives local adaptation of the integrated population.

As discussed above under Principle 3, the risks to native species from harvest-oriented programs for coho and fall Chinook will be minimized by actions designed to avoid negative interactions between native and non-native species. Monitoring and evaluation programs will aid managers in determining impacts to wild fish populations.

Principle 7: Ecological management is adaptive and experimental.

NPCC Fish and Wildlife Program:

> *The dynamic nature, diversity, and complexity of ecological systems routinely disable attempts to command and control the environment. Adaptive management — the use of management experiments to investigate biological problems and to test the efficacy of management programs — provides a model for experimental management of ecosystems. Experimental management does not mean passive "learning by doing," but rather a directed program aimed at understanding key ecosystem dynamics and the impacts of human actions using scientific experimentation and inquiry.*

Biological goals for spring Chinook and steelhead are based on both conservation and harvest objectives. The conservation component of the steelhead hatchery program is

designed to re-establish a viable population above Castile Falls in the event that natural colonization is ineffective or protracted. The program will target adult escapement near levels of estimated habitat capacity derived from scientifically based models prior to program suspension. Upon termination of the hatchery releases, M&E activities will be used to track the viability of the upper Subbasin's newly established population. Scientifically based information derived from such activities will be used to guide long-term adaptive management strategies pertaining to the population.

The spring Chinook abundance objective is to achieve a minimum and average escapement of 400 and 700 adults, respectively. In regard to spatial structure, the objective is to have spring Chinook spawn throughout their historical range in the Subbasin. Monitoring and evaluation programs will determine the success of the proposed spring Chinook programs and will be used to make modifications if needed.

The Master Plan proposes to test whether post-release survival of coho and fall Chinook can be improved by making several changes to current programs. If the changes are successful, hatchery production release numbers in the Klickitat Subbasin could be permanently reduced. The excess fish could be used outside the Subbasin and the current harvest levels for terminal fisheries could still be maintained. Program changes that will be tested include transition to local broodstock and elimination of direct stream releases of out-of-Subbasin juveniles. These changes are also expected to eliminate the potential for out-of-Subbasin disease transfers and/or outbreaks and should provide positive benefits for natural populations by reducing competition and predation impacts from hatchery fish.

Coho and fall Chinook hatchery production are being modified to use local broodstock; in addition, the coho program includes potential reduction and elimination of direct juvenile releases to the river, and the construction of new hatchery facilities. These measures are intended to increase survival sufficiently to meet harvest objectives. This "experiment", although focused on harvest, should provide benefits to wild fish by reducing competition and predation impacts from hatchery fish.

Proponents have considered the possibility of terminating the coho program if treaty harvest goals could be achieved by moving release and fishing locations out of the Klickitat Basin. Because of the special role of the Lyle Falls fishery in the exercise of treaty fishing rights through traditional fishing methods, there do not appear to be any viable alternative locations that satisfy treaty harvest goals.

The Master Plan does not account for, or assume, any improvements in habitat conditions in the mainstem Columbia or estuary. However, smolt-to-adult return rate data will be collected to track fish survival once they leave the Subbasin to see if survival rates change over time. M&E results will be used to determine if harvest and spawning escapement targets are being achieved. Subbasin fisheries management will be altered based on the results of M&E.

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

NPCC Fish and Wildlife Program:

> *As humans, we often view ourselves as separate and distinct from the natural world. However, we are integral parts of ecosystems. Our actions have a pervasive impact on the structure and function of ecosystems, while at the same time, our health and well being are tied to these conditions. These actions must be managed in ways that protect and restore ecosystem structures and conditions necessary for the survival and recovery of fish and wildlife in the basin. Success depends on the extent to which we choose to control our impacts so as to balance the various services potentially provided by the Columbia River Basin.*

Common threads running through the discussions of all eight scientific principles are human effects on anadromous fish and their habitats and the human need for anadromous fish. The Master Plan is designed to accommodate both the human-caused degradation of Klickitat Subbasin salmon and steelhead stocks and the cultural, economic, commercial, and recreational importance of those stocks by improving and protecting fish habitat, restoring and increasing naturally spawning populations, and accommodating treaty harvest rights.

The habitat portion of the Plan is focused on addressing human degradation of stream habitat throughout the Subbasin. The Master Plan does not account for, or assume, any improvements in habitat conditions in the mainstem Columbia or estuary. Strategies and actions are designed to target the key habitat factors limiting fish abundance, productivity, spatial structure, and life history diversity. The co-managers and other entities have identified approximately $130 million of habitat enhancement and protection actions for the Subbasin (Appendix A). A prioritization strategy has been developed to guide the action selection and implementation process.

The hatchery program attempts to balance the treaty harvest rights of the Yakama Nation with the impacts hatchery facilities and fisheries have on native fish communities. This balance is evidenced by the substantial changes to hatchery production programs proposed for the Subbasin.

Harvest levels and rates will be monitored and enforced under the proposed project. Selective sport fisheries that require fishers to release wild fish will be maintained throughout the Subbasin. Tribal members may choose to release unmarked fish to the stream as well.

3.2 Step 1 Requirements for All Projects

The Eight Scientific Principles are the basis for the review elements contained in the NPCC's Major Project Review. A discussion of how the Master Plan addresses each general project review element is presented in this section. The review elements are quoted from NPCC 2000.

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

Section 3.1 contained a thorough presentation of the Eight Scientific Principles and the ways in which the proposed Master Plan satisfies them. In addition, the Master Plan has been designed to satisfy the Step 1 requirements, all of which derive from the Eight Scientific Principles. The proposed project recognizes the inter-relationships between species, their habitats, natural forces, and human activities. Biological objectives with measurable attributes have been defined for each of the target species (Chapter 6.0) and the links between the proposal and other projects and activities in the Subbasin are described (Chapter 4.0). Implementation strategies as well as monitoring and evaluation are included in the Master Plan (chapters 6.0 and 7.0). Conceptual designs and costs are found in chapters 8.0 and 9.0.

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

The Klickitat Subbasin is the target of the proposed project. The Master Plan is linked to and consistent with the Klickitat Subbasin Plan (Yakama Nation, Klickitat County, and WDFW 2004) and the Klickitat Subbasin Recovery Plan (NOAA-Fisheries 2009). The goals and objectives defined for the proposed project echoes those found in the other plans. It is envisioned that the implementation of the proposed project will augment the actions performed under the Subbasin and recovery plan and will lead to healthy, harvestable, and sustainable populations of spring Chinook, fall Chinook, steelhead, coho, bull trout, and Pacific lamprey as well as improved habitat within the Subbasin. The Klickitat Subbasin Plan and recovery plan are discussed further in sections 4.2.1 and 4.2.2.

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

Biological objectives have been established for steelhead, spring Chinook, fall Chinook, and coho within the Klickitat Subbasin. The objectives are defined in terms of "primary" conservation and harvest objectives and numerical objectives. Conservation goals are measured in terms of productivity, abundance, life history diversity, and geographic distribution (spatial structure). Harvest goals are divided into Tribal and sport harvests in the mainstem and inside the Klickitat Subbasin. Habitat objectives are discussed in terms of limiting factors. The primary objectives and references to the sections and tables containing the measurable objectives are presented in Chapter 2.0 and discussed in detail in Chapter 6.0.

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.

Implementation strategies are contained in Chapter 6.0 for each of the target species. Strategies have been established to implement conservation, harvest, and habitat actions. All actions are aimed at accomplishing the goals and objectives established for each species. Sections where the strategies are detailed are 6.1.5 (steelhead), 6.2.5 (spring Chinook), 6.3.5 (coho), 6.4.5 (fall Chinook), 6.5.5 (Pacific lamprey), and 6.6.5 (bull trout). Appendix A also contains habitat information.

> *Address the relationship to the habitat strategies found in the 2000 Columbia River Basin Fish and Wildlife Program (Section D.3).*

The habitat objectives and strategies contained in the Master Plan are based on the habitat strategies found in the 2000 Columbia River Basin Fish and Wildlife Program (NPCC 2000). The FWP calls for protection and restoration "of freshwater habitat for all life history stages of the key species." It also requires that "ecological connectivity between aquatic areas, riparian zones, floodplains and uplands" be protected and increased. The habitat strategies proposed reflect these requirements.

Habitat strategies in this Master Plan reflect the identified limiting factors for the Klickitat Subbasin and focus on major and minor spawning areas (MaSA and MiSA). As an example, Table 6-6 for steelhead lists the target areas within the Subbasin and the limiting factors for each. Table 6-7 presents the six habitat strategies proposed for steelhead and the streams and/or reaches where the strategies will be implemented. The strategies include protecting stream corridor structure and function, restoring passage and connectivity between habitat areas, restoring floodplain function and channel migration processes, restoring riparian condition, restoring normative flow regimes, and restoring degraded water quality. Strategies for the other species are similar to those described for steelhead. These strategies will be refined in Steps 2 and 3.

> *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.*

Formulation of the proposed project included examination of other strategies (Sections 6.1.4, 6.2.4, 6.3.4, 6.4.4, 6.5.4, and 6.6.4). The discussions of strategies for each species include descriptions of the options and the reasons for their rejection. Generally, the options were 1) continue existing hatchery operations, 2) cease hatchery operations and concentrate on habitat improvement and restoration, and 3) institute an integrated hatchery program as well as habitat improvement and restoration. The YN considered current management activities in the Subbasin, province, and Basin before proposing the preferred options.

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

The historical and current status of the species of concern to this Master Plan is described in Chapter 6.0. In the case of each of the species, the numbers of fish have declined from

historical levels. Steelhead and bull trout numbers are low enough that these species are currently listed under the provisions of the Endangered Species Act. Spring Chinook populations are considered depressed by WDFW.

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

Chapter 6.0 also contains descriptions of both current and planned management of steelhead, spring Chinook, coho, fall Chinook, Pacific lamprey, and bull trout in the Klickitat Subbasin. It is recognized that past and current management of hatcheries, harvest, and habitat within the Subbasin have not led to increasing fish numbers and distribution. Therefore, new management strategies are being proposed under this Master Plan.

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

The proposed project has been designed to be compatible and consistent with the draft Klickitat Recovery Plan and the Klickitat Subbasin Plan. All of the plans have the goal of increasing naturally spawning anadromous fish numbers and distribution in the Klickitat Subbasin while minimizing negative effects to resident fish and wildlife. All the plans were stimulated by and based upon the NPCC's FWP (NPPC 2000).

Describe the status of the comprehensive environmental assessment.

The Klickitat Hatchery Complex draft environmental impact statement (DEIS) was completed July 2011. Public review of the DEIS concluded October 2011. A final EIS with a record of decision is expected in the autumn of 2012.

Describe the monitoring and evaluation plan.

The monitoring and evaluation plan proposed for this project is detailed in Chapter 7.0. The proposed monitoring and evaluation program deals with hatchery, harvest, and habitat components of the Master Plan. Habitat action effectiveness monitoring is discussed but not described in great detail here; it will be conducted using a combination of methods including the Columbia Habitat Monitoring Program (CHaMP), the YKFP-developed Rapid Aquatic Habitat Assessment Protocol (RAHAP), and more focused studies in selected areas. It will also be addressed through regional efforts such as the Coordinated Assessments project, subbasin recovery planning (NOAA 2009), and the Yakama Nation Status and Trends Report (STAR) project. This will assure that the program proposed for the Klickitat River habitat strategy is consistent with M&E protocols being used throughout the Columbia River Basin.

The M&E plan has been designed to be consistent with the Columbia River Basin regional strategies including Monitoring, Evaluation, Research, and Reporting (MERR); Anadromous Salmonid Monitoring Strategy (ASMS); Collaborative Systemwide Monitoring and Evaluation Project (CSMEP), and Pacific Northwest Aquatic Monitoring

Partnership (PNAMP). YN continues to participate in regional efforts to develop standardized research, monitoring, and evaluation methods and recommendations and is committed to using adaptive management to incorporate regional recommendations into Yakama Nation projects, including those proposed under this Master Plan for the Klickitat Subbasin.

M&E for hatchery activities below focus on determining the success of the hatchery programs, identifying the effects each program has on native stocks, and identifying and rectifying critical uncertainties. In relation to harvest, managers will use traditional time, area, and gear restrictions in combination with measures such as selective fisheries to target fisheries on stocks not intended to be used to restore natural production in the Subbasin. Fisheries will be monitored using creel and on-the-water methods; regulations will be enforced by Tribal and WDFW fish and wildlife officers. Estimated harvest by population and run sizes will be updated and analyzed on a regular basis so that in-season adjustments to fisheries can be made if necessary.

The results of M&E activities under the Master Plan will be presented in annual reports. A yearly workshop will be held to present study findings to other agencies and interested public. Study results and workshop materials will be stored on the web at www.ykfp.org.

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

The costs associated with the proposed project are presented in Chapter 9.0.

3.3 Step 1 Requirements for Artificial Production Projects

In addition to the NPCC requirements for all projects, the Major Project Review process has specific requirements for artificial production projects.

> *Address the relation and link to the artificial production policies and strategies [of the 2000 FWP, Sections D.4 and Technical Appendix]*

The proposed project is based on the artificial production policies and strategies found in the FWP (NPCC 2000). The primary FWP strategy for artificial production states that *"Artificial production can be used, under the proper conditions, to 1) complement habitat improvements by supplementing native fish populations up to the sustainable carrying capacity of the habitat with fish that are as similar as possible, in genetics and behavior, to wild native fish, and 2) replace lost salmon and steelhead in blocked areas."* One of the main purposes of the proposed project is to increase numbers and distribution of native species (spring Chinook and summer steelhead) by transitioning from traditional hatchery programs to HSRG-based integrated programs using genetically similar stocks (Chapter 6.0). The M&E plan is designed to ensure that production strategies are not harmful to naturally spawning native stocks. If problems are identified, management programs and strategies will be adjusted. As the abundance of restored stocks increases, harvest levels are maintained or increased, and fish begin to spawn in the wild and exploit

available habitats, hatchery supplementation is expected to decline and could eventually be eliminated.

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

HGMPs for the proposed Klickitat River Anadromous Fisheries Master Plan are found in Appendix B.

Describe the harvest plan (see 2000 Columbia River Basin Fish and Wildlife Program, Basinwide Provisions, Section D.5).

Harvest plans for the target species are outlined in Chapter 6.0. The goals of the harvest plans for each species are summarized in Chapter 2.0.

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

The conceptual designs for the proposed hatchery modifications and new facilities are contained in Chapter 8.0.

Provide a conceptual design of the proposed strategies and/or facilities.

The conceptual designs for the facilities are presented in Chapter 8. Strategies for harvest, hatcheries, and habitat are described in Chapter 6. Monitoring and evaluation strategies are presented in Chapter 7.

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CHAPTER 4.0 LOCAL AND REGIONAL CONTEXT FOR THE PROPOSED PROJECT

4.1 Local and Regional Context

4.1.1 Geography, Topography, Hydrology, Habitat, and Land Use

The Klickitat Subbasin is located in southcentral Washington State within the NPCC's Columbia Gorge Province (Figure 4-1). The Subbasin covers an area of about 1,350 square miles and is nearly equally divided between Yakima and Klickitat counties. The northern portion of the Subbasin lies within the boundaries of the reservation of the Confederated Tribes and Bands of the Yakama Nation.

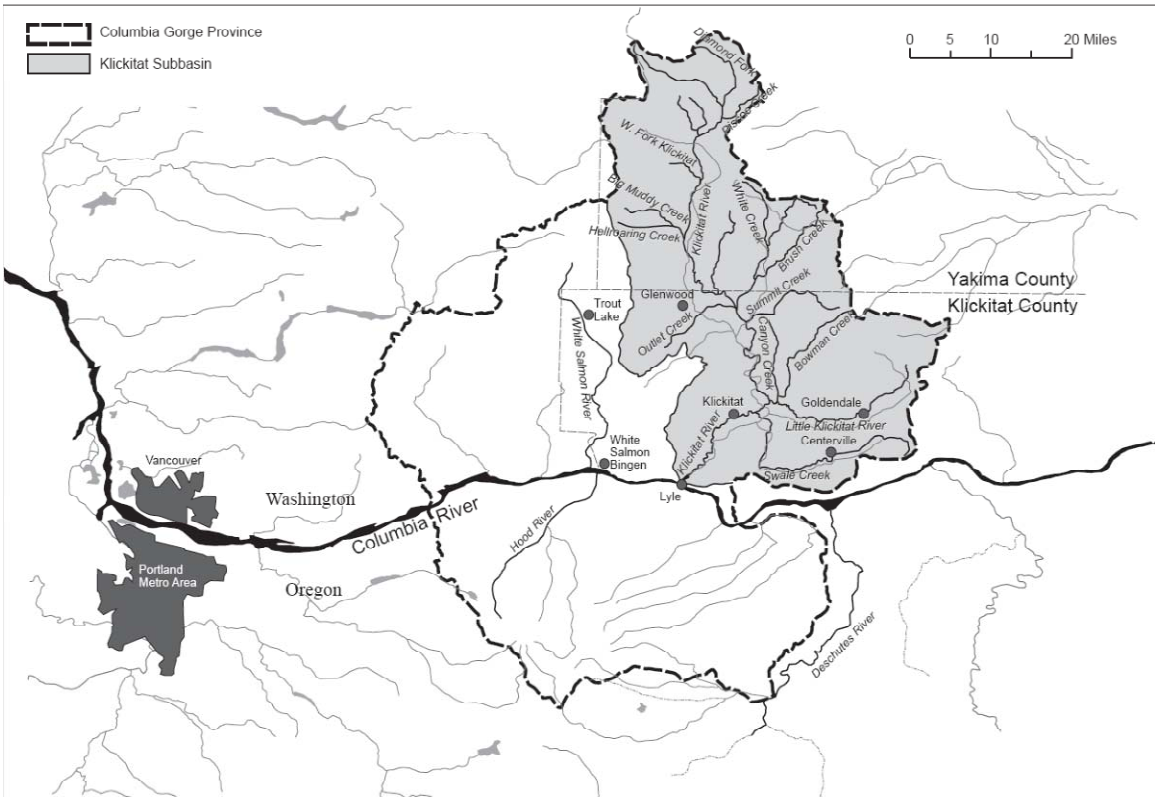
The area's climate is characterized by the Pacific Ocean's maritime influence and the more arid climates found on the east side of the Cascade Range. Temperatures in the northwest portion of the Subbasin are cooler and wetter than those in the southeast. Summers are dry with average temperatures of 55°F to 70°F and winters are cold and wet with average temperatures of 25°F to 37°F. Precipitation decreases from the west to the east side of the area. Mount Adams typically receives 140 inches of precipitation per year while east side areas receive about 9 inches. The months receiving the greatest precipitation are December and January; the driest months are July and August (Yakama Nation et al. 2004).

The Subbasin's geology is typical of the basalt-covered areas of eastern Washington and Oregon. Thick layers of basalt cover the land; rivers carve steep-walled canyons through the layers. Mountainous portions of the Subbasin are characterized by coniferous forests while more the arid regions are covered by vegetation typical of sagebrush steppes and grasslands. The Klickitat River occupies a relatively wide valley separated from the surrounding plateau by steep slopes.

Forests cover nearly 75% of the Klickitat Subbasin. Upland areas provide habitat for a variety of large and small mammals, birds, reptiles, and amphibians. According to the Klickitat Subbasin Plan (Yakama Nation et al. 2004), many wildlife species in this area are "listed as federal and/or state Threatened, Endangered, Sensitive or At-Risk." The area is important for overwintering mule deer and is part of the Pacific flyway for migratory waterfowl. Elk and mule deer use the higher elevations during the summer months and many neotropical migratory birds as well as the flammulated owl, breed in the Klickitat Subbasin. The Subbasin provides habitat for western gray squirrels, a species which is at low levels in other parts of Washington.

Terrestrial habitat has been adversely affected in many areas of the Subbasin. Logging, agriculture, residential development, road construction, and the introduction of invasive species of plants and animals have all played a part in reducing riparian, wetland, and upland habitats. Habitats such as white oak forests have been fragmented which adversely affects wildlife movements through the area.

Figure 4-1: Klickitat Subbasin and Columbia Gorge Province



The major rivers in the area are the Columbia River, Klickitat, and Little Klickitat. Each contains populations of anadromous and resident fish. The anadromous populations have decreased over the past century due to reduction in suitable aquatic habitat, fish passage blockage, and commercial overharvest. Life history, distribution, and population information about the fish species that are the focus of this Master Plan are found in chapters 1.0 and 6.0, Appendix B, and the Klickitat Subbasin Plan (Yakama Nation, Klickitat County, and WDFW 2004)

The Klickitat River headwaters lie in the Goat Rocks Wilderness at about 5,000 ft in elevation. From here, the river flows 95 miles before entering the Columbia River at Lyle, Washington, upstream of Bonneville Dam. The Klickitat is "one of the longest undammed rivers in the northwest" (Yakama Nation et al. 2004). Swale Creek, Little Klickitat River, Outlet Creek, the West Fork of the Klickitat, Diamond Fork, and Big Muddy Creek are major tributaries to the Klickitat.

The hydrology of the Klickitat Subbasin is described in detail in the Klickitat Subbasin Plan (Yakama Nation et al. 2004). Channel gradients range from 8% or greater near the headwaters to less than 1% along much of the mainstem. In the vicinity of the Klickitat Hatchery at RM 42.4, the channel gradient is 1% to 2%. The river has two major falls: Lyle Falls at RM 2.2 and Castile Falls at RM 64 to 64.5. Lyle Falls is a series of five falls ranging from 4 to 12 feet; Castile Falls is a series of 11 falls with a total elevation change of approximately 80 feet. The major tributaries are generally characterized by low gradient reaches on the valley floor, a falls or high gradient reach between the valley and the plateau.

River flows within the Subbasin are unregulated. Water is diverted from portions of some tributaries, including Swale Creek, Little Klickitat River, and Outlet Creek, for water supplies and irrigation. The remainder of the Subbasin exhibits a natural flow regime. Klickitat River flows, as well as those of tributaries in the middle and upper portions of the Subbasin, are dominated by snowmelt. The highest river flows occur in late spring. The snow pack on Mt. Adams contributes to river flows well into the summer months. In the mid-elevations, hydrographs are dominated by rain on snow; highest flows occur in the winter during warm winter storms.

In the lower elevations where channel gradients are nearly flat, stream velocities, stream energy, and erosion potential are low. In the steeper canyon areas, there is greater energy and greater erosion potential. Sedimentation occurs as a result of forest and agricultural practices and construction activities. The areas along the mainstem above Castile Falls and the riparian areas along parts of the Little Klickitat River are the most affected in the Subbasin.

The Subbasin experiences other water quality problems related to low instream flows and high water temperatures. Swale Creek and Little Klickitat River (and many of its tributaries) have flows too low to support fish during part of the year. Other streams, including the mainstem Little Klickitat, experience water temperatures too high for resident and anadromous fish. High water temperatures may be the result of low water and lack of riparian vegetation.

The natural hydrology of the lower reaches of the Subbasin has been altered by inundation due to the creation of the Bonneville Pool following construction of Bonneville Dam. The Klickitat Subbasin Plan (Yakama Nation et al. 2004) states that "[t]ravel corridors between the Klickitat River and the Columbia River, and connectivity to essential habitats (e.g., breeding, feeding, seasonal ranges) between and along the Columbia River to other subbasins [and] drainages was lost for a number of species (i.e., blacktail deer, western gray squirrels, neotropical birds)." In addition, hydroelectric development has resulted in the loss of wetland habitat especially in the valleys and on the plateaus. Though the lower Klickitat River has "remained relatively isolated from direct shoreline development over most of its length", channelization and constriction from road development has damaged habitat in some reaches.

Two major hydroelectric dams are located on the Columbia River near the mouth of the Klickitat River: Bonneville and The Dalles. Juvenile and adult anadromous fish must pass Bonneville Dam to complete their life history. Irrigation diversions or water supply facilities are located in Outlet Creek, Hellroaring Creek, Swale Creek, and the Little Klickitat River (Figure 4-1).

Existing artificial production facilities in the Klickitat Subbasin are Klickitat Fish Hatchery and fish ladders at Lyle Falls and Castile Falls (Figure 1-2). Descriptions of these facilities are found in Chapter 8.0 or earlier versions of this Master Plan.

4.1.2 Archeology, History, and Socio-economic Aspects

The Klickitat Subbasin is thought to have been occupied by humans for more than 30,000 years. Archeological evidence shows that salmon fishing has occurred on the Columbia River for more than 10,000 years. People traveled from outside the area to trade for salmon. European Americans began to arrive in large numbers in the Columbia River country in 1843.

Currently, the Klickitat Subbasin has about 11,000 residents. The population centers are Goldendale (3,760 residents) and the unincorporated towns of Klickitat, Lyle, and Glenwood (Figure 1-2). It estimated that residential development occurs on less than 0.5% of the Subbasin. The area is important for recreation, timber, and agriculture. There are two major hydroelectric dams (Bonneville and The Dalles) on the Columbia River in the vicinity of the Klickitat Subbasin.

Land use is consistent with the Subbasin's climate, vegetation, and topography. Most of the Subbasin is forested (Section 4.1.1) and is managed for commercial timber production. The primary landowner is the Yakama Nation; the rest of the forest lands are owned by the State of Washington and various private entities.

The remainder of the Subbasin is used mostly for agriculture: pasturage, dry-land farming, and livestock grazing. These activities occur outside of the areas unsuited to forest. About 8,600 acres are irrigated, primarily along Outlet Creek, the upper Swale Creek drainage, and along the Little Klickitat River near Goldendale.

The Klickitat Subbasin is about equally divided between Klickitat and Yakima counties (Yakama Nation et al. 2004; Figures 1-1 and 1-2). The northern half of the Subbasin is within the Yakama Nation Reservation. In the southern half, about 90% of the land is privately owned, about 10% is owned by various agencies of the State of Washington, and the rest (less than 1%) is owned by the federal Bureau of Land Management and the U.S. Fish and Wildlife Service (USFWS). Special use areas within the Subbasin include the Columbia River Gorge National Scenic Area, the Klickitat Wildlife Area, and Conboy Lake National Wildlife Refuge. The lower 10 miles of the Klickitat River are designated "recreational" under the federal Wild and Scenic Rivers Act in 1986.

4.2 Current and Planned Management Activities

The Klickitat Subbasin is currently covered by and consistent with several management plans including the Klickitat Subbasin Plan (Yakama Nation, Klickitat County, and WDFW 2004), NOAA-Fisheries Middle Columbia River Steelhead Recovery Plan (NOAA-Fisheries 2009), Washington State Watershed Planning Process, and the Washington State Salmon Recovery Planning Process.

4.2.1 Klickitat Subbasin Plan

The Klickitat Subbasin Plan was prepared for the NPCC in 2004. The subbasin planning process exists within the context of the Fish and Wildlife Program (NPCC 2000) which envisioned that the plans would provide locally developed fish and wildlife restoration and protection priorities. The Klickitat Subbasin Plan had as a major goal the identification of management actions that would promote compliance with the federal Endangered Species Act and the federal Clean Water Act. The plan's vision statement is as follows:

> *We envision healthy self-sustaining populations of indigenous fish and wildlife that support harvest and other purposes. Decisions and recommendations will be made in a community based, open and cooperative process that respects different points of view, and will adhere to all rights and statutory responsibilities. These efforts will contribute to a robust and sustainable economy.* (Yakama Nation et al. 2004)

The Subbasin goals identified by the plan are:

- *Protect or enhance the structural attributes, ecological function, and resiliency of habitats needed to support healthy populations of fish and wildlife.*

- *To restore and maintain sustainable, naturally producing populations of spring Chinook, steelhead that support tribal and non-tribal harvest and cultural and economic practices while protecting the biological integrity and the genetic diversity of the subbasin.* (Yakama Nation et al. 2004)

The proposed project is aimed at accomplishing both Subbasin goals, but is particularly concerned with the second goal.

4.2.2 NOAA Recovery Plan

NOAA Fisheries Service adopted a final ESA recovery plan to satisfy the requirements of the Endangered Species Act to support recovery of the middle Columbia River steelhead Distinct Population Segment (DPS) of steelhead found in the Klickitat Subbasin (NOAA 2009). The recovery plan was developed as a collaborative process initiated by NOAA with input and assistance from the Middle Columbia Forum (Mid-C Forum), a bi-state, tri-tribe group in which the YN participated. The plan includes a locally developed management unit plan for the Klickitat Basin (Appendix B, Recovery Plan for the Klickitat River Population of the Middle Columbia River Steelhead DPS). The purpose of the plan is to "restor[e] the Klickitat steelhead population and its habitats to a level that supports recovery of the Middle Columbia River steelhead DPS and allows the population to become a viable component of its ecosystem." NMFS policy with recovery of salmonid populations must also achieve the goal of restoration of the meaningful exercise of tribal fishing rights.

The proposed project is consistent with the goals of the NOAA Recovery Plan. One of the project's major goals is to enhance and restore summer steelhead to their historical range within the Klickitat Subbasin. Past analysis of steelhead production potential by the ICTRT and YN indicate that habitat above Castile Falls may support 750 steelhead. In 2005, full passage was restored into the Upper Klickitat Watershed for migratory salmonid species as a result of improvements made to the Castile Falls Fishway. Prior versions of the Master Plan called for delaying action for 9 years to see if wild steelhead were able to re-colonize this habitat without human assistance. If by 2020 (2-3 fish generations from 2005 when passage was fully restored above Castile Falls) steelhead escapement above Castile Falls has not reached 150 adults in at least one year or if the mean passage above Castile Falls from 2012-2019 is less than 120 fish (<16% of estimated capacity), hatchery supplementation will be used as a tool to accelerate the re-colonization process. The hatchery program (fully described in Chapter 6) may use both anadromous and resident rainbow trout (and associated crosses) as broodstock. A new juvenile acclimation facility would be constructed at McCreedy Creek for hatchery juvenile steelhead released upstream of Castile Falls. Broodstock for the program would be collected at Castile Falls Fishway. The number of adults collected would depend on run size and would never exceed 25% of total natural-origin returns. The program would be closely monitored and could be terminated if it was not achieving defined objectives or if steelhead population goals were achieved in this portion of the Subbasin.

4.2.3 Washington State Watershed Planning Process

The watershed planning process for the State of Washington began with passage of ESHB 2514 in 1998 (Ch. 90.82 RCW). The planning process is aimed at finding local solutions to watershed issues. The primary goal of the program is to successfully manage water to ensure that the supply is sufficient for all users including people, farms, and salmon.

4.2.4 Washington State Salmon Recovery Planning Process

In 2000, the State of Washington instituted the salmon recovery planning process under the concept that "extinction is not an option." The goal of the process is to "[r]estore salmon, steelhead, and trout populations to healthy harvestable levels and improve those habitats on which the fish rely" (Joint Natural Resources Cabinet 2002). Lead entity strategic plans must include objective, measurable criteria for recovery; site-specific management; and time and cost estimates aimed at recovery of salmonid populations. The plans integrate local habitat efforts with actions involving hatcheries and harvest. These planning elements are entirely consistent with the proposed project.

The lead entity for the salmon recovery area encompassing the Klickitat River is Klickitat County. The YN is represented on both the Citizen's Advisory Committee and the Technical Advisory Committee along with a variety of local, state, and federal agencies and organizations. The Klickitat Lead Entity Region Salmon Recovery Strategy document is available online at http://klickitatcounty.org/NaturalR/FilesHtml/SalmonHabitatRecovery/LEstrategy2010Final.pdf.

The vision statement of the Klickitat Lead Entity Region Salmon Recovery Strategy is as follows:

> *Restore salmon, steelhead, and trout populations to healthy, self-sustaining, and harvestable levels and improve and maintain habitat on which fish rely, with strong community support and participation in the Klickitat Lead Entity geographic area.*

Their mission is to: "support salmon recovery by identifying credible and fundable habitat protection and enhancement projects and support related programs and activities that produce sustainable and measurable benefits for fish and fish habitat." (Klickitat County 2010).

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CHAPTER 5.0 PROJECT RATIONALE

Chapter 5.0 discusses the rationale behind the proposed project from the historical, legal, socio-economic, and ecological standpoints. This discussion is intended to further address ISRP comments on the 2004 and 2008 draft Master Plans regarding the need for additional project justification and rationale.

5.1 Historical and Legal Rationale

Timeline of Major Events Affecting Columbia River Salmon Management and Treaty Fisheries

1855 The United States enters into several treaties with Indian tribes living along the Columbia River and its tributaries in what are now the states of Oregon, Washington and Idaho. A key provision of all four treaties is: **"That the exclusive right of taking fish in the streams running through and bordering said reservation is hereby secured to said Indians; and at all other usual and accustomed stations, in common with the citizens of the United States . . . "** (12 Stat. 951). Prior to the treaties, combined salmon and steelhead returns to tribal usual and accustomed fishing areas in the Columbia Basin were estimated to range upwards of 10 million (CRITFC 1995, 2000; NPCC 2009). Human population in the region encompassing the present states of Oregon, Washington and Idaho was likely less than 1 million (estimated from available census data).

1855-1968 Non-Indian settlement and development in the Columbia River Basin proceeds.

In 1938, Bonneville Dam is completed. The "Mitchell Act" is enacted to "provide for the conservation of fishery resources in the Columbia River...." Department of Interior allows federal and state agencies to implement Mitchell Act by constructing numerous fish hatcheries in the lower Columbia River below most of the tribal usual and accustomed fishing places.

In 1957, The Dalles Dam is completed inundating Celilo Falls and eliminating the major tribal fishing area. With the construction of The Dalles and John Day (1971) dams, federal, state, and tribal fishery agencies estimated that spawning grounds for as many as 65,000 adult fall Chinook were eliminated (U.S. v Oregon Production and Technical Advisory Committees).

1968 In July 1968, fourteen members of the Confederated Tribes and Bands of the Yakama Indian Nation file suit in federal district court in Oregon against the Oregon Fish Commission and Oregon Game Commission (Sohappy v.

Smith). The tribal fishermen seek a decree that would define their treaty fishing rights and a clarification on the manner and extent to which the State of Oregon may regulate Indian fishing.

In September, the United States files suit in federal district court in Oregon against the State of Oregon seeking a judgment and injunction to enforce Indian off-reservation fishing rights in the Columbia River Basin (United States v. Oregon).

The Confederated Tribes and Bands of the Yakama Indian Nation, the Confederated Tribes of the Umatilla Indian Reservation, the Nez Perce Tribe, and the Confederated Tribes of the Warm Springs Reservation of Oregon intervene in U.S. v. Oregon as plaintiffs.

Judge Robert Belloni is the judge assigned to the cases. In November, Judge Belloni consolidates the Sohappy v. Smith and U.S. v. Oregon proceedings.

1969 Judge Belloni renders his decision in the Sohappy v. Smith and U.S, v. Oregon proceedings. He rules that the tribes have a right to a fair share of the available harvest and that the state is limited in its power to regulate the exercise of the Indians' federal treaty rights. Judge Belloni also finds that it is patently unfair to manage the Columbia Basin salmon such that few fish survive to reach the tribes' usual and accustomed fishing places and that the tribes have an absolute right to that fishery and thus are entitled to a fair share of the fish **produced** by the Columbia River system.

1970-1977 In 1973, Congress passes the Endangered Species Act (ESA) which authorizes "… the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to [the ESA] are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance, **propagation**, live trapping, and transplantation…" 16 U.S.C. Sect. 1532(3).

In 1974, the State of Washington is granted intervention in the U.S. v. Oregon proceedings. Judge Belloni modifies his original decision to read: "The Indian treaty fishermen are entitled to have the opportunity to take up to 50% of the [spring] chinook run destined to reach the tribes' usual and accustomed grounds and stations. By `destined to reach . . . ' I am referring to that portion of the [spring] run which would, in the normal course of events, instinctively migrate to these places except for prior interception by non-treaty harvesters **or other artificial factors**."

In the first U.S. v Oregon management plan adopted in 1977, the parties agreed to "diligently pursue and promote through cooperative efforts upriver maintenance and enhancement of fish habitat and hatchery rearing programs…" Since 1977, the parties to U.S. v Oregon have negotiated a series of plans for fisheries management in the Columbia River Basin. These plans have been adopted as orders of the U.S. District Court for the District of Oregon. The U.S. v Oregon management planning process is the principal forum through which problems of anadromous fish harvest, stock restoration, and production are addressed.

1980 Congress passes the Pacific Northwest Electric Power, Planning and Conservation Act, establishing the Northwest Power Planning Council, now known as the Northwest Power and Conservation Council. The act requires the Council to develop a fish and wildlife protection and restoration program. The 2009 program with amendments includes the following biological objectives:

"Significantly increase the total adult salmon and steelhead runs in the Columbia River Basin, especially those that originate above Bonneville Dam, in a manner that supports tribal and non-tribal harvest and complements regional harvest management agreements, such as the Columbia River Compact, the U.S. v Oregon Management Agreement, and the Pacific Salmon Treaty. Efforts to increase abundance must also be consistent with achieving recovery of ESA-listed populations and preventing additional ESA listings of species. Within 100 years, achieve population characteristics that, while fluctuating due to natural variability, represent on average full mitigation for losses of anadromous fish." (Council Document 2009-9, p. 11)

1991-Present Beginning in 1991, 13 species of Columbia and Snake River salmon and steelhead are listed for protection under the ESA further restricting the tribes' treaty fisheries. The National Marine Fisheries Service (NOAA Fisheries) issues a series of biological opinions concerning operation of the Federal Columbia River Power System (FCRPS) which are sequentially challenged in federal court by a number of different states, environmental groups and tribes.

In 1994, combined counts of salmon and steelhead at Bonneville Dam number fewer than 0.5 million.

In 2008, human population in the states of Oregon, Washington and Idaho combined was approximately 12 million.

The Parties to U.S. v Oregon sign the 2008-2017 Management Agreement which is adopted by a federal court order stating, "The Court has examined

> the 2008-2017 *United States v. Oregon* Management Agreement in light of the Court's Judgment of October 10, 1969, as amended May 10, 1974, and other materials in the case files. The Court concludes that the 2008-2017 *United States v. Oregon* Management Agreement is fundamentally fair, adequate, and reasonable, both procedurally and substantively, in the public interest, and consistent with applicable law, and that is has been negotiated by the parties in good faith."
>
> In 2008, the Yakama Nation, Confederated Tribes of Umatilla, and Confederated Tribes of Warms Springs entered into the Columbia Basin Fish Accords. The Accords are an agreement between the federal government and signatory tribes and were designed to supplement NOAA Fisheries' biological opinions for listed salmon and steelhead and the Northwest Power and Conservation Council's fish and wildlife program. Under the Accords, the federal agencies and tribes agree to work together as partners "on the ground" to provide tangible survival benefits for salmon recovery - by upgrading passage over federal dams, by restoring river and estuary habitat, and by creative use of hatcheries. In exchange, the tribes agreed to forego litigation regarding existence and operation of the FCRPS for the duration of the agreements.

This timeline provides the historical, human, legal, and political context within which the Klickitat Master Plan was developed and will be implemented. Rationale and justification for the objectives and strategies described in the Master Plan relate directly to this context. While many alternatives were considered, the preferred alternatives describe those strategies which proponents believe will most effectively contribute to meeting federal treaty trust, mitigation, and restoration obligations arising from this context.

5.2 Socio-economic Rationale

The economic benefits of harvesting salmon have been discussed in numerous reports in recent years. The proposed project is expected to result in harvest of 14,000 coho; 18,000 fall Chinook; 4,000 spring Chinook; and 2,000 steelhead annually (Chapter 6.0). In their "Economic Effects from Columbia River Basin Anadromous Salmonid Fish Production" report (2005), the Independent Economic Analysis Board (IEAB) concluded, "Based on preliminary information of adult survival rates for early 2000's brood stock, the Columbia River Basin anadromous salmonid production will contribute about $142 million total personal income [2003 dollars] annually to communities on the West Coast". Using data in this report we estimate the benefit of producing 38,000 salmon would approach $2-3 million annually. No estimate of the economic value of ceremonial and/or subsistence use was made in the IEAB report, though subsistence harvest is beneficial economically to Tribal members because they are able to catch salmon rather than buy them. As the IEAB noted, "Although the impact from Columbia Basin salmonid production may be relatively small in comparison [to the regional economy], this economic impact can be

significant in some local communities with close ties to the fishing industry". We expect much of the economic benefits from programs described in this Master Plan to accrue to smaller communities, many of which are in currently economically depressed areas along the Columbia River and in Klickitat County.

5.3 Ecological Rationale

The ecological rationale for the proposed project is rooted in the recognition that hydroelectric installations and habitat degradation have lead to critically low populations of salmonids in the Klickitat Subbasin. Some populations (steelhead and bull trout) are considered endangered or threatened. Secondly, habitat, hatchery, and harvest actions to date have not resulted in naturally producing, sustainable populations of salmon and steelhead.

The proposed project is part of a holistic approach to returning salmon populations and habitat to a state as close as possible to those existing prior to development. The purpose of the proposed project is to produce, in a hatchery setting, salmon and steelhead that will be used to supplement populations in the Klickitat Subbasin with the goal of eventually discontinuing the hatchery production as the naturally spawning populations become self-sustaining and begin to increase. The hatchery programs are designed to avoid adverse impacts to resident and native anadromous populations. Brood stocks as close to the native stocks as possible will be used.

In addition, habitat restoration and enhancement activities will be carried out to assure that the increased fish produced in the hatchery programs will have some place to spawn and rear. Returning as much damaged habitat as possible to an approximation of its original form will benefit not only the target species, but others as well including terrestrial species.

Chapter 6.0 describes in detail the proposed hatchery, habitat, and harvest programs for spring Chinook, steelhead, fall Chinook, coho, bull trout, and Pacific lamprey.

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CHAPTER 6.0 PROPOSED PROGRAMS

The YN reviewed multiple strategies and approaches for achieving fisheries objectives in the Klickitat River. While many alternatives were considered, the preferred alternatives describe those strategies which YN believes will most effectively contribute to meeting federal treaty trust, mitigation, and restoration obligations as described in Chapter 5.

The Master Plan recognizes that to be successful, actions must be integrated across what the region refers to as the "4 Hs" (Hatcheries, Habitat, Harvest, and Hydro). The Master Plan focuses primarily on Habitat, Hatcheries, and Harvest because there are no hydroelectric facilities on the Klickitat River. However, the effect mainstem Columbia River dams (Hydro) have on the survival of fish populations originating in the Klickitat River was taken into consideration when setting hatchery release numbers, adult escapement, and harvest goals.

A brief summary of the major actions or objectives proposed for each "H" examined in the plan is presented below.

Habitat: Protecting existing high quality stream habitat and restoring degraded habitat is essential if ESA-listed populations of steelhead and bull trout are to be recovered in the Subbasin. The Master Plan identifies the major habitat factors limiting fish production and relies on the strategies and actions proposed in the Klickitat River Basin Salmon Recovery Plan to improve habitat quality and quantity. The habitat strategies are targeted primarily at Major Spawning Areas for ESA-listed steelhead, but are expected to provide benefits to other resident and anadromous fish species inhabiting the same portions of the Subbasin. Additionally, fish passage at both Lyle Falls and Castile Falls has been improved to create better migration conditions for all native fish species. The habitat strategy is expected to result in an 85% and 26% relative increase in ESA-listed steelhead abundance and productivity, respectively (Appendix C). Habitat actions will also provide substantial benefits to native spring Chinook as well as ESA-listed bull trout and Pacific lamprey.

Hatcheries: The YN recognizes that current hatchery practices need to be changed to reflect recent scientific advances and to avoid negative effects hatchery fish may have on naturally spawning populations including listed species. Because hatchery fish may interbreed with, compete with, and prey on, native fish populations, the following actions are proposed to reduce these impacts:

1. Coho hatchery releases in the Subbasin will be reduced from approximately 3.7 million to as few as 1.0 million juveniles.

2. A new hatchery and acclimation facility (Wahkiacus) will be constructed at RKm 27 (Figure 1-2) so that hatchery coho and fall Chinook may be released lower in the Subbasin, thereby reducing impacts to native fish species.

3. The conservation goal for steelhead includes natural re-colonization above Castile Falls. Hatchery steelhead will not be released above Castile Falls until it is determined that wild fish cannot re-colonize this habitat on their own.

4. Hatchery adult spring Chinook (progeny of natural-origin parents) will be collected at Lyle Falls or the Klickitat River Hatchery, then transported and released into suitable habitat above Castile Falls in an effort to re-supply marine derived nutrients and to re-establish spring Chinook production in the upper Klickitat River.

5. If wild steelhead do not naturally re-colonize stream habitat above Castile Falls, a new juvenile acclimation facility would be constructed at McCreedy Creek for hatchery juvenile steelhead released upstream of Castile Falls. The hatchery program may use both anadromous and resident rainbow trout as broodstock depending on additional literature review and results from ongoing genetic research in this and other basins. The use of resident trout for broodstock would reduce mining of anadromous adults, take advantage of local genetics, and contribute to regional research data needs on this topic.

6. Volitional release strategies will be implemented for all cultured species.

7. The coho and fall Chinook programs will begin shifting to the use of local-origin broodstock.

8. Hatchery programs for steelhead and spring Chinook will be monitored against specific objectives for natural escapement and production. Adaptive management measures are specified and will be implemented as necessary to assure that the hatchery programs minimize impacts to natural populations.

9. Out-of-Subbasin transfers of hatchery coho and fall Chinook fish into the Klickitat River Subbasin will be phased out over time to the extent possible with a goal of completing all hatchery culture phases within the Subbasin (contingent on construction of WHAF or completing expansion/upgrades at Klickitat hatchery).

10. The long-term goal for the preferred alternative is to be consistent with hatchery reform guidelines for the composition of hatchery and natural origin steelhead and spring Chinook spawners used for hatchery broodstock and escaping to the natural spawning grounds.

11. Hatchery releases above Castile Falls will be terminated once steelhead population goals are achieved in this portion of the Subbasin.

12. Hatchery programs will be operated in compliance with Tribal and federal environmental regulations, including requirements to maintain water quality, water quantity, and fish passage. These actions will assure that hatchery operations will not reduce the productivity and capacity of a watershed to support natural stocks.

Harvest: A major goal of the Master Plan is to provide harvest to Tribal members as required by treaty obligations and for sport fishing, while at the same time protecting naturally spawning populations and contributing to the recovery of ESA-listed steelhead and bull trout. Because hatchery fish provide most of the harvestable fish in the Subbasin, the Master Plan is structured to balance potential hatchery impacts to listed species with the harvest benefits they provide. This balance will be achieved by experimenting with reduced hatchery production while at the same time implementing measures that increase hatchery fish survival. The goal is to provide greater harvest benefits from fewer hatchery smolts. If successful, the average number of fish harvested in all fisheries is expected to be:

Coho	14,000
Fall Chinook	18,000
Spring Chinook	4,000
Steelhead	2,000

Additional harvest actions that will be implemented to better meet harvest goals or protect listed fish species include:

1. Marking hatchery fish released in the Subbasin so they can be distinguished from natural-origin fish in the hatchery broodstock, on the spawning grounds, and in fisheries.

2. Utilizing harvest practices that improve spawning escapement of natural-origin steelhead and spring Chinook while fully harvesting hatchery-origin fish.

Klickitat River sport fishery regulations require that all steelhead caught with an intact adipose fin must be released. In Tribal fisheries, fishermen generally retain all fish captured at traditional fishing areas. The goal under the Master Plan is to increase average annual wild steelhead escapement to 2,500 adults.

The strategies proposed in this Master Plan for steelhead, spring Chinook, coho, fall Chinook, Pacific lamprey, and bull trout are described below. Included in each section are descriptions of the alternative approaches considered, as well as the rationale for rejection.

6.1 Steelhead

This section of the Plan contains information on the proposed steelhead program. The section includes a brief stock assessment, a review of recent management strategies, proposed program goals and objectives, alternatives considered, and rationale for the selection of the preferred alternative.

6.1.1 Steelhead Stock Assessment

Steelhead Conservation Status

The ICTRT has identified Klickitat River steelhead as an independent population belonging to the Mid-Columbia ESU. The Middle Columbia steelhead ESU was listed as threatened under the ESA on March 25, 1999 (64 FR 14517). The Klickitat steelhead population includes both summer-run and winter-run steelhead.

Temporal and spatial spawning segregation between the Klickitat steelhead summer and winter runs has not been clearly defined, but is being investigated via radio telemetry studies. Genetic analysis of juveniles and adults is expected to provide additional information about the spatial and temporal distribution of both steelhead races (Chapter 7.0).

Genetic analysis on steelhead has shown some degree of genetic differentiation between tributaries to the Klickitat River; genetic samples from naturally-produced fish from multiple areas within the subbasin diverge widely from the Skamania Hatchery stock (Narum 2006, Marshall unpubl.). Tributaries in the mid and lower subbasin typically produce the most steelhead while upper parts of the watershed support primarily resident rainbow trout (Narum et al 2007, Narum et al 2008). Analysis indicates there may be six to seven genetically distinct populations of naturally reproducing steelhead in this river system. The results also suggest the genetic integrity and variation of native Klickitat River steelhead have been maintained despite repeated hatchery introduction and that the potential is high for restoring the population's viability (Narum et al. 2006).

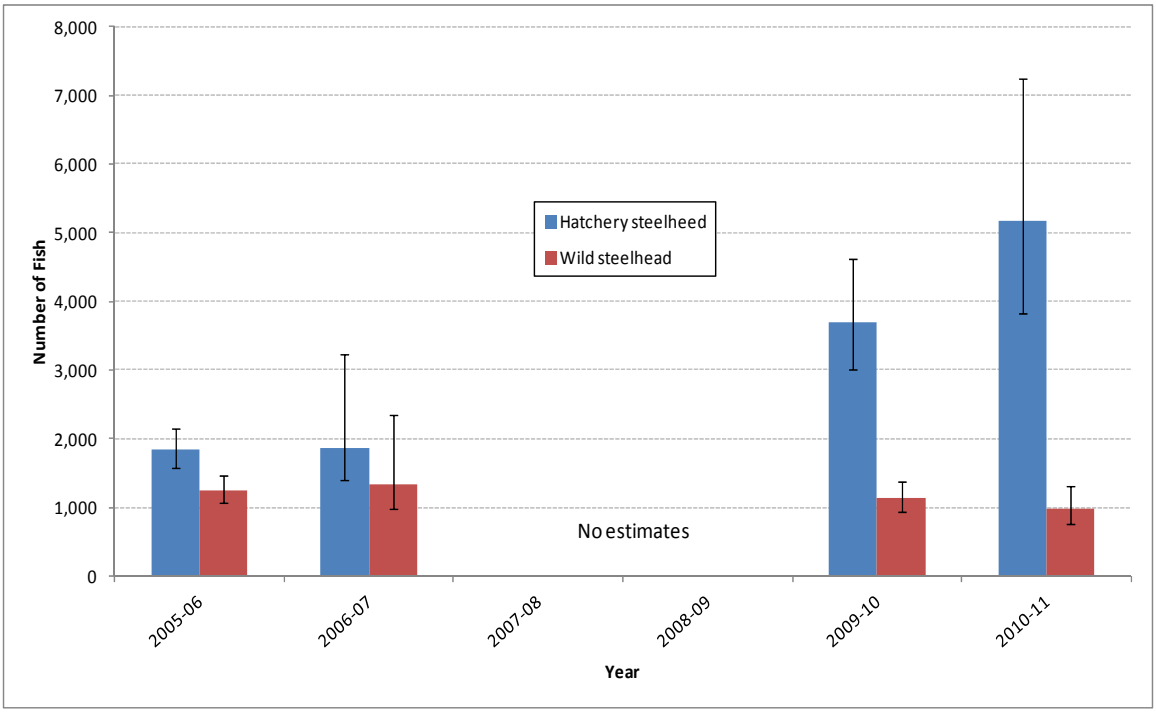
No solid historical data exist on the size and productivity of the Klickitat summer steelhead run. Based on NOAA Fisheries historical intrinsic potential analysis, the ICTRT considers the Klickitat River population to be an "intermediate" sized population that can support a minimum of 1,000 spawners (ICTRT 2007). They concluded that spawner abundance should be distributed over 6 major spawning areas and 4 minor spawning areas within the Klickitat population boundaries (Figure 6-1). The percent of total Subbasin steelhead habitat present in each MaSA and MiSA is shown in Figure 6-2[5].

The escapement of naturally spawning (summer and winter, hatchery and wild combined) steelhead in the Klickitat River from 1987 to present has been estimated at approximately 700 fish (see Table 6-1 below). However, this estimate is based on redd count data which is believed to be an underestimate because of difficulties associated with conducting accurate counts during spring flow conditions (NPCC 2004). YN biologists hypothesize that the actual mean escapement is closer to 900-1000 spawners annually. Mark-recapture estimates of steelhead run size to Lyle Falls on the lower Klickitat River in recent years, conducted by tagging fish at Lyle Falls then recapture via anglers upstream,

[5] The ICTRT analysis assumes that steelhead have access to all habitat in the West Fork and Upper Little Klickitat MaSAs. However, the YN is of the opinion, and redd surveys confirm, that few steelhead spawn in these areas even though habitat quality in these areas is excellent. Barriers in each basin likely prevent steelhead adults from using the majority of the habitat present in both areas.

have averaged about 1400 total wild steelhead and 1200 wild summer steelhead (Zendt et al. 2010 and Figure 6-1). Winter steelhead estimates are from trap counts (due to no angler recaptures) and are likely underestimates. Mark-recapture methods have yielded higher run size estimates than the run reconstruction methods in Table 6-1, especially for hatchery steelhead. This may be partly due to dip-ins and inherent undercounting of redds.

Figure 6-1: Klickitat River summer steelhead mark-recapture estimates of run size to Lyle Falls with 95% confidence intervals



Additionally, from the early 1960s to 2005, Castile Falls likely blocked all steelhead from stream habitat located upstream of the falls. By 2005, upstream fish passage conditions at Castile Falls were improved to allow steelhead access to this portion of the Subbasin. Habitat modeling work indicates that adult steelhead production potential above the falls may be as high as 750 adults (Appendix C). If the production potential estimate is accurate, total steelhead production in the Klickitat River Subbasin could increase to over 2,000 fish in the near future.

Figure 6-2: Klickitat River Steelhead Major and Minor Spawning Aggregations

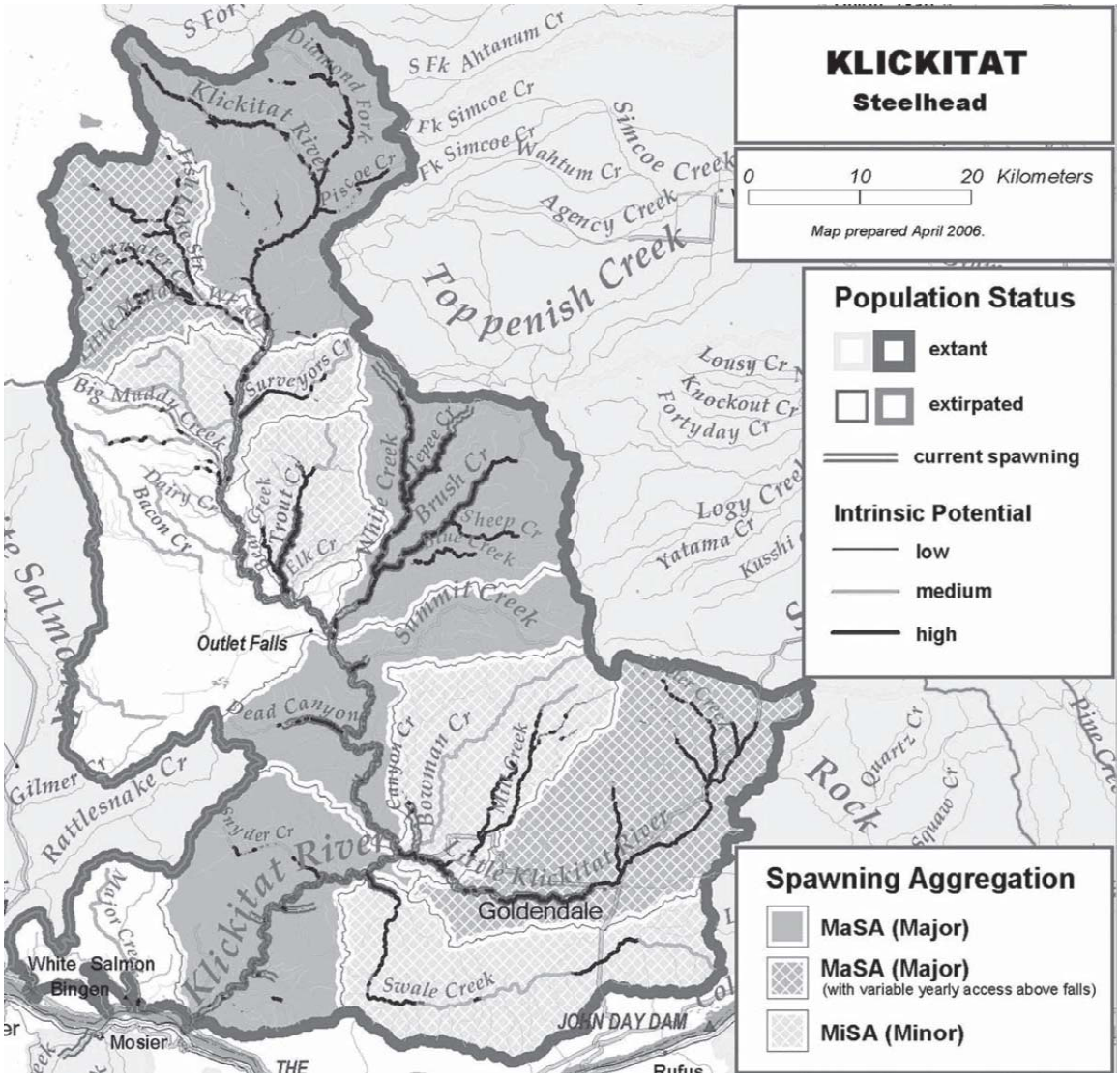
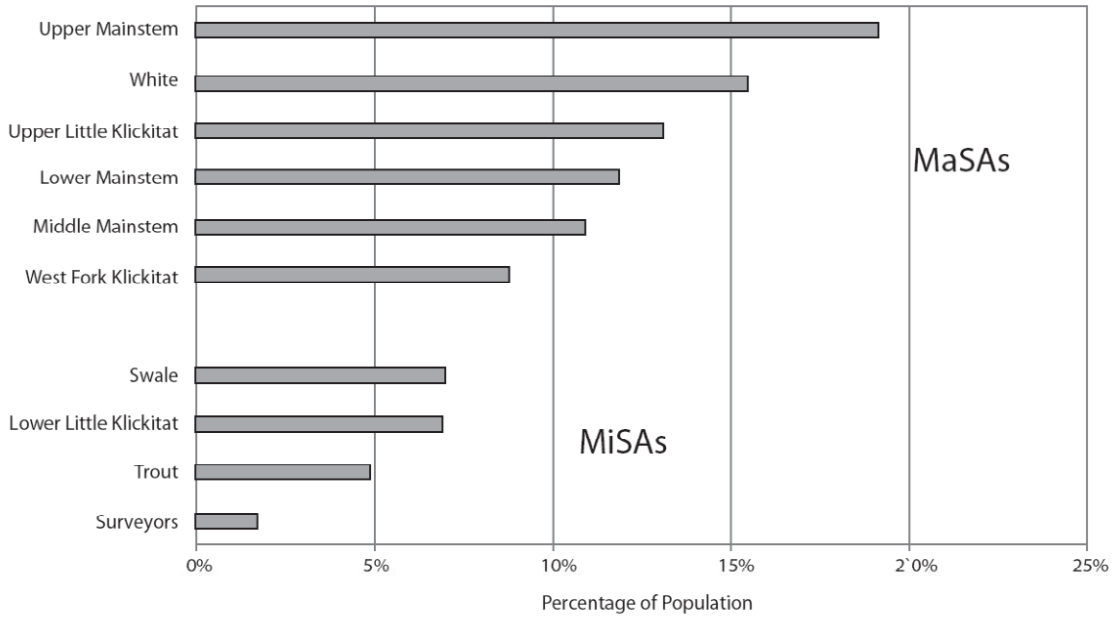


Figure 6-3: Percentage of Historical Spawning Habitat by Major/Minor Spawning Area



Based on population parameters developed for the area mainly below Castile Falls, the ICTRT rated Klickitat steelhead as having only a moderate risk in regards to the key population parameters of abundance/productivity and spatial structure/diversity. Thus, the population does not meet ICTRT criteria for a viable population, although it does meet criteria for a "Maintained" population (ICTRT 2007).

Steelhead Harvest Status

Steelhead harvest (sport and Tribal combined) in the Klickitat River has averaged about 2,500 fish annually since 1987, with Skamania steelhead comprising greater than 98% of the sport catch on average. Harvest of hatchery steelhead has averaged about 2,350 fish annually between 1986 and 2011 (Table 6-1). Harvest rates on hatchery steelhead are estimated at 80% to 90%, dependent upon the return year.

Table 6-1: Summary of Klickitat River steelhead terminal harvest, estimated escapement and total run size to the mouth (1986-2011)

		Sport[2]			Tribal				
Year	Run[1]	Hatchery	Wild	Total	Hatchery[3]	Wild[3]	Total	Escape-ment[4]	Redds[5]
1986-87	9,834	1,426	54	1,480	5,107	901	6,008	2,346	
1987-88	3,751	1,480	34	1,514	1,141	201	1,342	895	
1988-89	4,208	1,718	0	1,718	1,263	223	1,486	1,004	
1989-90	1,702	833	0	833	536	95	631	238	95
1990-91	2,957	1,055	0	1,055	1,464	258	1,722	180	72
1991-92	3,595	823	8	831	1,620	286	1,906	858	
1992-93	3,251	1,260	0	1,260	1,033	182	1,215	776	
1993-94	3,402	1,211	25	1,236	1,151	203	1,354	812	
1994-95	1,915	857	34	891	482	85	567	457	
1995-96	1,805	864	9	873	433	76	509	423	169
1996-97	1,082	608	14	622	241	43	284	176	71
1997-98	2,185	1,062	18	1,080	455	80	535	570	228
1998-99	1,521	650	12	662	224	39	263	596	239
1999-00	1,725	575	28	603	214	0	214	908	363
2000-01	2,851	1,433	59	1,492	495	67	562	797	319
2001-02	5,264	3,708	16	3,724	724	55	779	761	304
2002-03	6,022	3,552	97	3,649	1,285	363	1,648	725	290
2003-04	2,766	1,673	0	1,673	369	151	520	573	229
2004-05	2,957	1,658	0	1,658	747	153	900	399	160
2005-06[6]	2,144	1,115	0	1,115	368	98	466	563	12
2006-07[6]	2,569	1,610	0	1,610	242	43	285	674	74
2007-08[6]	2,544	1,531	3	1,534	291	51	342	668	62
2008-09[6]	3,919	1,742	67	1,809	919	162	1,081	1,029	77
2009-10	3,045	2,153	3	2,156	333	59	392	497	199
2010-11	3,508	2,467	5	2,472	687	55	742	294	118
Avg:	3,221	1,483	19	1,502	873	157	1,030	689	204

[1] Sum of harvest and escapement.

[2] Sport Harvest numbers include data from May 1 - April 30 for 1986-87 through 2005-06, and April 1 - March 31 for 2006-07 on.

[3] Hatchery and wild proportions of Tribal harvest are estimated as follows. For 1999-00 through 2005-06, percentages estimated from sampling of ceremonial and subsistence harvest were applied to total Tribal harvest. For 1986-87 through 1998-99 and 2006-07 through 2009-10, the average percentages from the 1999-2005 sampling were applied to total Tribal harvest.

[4] Assumes 2.5 fish per redd. For years when redd counts were unavailable, assumes average escapement-to-total-harvest ratio from years when reasonably accurate redd counts were available.

[5] Actual redd counts expanded for mileage surveyed.

[6] High flows, turbidity, and/or poor access limited survey ability and effectiveness, probably biasing the redd count low.

The Tribal fishery occurring in the Lyle Falls vicinity has harvested an annual average of 873 hatchery- origin steelhead and about 157 wild summer steelhead since 1986. Tribal harvest regulations do not require the release of unmarked fish.

To protect the winter-run, current state sport fishing regulations prohibit fishing for steelhead in the Klickitat River from December through May. The treaty fishery is also

closed from January through March, which protects the majority of the winter steelhead passing Lyle Falls each year (YN, Klickitat County, and WDFW 2004).

WDFW estimates that harvest impacts on listed steelhead from all sport fisheries in the Klickitat River is less than 2% for winter steelhead and 6.3% for summer steelhead (D. Rawding, WDFW, personal communication, August 13, 2007). Total harvest rate on Klickitat River wild steelhead in mainstem Columbia River and Klickitat River sport and Tribal fisheries is estimated at < 15% (Appendix C).

6.1.2 Recent Steelhead Management Strategies

Steelhead Habitat Management

Over the last 10 years, habitat management in the Klickitat River Subbasin has been focused on the development and implementation of actions that restore ecological function and allow anadromous fish access to areas blocked by obstructions. Typical actions that have been implemented in the Subbasin include increasing and reconnecting floodplains and side-channels, replacing culverts, rehabilitating and decommissioning roads as appropriate, fish ladder improvement, re-establishing and/or enhancing native vegetation within floodplain, and increasing large-woody-debris levels in the stream.

Habitat improvement projects expected to increase steelhead performance in the Subbasin are listed in Table 6-2. More detailed information on the status of the action, rationale for implementation, and objectives can be found in Appendix B.

Steelhead Hatchery Management

Historical hatchery releases of steelhead in the Klickitat have consisted of summer steelhead smolts derived from the Skamania-origin hatchery broodstock. The founder broodstock of the Skamania stock came from the summer runs of the Washougal and Klickitat steelhead populations. Steelhead releases in the Klickitat began in 1961 and continued to the present time. The present release target is 90,000 smolts. Since 1961, the releases have ranged from a low of approximately 16,000 to a high of approximately 125,000 and have averaged about 85,000 fish (Table 6-3).

Table 6-2: Major habitat actions implemented to improve Klickitat River steelhead performance

Steelhead Habitat Projects			
1. Klickitat River Floodplain (RM 18-32) Conservation and Restoration	2. Lower Klickitat River Riparian Re-vegetation Project	3. Klickitat River (RM 12) Salmon Habitat Restoration Project	4. Klickitat Riparian Restoration (MCFEG)
5. Lower White Creek Restoration Project	6. White Creek Road Rehabilitation	7. White Cr.—IXL Road Fish Passage Enhancement	8. Swale Cr. Riparian Enhancement
9. Swale Canyon Upland and Riparian Habitat Enhancement	10. Swale Creek Livestock Exclusion Fencing and Watering	11. Tepee Creek Fish Passage Restoration	12. Tepee Creek – IXL Meadows Restoration
13. Upper Klickitat River In-	14. Surveyors Cr. Passage	15. Castile Falls Passage	16. Lyle Falls Fish

Channel and Floodplain Enhancement Project	Enhancement	Improvement	Passage
17. Trout Creek Fish Passage Improvement	18. Dead Canyon Fencing	19. Klickitat Meadows (Diamond Fork) Restoration	20. Klickitat River Meadows Restoration
21. Piscoe Meadows Restoration Project	22. Little Klickitat River Riparian Enhancement	23. Little Klickitat River Restoration	24. Klickitat Mill (Snyder Creek) Fish Passage
25. Snyder Swale Meadow Restoration (UCD)	26. Lower Klickitat Tributary Riparian Revegetation	27. Logging Camp Canyon Passage	28. Dillacort Canyon White Oaks Preserve
29. Snyder Creek Culvert Replacement (WSDOT)	30. Bowman Creek Culvert Replacement	31. Improve Farming Practices (No-Till Drill Acquisition)	

Table 6-3: Number of Skamania-origin hatchery smolts released in the Klickitat River between 1991 and 2011

Release Year	Number Released
1991	58,655
1992	66,180
1993	71,586
1994	80,674
1995	15,938
1996	76,926
1997	44,530
1998	124,866
1999	123,709
2000	118,454
2001	101,844
2002	99,941
2003	103,800
2004	107,439
2005	100,725
2006	100,076
2007	91,135
2008	92,013
2009	95,055
2010	90,871
2011	88,300

Data source: Fish Passage Center

Hatchery smolts are 100% adipose-clipped for harvest retention and have historically been scatter-planted at various locations ranging from as high as the Klickitat hatchery at Rkm 69 and as low as Rkm 0.8 near the river mouth. The program is currently funded under the Mitchell Act for mitigation of lost harvest opportunity resulting from the construction of mainstem Columbia River federal hydroelectric projects. The hatchery

program has been extremely successful in meeting its harvest objective due to the unique sport and Tribal fishing opportunities offered in the Klickitat River Subbasin.

Adult hatchery steelhead escaping terminal fisheries are assumed to spawn in the wild due to the inability of managers to remove surplus adult fish from the river. Recent genetic work suggests introgression between Skamania hatchery steelhead and Klickitat River steelhead is relatively low; only 4.0% of naturally produced steelhead were likely the offspring of hatchery-origin parents (Narum et al. 2006). Explanations for the lack of genetic introgression between wild and hatchery stocks could include the relatively low reproductive success of Skamania hatchery steelhead, differential spawn timing and distribution, and high harvest rates limiting the number of hatchery origin spawners.

Current Hatchery Performance

No empirical estimates of SAR exist for Skamania hatchery steelhead released in the Klickitat River (PIT-tagged returns beginning in 2012 will provide future estimates). The use of limited age structure and harvest rate information estimate SAR at approximately 2.65% on average for the release years 1991-2002 (Appendix C). This seems to be a reasonable estimate when compared to other hatchery summer steelhead smolt-to-adult (SAR) numbers in tributaries existing in the Bonneville pool. For example, Foster Creek hatchery stock from the Hood River has averaged about 2.51% over this same time frame (Olsen 2006). The run size of hatchery steelhead back to the mouth of the Klickitat River has ranged from about 900 to 8,000, assuming that approximately 80% are harvested in terminal fisheries.

Broodstock collection, incubation, and rearing to a one-year-old smolt occur at the Skamania hatchery located on the Washougal River. Egg-to-smolt survival at the Washougal Hatchery has averaged about 78% from brood years 1995-2001. According to the Hatchery Genetics Management Plan (HGMP), Skamania steelhead are susceptible to bacterial cold water disease and IHN. Losses have been minimal due to disease outbreak and, when needed, appropriate therapeutic treatment was used to control and prevent further outbreaks of the diseases (Steelhead HGMP in Appendix B).

Steelhead Harvest Management

Sport fisheries targeting hatchery-origin summer run steelhead in the Klickitat River are conducted as follows:

- Sport fisheries upstream of the #5 fishway at Lyle Falls begin on June 1 and end on November 30.
- The lower Klickitat River and tributaries below the #5 fishway is open to steelhead fisheries beginning April 1.
- The area upstream of the Klickitat River hatchery above the Yakama Reservation boundary is closed to recreational fisheries.

- Sport fishermen are required to release all wild or adipose-present (unclipped) steelhead and have a daily retention limit of two hatchery steelhead.

Tribal fisheries within the Klickitat Subbasin generally occur in the vicinity of Lyle Falls near the mouth of the Klickitat River. Tribal fishermen are permitted to retain wild steelhead, although Tribal fisheries primarily target spring, summer, and fall Chinook.

Most steelhead are caught from June through September. Harvest of steelhead in the Klickitat River may include "dip-in" fish, which are destined for tributaries further up the Columbia River and Snake River systems. These fish hold as adults in the Klickitat River to take advantage of the cool water present in the river.

Fisheries on dip-in steelhead in the Klickitat River are concentrated in the river's lower reaches. Impacts to dip-in fish caused by the fisheries are addressed in the NMFS's Columbia River mainstem fisheries section 7/10 consultation process. The contribution to harvest of dip-in hatchery steelhead in the Klickitat River harvest is small. Most hatchery steelhead are taken from river sections upstream of where dip-in fish are found; the proportion of the harvest is primarily 2- and 3-salt fish[6] typical of the Klickitat River steelhead (C. Fredericksen; YKFP; personal communication; February 11, 2008).

The whitefish fishery, in effect from December 1 to March 31, remains largely unmonitored. Catch and mortality rates on wild steelhead caught incidentally in this fishery are unknown, though suspected to be minimal. Sport regulations for the Klickitat allow the use of bait and angling from a moving boat. Both Tribal and sport fisheries are closed in the winter months to protect the wild winter steelhead run during its migration period and the combined spawning aggregate of summer and winter steelhead during the spawning window.

Restrictive fisheries currently prevent large numbers of steelhead from being harvested in the mainstem Columbia River. A federally established limit of 2% incidental kill of wild steelhead was set in 2004 for non-Tribal fisheries. Washington and Oregon generally manage Columbia River mainstem non-Indian fisheries such that the incidental mortality of wild winter steelhead does not exceed 2%. The states have concluded that the catch of wild summer steelhead in the winter and spring commercial fishery is low (WDFW and ODFW 2007). The estimated harvest rate on wild steelhead in Tribal fisheries Zone 6 (a 130-mile treaty Indian commercial fishery between Bonneville Dan and McNary Dam) has averaged 5.0% (range 2.5%to 10.4%) since 1977 (WDFW and ODFW 2007).

6.1.3 Biological Goals for Steelhead

The programmatic objectives for Klickitat River steelhead consist of distinct and separate goals for conservation and harvest. The conservation goals are distilled into separate, measurable objectives for the VSP parameters that define a viable salmonid population. Harvest goals are expressed as a mean number of fish caught annually in the terminal fisheries for Tribal and sport fishers.

[6] 2- and 3-salt fish are those that spend 2 to 3 years in the marine environment before returning to their natal streams to spawn.

Steelhead Conservation

The primary steelhead conservation objective is to reduce the 5% extinction probability from a moderate risk rating to a very low risk rating using the ICTRT criteria outlined in the Klickitat Subbasin Recovery Plan (NOAA-Fisheries 2009). When this is achieved, the population would be considered a highly viable population able to withstand natural environmental perturbations with a high level of resiliency.

The steelhead (winter and summer) abundance objective is to achieve a minimum and average escapement of 500 and 1,500 adults respectively in the short term (about 10 years). The long-term objective (more than 10 years) is to increase average adult abundance to 2,500 adults. These abundance objectives were based primarily on the expected improvement in fish performance from the implementation of habitat strategies and actions described in Appendix A. The habitat actions are also hypothesized to increase productivity from 4.2 to 5.3 which therefore becomes the steelhead productivity objective for this plan.

The spatial structure objective is to have adult steelhead spawning throughout their historical range.

A summary of the conservation objectives proposed for Klickitat River steelhead is presented in Table 6-4.

Table 6-4: Summary of conservation objectives for Klickitat River steelhead

Parameter	Short Term Objective (~ 10-Years)	Long Term Objective (>10-Years)
Productivity	4.5 Recruits/Spawner	5.3 Recruits/Spawner
Abundance	Minimum Adult Escapement 500 per year Average Adult Escapement 1,500 per year	Minimum Adult Escapement 1,000 per year Average Adult Escapement 2,300 per year
Spatial Structure	Maintain historic spawner distribution	Maintain historic spawner distribution
Contribution of hatchery-origin parents to natural smolt production	<=5%	<=5%

Steelhead Harvest

The primary harvest objective for Klickitat River hatchery steelhead is to maintain or exceed the current harvest opportunities for the Terminal Treaty and Sport fisheries, without substantially impacting the viability of the wild component of the composite run. The unique features offered by the Klickitat River's landscape have created highly popular fisheries for both recreational and tribal fishers. Harvest of hatchery steelhead in

the Treaty and Sport fisheries has averaged about 873 and 1,483 fish respectively since 1986 (Table 6-1).

Harvest objectives are outlined in Table 6-5.

Table 6-5: Harvest goals for Klickitat River steelhead

Fishery	Objective
Klickitat River Terminal- Tribal	1,000
Klickitat River Terminal- Sport	1,400

The Master Plan proposes a not-to-exceed 15% harvest standard on wild summer and winter steelhead captured in terminal fisheries. This guideline will be re-evaluated periodically to ensure consistency with *U.S. v Oregon* principles and objectives.

6.1.4 Steelhead Strategies Considered

The YN considered three options for managing Klickitat River steelhead in the future.

1. Maintain Existing Program
2. Eliminate Hatchery Program and Improve Habitat
3. Develop Local Hatchery Program and Improve Habitat

Option 3 best achieved the conservation and harvest objectives identified for steelhead. A description of Option 3 and its rationale is presented in Section 6.1.5.

A brief description of the other two options and rationale for rejection is provided below.

Maintain Existing Steelhead Hatchery Program

Current hatchery management of summer steelhead releases in the Klickitat function to support the Tribal and sport terminal fisheries with no conservation objectives or realized benefits. The program has a target annual release of 90,000 out-of-Subbasin Skamania-origin steelhead smolts at various locations in the lower watershed. Broodstock collection and juvenile rearing for this program all occur at the Skamania Hatchery on the Washougal River.

If this program is continued, the terminal fisheries would be expected to maintain similar harvest opportunities. From a harvest perspective, the program would be successful. However, the program has no conservation objectives for recovery of the wild Klickitat steelhead population. The program may, in fact, pose unacceptable risks to the wild population from potential interbreeding. Concerns and risks associated with current program impacts to wild steelhead include:

- Introgression and domestication
- Reduction in natural population genetic diversity

- Alteration of juvenile and adult run-timing and age structure
- Direct juvenile competition and predation
- Competition and predation on other anadromous species
- Importing fish from out-of-Subbasin increases disease risks to native fish stocks.

Although the current program does achieve identified harvest objectives, the program may pose unacceptable risks to conservation goals. Although this option is included in the preferred option, it will be closely monitored and may be modified or terminated depending on performance relative to conservation goals.

Eliminate Hatchery Program and Improve Steelhead Habitat

This management option would eliminate hatchery juvenile outplants, relying instead on habitat restoration to meet steelhead conservation and harvest goals. This option has a number of advantages as follows.

1. Analysis based on expected habitat improvements suggest that the abundance of the natural component of the steelhead population might increase by 85%, dependent on the effectiveness of the habitat program[7].

2. Improving habitat would primarily increase the abundance and productivity of the population. To some degree, spatial structure and diversity would see minor improvements in the form of increased occupancy of major and minor spawning areas. Some wildlife species would also benefit from improved riparian habitat condition and the resulting increase in fish abundance.

3. Terminating the hatchery program eliminates predation, competition, and genetic risks to native fish species (see above).

4. Program termination results in a cost savings estimated at $157,000 based on an estimated cost of $1.57 per smolt. These monies can then be used to help fund the habitat program.

Analyses indicate that, with optimistic assumptions regarding the effectiveness of the habitat actions, the adult escapement target of 2,500 adults may be achieved. However, the run size back to the Subbasin is insufficient to meet the 2,400 harvest objective for combined Tribal and sport fisheries. In addition, financial and policy commitments have not yet been secured to ensure that sufficient habitat improvements would occur and this program is included in the legally binding 2008-2017 *U.S. v Oregon* Management Agreement.

Because this alternative does not meet harvest goals and U.S. v OR production obligations, it was not selected for implementation. However, it is clear that fish would be greatly benefited by habitat actions and, therefore, habitat actions have been included in the preferred option.

[7] The 85% value is based on the 40% habitat restoration scenario (see Appendix C).

6.1.5 Preferred Steelhead Option: Develop Local Hatchery Program and Improve Habitat

The proposed hatchery program is designed to benefit conservation and recovery of Klickitat River steelhead while sustaining harvest opportunities for treaty and non-treaty fisheries. The program has the following components:

1. Continue Skamania program until Klickitat Hatchery upgrades are implemented.
   - Mark all releases to allow live detection of adult returns at Lyle

2. When Klickitat Hatchery upgrades are implemented, convert Skamania program to the following:
   - Collect local HOR fish for brood at Lyle
   - Spawn, rear and acclimate using spring water, release at Klickitat Hatchery
   - Cull diseased fish

3. Current data suggest that <5% of natural smolt production is the progeny of hatchery-origin fish (Narum et al. 2006). Continue to monitor. If this increases to >5% for 3 consecutive years or more than 5 years in 10, then options are:
   - Discontinue program if all parties/stakeholders agree
   - Change the hatchery program to an integrated program using NOR brood stock

   Note that the 5% introgression threshold is based on recommendations published by the Hatchery Scientific Review Group (2005). This threshold may be modified consistent with the project's adaptive management protocols, based on additional literature review and future M&E findings from this or other Columbia Basin steelhead programs.

4. By 2020 (2-3 fish generations from 2005 when passage improvements above Castile first became operational), if passage at Castile Falls has not exceeded 150 fish (20% of estimated 750 fish capacity) in at least 1 year, or if the mean passage at Castile Falls from 2012-2019 is less than 80% of the 150 fish goal (< 120 fish), then:
   - Implement an integrated NOR program at McCreedy Hatchery
   - Base the program size (number of smolts released) on a maximum 25% collection rate of NOR passage at Castile for brood stock. The maximum size of the program would be sufficient brood collection to release 70,000 smolts.

The option also calls for implementing habitat actions to improve steelhead habitat quality and quantity throughout the Klickitat River Subbasin. Habitat actions are expected to increase steelhead abundance and productivity by 85% and 26%, respectively (Appendix C)[8].

[8] The level improvement is based on the combined results of passage improvement and the 40% habitat restoration scenario.

Long-term implementation and adaptive management of the program will be guided by ongoing M&E activities targeting viable salmon population (VSP) parameters affected by the hatchery and habitat programs (see Chapter 7). This work will be conducted as part of the Klickitat Subbasin Recovery Plan (NOAA-Fisheries 2009).

Steelhead Habitat Plan

The plan for steelhead habitat involves implementation of a suite of actions to address the limiting factors identified for each MaSA and MiSA (Table 6-6). The limiting factors strategies and proposed actions for each area were developed as part of steelhead recovery planning by NOAA (NOAA-Fisheries 2009).

Table 6-6: Habitat limiting factors for Klickitat River steelhead by MaSa and MiSA

Area	Limiting Factors
Upper Klickitat River (MaSA)	Obstructions, sediment load, temperature, channel stability, key habitat quantity, habitat diversity, hydroconfinement, food, harassment/poaching
White Creek (MaSA)	Flow, key habitat quantity, habitat diversity, obstructions, altered hydrology, sediment load, hydroconfinement, temperature, food, channel stability.
Middle Klickitat River (MaSA)	Sediment load, key habitat quantity, habitat diversity, temperature, harassment/poaching, flow, predation, competition with hatchery fish, channel stability, obstructions.
Lower Klickitat River (MaSA)	Key habitat quantity, habitat diversity, food, temperature, sediment load, predation, competition with hatchery fish, obstructions, channel stability, withdrawals, flow, harassment/poaching.
Swale Creek (MiSA)	Temperature, key habitat quantity, sediment load, pathogens, food, habitat diversity, predation, flow, channel stability
Klickitat Canyon (MiSA)	Sediment load, food
Lower Little Klickitat River (MiSA)	Temperature, pathogens, sediment load, food, key habitat quantity, predation, flow, habitat diversity, competition with hatchery fish.
Upper Little Klickitat River (MaSA)	Habitat diversity, flow, sediment load, temperature, key habitat quantity, hydroconfinement, pathogens, predation, obstructions, food, competition with hatchery fish, channel stability, withdrawals, oxygen.
Upper Middle Klickitat River (MiSA)	Sediment load, predation, habitat diversity, competition with hatchery fish, channel stability, key habitat quantity, obstructions.
Trout Creek (MiSA)	Sediment load, food, temperature, key habitat quantity, habitat diversity, flow, obstructions.
West Fork Klickitat River (MaSA)	Obstructions, sediment load.

The six strategies that will be used to address limiting factors in key areas of the Subbasin are shown in Table 6-7.

Table 6-7: Relationship between steelhead habitat strategies and key geographic areas in the Klickitat River Subbasin

Strategy	Areas For Implementation
Strategy 1: Protect Stream Corridor Structure and Function	Mainstem Klickitat and throughout MaSA watersheds
Strategy 2: Restore Passage and Connectivity between Habitat Areas	Piscoe Creek, McCreedy Creek, White Creek and tributaries, Little Klickitat tributaries, upper Klickitat mainstem, West Fork Klickitat, Trout Creek
Strategy 3: Restore Floodplain Function and Channel Migration Processes	All areas
Strategy 4: Restore Riparian Condition	Trout Creek, Upper Little Klickitat, Lower Little Klickitat, Klickitat Canyon, Swale Creek, Lower Klickitat, Middle Klickitat, White Creek, Upper Klickitat
Strategy 5: Restore Normative Flow Regimes	Lower Klickitat, Middle Klickitat, Lower Little Klickitat, Upper Little Klickitat, White Creek, Trout Creek, Swale Creek
Strategy 6: Restore Degraded Water Quality, including Water Temperatures	All areas

The types of actions that would be included in each strategy are presented below. More detailed information on both strategies and actions can be found in Appendix A.

Strategy 1

- Protect existing habitat from future degradation through conservation easements, acquisitions, reclassification of lands as natural areas, enforcement of land use regulations
- Riparian forest management and planning: plan to leave buffer strips in riparian forest zones
- Limit riparian livestock grazing
- Assess effects of groundwater development on tributary flow
- Manage diversions to maximize instream summer flows

Strategy 2

- Replace culverts
- Monitor effectiveness of passage improvements at Castile Falls
- Study passage at mouths of spawning tributaries relative to flow and alluvial fan morphology
- Monitor and continue restoration efforts in Snyder Creek mill reach (flume passage improvements and riparian re-vegetation)
- Determine extent of problem for inadequately screened intakes
- Ensure that pump intakes are adequately screened

Strategy 3

- Place large woody debris or other structures to stop headcutting areas
- Restore stream length
- Restore cross-sectional morphology and roughness
- Augment gravel
- Increase pool quantity and quality and pool: riffle ratio
- Improve pool cover and hiding refugia
- Restore floodplain and side-channel connectivity
- Increase floodplain and channel roughness
- Re-vegetate riparian areas
- Relocate/soften floodplain infrastructure. Modify historic railroad grade
- Disconnect roads from stream network to improve watershed and water retention
- Improve surface and drainage characteristics of roads in tributary watersheds
- Perforate roads to allow peak flows to move onto floodplain
- Relocate/abandon mid-slope roads where possible; relocate/abandon valley-bottom roads where possible
- Close/relocate off-road vehicle trails
- Limit riparian livestock grazing
- Investigate off-channel livestock watering
- Promote no-till cropping and riparian buffers in agricultural areas
- Modify land-uses and/or implement structures to retain storm flow and decrease time of concentration from watershed upstream of canyon (Swale Creek)

Strategy 4

- Re-vegetate riparian areas
- Limit riparian livestock grazing
- Monitor and continue restoration efforts in Snyder Creek mill reach (flume passage improvements and riparian re-vegetation)
- Limit livestock grazing in riparian areas
- Control/eradicate noxious invasive plant species from priority habitats

Strategy 5

- Obtain instream flow right for mainstem Klickitat
- Restore floodplain connectivity in tributaries
- Assess effects of groundwater development on tributary flow
- Manage diversions to maximize instream summer flows
- Encourage mainstem hydropower operations that mimic natural flow regimes

Strategy 6

- Short-term fertilization of stream with carcasses or carcass analogs
- Improve road drainage characteristics and surfacing
- Re-vegetate riparian areas to reduce stream temperatures
- Conduct pathogen sampling and monitoring
- Limit livestock grazing in riparian areas

- Assess nutrient and dissolved oxygen levels in the Little Klickitat River, particularly downstream of Goldendale
- See also actions for Strategy 3

The implementation of the six habitat strategies may result in 85% and 26% increases in steelhead abundance and productivity, respectively. Spatial structure would also increase as habitat conditions are improved in each MaSA and MiSA.

It should be noted that the cost of the actions are not included in the overall budget for this plan (Chapter 9.0). Instead, funding requests for implementing each action will be made to the Council through Subbasin planning and to the State of Washington through the Salmon Recovery Board.

It should also be noted that the proposed habitat actions will provide benefits to other anadromous and resident fish species as well as some wildlife species. Expected benefits for each fish species are presented in succeeding sections of the Master Plan.

Steelhead Hatchery Plan

The hatchery program has both harvest and conservation components.

Harvest Component

The harvest component will consist of a target annual release of 90,000 juveniles from the Klickitat hatchery. The program will continue to be operated as a Segregated Harvest program using Skamania steelhead. If monitoring indicates that the percentage of natural juvenile production from hatchery-origin parents increases to more than 5% for three consecutive years or more than 5% for 5 years in a 10-year period, then we will seek to improve the segregated program by moving to a local brood program, collecting hatchery-origin steelhead returning to the Klickitat Subbasin at Lyle Falls. If the rate of hatchery-origin contribution to natural smolt production increases to greater than 10%, then the harvest program could be eliminated by agreement of the parties to *U.S. v Oregon* or converted to an integrated program using local, natural-origin brood stock collected at Lyle Falls. The goal of the program is to provide harvest benefits while, at the same time, minimizing adverse impacts to the natural spawning population by implementing hatchery reform recommendations to limit the contribution of hatchery-origin fish to the natural population if monitoring suggests this contribution is increasing.

If a local brood (either hatchery- or natural-origin) program is determined to be necessary, the program will require from 70 to 80 adults to produce the target release of 90,000 age-1 steelhead[9]. Releases would be 100% marked with an adipose-fin clip. Broodstock for the harvest program would be distinguished by the absence (hatchery-origin; segregated program) or presence (natural-origin; integrated program) of an adipose fin. Harvest and homing strategies will be used to limit the proportion of hatchery-origin fish on the natural spawning grounds to a rate less than or equal to about 5%. The HSRG has concluded that genetic and reproductive risks to wild fish from

[9] Variability in fecundity over time may alter the number of fish collected for broodstock each year.

hatchery fish spawning in the wild are low as long as hatchery fish make up less than 5% of the total spawning population (HSRG, WDFW, and Northwest Indian Fisheries Commission 2004b).

Adults will be collected near the mouth of the Klickitat River at the Lyle Falls fish trapping facility. The summer run extends roughly from May through the end of October or early November. Collecting adults for broodstock in November will depend on future refinements in run-timing and differentiation between summer and winter run steelhead. Data from trapping operations conducted between 2004 and 2011 suggest that the summer steelhead run timing tapers off near the end of October/early November while the winter run component begins showing up in early to mid-November (YKFP data, available at http://www.ykfp.org/klickitat/Data_lyleadulttrap.htm).

The number of adults collected on a monthly basis will coincide with stock- specific cumulative passage dates to ensure that adults used in the program are taken throughout the entire migration period of the summer run component. Data collected from future trapping operations will be used in conjunction with the 2004-present trapping data to refine the distribution of summer run steelhead passage within the migration period observed at Lyle Falls. Future work is needed to better define the weekly cumulative passage because trapping is currently limited to a few days per week and recent improvements to passage and attraction flow has changed fishway use rates. It is anticipated that trapping operations will be capable of running 5 to7 days per week. A prototypical monthly broodstock collection schedule is given in Table 6-8.

Table 6-8: Number of wild and hatchery steelhead trapped monthly at Lyle Falls Fishway from 2007-2011 with projected broodstock collection

Wild Steelhead	May	Jun	Jul	Aug	Sep	Oct	Total
2007	14	9	26	16	10	25	100
2008	8	14	22	16	2		62
2009	19	80	85	17	32	6	239
2010	9	20	35	30	8		102
2011	7	34	13	107	27	17	205
Average	11	31	36	37	16	16	142
Average monthly proportion	8%	21%	24%	25%	11%	11%	100%
Projected # collected for broodstock	6	17	20	20	9	9	80
Hatchery Steelhead							
2007	26	75	41	5	30	15	192
2008	11	100	55	13			179
2009	100	267	291	26	57	5	746
2010	335	203	222	37	9		806
2011	37	194	10	27	11	3	282
Average	102	168	124	22	27	8	441
Average monthly proportion	23%	37%	28%	5%	6%	2%	100%
Projected # collected for broodstock	18	30	22	4	5	1	80

Given these data, maintaining an integrated program with the proposed release target (approximate brood need of 80 fish) and 100% natural-origin fish as broodstock would require returns of at least 320 natural-origin steelhead to keep collection rates below 25%. Table 6-1 indicates that returns of natural-origin steelhead have averaged about 765 fish annually since 1986 with only 2 years falling below the 320 fish threshold. Therefore, an integrated program with 100% pNOB should be feasible in most years while keeping total brood collections of natural-origin steelhead less than 10% (maximum 25%) of the total natural-origin return. The impact of the local brood program to the natural-origin return could be reduced by using a pNOB less than 100%. Assuming the parties to *U.S. v Oregon* agree on the need for this program, we intend to develop the management parameters for this program collaboratively with other management entities.

In an effort to minimize physiological stress on fish sampled at the Lyle Falls trap, several non-chemical anesthetic methods may be used for fish handling including: low-voltage electronarcosis (as described in Hudson et al. 2011); non-lethal black-out tubes (water-filled PVC tubes with cut-away sections into which fish are inserted that allow sampling while the head of the fish is kept in a dark environment); or if necessary, saturated water bath of carbon dioxide gas. Biological data will be collected on every steelhead caught during trap operations. Data collected will include sex, fork length, weight, existing marks, scales, and a fin-clip DNA sample.

Adult steelhead will be trucked to the Klickitat hatchery daily where they will be held in a temporary holding tank while a real-time DNA analysis is conducted. The purpose is to ensure that only local Klickitat steelhead are used for artificial propagation. DNA samples taken from adults selected for broodstock will be immediately shipped to the genetic lab for a real-time DNA analysis. Turn-around time on the analysis will be roughly 2 to 3 days upon arrival at the genetics lab. Any steelhead identified as out-of-Subbasin stock will be trucked to the mouth of the Klickitat River and released. Total estimated time from trapping to release will be about 4 to 5 days. The remainder of adults identified as Klickitat River steelhead will be transferred to a permanent holding pond. Results from the real-time DNA analysis will be used to track Klickitat River sub-populations used for the hatchery composite stock.

Releasing juveniles volitionally from the Klickitat hatchery should result in high adult homing fidelity and volunteer rates back into the hatchery similar to those observed for spring Chinook, i.e. 80% to 90%. The high adult homing rate, combined with the target terminal harvest rate of 85% is expected to prevent 95% of the hatchery adults returning to the Subbasin from spawning in the wild. The HSRG has concluded that genetic and reproductive risks to wild fish from hatchery fish spawning in the wild are low as long as hatchery fish make up less than 5% of the total spawning population (HSRG, WDFW, and Northwest Indian Fisheries Commission 2004b).

Thus, the program has a goal of limiting the contribution of hatchery-origin fish to natural juvenile production to less than or equal to 5% for stream reaches upstream of Lyle Falls over the long term. The actual rate of contribution will depend on adult homing fidelity to the release site and the ability of sport and Tribal harvesters to selectively remove hatchery-origin adults. Results from M&E activities will be reviewed

annually and adaptive management will be used to modify the program if results indicate natural populations are being negatively impacted.

Conservation Component

Background

In the 1960s, an attempt was made to improve passage at Castile Falls, but passage did not improve and may have even worsened due to design flaws. In 2005, full passage was restored into the Upper Klickitat Watershed for migratory salmonid species as a result of improvements made to the Castile Falls Fishway. With these improvements, we have observed limited passage at Castile Falls; however, monitoring capabilities have also been limited. Year-round monitoring using digital imagery video is now being implemented. Analysis of steelhead production potential by the ICTRT and YN indicate that habitat above Castile Falls may support 750 steelhead.

Prior versions of the Master Plan called for delaying action for 9 years to see if wild steelhead were able to re-colonize this habitat without human assistance. If by 2020 (2-3 fish generations from 2005 when passage was fully restored above Castile Falls) steelhead escapement above Castile Falls has not reached 150 adults in at least one year or if the mean annual passage above Castile Falls from 2012-2019 is less than 120 fish (<16% of estimated capacity), hatchery supplementation will be used as a tool to accelerate the re-colonization process[10]. The discussion under the Conservation Program (below) outlines this approach.

The Conservation Program

Broodstock for the conservation program will be collected at Castile Falls Fishway. The number of adults collected will depend on run size and will never exceed 25% of total natural-origin returns. Given the low number of adults that would likely be available if the program were implemented, the program may be designed to use both anadromous and resident life history types of *O. mykiss*.

The initial phase of artificial propagation will determine if the upper Klickitat resident life history type is capable of producing anadromous offspring from both fidelity and hybrid crosses. If the resident life history fish demonstrate the ability to produce anadromous offspring, breeding lines producing the highest proportion of anadromous offspring may receive priority for future propagation, assuming a limited number of anadromous adults are available for broodstock. For example, one study on an Alaskan stream using similar breeding lines demonstrated the ability of the Resident female (Rf) x Anadromous male (Am) breeding line was capable of producing a similar proportion of smolts as the Anadromous female (Af) x Anadromous male line. The Af x Resident male (Rm) and Rf x Rm breeding lines both produced a high proportion of resident offspring, particularly males (Thrower et al. 2004).

[10] The decision to proceed with a supplementation program may also be based on the health of the lower Klickitat River populations and the status of the ESU. The decision to proceed with the program will be made through consultations with NMFS and the WDFW.

Four different breeding lines will be created using anadromous and resident *O. mykiss* for broodstock including:

Af x Am

Af x Rm

Rf x Am

Rf x Rm

The size and duration of the program will be dependent on the number of anadromous and resident adults available for broodstock, the ability of the resident life history to contribute to anadromous production, and the re-colonization rate after the program has been implemented. The program will be small in order to minimize broodstock mining rates and avoid homogenizing or reducing the genetic diversity of the upper Subbasin *O. mykiss* population. If the breeding lines using the resident life history type fail to produce sufficient anadromous offspring capable of contributing to anadromous adult production, a decision will be made to either eliminate the use of resident *O. mykiss* in the program or terminate the conservation hatchery program and continue with natural re-colonization.

Juveniles produced from the program will be marked (adipose fin clip), acclimated at McCreedy Creek, and released volitionally during the typical outmigration period for steelhead. Currently, the program calls for releasing yearling smolts. However, data collected on the applicability and success of 2+ steelhead smolt releases undertaken by other parties will be tracked and evaluated for possible incorporation into the program.

Regardless of the decision to intervene by artificial means, critical M&E activities will be put into place prior to and during the program's implementation stages in order to adequately assess natural re-colonization and/or contribution of the conservation hatchery program to re-colonization of the upper Klickitat watershed. Monitoring activities are described in Chapter 7.0.

Steelhead Harvest

Harvest will be managed to maximize the exploitation of all adipose-clipped hatchery fish while minimizing the impacts to wild summer and winter steelhead. Wild steelhead will not be targeted for harvest in recreational fisheries. A harvest rate standard of not-to-exceed 15% of the total number of natural/wild steelhead adults entering the Klickitat River will be used to manage the fishery.

Current regulations in place for treaty and sport fisheries will provide the basis for future provisions. In-season harvest modifications, i.e. reductions, will be implemented if minimum wild steelhead escapement targets are not likely to be achieved.

The daily bag limit currently is two adipose fin-clipped steelhead with a season beginning on June 1 and closing on November 30. In years of strong hatchery returns, the daily bag limit may be increased for the purpose of removing surplus hatchery fish from the harvest

component, and decreasing contribution of hatchery-origin fish to natural production. Provisionary adult abundance estimates and hatchery/wild ratios from tagging information and adult trapping operations will be used to adjust in-season daily bag limits if need be. If the removal of hatchery fish during the regular scheduled fishery still results in a large escapement of hatchery-origin fish or an excessive number of hatchery adults are observed during the winter trapping months (November through April), an emergency fishery may be opened that will target the removal of hatchery fish. This fishery will likely require restrictive gear usage in order to minimize the impact to wild summer and winter steelhead prior to their spawning period.

Fishing for steelhead upstream of Castile Falls will not be allowed until such time as the annual adult escapement goal of 500 fish is exceeded for at least three consecutive years.

6.1.6 Facilities

Upgrades to the Klickitat Hatchery and a number of new facilities are needed to implement the steelhead program. See Chapter 8 for additional details.

Klickitat Hatchery

The Klickitat Hatchery has undergone a number of modifications and renovations between 1950 and 2010. Since 1993, only minor improvements have taken place. The hatchery requires significant upgrading to be consistent with scientific and technological advances.

Smolt Trapping Facilities

Smolt traps will be needed downstream of the release sites. Trapped smolts will allow estimation of the contribution of hatchery-origin parents to juvenile production as well as evaluation of juvenile migration timing and presence in the Subbasin. No monies are being asked for purchase or operation of these traps; funding will be obtained from other sources.

McCreedy Creek Acclimation Facility

This will be a new facility built to acclimate up to 70,000 steelhead each year. The facility will be built only if a decision is made to proceed with the conservation component of the hatchery program.

Lyle Falls Fishway: Fish passage improvements and a counting facility have been completed at the Lyle Falls Fishway.

Castile Falls Adult Trap: An adult trap, equipped with PIT tag detection ability and a video camera, has been built at the Castile Falls fishway enabling biologists to collect DNA samples on migrants and estimate adult escapement.

6.2 Spring Chinook

6.2.1 Spring Chinook Stock Assessment

Spring Chinook Conservation Status

The Klickitat spring Chinook population is part of the mid-Columbia Spring Chinook ESU, which is currently not listed under ESA. However, the Washington Department of Fish and Wildlife (WDFW) consider the population depressed due to chronically low adult returns (WDFW 2005). On average, the Klickitat spring Chinook run comprises approximately 75% hatchery and 25% natural fish (Appendix C). Low numbers of returning natural-origin adults along with potential genetic issues (described below in Section 6.2.2 under Hatchery Management) have led to concerns regarding the status and trends of this native population.

Data on the total natural origin adult returns, spawning escapement, age composition and recruitment rates of the natural Klickitat spring Chinook population for brood years 1984 through 2006 are presented in Table 6-9. The data show that over this period, spring Chinook adult production averaged 723 fish, ranging from 54 to 2,359.

Table 6-9: Returns, spawning escapement and recruitment rate estimates for natural Klickitat spring Chinook, brood years 1984 – 2006

Brood Year	Natural Spawners	Age Distribution of Natural Returns				Estimated Brood Year Recruitment	Natural Recruits per Spawner
		Age-3	Age-4	Age-5	Age-6		
1984	102	29	782	65	6	882	8.65
1985	79	117	381	504	1	1004	12.71
1986	142	43	215	155	4	418	2.94
1987	312	112	303	176	12	603	1.93
1988	1108	76	334	387	3	800	0.72
1989	295	44	318	105	5	471	1.60
1990	224	9	19	25	2	54	0.24
1991	241	10	60	38	4	113	0.47
1992	318	35	334	294	23	686	2.16
1993	430	37	479	145	0	660	1.54
1994	96	22	137	42	0	201	2.09
1995	72	64	108	105	4	282	3.91
1996	274	115	1002	276	0	1393	5.09
1997	595	157	250	120	0	527	0.89
1998	240	198	1179	614	2	1993	8.30
1999	119	416	1421	513	9	2359	19.82
2000	516	313	795	17	2	1127	2.18
2001	312	373	262	107	0	742	2.38
2002	898	28	311	223	0	562	0.63
2003	1142	37	207	87	0	330	0.29
2004	817	64	322	36	0	422	0.52
2005	125	168	203	48	0	420	3.36
2006	242	168	352	63		583	2.41
Mean	378	115	425	180	4	723	3.69

Yakama Nation Fisheries

Spring Chinook spawning escapement has ranged from 72 to 1,142 with a mean of 378. A proportion of these spawners were probably hatchery fish, but since most returning hatchery adults were not marked prior to 2007, and sample sizes of recovered carcasses on spawning grounds since then are small, it is not possible to develop a precise estimate (Yakama Nation, Klickitat County, and WDFW 2004, and Zendt et al. 2010).

Mark-recapture estimates of spring Chinook run size to Lyle Falls on the lower Klickitat River in recent years, conducted by tagging fish at Lyle Falls then recapture upstream at Klickitat Hatchery, have averaged about 3200 hatchery and 500 wild fish (total adults and jacks; Zendt et al. 2010 and more recent YKFP unpublished data). Mark-recapture methods have yielded higher run size estimates than the run reconstruction methods in Table 6-9, but are likely influenced by higher-than-average returns of hatchery fish in some recent years, and possibly by undercounting of redds.

Spring Chinook Harvest Status

Spring Chinook are caught primarily in Columbia River mainstem and terminal fisheries in the Klickitat River. From 1996 to 2005, spring Chinook catch in mainstem non-Tribal and Tribal fisheries averaged 26 and 159 fish respectively[11]. The combined sport and Tribal harvest of spring Chinook within the Klickitat River Subbasin has averaged 894 fish over this same period. The fisheries result in a combined total exploitation rate of 43% (Appendix C).

Historically, hatchery spring Chinook released into the Klickitat River were not marked. Therefore, it was not possible to determine if harvest rates varied for wild and hatchery fish. Beginning in 2002, all spring Chinook juveniles released from the Klickitat River were adipose fin-clipped allowing future managers to calculate harvest and exploitation rates for both run components.

6.2.2 Recent Management Strategies

Spring Chinook Habitat Management

Over the last 10 years, habitat management in the Klickitat River Subbasin has focused on the development and implementation of actions that restore ecological function and allow spring Chinook and other anadromous fish access to areas blocked by obstructions. A list of the major habitat actions that have been recently implemented in the Klickitat River Subbasin is presented in Table 6-2.

Spring Chinook Hatchery Management

Propagation of the indigenous Klickitat Spring Chinook stock began in 1951 when the Klickitat River Hatchery began operations. Between 1951 and 1959, natural-origin (NOR) adults were collected for broodstock at the Lyle Falls Fishway near the mouth of the Klickitat River (RKm 3.2). Since then, collection of broodstock has relied upon volunteer fish at the on-site hatchery trap (RKm 69). This method of broodstock

[11] Harvest numbers for mainstem fisheries are based on assumed harvest rates for Upper Columbia River spring Chinook as Klickitat River fish cannot be distinguished from the run at large.

collection has resulted in the incorporation of very few natural-origin spring Chinook on an annual basis.

Marshall (unpublished) found substantial genetic divergence between the hatchery and natural components of the population. More recent analysis (Hess et al. 2011), however, finds that the hatchery and natural-origin fish are quite similar and that some introgression has occurred between the stream-type Klickitat spring Chinook population and ocean-type Chinook stocks (likely Wells Hatchery summer Chinook that were released in the Klickitat in the late 1970s). This analysis points to past hatchery practices (possible incorporation of returning summer Chinook into spring Chinook brood mating, which has been discontinued) that likely initiated this interbreeding, and to the fact that the introgressed genotype persists in much of the hatchery and wild spring Chinook population with an unknown effect on fitness. Additional research is occurring to determine the effects.

Annual hatchery releases have consisted of both yearling and subyearling spring Chinook ranging from 419,500 to 960,000 for release years 1996 through 2011 (Table 6-10). Currently, hatchery spring Chinook yearlings are volitionally released from their rearing ponds at the Klickitat Hatchery (RKm 68) in March at about 13 to15 fpp in size. Subyearling spring Chinook have been transported and released directly into the Klickitat River from May through August at a size of 50 to 80 fpp. No releases of subyearlings have occurred since 2007.

Table 6-10: Spring Chinook subyearling and yearling hatchery releases for years 1996-2011

Release Year	Subyearling Release			Yearling Release		
	Number	Date (MM/DD)	Avg Size (fpp)	No.	Date (MM/DD)	Avg Size (fpp)
1996	223,000	5/28-5/29	54	610,000	2/8-2/9; 3/1-3/16	6
1997	382,500	5/27-5/29	49.5	580,600	3/1-3/15	7
1998	343,380	5/6, 5/7, 6/30	77	584,500	3/2-3/12	7
1999	40,600	5/11	81	538,000	3/1, 3/2	7.5
2000	190,842	5/2, 5/3, 8/9, 8/17	63.6	562,000	3/1-3/10, 3/20-3/31	6.4
2001	252,098	5/13, 7/22	51.4	615,000	3/7-3/9	7.7
2002	223,298	5/13	51.4	605,000	3/8-3/10	7.7
2003	286,400	5/6,8/6	71/36	607,500	3/5-3/8	8.0
2004	348,910	4/4, 5/10	70/60	609,800	3/1 – 3/5	13.7
2005	269,800	5/5 – 5/17	68	628,196	3/1 – 3/7	14.5
2006	155,230	5/21, 6/12, 7/12	58/68/56	607,900	3/6 – 3/10	14.1
2007				606,000	3/5 – 3/6	15.0
2008				615,306	3/3 – 3/8	14.4
2009				624,650	2/25 – 2/28	14.2
2010				419,475	3/9 – 3/11	15.0
2011				621,375	3/15 – 3/22	13.2

Until the 2002 brood year, the majority of juvenile spring Chinook released each year were not adipose fin-clipped. Since this time, all spring Chinook hatchery juveniles have been marked with an adipose fin-clip. In addition, some have been given a coded-wire-tag (CWT).

Current Hatchery Performance

Hatchery spring Chinook smolt-to-adult survival rates have averaged approximately 0.35% and ranged from 0.01% to 1.31% for brood years 1990 through 2000 (Appendix C). Preliminary PIT tag return data indicates an average smolt-to-adult survival rate of about 0.43%. This rate of survival has resulted in a measured recruit per spawner ratio (R/S) of 2.67. In contrast, the natural spring Chinook population over this same time period had an average R/S value of 3.69 (Table 6-9).

Total hatchery spring Chinook production for return years 1990 through 2006 ranged from 746 to 4,838 and averaged 2,186. This estimate does not include those fish harvested in marine and mainstem Columbia River fisheries. The inclusion of these fish would increase total production by between 3% and 13% dependent on the return year[12].

Culture practices at the Klickitat Hatchery have resulted in an egg-to-smolt survival rate of 73%. Bacterial Kidney Disease (BKD) has been a problem in the past, but has been reduced through the implementation of better culture methods at the Klickitat Hatchery.

Prior to 2003, spring Chinook yearlings were released from the hatchery at approximately 8 fpp or larger (Table 6-9)[13]. Releasing fish at 8 fpp is likely responsible for the high rate of mini-jack returns to the hatchery, which averaged 75% for the 1996 through 2003 brood years[14]. To correct this problem, spring Chinook yearling release size was decreased to 13 to 15 fpp in 2004 to better mimic the wild juveniles being produced from the Subbasin (Table 6-10).

Spring Chinook Harvest Management

Klickitat River spring Chinook are caught primarily in Columbia River mainstem and in the Klickitat River. In 2008, *U.S. v Oregon*[15] parties signed the 2008-2017 Management Agreement that scheduled harvest rates according to the strength of the ESA-listed upriver spring Chinook run size (*U.S. v Oregon* Parties 2008). Harvest rates on the natural component of the spring Chinook run in Zones 1-5 and the Zone 6 treaty fishery range from 1% to 2% and 3% to13%, respectively (Appendix C). Also in 2001, a

[12] Harvest rates on Klickitat River spring Chinook caught in Columbia River fisheries are not available. It is assumed that Klickitat River-origin fish are caught at similar rates as Upper Columbia River spring Chinook.

[13] Fish at 8 fpp are larger than fish at 16 fpp as it requires more fish to equal one pound.

[14] The mini-jack rate was calculated by dividing the number of mini-jacks returning to the hatchery by the total number of fish (adults, mini-jacks and jacks) collected at the hatchery.

[15] *United States v. Oregon*, originally a combination of two cases, *Sohappy v. Smith* and *U.S. v. Oregon* (302 F. Supp. 899), legally upheld the Columbia River treaty tribes reserved fishing rights. Although the Sohappy case was closed in 1978, *U.S. v. Oregon* remains under the federal court's continuing jurisdiction serving to protect the tribes' treaty reserved fishing rights.

selective fishery for hatchery spring Chinook was established in the Columbia River which requires sport fishers to release unmarked spring Chinook back to the river.

Because returning age-4 adult Klickitat River hatchery spring Chinook were not adipose fin-clipped prior to 2006, it was assumed that mainstem Columbia River harvest rates on both the hatchery and natural components are similar to those occurring on ESA-listed Upper Columbia River spring Chinook, i.e. between 3% and13%.

Until 2006, spring Chinook fisheries in the Klickitat River were non-selective for hatchery fish. Sport fishers in the Klickitat River since 2006 are allowed to keep only marked hatchery spring Chinook, while Tribal fishers may retain any spring Chinook caught. The combined sport and Tribal harvest rate on spring Chinook returning to the Subbasin was about 35% for the 1996-2005 period. When selective fisheries are implemented in the Subbasin, harvest rates on hatchery and natural-origin spring Chinook are expected to be 38% and 20%, respectively (Appendix C).

The Tribal fishery is generally open Tuesdays through Saturdays from early April until the end of May and closes for most of June to allow adequate adult escapement to the Klickitat Hatchery. In years of lower abundance, the Tribal fishing season has been shortened by a day or two each week. The sport fishery is generally open 1 to 3 days per week downstream of the Fisher Hill Bridge (RKm 2.9). In years of higher spring Chinook abundance, the fishery is generally open above Lyle Falls to the Klickitat River Hatchery (RKm 68).

6.2.3 Biological Goals for Spring Chinook

Both conservation and harvest goals are proposed for Klickitat spring Chinook. Conservation goals are measured in terms of productivity, abundance, life history diversity, and geographic distribution (spatial structure). Harvest goals are divided into Tribal and sport harvests in the mainstem and inside the Klickitat Subbasin.

Spring Chinook Conservation

The main conservation objectives for Klickitat spring Chinook are: 1) to increase population viability by ensuring that the adaptation of the population is driven by the natural environment and 2) to ensure that the population size remains large enough to allow the population to maintain itself.

For natural/hatchery composite programs such as Klickitat spring Chinook, the influence of the hatchery and natural environments on the adaptation of the composite population is dependent on the proportion of natural-origin broodstock in the hatchery (pNOB) and the proportion of hatchery-origin fish in the natural spawning escapement (pHOS). The larger the ratio pNOB/(pHOS+pNOB), the greater the strength of selection from the natural environment relative to that of the hatchery environment. The value produced from this calculation is the proportion of natural influence or PNI (HSRG, WDFW, and Northwest Indian Fisheries Commission 2004a). The HSRG recommends a PNI value of 0.67 for programs that have a goal of increasing stock viability. The objective for spring Chinook in the Klickitat is to achieve a PNI of 0.67.

The spring Chinook abundance objective is to achieve a minimum and average escapement of 400 and 700 adults, respectively. These abundance objectives were based primarily on the expected improvement in fish performance from the implementation of habitat actions described in the Klickitat Subbasin Recovery Plan (NOAA-Fisheries 2009). The habitat actions are also hypothesized to increase population productivity from about 6 to over 7 recruits per spawner (Appendix C). This is the productivity objective for this species.

In regard to spatial structure, the objective is to have spring Chinook spawn throughout their historical range in the Subbasin. Re-establishing their historical spawning distribution should expose the fish to the widest possible range of environmental conditions within the Subbasin. This, in turn, should increase population life history diversity.

A summary of the conservation objectives for spring Chinook is presented in Table 6-11.

Table 6-11: Conservation goals for Klickitat River spring Chinook

Parameter	Objective
Productivity	Recruits/Spawner > 7.0[a]
Abundance	Average Adult Escapement > 700 per year / Minimum Escapement > 400
Spatial Structure	Spawning Throughout Historical Range
PNI	0.67

[a] see Appendix C

Spring Chinook Harvest

The primary harvest objective for spring Chinook is to meet or exceed Treaty harvest obligations consistently and on a long-term sustainable basis. This includes a contribution to the Zone 6 component and the terminal fishery at which are some of the last historical fishing sites remaining for Treaty-Indian fishers.

A secondary objective is to maintain or increase recreational fisheries on a long-term sustainable basis. Recently, all fish released from the Klickitat River Hatchery have been marked. This is expected to result in an increased harvest of spring Chinook in the mainstem Columbia and the Klickitat River because marking will allow sport fishers to distinguish between wild and hatchery fish in the mixed wild/hatchery run.

A mandatory condition of all harvest objectives is that they be attainable while still meeting the conservation objectives described above. This means that harvest will not occur at the expense of conservation-- conservation objectives will be given a higher priority than harvest.

The harvest objectives and performance criteria for Klickitat River spring Chinook are summarized in Table 6-12.

Table 6-12: Harvest objectives for Klickitat River spring Chinook

Fishery	Objective

Mainstem Columbia River- Tribal	600
Mainstem Columbia River- Non-Tribal	400
Klickitat River Terminal- Tribal	1,800
Klickitat River Terminal- Sport	1,200
Total Harvest	4,000

6.2.4 Alternative Strategies Considered for Spring Chinook

As with steelhead (Section 6.1.4), the YN considered three options for the future management of Klickitat River spring Chinook:

1. Maintain existing hatchery program
2. Eliminate hatchery program and improve habitat
3. Develop integrated hatchery program and improve habitat

Of the three options considered, option 3 best achieved the conservation and harvest objectives identified for spring Chinook. This option is described in more detail in Section 6.2.5. The two options that were rejected are described in the following paragraphs.

Maintain Existing Hatchery Program

This alternative would maintain the status quo for hatchery production and operation. Currently, 600,000 spring Chinook juveniles are released at the Klickitat Hatchery (RKm 68) to provide fish for Tribal and non-Tribal fisheries.

Subbasin habitat would be improved over time as habitat actions designed to recover ESA-listed steelhead are implemented in the Subbasin. Spring Chinook geographic distribution would also increase due to the recent implementation of the fishway at Castile Falls that improves fish access to the Upper Klickitat River watershed.

Current harvest strategies would persist for both Treaty and non-treaty fisheries occurring in the Columbia River mainstem and Klickitat River. This includes a non-selective fishery for Tribal fishers and a selective fishery targeting hatchery fish for recreational fishers. Though the habitat improvement component of this alternative produces substantial benefits to spring Chinook and other fish species, the alternative was rejected due to problems associated with the hatchery program. These problems include:

- The observed recruits per spawner ratio (R/S) for the current hatchery program (2.2) is less than that of the natural environment (3.2) under existing habitat conditions. Therefore, bringing fish into the hatchery environment actually reduces the productivity and, therefore, viability of the combined (hatchery + natural) spring Chinook population.

- Historically, the hatchery program produced large numbers of mini-jacks each year. As mini-jacks are not generally found in the wild, their production may be impacting the life history diversity of the spring Chinook population. A decrease in life history diversity may decrease population fitness.

- Mini-jacks spend the majority of their lives in freshwater rather than migrating to the ocean. These fish may prey on and compete with other juvenile anadromous fish rearing or migrating through the Klickitat and Columbia rivers. This increased predation and competition could potentially reduce the survival rates for ESA-listed fish species inhabiting these same areas.

- Because of low hatchery productivity, the overall harvest goal of 3,000 adults in terminal sport and Tribal fisheries has not been achieved. Since 1994, the number of adult harvested in these terminal fisheries has averaged 498 fish (Appendix C).

Eliminate Spring Chinook Hatchery Program and Improve Habitat

Under this option, the existing hatchery program for spring Chinook would be eliminated. The primary strategy for meeting both conservation and harvest goals for this species would be to improve stream habitat throughout the Klickitat River Subbasin. Harvest rates would be controlled so that spawning escapement averaged 700 adults.

The benefits of implementing this option include:

1. Analysis based on expected habitat improvements suggest that the abundance of the natural component of the spring Chinook population might increase by 132%, resulting in an average total run size of approximately 1,200 adults.

2. Improving habitat would likely increase the abundance, productivity, spatial structure, and diversity of other fish species inhabiting both tributary and mainstem areas. Some wildlife species would also benefit from improved riparian habitat condition and the resulting increase in fish abundance.

3. Terminating the hatchery program would eliminate predation and competition risks to native fish species associated with the release of 600,000 juvenile spring Chinook each year.

4. Program termination would result in a cost savings of $228,050. These monies could then be used to help fund the habitat program.

The risks to harvest and conservation goals from the implementation of this option include:

1. Harvest goals are unlikely to be achieved with natural production alone. It is projected that fewer than 500 fish on average would be harvested each year.

2. In-river harvest would have to be severely reduced or eliminated in many years to meet the minimum spawning escapement needed to protect wild fish. The

elimination of fisheries does not achieve the harvest objective of *"meeting or exceeding Treaty harvest obligations consistently and on a long-term sustainable basis"*.

3. This program was included in the legally binding 2008-2017 *U.S. v Oregon* Management Agreement.

Because this option did not meet the harvest goals and *U.S. v OR* production obligations identified for the Subbasin, it was not selected for implementation. However, because it was obvious that habitat actions can produce important benefits for fish, a habitat component was included in the preferred option (Section 6.2.5).

6.2.5 Preferred Option for Spring Chinook: Develop Integrated Hatchery Program and Improve Habitat

The preferred option incorporates an integrated hatchery program and substantial improvements in stream habitat to meet conservation and harvest objectives. A detailed description of the habitat, hatchery, and harvest actions included in the preferred alternative is presented below.

Spring Chinook Habitat

The habitat objective of this alternative is to increase the quantity and quality of Klickitat River mainstem and tributary habitat that currently supports or historically supported spring Chinook. This objective will be achieved by implementing strategies and actions that target factors limiting spring Chinook production in the Subbasin (Tables 6-13 and 6-14).

Table 6-13: Relationship between spring Chinook habitat strategies and key geographic areas in the Klickitat River Subbasin

Strategy	Areas For Implementation
Strategy 1: Protect Stream Corridor Structure and Function	Mainstem Klickitat
Strategy 2: Restore Passage and Connectivity between Habitat Areas	Lyle Falls and Castile Falls
Strategy 3: Restore Floodplain Function and Channel Migration Processes	Entire Klickitat Mainstem and Swale Creek
Strategy 4: Restore Riparian Condition	Swale Creek, Lower Klickitat, Lower Little Klickitat, Middle Klickitat, Upper Klickitat
Strategy 5: Restore Normative Flow Regimes	Lower Klickitat, Middle Klickitat, Lower Little Klickitat, Swale Creek
Strategy 6: Restore Degraded Water Quality, including Water Temperatures	Entire Klickitat Mainstem

Table 6-14: Habitat limiting factors for Klickitat River spring Chinook by geographic area

Area	Limiting Factors
Upper Klickitat River	sediment load, temperature, key habitat quantity, habitat diversity, food
Middle Klickitat River	habitat diversity, key habitat quantity
Lower Klickitat River	habitat diversity, food
Klickitat Canyon	food
Upper Middle Klickitat River	predation, habitat diversity, food, flow

A more detailed description of the types of actions that will be implemented throughout the Klickitat River Subbasin can be found in Appendix A. The total cost of implementing the habitat actions and critical habitat preservation is estimated at $130 million (Appendix A). The habitat actions are theorized to result in a 132% and 24% improvement in spring Chinook abundance and productivity, respectively (Appendix C).

Integrated Hatchery Programs for Spring Chinook

The hatchery component of the preferred option involves conversion of the existing segregated harvest program to an integrated harvest program (HSRG, WDFW, and Northwest Indian Fisheries Commission 2004a). The program is designed to increase the viability of the natural population while simultaneously producing the adults needed to meet the 4,000 fish harvest objective for all fisheries combined. To achieve the objectives, it is estimated that the hatchery program should release 800,000 yearling spring Chinook annually.

An additional possible objective of the hatchery program is to provide spring Chinook for reintroduction into the White Salmon River following Condit Dam removal and fish passage and return monitoring. Fishery managers have identified wild Klickitat spring Chinook as a possible brood source for spring Chinook reintroduction into the Big White Salmon River (NOAA 2011a). A robust integrated hatchery program that maximizes Klickitat spring Chinook natural production may provide surplus adults which can be made available to aid the Big White Salmon reintroduction effort.

Hatchery Operations

The existing segregated harvest program will be converted to an integrated conservation/harvest program by incorporating an increasing proportion of NOR Klickitat River spring Chinook into the broodstock over time (HSRG, WDFW, and Northwest Indian Fisheries Commission 2004a). The pace of broodstock conversion will depend on the size of the natural-origin spring Chinook run which is expected to vary annually. To reduce impacts to the natural-origin spring Chinook population, no more than 1 of every 2 NOR fish passing upstream through the Lyle Falls facility will be taken for brood stock. Present data indicate that 20-50% (averaging about 30%) of the return passes upstream using the ladder at Lyle (Table 6-15). Therefore, taking at most 1 of every 2 of these fish will limit NOR brood collection to at most 10-25% of the total run's

natural-origin component taken for the integrated hatchery program in any year. Future work is also needed to better define the passage rates because recent improvements to passage and attraction flow has changed fishway use rates. The program will be managed to increase the viability of the natural population while simultaneously producing the adults needed to meet harvest objective for all fisheries combined. To achieve both conservation and harvest objectives, it is estimated that the hatchery program will maintain a release number of approximately 800,000 yearling spring Chinook.

Table 6-15: Lyle Falls Fishway Spring Chinook Passage Estimates

Return Year	Total Run Size Estimate[1]	Wild Run Size Estimate[1]	Hatchery Run Size Estimate[1]	Total Handled	Wild Fish Handled	Hatchery Fish Handled	Overall Handling Rate	Overall Ladder Efficiency Rate[2,3]
2007	1966	413	1553	254	53	201	0.129	0.319
2008	1432	416	1016	103	22	81	0.072	0.302
2009	6521	675	5846	671	64	607	0.103	0.206
2010	4511	489	4022	204	22	182	0.045	0.122
2011	4445	636	3809	549	83	466	0.124	0.532
						Avg.	*0.095*	*0.296*

[1]Run size estimates to Lyle Falls using mark-recapture methods

[2]Based on handling rate expanded for days trap fished and run duration

[3]Mark-recapture run size are generated assuming a similar ladder-use rate for hatchery and wild fish (by using tag recapture data from hatchery fish for wild fish estimates), so only an overall ladder efficiency estimate is given (inferring different hatchery and wild efficiency rates would not be valid).

The 800,000 fish will be incubated, reared, and released volitionally at the Klickitat River Hatchery. Offspring of NOR adults used as broodstock will be differentially marked (e.g., CWT and/or eye elastomer tag, but no adipose fin-clip) so that, upon their return as adults, they can be distinguished from the progeny of hatchery-origin broodstock. The fish will be released volitionally from the hatchery starting in May at a size of 12 to15 fpp. All juveniles produced from hatchery-origin broodstock will be adipose-clipped so that they may be targeted in selective fisheries. Approximately 17% of both groups will be tagged with a CWT to determine overall survival and harvest rates in ocean, mainstem Columbia River, and Subbasin fisheries.

Both hatchery-origin (HOR) and natural-origin (NOR) adults returning to the Subbasin may be used as broodstock. Priority for broodstock use will be as follows:

1. Natural-origin adults.

2. Hatchery-origin adults with a CWT/elastomer tag (progeny of NOR broodstock).

3. Hatchery-origin adults with an adipose clip (progeny of HOR broodstock). It is anticipated that this portion of the program will be phased out over time as returns of NOR and integrated hatchery program fish increase.

Broodstock will be managed to achieve a PNI of 0.67 over time. This objective will be achieved by controlling the number of hatchery fish spawning naturally and NOR adults used as broodstock.

Broodstock may be collected at Lyle Falls, Klickitat River Hatchery, and Castile Falls. As returns from the integrated program increase, a portion of these adults (collected at Lyle Falls or the hatchery) will be transported and released above Castile Falls to reduce the abundance of hatchery-origin fish on the primary natural spawning grounds, and to re-stock marine-derived nutrients and augment natural populations above Castile Falls. As natural escapement levels above Castile Falls increase over time, releases of integrated hatchery-origin fish above Castile Falls will be reduced to meet the PNI standard of 0.67. A PNI value of 0.67 ensures that the natural, not the hatchery, environment drives local adaptation (HSRG, WDFW, and Northwest Indian Fisheries Commission 2004a). Achieving this objective will require monitoring natural and hatchery spring Chinook adults migrating past Castile Falls to determine the proportion of the composite population each represents.

With implementation of the hatchery program described here, we anticipate a substantial increase in recruit performance from the 2.18 and 3.5 R/S values observed for the current hatchery program and natural production, respectively (Appendix C). The increase in hatchery fish survival will most likely derive from the implementation of better hatchery culture practices, use of NOR broodstock, and implementation of volitional release strategies. The Yakima River Cle Elum Supplementation and Research Facility spring Chinook program uses these strategies identified for the conservation component and has been able to achieve a geometric mean R/S value of 6.6 (Bosch 2011); therefore, the substantial increase modeled for the Klickitat spring Chinook program (Appendix C) is considered achievable over the long-term.

As the program becomes established and successful, surplus broodstock may be used to start a conservation hatchery program for the Big White Salmon River. Fishery managers have identified Klickitat River spring Chinook as a possible broodstock for restoring spring Chinook production to the Big White Salmon subbasin following Condit Dam removal. However, the costs, facilities, and permits needed for this program are not the responsibility of the YN and are not included in this Master Plan.

Harvest Management for Spring Chinook

Harvest management provisions will be designed to maximize harvest of adipose- clipped hatchery-origin fish while reducing harvest levels on the natural component of the population. Major actions that will be undertaken as part of the harvest strategy include the following.

- Sport and Tribal terminal fisheries will be modified if estimated NOR escapement to the Subbasin falls below 400 adults.

- The daily bag limit of two hatchery-origin adults may be increased to four adults for the sport fishery occurring above the Tribal dipnet fishery at Lyle Falls. The increased catch limit for hatchery fish (adipose fin-clipped) would help reduce the proportion of hatchery-origin fish spawning in the wild and would help to meet or exceed the PNI standard (0.67).

- Implementing and maintaining a selective sport fishery in the Klickitat River will reduce the harvest effects on the natural population by approximately 15%. The reduced harvest rate is the result of fishers releasing adipose fin-clipped adults. (Appendix C).

- Surplus hatchery fish escaping the fisheries to the Klickitat River Hatchery will be distributed to Tribal members for subsistence and ceremonial purposes. Surplus hatchery fish will not be returned to the river to spawn.

- The Tribal fishery will likely be open from Tuesday through Saturday from early April until the end of May to allow for adequate escapement of natural and hatchery broodstock. In years of lower spring Chinook abundance, the Tribal fishing season may be shortened by a day or two each week. The sport fishery will open 1 to 3 days per week downstream of the Fisher Hill Bridge (Rkm 2.9). In years of higher abundance, a selective sport fishery may be opened in the river reach extending from Lyle Falls to the Klickitat River Hatchery (Rkm 68).

- The majority of broodstock collection may be shifted to the Lyle Falls Fishway near the mouth of the Klickitat River. This action is designed to ensure that both natural escapement and hatchery broodstock needs are met without having to substantially reduce Tribal and sport terminal fisheries.

6.2.6 Facilities

The facilities listed below are required to implement the preferred strategy for spring Chinook. See Chapter 8 for more details.

Klickitat Hatchery

The Klickitat Hatchery has undergone a number of modifications and renovations between 1950 and 2010. Since 1993, only minor improvements have taken place. The hatchery requires significant upgrading to be consistent with scientific and technological advances.

Smolt Trapping Facilities

Smolt traps will be needed downstream of the release sites. Trapped smolts will allow estimation of juvenile migration timing and presence in the Subbasin. No monies are being asked for purchase or operation of these traps; funding will be obtained from other sources.

Lyle Falls Fishway

Lyle Falls Fishway has been modified to improve fish passage and to install a fish counting facility.

Castile Falls Fishway

Additional monitoring facilities are now in operation that will allow us to determine the number of hatchery and natural-origin spring Chinook adults passing the Castile Falls Fishway. This information will be used to ensure that the PNI 0.67 standard is achieved.

6.3 Coho

6.3.1 Stock Assessment

The conservation and harvest status of Klickitat River coho are discussed below.

Conservation Status of Coho

Coho are not native to the Klickitat River Subbasin. They were originally introduced in 1952 to achieve harvest objectives (Coho HGMP in Appendix B). Current returns of coho to the Klickitat Subbasin are from smolts imported from lower Columbia River hatchery facilities (Washougal and Lewis River stock) and released in the Subbasin. Lower Columbia River (LCR) coho were identified as a separate ESU and listed as threatened on June 28, 2005; however, the Klickitat River is upstream of the ESU boundary (NOAA 2011b).

Since 1987, the YN estimates that the number of coho returning to the Subbasin each year has averaged approximately 5,500 fish. Escapement to spawning areas within the Klickitat River has averaged approximately 900 coho over this same time period, with the vast majority of these fish being of hatchery origin (Appendix C). The YN has estimated that naturally spawning coho produce less than 10,000 juveniles each year (Table 6-16).

Table 6-16: Estimated juvenile releases, natural juvenile coho production, total adult returns to the Klickitat River mouth, and SAR for coho released directly into the river and from the hatchery for release years 1987-2011

	Number Released[1]					
Release Year	Direct Stream Plants	Klickitat Hatchery	Natural Prod.[2]	Total Release	Total Return[3]	SAR
1987	2,487,600	1,383,600		3,871,200	12,386	0.32%
1988	2,478,200	1,320,900	49,177	3,848,277	8,857	0.23%
1989	2,405,000	1,209,700	380	3,615,080	3,055	0.08%
1990	2,500,000	1,563,200	14,271	4,077,471	9,702	0.24%
1991	2,433,700	1,354,000	10,660	3,798,360	534	0.01%
1992	2,500,000	1,250,000	3,676	3,753,676	549	0.01%
1993	2,500,100	1,360,000	11,676	3,871,776	3,882	0.10%
1994	2,232,600	1,052,900	642	3,286,142	2,012	0.06%
1995	2,573,500	966,000	661	3,540,161	896	0.03%
1996	2,620,827	1,568,800	4,672	4,194,299	1,470	0.04%
1997	1,949,949	1,358,869	2,421	3,311,239	3,379	0.10%
1998	2,719,988	1,130,000	1,259	3,851,247	3,930	0.10%

Release Year	Number Released[1]		Natural Prod.[2]	Total Release	Total Return[3]	SAR
	Direct Stream Plants	Klickitat Hatchery				
1999	2,514,927	1,100,000	2,933	3,617,860	5,808	0.16%
2000	2,138,220	1,420,000	3,395	3,561,615	14,078	0.40%
2001	2,802,100	1,296,000	3,156	4,101,256	9,901	0.24%
2002	2,453,166	1,025,000	5,977	3,484,143	8,640	0.25%
2003	2,554,300	998,900	23,125	3,576,325	5,959	0.17%
2004	2,543,138	942,600	7,650	3,493,388	8,276	0.24%
2005	2,499,530	1,000,175	1,785	3,501,490	8,166	0.23%
2006	2,424,276	922,520	908	3,347,704	3,339	0.10%
2007	2,403,690	1,071,000	3,812	3,478,502	22,292	0.64%
2008	2,625,000	1,092,550	3,812	3,721,362	40,826	1.10%
2009	2,503,299	1,158,000	3,028	3,664,327	14,957	0.41%
2010	2,416,350	992,146	8,845	3,417,341		
2011	2,501,000	1,021,150	3,411	3,525,561		
Average	2,471,218	1,182,320	7,139	3,660,392	8,387	0.23%

[1] Data from TAC ASR (1987-1995) and Fish Passage Center (1996-2011).

[2] Assumes 85% pre-spawn survival, 50% females, 50% reproductive success rate, 3000 eggs per female, and 1% egg-to-yearling-smolt survival.

[3] Assumes all fish return as age-3 adults one year after release.

Harvest Status of Coho

The combined annual harvest of Klickitat River coho salmon in all fisheries averaged approximately 21,400 fish from 1987 to 2010. Marine fisheries account for approximately 54% of the total harvest while about 16% and 30% are taken in lower Columbia and Klickitat River terminal fisheries, respectively (YN databases). Harvest increased in recent years with over 40,000 coho harvested in the Klickitat River alone in 2009. The YN estimates that 85-95% of all adults returning to the Klickitat Subbasin are harvested in terminal fisheries (YN Databases).

6.3.2 Recent Management Strategies for Coho

Habitat Management for Coho

Habitat actions in the Klickitat Subbasin have targeted protection or restoration of native species (steelhead, spring Chinook, and bull trout). Since coho are not native to the Klickitat River, habitat actions focused on improving the survival of this species have not been a priority.

Hatchery Management for Coho

Coho releases from the Klickitat Hatchery began in 1952. However, it appears that coho were released into the system prior to hatchery completion because 29 adult coho reportedly returned to the hatchery in 1952.

Pursuant to *U.S. v Oregon* management agreements, an average of 3.7 million hatchery coho smolts have been released annually in the Klickitat Subbasin since 1987 for harvest augmentation (Table 6-16). Releases have been primarily late-run (type N) stock transferred from lower Columbia River hatcheries. Of the total, about 1.2 million were transferred as eyed eggs to the Klickitat Hatchery for on-station rearing and release, with the remaining 2.5 million smolts being transferred from the Washougal Hatchery and released directly into the Klickitat River between RKm 16 and RKm 27.

Current Hatchery Performance for Coho

The average survival of coho from release as yearling smolts to adult returns to the mouth of the Klickitat River has been 0.23% since 1987 (Table 6-16). Estimated coho run size back to the Klickitat River from 1987 to 2010 has averaged approximately 8,400 fish and has ranged from a low of 534 for releases made in 1991 to a high of nearly 41,000 for the 2008 release group (Table 6-16). The program has also provided an average of 21,000 coho for harvest in marine and freshwater fisheries (YN Databases).

The Technical Advisory Committee (TAC) in their 1996 All Species Review (ASR) compared CWT recoveries per 1,000 tagged releases for coho transferred as eyed-eggs from the Washougal Hatchery to Klickitat Hatchery with direct plants from the same hatchery made directly into the lower Klickitat River (Technical Advisory Committee 1997). The ASR reported that recovery rates for coho hatched, reared, and released from the Klickitat Hatchery were about 3 times higher than recovery rates for direct stream releases of coho smolts in the lower Klickitat River. We conducted a similar analysis of CWT recovery data for brood years 1999-2007 and reached a similar conclusion. Recovery rates per release for Klickitat Hatchery releases relative to Washougal-reared direct stream releases ranged from 1.2 to 8.4 and averaged 4.1 for the 8 brood years for which comparable recovery rate data were available.

Harvest Management of Coho

YN treaty fisheries targeting coho in the Klickitat River generally begin in early August and run through late December. The Tribal fishery is typically conducted on a weekly basis from Tuesday through Saturday. This is a commercial fishing opportunity coincident with Zone 6 fisheries during the fall, but the YN usually issues regulations allowing commercial sales of coho caught in the Klickitat River to continue until the end of the year. Nearly 100% of Tribal fishing effort is located near Lyle Falls although fishing is permitted up to the Big Muddy confluence (RKm 85) (Figure 4-1).

Washington State issues recreational fishery regulations which allow fishers to keep any coho caught from the mouth of the river upstream to just below the Klickitat River hatchery (RKm 68).

6.3.3 Biological Goals for Coho

Conservation Goals for Coho

There is no natural production goal for Klickitat River coho because this species is not native to the Subbasin. Coho were introduced as a means to achieve harvest goals and objectives. There are no plans to establish a viable naturally reproducing population in the Subbasin in the foreseeable future. There is, however, a goal of establishing a locally adapted, segregated hatchery population.

The Master Plan does have natural production goals for other species that could be affected by the coho program. Therefore, the preferred coho alternative must not only achieve harvest objectives, but must do so in a manner that minimizes potential negative impacts to native fish species.

Harvest Goals for Coho

The primary harvest objective of the coho program is to provide the fish necessary to support Tribal fisheries mandated by federal court orders and the Treaty of 1855 (see Chapter 5).

The program has an objective to produce a total of 14,000 coho for harvest in all fisheries, with the majority of this harvest to occur in Tribal fisheries in Zone 6 and the Klickitat River. YN databases indicate this goal has been attained in 9 of the past 10 years with the current release program of approximately 3.7 million smolts annually. Maintaining fisheries in the Klickitat River is important to the YN, as Tribal families have been fishing at traditional sites near Lyle Falls for generations.

6.3.4 Options Considered for Coho Management

The YN considered three options for managing Klickitat River coho.

1. Maintain Existing Program
2. Eliminate Hatchery Production
3. Reduce Hatchery Smolt Production/Convert to Local Broodstock

Of the options considered, option 3 (reduced hatchery smolt production) best met YN goals and objectives for coho as well as for other species. The reduced hatchery alternative is described in more detail in Section 6.3.5. The other two options, discussed below, were eliminated from further consideration.

Maintain Existing Program for Coho

The existing management strategy for coho focuses primarily on hatchery production to achieve harvest goals for this species. A total of 3.7 million juvenile coho are released into the Subbasin each year. Approximately 2.5 million juveniles are obtained from the Washougal Hatchery located below Bonneville Dam.

The existing strategy meets the harvest goal of 14,000 adult coho, but does so in a manner that imposes avoidable risks to other native fish species. Major problems with this alternative include the following.

- The large number of hatchery coho (3.7 million) being released each year may be competing with, and preying on, ESA-listed juvenile steelhead.

- Approximately 2.5 million of the coho released are obtained from outside of the Subbasin. Fish transfers between subbasins increase the risks of introducing, or amplifying, disease in the receiving subbasin (HSRG 2005). Historically, fish obtained from the Washougal Hatchery have had problems with cold-water disease which has resulted in large losses of fish after release.

- Coho obtained from the Washougal Hatchery are released directly into the Klickitat River. Transporting and releasing fish directly to a river system without acclimation has been shown to reduce their survival rate. According to a study conducted by TAC (1997) and confirmed in analyses performed for this Master Plan, coho released from the Klickitat River Hatchery had survival rates 3 to 4 times higher than for fish transported from the Washougal hatchery and released directly into the lower river.

Because of the potential risks posed to other native fish species, the existing program does not meet current conservation goals identified for the Subbasin and has been rejected.

Eliminate Hatchery Production of Coho

Under this option, hatchery production of coho would be discontinued in the Subbasin. Because some hatchery fish escape each year to spawn naturally, limited coho production would likely continue for an unknown period of time. However, as coho are not native to the Subbasin, present habitat conditions (and, presumably, historical conditions) are likely insufficient to maintain runs that would meet the coho harvest objectives identified by the YN. It is assumed under this option that, to replace lost harvest opportunities, YN fishers would either move coho fishing operations into the mainstem Columbia River below Bonneville Dam or increase harvest rates on other species in Zone 6 fisheries to make up for the loss in coho harvest.

Possible benefits and risks of option 2 to Subbasin conservation objectives include the following.

- The elimination of coho hatchery production would reduce competition and predation impacts this species may have on native steelhead and spring Chinook.

- Disease introduction from out-of-Subbasin fish transfers would be prevented.

- Hatchery rearing space and water currently used for this program at the Klickitat Hatchery could be reprogrammed to increase the quality of hatchery steelhead and spring Chinook being used to restore these species in the Subbasin.

- Any incidental harvest of listed steelhead and bull trout in coho fisheries by sport and Tribal fishers would be eliminated.

Possible benefits and risks to meeting harvest objectives are the following.

- The goal of producing substantial coho harvest opportunities for Tribal fishers in the Klickitat River would not be achieved.

- Moving fishing operations to below Bonneville Dam or Zone 6 may result in increased take of listed Snake River Fall Chinook and Lower Columbia River chum, coho, and Chinook. Whether the 14,000 total coho harvest objective could be achieved would depend on NMFS' decisions regarding the impact Tribal fishers may have on ESA-listed species.

- Elimination of coho production in the Klickitat River would be contrary to existing *U.S. v. Oregon* management agreements. The agreements are orders of the federal court; therefore, elimination of coho production in the Klickitat River would not only upset the delicate balance required to achieve the agreements, but would be in violation of federal law.

In addition, any changes in fishing locations, species mix, and harvest levels on ESA-listed fish stocks would require extensive negotiations through *U.S. v. Oregon* and with National Marine Fisheries Service (NMFS). It is expected that these types of negotiations would take years to complete.

Because YN harvest objectives for coho cannot be achieved with the elimination of the hatchery program, option 2 was eliminated from further consideration.

6.3.5 Preferred Alternative for Coho: Reduce Hatchery Smolt Production and Convert to Local Broodstock

As indicated above, the existing program poses many potential risks to native fish species in the Subbasin. The primary objective of the preferred alternative is to select habitat, hatchery, and harvest measures that reduce these risks, but which will still allow the YN to meet the identified harvest objective for this species. A description of the proposed/preferred alternative is presented below.

Habitat Actions for Coho

Because coho are not native to the Subbasin, the YN does not propose to implement habitat measures that would promote establishment of a self-sustaining naturally spawning coho run. In addition, the fish passage improvements made to the Lyle Falls Fishway would be expected to benefit coho. It is recognized that the quality and quantity of receiving waters likely affect the survival of hatchery fish released to the stream. Therefore, the habitat goal for coho is to prevent further degradation of those sections of the river used by coho smolts released from the hatchery (Klickitat River from RKm 0 to RKm 27). Habitat actions designed to protect and restore the lower 27 Km of the Klickitat River can be found in Appendix A.

Hatchery Strategy for Coho

The hatchery strategy calls for the implementation of a segregated harvest program that uses coho returning to the Klickitat River as broodstock. The hatchery strategy will be implemented adaptively over time to determine if the conservation and harvest goals identified for coho can be achieved with the following suite of actions:

- Reduce hatchery production from 3.7 million to as few as 1.0 million juveniles
- Eliminate all out-of-Subbasin coho transfers over time
- Convert to the use of locally adapted broodstock
- Eliminate the direct planting of Washougal River-origin coho to the mainstem Klickitat River
- Develop the Wahkiacus Hatchery and Acclimation Facility (Wahkiacus) to allow for the implementation of acclimation and volitional release strategies

The coho program will be implemented in three phases. In Phase 1, hatchery production for the ~1.0m on-station release will be converted from Washougal brood source to local brood source collected at Lyle Falls, then reared and released from Klickitat Hatchery. In Phase 2, hatchery production for the ~1.0m on-station release will be collected at Lyle Falls, then reared and released from the Wahkiacus Acclimation Facility. In Phase 3, when the Wahkiacus facility is fully completed, all broodstock collection, incubation, and rearing will occur at the Wahkiacus Hatchery and Acclimation Facility for the ~1.0m portion of the program. Throughout all three phases, we will continue to investigate alternatives for the ~2.5m direct stream releases including program reduction, local brood source, and alternative rearing and release locations; when acceptable alternatives are identified they will be implemented. Figures 6-4a and 6-4b illustrate the decision process for the phased implementation.

This approach is expected to improve coho smolt-to-adult survival rate, minimizing the number of juveniles needed to meet the 14,000 adult coho harvest objective. The reduction of coho hatchery production and elimination of out-of-Subbasin fish transfers over time should decrease the negative impacts the coho program may be having on other fish species, e.g. ESA-listed steelhead.

A major uncertainty associated with the new program is whether or not smolt-to-adult survival rates can be increased to produce the same number of adults previously obtained from juvenile releases that were as much as 3.7 times higher. Therefore, a major component of the coho plan will be to conduct the evaluations needed to determine if the harvest objective of providing 14,000 coho for commercial sport and Tribal fisheries can be achieved. As noted above in Section 6.3.2 (Recent Management Strategies), the U.S. v OR TAC (1997) reported CWT recoveries for Klickitat Hatchery coho releases that were about 3 times higher than recovery rates for direct stream (Washougal) releases. We conducted an analysis of CWT data for more recent brood years and found similar

results. However, we also found that approximately 50% of current harvest in all fisheries combined of coho released in the Klickitat River derives from the Washougal direct-stream releases. Therefore, it is unlikely that the goal of maintaining or increasing current harvest levels (~14,000 coho for all fisheries combined) can be achieved with just the Klickitat on-station release program. We also considered the possibility of terminating the coho program if treaty harvest goals could be achieved by moving release and fishing locations out of the Klickitat Basin. Because of the special role of the Lyle Falls fishery in the exercise of treaty fishing rights through traditional fishing methods, there do not appear to be any viable alternative locations that satisfy treaty harvest goals. These new analyses have resulted in slight alterations of the coho program from those described in earlier versions of this Master Plan.

The three phases of the coho hatchery program are described below.

Phase 1: Lyle Falls Facility complete

- A hatchery escapement goal of 750 coho adults will be established for the Subbasin[16]. These fish will provide the local broodstock needed to run a Segregated Harvest program that releases approximately 1,000,000 coho juveniles each year.

- The hatchery program will be run as a "Segregated Harvest" program, with adults collected at Lyle, and spawning, rearing, and release occurring at Klickitat Hatchery at about 15 fpp. Fish will be volitionally released into the Klickitat River starting in May. The switch to a local brood program is expected to reduce disease incidence and potential straying into areas occupied by ESA-listed coho in the Lower Columbia River are expected to be reduced.

- ATPase samples will be collected from the juvenile coho to determine smoltification level and migratory status. This information will be used to refine release dates over time.

- A total of 500,000 Klickitat River-origin juveniles will be marked with an adipose fin-clip. About 100,000 of these fish will also be marked with a CWT to determine survival and stray rates as well as contribution to fisheries.

- The remaining 500,000 Klickitat River-origin fish will not be marked. This is aimed at increasing the number of adult coho escaping to the Subbasin which will, in turn, increase in-river harvest numbers and provide adults needed for broodstock[17].

[16] Coho escapement has averaged about 900 fish since 1987 (YN Databases). Therefore, as long as survival goals are met, harvest levels would not likely need to be reduced to achieve the escapement goal in most years.

[17] If the adipose fins of these fish are not clipped, fishing regulations require that they be released in lower Columbia River commercial and sport fisheries. This will increase the number of adults returning to Zone 6 and the Klickitat River.

- Migrating juvenile hatchery coho will be collected in existing smolt monitoring traps to determine if they are preying on ESA-listed steelhead or bull trout. A subset of the coho released would also be radio-tagged to determine migration characteristics (time spent in Subbasin, habitat use, etc.). This information will also help to determine the risk coho pose to other species.

Figure 6-4a: Decision Diagram for Coho Phased Implementation (~1.0m Klickitat release)

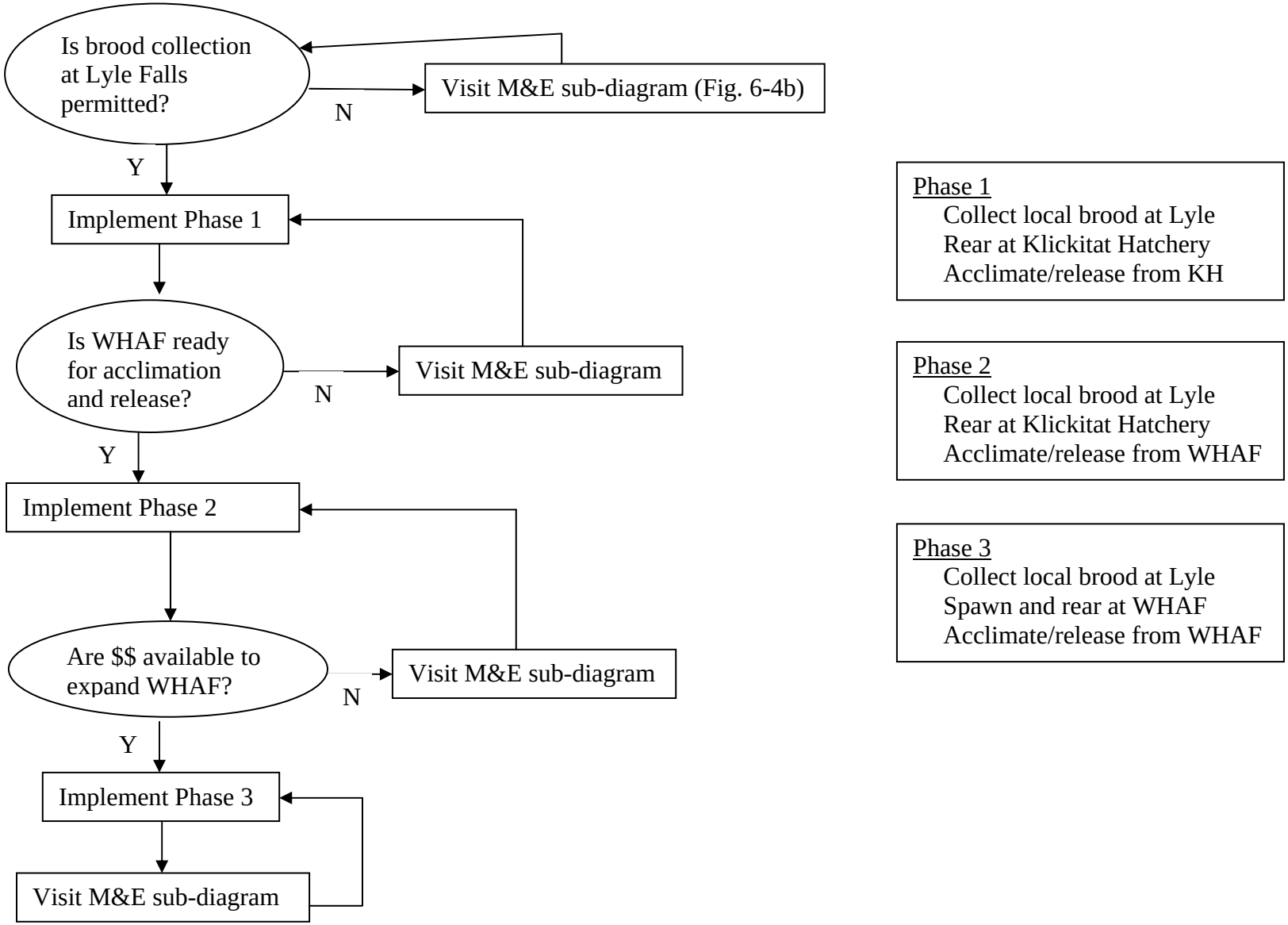
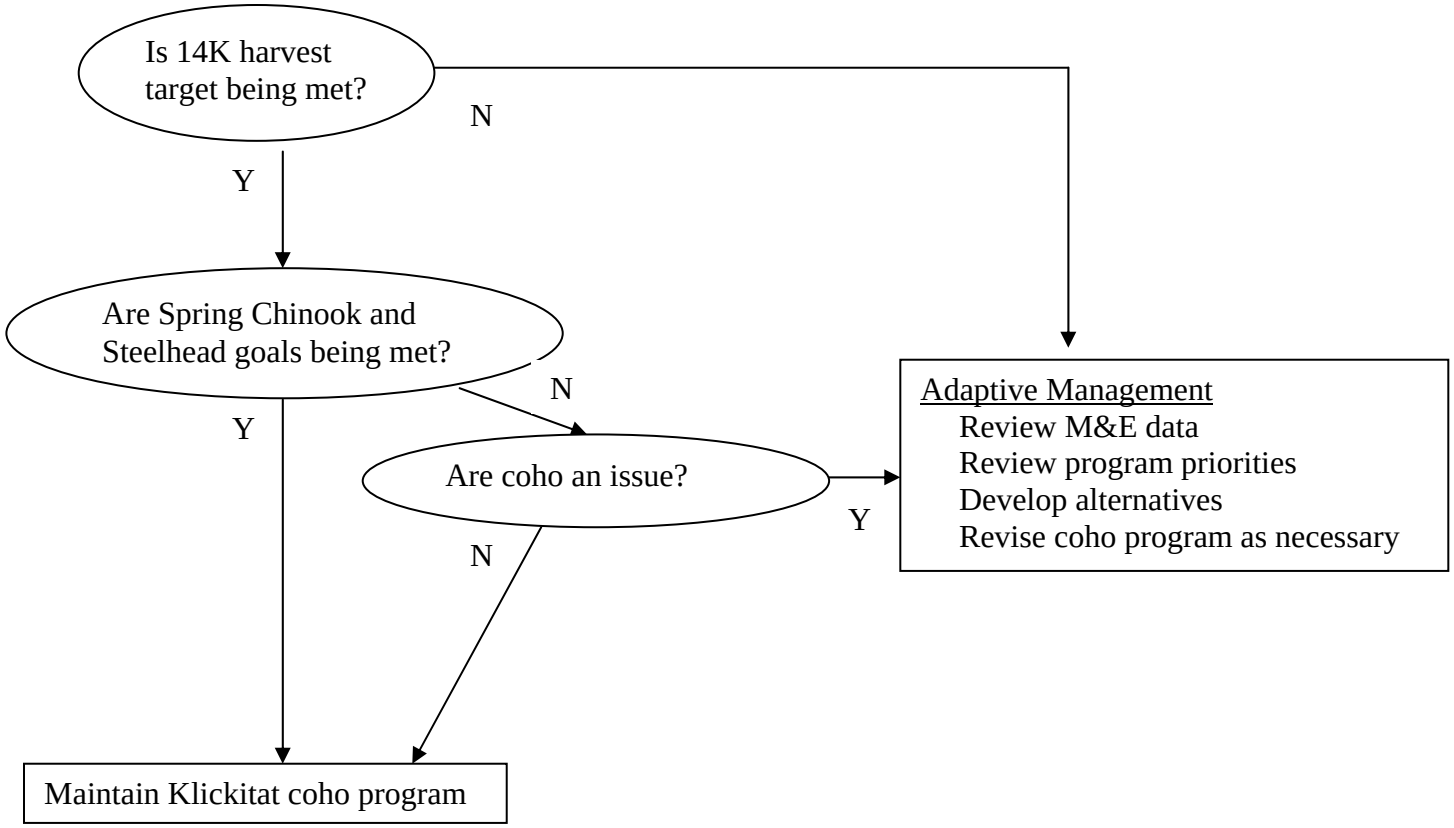


Figure 6-4b: M&E Decision Sub-Diagram for Coho Phased Implementation



Phase 2: Wahkiacus Acclimation Ponds complete

In Phase 2, the program described above will be continued except that coho will be released from the Wahkiacus acclimation ponds. Fish will be acclimated for 8 weeks at Wahkiacus and released volitionally in the lower Subbasin (RKm 27) starting in May at about 15 fpp. Releasing fish from Wahkiacus is expected to reduce potential coho predation and competition effects on the Subbasin's native fish species and should result in higher smolt-to-adult survival rates for cultured coho. In addition, the Master Plan calls for monitoring water quality and quantity at this facility for 5 years to insure that environmental conditions are acceptable.

Phase 3: Wahkiacus Facility fully constructed and operational

The preferred implementation strategy in Phase 3 will be establishment of a fully segregated harvest program in which all hatchery operations are completed within the confines of the Klickitat River Subbasin. Transfer of coho eggs, juveniles, and adults between subbasins would be terminated.

Throughout the phased implementation strategy, annual results for all species will be reviewed and evaluated relative to biological objectives. The YN will also review the water quality, survival, stray rate, predation levels, and harvest data collected during prior phases to determine the success of the coho program and its impact to steelhead and spring Chinook[18]. A major performance indicator used for this purpose would be whether the harvest goal of 14,000 adult has been achieved. We will continue to investigate alternatives to the direct stream releases of approximately 2.5m Washougal-reared coho. The foremost objective of the alternatives will be to increase the quality and reduce the quantity of these releases to the maximum extent possible, while still achieving program goals. Alternatives may include any or all of the following: program reduction, using local brood source for these releases, finding alternatives to Washougal Hatchery for rearing, and finding alternative locations for release. It is expected that appropriate alternatives will be selected, reviewed and approved by the *U.S. v Oregon* Policy Group, and implemented within 10 years of approval of this Master Plan. Strategies for the coho program may be changed depending on the annual review (Figure 6-4b).

Harvest Strategy for Coho

The harvest strategy is as follows.

Fisheries will be operated in a manner that ensures that the 750 hatchery adult escapement target is met each year. To reduce effects on fisheries, the escapement target may also be achieved through the manipulation of river flow passing through the updated Lyle Falls Fishway. By controlling the amount of flow passing through this fishway, managers may be able to attract and capture more adults for use as broodstock.

[18] Smolt-to-adult survival rates for other hatcheries would also be reviewed to determine marine survival conditions present during the time frame the survival data were collected.

Fishing regulations will be developed that best fit the overall implementation strategy. Selective fisheries for coho are not expected to be necessary as the program does not call for establishment of a self-sustaining run of coho in the Subbasin.

Facilities Needed for Implementation of the Coho Strategy

The facilities listed below will be required to implement the preferred strategy for coho.

Wahkiacus Hatchery and Acclimation Facility (WHAF)

This would be a new facility built with sufficient space and water to collect, hold, incubate, rear, mark, and release 1.0 million coho juveniles each year. A more detailed description of this facility can be found in Section 8.4.

Smolt Trapping Facilities

Smolt traps will be needed downstream of the release site to make qualitative assessments of coho predation on ESA-listed steelhead and bull trout populations, as well as coho migration timing and presence in the Subbasin. No monies are requested to purchase or operate these traps because they are currently funded through other processes.

Lyle Falls Fishway

The Lyle Falls Fishway has been modified to improve fish passage and install a fish counting facility.

6.4 Fall Chinook

6.4.1 Stock Assessment

Conservation Status of Fall Chinook

Fall Chinook are not indigenous to the Klickitat Subbasin above Lyle Falls. Managers and biologists assume that, based on Tribal history, Lyle Falls was impassable to Chinook during the low water conditions that generally prevail in late summer and early fall (Bryant 1949). Construction of the Lyle Falls fishway and alterations to the natural falls allowed for fall Chinook passage (although the original fishway had hydraulic and bedload issues limiting its effectiveness). Currently, fall Chinook returning to the Klickitat River are hatchery-origin upriver bright (URB) stock imported as eyed eggs from Priest Rapids Hatchery and reared and released as subyearling smolts from the Klickitat Hatchery. The URB-stock fall Chinook are part of the Upper Columbia summer/fall Chinook ESU which is not listed under the ESA.

Harvest Status of Fall Chinook

Columbia River upriver bright fall Chinook (URBs) are harvested in marine fisheries from Alaska south into Oregon and northern California, in Columbia River fisheries from

the mouth to the Hanford Reach, and in terminal fisheries in the tributaries. The URBs are major contributors to Pacific Fishery Management Council (PFMC) and Pacific Salmon Commission (PSC) fisheries, and are an escapement indicator stock/ model stock to the Chinook Technical Committee (CTC) of the PSC. The URBs are also very important to non-Treaty and especially Treaty fall season fisheries in the Columbia River, accounting for approximately 30% and 90% of the commercial value of these respective fisheries in recent years (derived from ODFW/WDFW 2002). The 1982-89 brood year average ocean fisheries exploitation rate for mid-Columbia River summer/fall Chinook was 39%, with a total exploitation rate (marine and freshwater combined) of 68% estimated for the same years (PSC 1994). Chapman et al. (1994) estimated that the 1975-87 brood year mean exploitation rate for URBs released from Priest Rapids Hatchery was 64% (with adult-equivalents accounted for). Out-of-basin harvest rates have not been estimated specifically for Klickitat River releases of URB fall Chinook, but it is assumed that Klickitat River fall Chinook would be harvested at the same rate in these fisheries as other upriver bright fall Chinook.

The average annual harvest of fall Chinook from Klickitat River releases in combined ocean, Columbia River, and Klickitat River fisheries is estimated to exceed 19,000 fish. Sport and Tribal fall Chinook fisheries in the Klickitat River harvested an average of about 6,100 fall chinook annually since 2000 (YN Databases). Klickitat River terminal harvest rates of fall Chinook averaged approximately 50% from 2000 to 2010 (YN Databases).

6.4.2 Recent Management Strategies for Fall Chinook

Habitat Management

Habitat actions in the Klickitat have been targeted on protecting and restoring habitat associated with native steelhead, spring Chinook, and bull trout in the Subbasin. Since fall Chinook are not native to the Klickitat River, habitat actions focused on improving the survival of this species have not been a priority.

Hatchery Management of Fall Chinook

Hatchery fish from outside the Subbasin were first released in 1946 and releases from the Klickitat River Hatchery began in 1952. Releases have included fish stocks from Cowlitz, Toutle, Kalama, Washougal, Bonneville, Cascade, and Ringold hatcheries.

The Klickitat fall Chinook program was originally developed to rear tule fall Chinook from the Spring Creek National Fish Hatchery (NFH) on the Columbia River, 21.6 RKm downstream of the Klickitat River. When the Spring Creek program failed to provide the necessary eggs, the program was changed to URB Chinook. It is assumed that tule fall Chinook from the Spring Creek NFH and other lower Bonneville Pool tributaries occasionally stray into the Klickitat River.

Beginning in 1986, Klickitat Hatchery production switched from the tule stock to URB fall Chinook. Approximately 4 million hatchery URB smolts are released annually as part of a program to mitigate for lost natural production due to the construction of the

John Day and The Dalles dams. Fall Chinook eyed eggs are transferred from Priest Rapids Hatchery to the Klickitat Hatchery for final rearing.

Current Hatchery Performance of Fall Chinook

The average survival rate of fall Chinook released as sub-yearlings at the Klickitat River Hatchery to adult return to the Klickitat River mouth has been about 0.25% since 1986 (Table 6-17).

Table 6-17: Estimated releases, adult returns to the Klickitat River mouth, age-at-return, and SAR for Klickitat River fall Chinook for release years 1986-2011

Release Year	Hatchery Release[1]	Age Composition of Total Return[2]					Total Return[2]	SAR
		2	3	4	5	6		
1986	4,202,500	0	0	3,036	532	0	3,569	0.08%
1987	4,805,100	0	615	4,367	1,913	80	6,976	0.15%
1988	4,467,700	10	521	3,568	1,678	13	5,790	0.13%
1989	4,604,500	48	256	2,744	1,864	18	4,931	0.11%
1990	4,212,900	0	80	1,555	1,920	0	3,555	0.08%
1991	5,183,300	0	154	3,273	2,078	0	5,505	0.11%
1992	4,277,000	0	147	1,825	958	0	2,930	0.07%
1993	4,185,000	18	275	5,313	1,872	0	7,479	0.18%
1994	5,288,880	35	3,472	9,797	2,133	441	15,878	0.30%
1995	4,207,000	424	163	8,445	3,200	0	12,233	0.29%
1996	4,380,000	108	2,721	11,668	6,521	0	21,018	0.48%
1997	3,625,870	267	2,574	5,924	1,743	0	10,508	0.29%
1998	4,044,100	22	1,673	3,414	2,031	0	7,140	0.18%
1999	4,289,100	310	2,129	13,202	5,371	170	21,182	0.49%
2000	3,972,106	41	4,148	19,272	7,468	0	30,930	0.78%
2001	3,850,300	126	3,374	5,564	1,801	0	10,865	0.28%
2002	3,938,900	982	1,971	6,232	3,954	54	13,192	0.33%
2003	4,225,100	96	4,775	4,716	1,338	0	10,925	0.26%
2004	4,225,650	113	1,241	2,860	3,461	0	7,675	0.18%
2005	4,090,940	42	1,139	3,062	3,529	0	7,773	0.19%
2006	4,548,270	89	602	7,102	2,812	0	10,603	0.23%
2007	4,356,500	5	906	6,686	834		8,431	0.19%
2008	3,552,437	93	6,786	4,112			10,991	0.31%
2009	4,376,100	354	1,339					
2010	4,152,736	248						
2011	3,976,177							

Average	4,270,699						10,438	0.25%

[1] Data from RMIS and Fish Passage Center.

[2] Return to the Klickitat River mouth; data from YN/WDFW databases; most recent data are preliminary.

Estimates of hatchery fall Chinook escaping fisheries and spawning naturally in the Klickitat River have averaged about 6,500 (range 2,500 to 25,000) fish from 1989 to 2010 (YN Databases). Fall Chinook spawn in the mainstem Klickitat River between RKm 8 and RKm 68 (Figure 1-5).

Harvest Management of Fall Chinook

YN treaty fisheries targeting fall Chinook in the Klickitat River generally begin in early August and run through late December each year. The Tribal fishery is typically conducted on a weekly basis from Tuesday through Saturday. This fishery provides a commercial fishing opportunity coincident with Columbia River Zone 6 fisheries during the fall, but the YN usually issues regulations allowing commercial sales of fall Chinook caught in the Klickitat River to continue until the end of the year. Nearly 100% of Tribal fishing effort is located near Lyle Falls, although fishing is permitted up to the Big Muddy confluence (RKm 85) for Tribal fishers.

Washington State recreational fishery regulations for Chinook vary by river location. Fishing regulations for the Klickitat River are as follows.

1. In the Klickitat River reach extending from the river's mouth to Fisher Hill Bridge, a selective Chinook fishery designed to protect wild spring Chinook occurs for the period from April 1 to July 31. From August 1 to January 31, fishing regulations allow fishers to keep any Chinook caught in this portion of the Subbasin.

2. In the river reach extending from upper Lyle Falls to the Klickitat River Hatchery (RKm 68), a selective fishery for Chinook occurs from June 1 to July 31. For the period of August 1 through October 31, the Chinook fishery is non-selective and targets fall Chinook in this upper section, i.e. fishers can keep any fall Chinook caught.

6.4.3 Biological Goals for Fall Chinook

Fall Chinook Conservation Goals

No conservation goal has been established for Klickitat River fall Chinook because this race of Chinook is not native to the Subbasin. Fall Chinook were introduced into the river system as a means to achieve harvest objectives (below). There are no specific plans to establish a viable, naturally reproducing population of fall Chinook in the Subbasin in the foreseeable future (though recently completed fish passage improvements at Lyle Falls could significantly benefit fall Chinook). The goal is to establish a locally adapted, segregated hatchery population designed to provide fish for harvest.

Fall Chinook Harvest Goals

The primary objective of the fall Chinook program is to provide the fish necessary to support Tribal fisheries mandated by federal court orders and the Treaty of 1855. The objective is production of 18,000 fall Chinook for harvest in all fisheries with the majority occurring in Tribal fisheries in Zone 6 and the Klickitat River.

6.4.4 Strategies Considered for Fall Chinook

The YN considered five options for managing Klickitat River fall Chinook.

1. Maintain existing program
2. Transition to fully integrated hatchery program
3. Eliminate hatchery production
4. Restore the natural fall Chinook spawning habitat eliminated by the construction of The Dalles and John Day dams.
5. Convert existing program to local broodstock

The option that best meets the goals identified by the YN for fall Chinook is Option 5 which relies on local broodstock. The preferred option is discussed in Section 6.4.5. The options that were rejected are described below.

Maintain Existing Program

The existing fall Chinook program releases 4.0 million fall Chinook subyearlings into the Klickitat River each year. The juveniles originate from eyed eggs transferred from the Priest Rapids Hatchery to the Klickitat Hatchery. Though the program produces sufficient adult fall Chinook to meet the harvest goal of 18,000, it also poses risks to other native fish species. The major problems associated with this alternative include the following.

- All of the fall Chinook juveniles released in the Subbasin each year are obtained outside the Subbasin as eyed eggs. Egg transfers between subbasins increase the risks of introducing or amplifying disease in the receiving subbasin which may reduce the survival and productivity of native fish species.
- Fall Chinook that escape fisheries are able to spawn naturally in stream reaches that may also be used by spring Chinook. As fall Chinook spawn in similar habitat later in the season than spring Chinook, their spawning activities may displace or degrade the quality of spring Chinook redds. This may result in decreased spring Chinook egg-to-fry survival.

- Offspring of fall Chinook natural spawners may compete for food and space with native spring Chinook juveniles. This competition for resources may also result in decreased survival and productivity of spring Chinook.

Because of the potential risks posed to native spring Chinook, the existing program does not meet current conservation goals identified for the Subbasin and was therefore rejected.

Transition to a Fully Integrated Hatchery Program

The goal of this option would be to develop over time an integrated fall Chinook program at the Klickitat Hatchery[19]. Broodstock for the program would come from both NOR and HOR adults returning to the Klickitat River Subbasin, i.e. local broodstock. All culture activities (incubation, rearing, and release, etc.) would occur at the Klickitat Hatchery. Approximately 2.0 million of the juveniles would be acclimated and released at the proposed Wahkiacus facility.

The benefits of this option are as follows:

- Juvenile release size of 4.0 million would be maintained, making it likely that the 18,000 fall Chinook harvest goal can be achieved.

- Out-of-Subbasin egg transfers from Priest Rapids Hatchery to the Klickitat River would be eliminated, reducing disease transfer risks.

- Moving a portion of the hatchery production from the Klickitat Hatchery (RKm 68) to the Wahkiacus facility (RKm 27) is expected to decrease interactions between hatchery fall Chinook and native spring Chinook.

- Using only locally adapted fish for hatchery broodstock is expected to increase smolt-to-adult survival rates. If survival does increase, the harvest objective may be achieved more frequently.

Risks associated with Option 2 are as follows.

- Program integration requires establishment of a natural self-sustaining run of fall Chinook in the Klickitat River upstream of Lyle Falls. This would require increasing the number of non-native fall Chinook spawning naturally in the Subbasin.

- Because fall Chinook spawn in similar habitats and later in the season than spring Chinook, their spawning activities may displace or degrade the quality of spring Chinook redd which may result in decreased spring Chinook egg-to-fry survival.

[19] A hatchery program is an integrated type if the intent is for the natural environment to drive the adaptation and fitness of a composite population of fish that spawn both in the stream and hatchery.

- Off-spring of fall Chinook natural spawners may compete with spring Chinook juveniles for food and space. This competition for resources may result in decreased survival and productivity of spring Chinook.

- In low adult return years, fisheries may have to be curtailed to allow adequate adult escapement to protect the natural component of the fall Chinook run. A reduction in harvest to levels below 18,000 is inconsistent with the YN harvest objective.

Option 2 was rejected due primarily to the negative impacts this type of program may have on spring Chinook.

Eliminate Hatchery Production

The fall Chinook hatchery program would be eliminated under Option 3. This option was considered not viable because it did not meet the 18,000 fish harvest objective and is not consistent with federal law, mitigation, and treaty trust obligations (see Chapter 5).

Restore Natural Fall Chinook Spawning Habitat Eliminated by the Construction of The Dalles and John Day Dams

The fall Chinook program in the Klickitat River was established to partially mitigate for habitat and fish production lost in the mainstem Columbia River due to the construction of The Dalles and John Day dams. Option 4 would re-claim the lost habitat by removing the two dams.

This option is not practical for a number of reasons. First, the direct costs associated with the removal of the dams would be very great, possibly in the billions of dollars. Thus, from a cost perspective alone, the option cannot be considered under this Master Plan.

In addition to the direct expenses involved in dam removal, secondary expenses would accrue from providing an alternative to lost electrical generation and shipping as well as the cost of habitat mitigation required during and after dam removal. Dam removal would also require broad political support.

Though the benefits to fish could be very large, the alternative was rejected on economic grounds.

6.4.5 Preferred Option for Fall Chinook

The existing fall Chinook program poses many potential risks to native spring Chinook. Therefore, the primary objective of the preferred option is to select habitat, hatchery, and harvest measures that reduce these risks while still allowing the YN to meet the fall Chinook harvest objective.

Habitat Strategy for Fall Chinook

Because fall Chinook are not native to the Klickitat River above Lyle Falls, the YN will not implement habitat actions designed to establish a self-sustaining population of fall Chinook. The habitat strategies and actions designed to improve steelhead production in the mainstem Klickitat River will likely improve juvenile migration conditions for hatchery fall Chinook releases. Better migration conditions should increase the survival rate of hatchery fish and lead to higher returns of adult fall Chinook. In addition, improved fish passage at the Lyle Falls Fishway should greatly benefit returning fall Chinook.

Hatchery Strategy for Fall Chinook

The hatchery strategy calls for the implementation of a segregated harvest program that uses fall Chinook returning to the Klickitat River as its broodstock. The major actions included in the hatchery strategy are described below. Decision diagrams illustrating implementation of the hatchery strategy are given in Figures 6-5a and 6-5b.

Eliminate Eyed-Egg Transfers from Priest Rapids Hatchery

Eyed-egg transfers from Priest Rapids Hatchery to the Klickitat Hatchery will be eliminated[20]. This action should reduce the risk of disease transfer between subbasins and facilities.

Develop Locally Adapted Broodstock

Adult and jack fall Chinook returning to the Klickitat River will be used as the broodstock source for the program. The broodstock will be collected at the Lyle Falls, Wahkiacus, and Klickitat Hatchery facilities. Approximately 2,500 adults will be needed to produce a release of 4.0 million subyearling fall Chinook. Broodstock will be collected throughout the entire adult migration period to increase the diversity of life histories being reared at the hatchery.

Since 1989, fall Chinook escapement to spawning grounds in the Klickitat River has averaged about 6,500 fish and is sufficient to meet the broodstock needs identified for the program (fall Chinook HGMP in Appendix B).

Construct the Wahkiacus Facility

A new juvenile acclimation and hatchery facility will be built at RKm 27. This facility will incubate, rear, and release 2.0 million fall Chinook subyearlings (about 50 to 80 fpp) on an annual basis. The fish will be allowed to migrate volitionally from the rearing ponds starting in June.

[20] Eyed eggs from Priest Rapids may be imported to the basin if adult returns to the Klickitat River are insufficient to meet broodstock needs.

Mark All Juvenile Hatchery Fish

All hatchery juvenile fall Chinook will be marked in a manner that allows them to be identified in fisheries and on the spawning grounds both within and outside of the Klickitat River Subbasin.

Release 4.0 Million Fall Chinook Subyearlings at 50 to 80 FPP Annually

The harvest data presented in Appendix C indicate that a release of 4.0 million fall Chinook subyearlings is sufficient to achieve the 18,000 harvest objective in the majority of years. The number of juveniles to be released in this program will be revisited in Year 10 of the Master Plan to see if the use of local broodstock increased or decreased the number of adults produced. Fish release numbers will then be adjusted accordingly.

Of the 4.0 million subyearlings produced, 2.0 million will be reared and released at Wahkiacus (RKm 27) and 2.0 million will be reared at the Klickitat Hatchery (RKm 68) and released at Wahkiacus (RKm 27) following the release of the initial 2.0 million fish. Moving the fall Chinook juvenile production release to Wahkiacus is expected to reduce competition with spring Chinook juveniles inhabiting the Klickitat River reach between RKm 27 and RKm 68. Because subyearling fall Chinook are released at an average length of about 82 mm, predation rates on spring Chinook or steelhead juveniles are expected to be negligible (Fall Chinook HGMP in Appendix B).

Harvest Strategy for Fall Chinook

Harvest seasons are expected to be similar to those described under Harvest Management in Section 6.4.2. Fisheries will be managed to consistently meet hatchery broodstock needs and to ensure that the number of fall Chinook adults spawning naturally in stream reaches upstream of Lyle Falls is minimized.

Facilities

The facilities listed below are required to implement the preferred strategy for fall Chinook.

Wahkiacus Hatchery and Acclimation Facility

This will be a new facility built with sufficient space and water to collect, hold, incubate, rear, mark, and release 2.0 million fall Chinook juveniles each year. A more detailed description of this facility can be found in Section 8.4

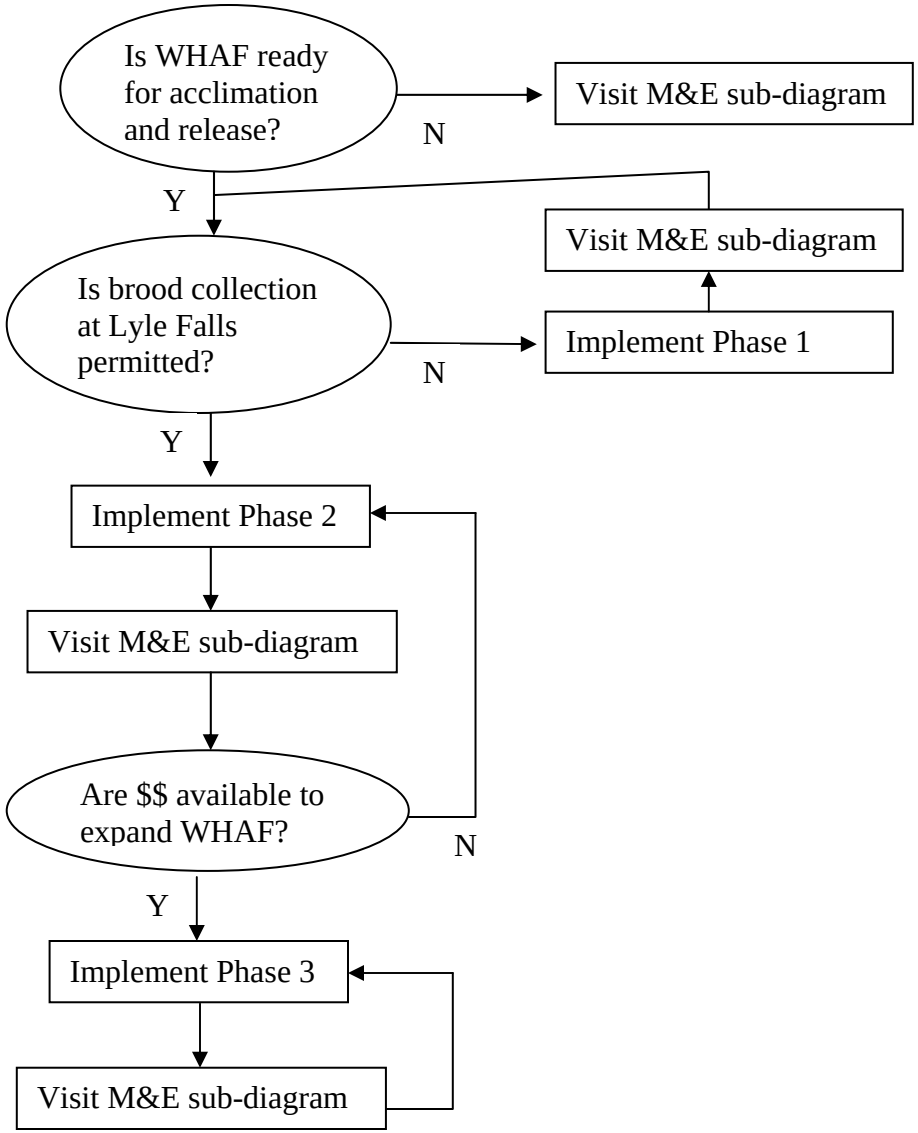
Smolt Trapping Facilities

Smolt traps will be needed downstream of the release sites to develop qualitative estimates fall Chinook juvenile migration timing and presence in the Subbasin. (Note that the smolt traps are funded from other sources and are not included in the projected costs in this Master Plan.)

Lyle Falls Fishway

The Lyle Falls Fishway may be needed to collect fall Chinook adults for hatchery broodstock.

Figure 6-5a: Decision Diagram for Fall Chinook Program Implementation

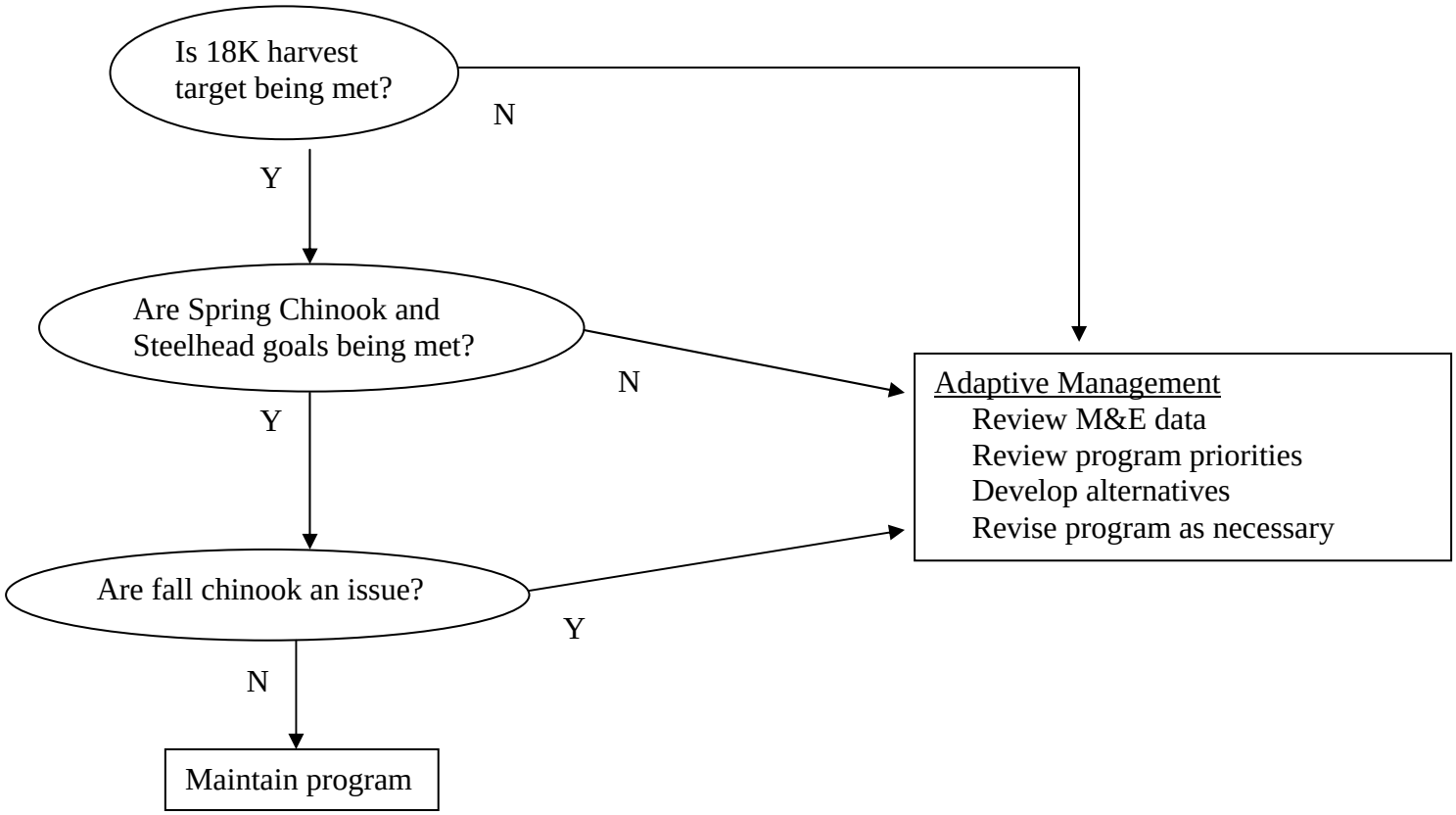


Phase 1
Transfer eyed eggs from PRH
Rear 4.0m at Klickitat Hatchery
Acclimate/release 2.0m from WHAF

Phase 2
Collect local brood at Lyle
Rear 4.0m at Klickitat Hatchery
Acclimate/release 2.0m from WHAF

Phase 3
Collect local brood at Lyle
Spawn and rear 2.0m at WHAF
Acclimate/release 2.0m from WHAF
Maintain 2.0m program at Klickitat

Figure 6-5b: M&E Decision Sub-Diagram for Fall Chinook Program Implementation



6.5 Pacific Lamprey

6.5.1 Stock Assessment

Conservation Status of Pacific Lamprey

Pacific lamprey are known to occur in the Klickitat River Subbasin. The historic and present distribution and abundance of this species in the Subbasin is, for the most part, relatively unknown. Juvenile out-migrants are occasionally collected at the rotary screw trap station at RKm 4.5. A few adult Pacific lamprey have been observed at RKm 91.7 and at Lyle Falls. Recent sampling has detected juvenile Pacific lamprey throughout the Klickitat subbasin up to about the Klickitat Hatchery at RKm 68 (CRITFC 2011 and YN data).

Harvest Status of Pacific Lamprey

There are no regulated sport or Tribal fisheries that target Pacific lamprey in the Klickitat River Subbasin. WDFW regulations state that sport fishers may not retain any Pacific lamprey. Some Tribal members may harvest a few of these fish at traditional fishing areas each year, but the total number of fish caught is unknown.

6.5.2 Recent Management Strategies for Pacific Lamprey

Habitat Management

Historically, habitat actions have not been implemented specifically to benefit Pacific lamprey. Instead, it has generally been assumed that habitat projects designed to increase salmon production would also benefit Pacific lamprey. The recently completed Lyle Falls Fishway upgrade was designed to create better upstream passage conditions for both salmon and adult Pacific lamprey.

Hatchery Management

There are no artificial production programs for Pacific lamprey in the Klickitat River basin. However, the Columbia River Treaty Tribes have developed a "Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin" (CRITFC 2011). A future production program for Pacific lamprey in the Klickitat River basin may be developed pursuant to the Tribal Lamprey Restoration Plan.

Harvest Management

Sport fishers are not allowed to retain any Pacific lamprey caught in the Subbasin. There have been no studies to determine the number of fish caught by sport fishers or the survival rate of the fish released.

Tribal members harvest a few adult Pacific lamprey each year, but information is not available on the total number caught.

6.5.3 Biological Goals for Pacific Lamprey

The primary biological goal for Pacific lamprey is to rebuild populations to a level that sustains the population over time, but still allows for harvest by Tribal fishers.

Conservation

Currently, data are insufficient on Pacific lamprey abundance and distribution to allow establishment of numeric or spatial structure objectives. Until this information is available, the conservation objective remains broad: increase species abundance over time.

Harvest

The long-term the harvest objective for Pacific lamprey is to increase the population size to a level that can support some harvest for Tribal fishers.

6.5.4 Strategies Considered for Pacific Lamprey

A strategy focused on habitat restoration for Pacific lamprey was the only alternative considered for implementation at this time. Hatchery rearing techniques for Pacific lamprey are still being developed.

6.5.5 Preferred Option for Pacific Lamprey

Habitat improvement is the preferred option for increasing the population and distribution of Pacific lamprey in the Klickitat Subbasin at this time. The habitat actions described for steelhead (Section 6.1.5) are expected to provide benefits to Pacific lamprey. Specific habitat actions targeted to Pacific lamprey will be developed over time as more information is gathered on species distribution and abundance. The information will be gathered in cooperation with CRITFC, WDFW and the USFWS. A future production program for Pacific lamprey in the Klickitat River basin may be developed pursuant to implementation of the Tribal Lamprey Restoration Plan.

6.6 Bull Trout

6.6.1 Stock Assessment

Conservation Status of Bull Trout

Klickitat River bull trout are listed as threatened by USFWS under the ESA and are included in the Lower Columbia Recovery Unit. The Klickitat River bull trout Core Area includes the Klickitat River and all tributaries downstream to the confluence with the Columbia River (USFWS 2002).

Data collected in the Subbasin indicate that bull trout are found in the mainstem Klickitat River and the West Fork Klickitat River and its tributaries. Portions of the West Fork watershed drain the Primitive Area of the Yakama Reservation and have some of the best stream habitat remaining in the Subbasin.

According to the USFWS, Klickitat River bull trout mainly exhibit a resident life history form. Bull trout abundance in the Subbasin is not currently known, but is assumed by the USFWS to be below 1,000 adults (USFWS 2002). Studies are on-going to better estimate the abundance and distribution of this species in the Subbasin.

Harvest Status of Bull Trout

There is no regulated sport or Tribal fishery that targets bull trout in the Klickitat River Subbasin. WDFW regulations state that sport fishers must return all bull trout unharmed to the stream.

6.6.2 Recent Management Strategies for Bull Trout

Habitat Management

Because bull trout are mostly found in the relatively pristine West Fork watershed, there has been little need to develop habitat actions to protect this species. The USFWS is currently developing a recovery plan identifying broad actions that should be implemented in the Subbasin to protect bull trout. The main habitat objective proposed by the USFWS is to "Protect, restore, and maintain suitable habitat conditions for bull trout." Because information about bull trout life history, abundance, and distribution in the Subbasin is lacking, the USFWS proposes to implement the studies and research needed to better define their habitat needs within the Subbasin.

Hatchery Management

The Lower Columbia Recovery Unit Team has stated that re-establishment of local bull trout populations in the White Salmon and Klickitat Rivers within 25 years may require the use of artificial propagation. However, there are currently no artificial production programs for bull trout in the Klickitat River Subbasin.

Harvest Management

Sport fishers are not allowed to retain any bull trout caught in the Subbasin. There have been no Subbasin-specific studies to determine the number of bull trout caught by sport fishers or the survival rate of released fish.

6.6.3 Biological Goals

The primary bull trout goal is "to ensure the long-term persistence of self-sustaining, complex, interacting groups of bull trout distributed throughout the species' native range, so that the species can be de-listed" (USFWS 2002).

The conservation and harvest objectives included in this Master Plan for bull trout are discussed below.

Conservation Objectives for Bull Trout

The following objectives identified by the USFWS for bull trout have been included in this Master Plan.

- Maintain current distribution of bull trout and restore distribution in previously occupied areas within the Lower Columbia Recovery Unit
- Maintain stable or increasing trends in abundance of bull trout
- Restore and maintain suitable habitat conditions for all bull trout life history stages and strategies
- Conserve genetic diversity and provide opportunity for genetic exchange

Until bull trout recovery objectives are finalized by the USFWS, the Master Plan has set an abundance target of 1,000 adults, distributed in the West Fork, its tributaries, and mainstem Klickitat River.

Harvest Objectives for Bull Trout

The long-term harvest objective is to increase population size to a level that can support a catch-and-release sport fishery as well as incidental harvest in Tribal fisheries.

6.6.4 Alternative Strategies Considered

A strategy focused on habitat restoration for this species was the only alternative considered for implementation. Although the Lower Columbia Recovery Unit 10 team suggested that artificial production may be needed to recover this species, the YN are of the opinion that this action should not be considered until more is known about species abundance levels in the Subbasin.

6.6.5 Preferred Alternative: Habitat Improvement and Protection

The habitat plan for bull trout assumes that factors limiting steelhead production in the Subbasin are likely reducing bull trout abundance as well. Key limiting factors identified for steelhead in areas of the Subbasin where bull trout are present or thought to be present are shown in Table 6-18.

Table 6-18: Habitat limiting factors for Klickitat River bull trout by geographic area

Area	Limiting Factors[1]
Upper Klickitat River	Obstructions, sediment load, temperature, channel stability, key habitat quantity, habitat diversity, hydroconfinement, food, harassment/poaching
Middle Klickitat River	Sediment load, key habitat quantity, habitat diversity, temperature,

	harassment/poaching, flow, predation, competition with hatchery fish, channel stability, obstructions
Lower Klickitat River	Key habitat quantity, habitat diversity, food, temperature, sediment load, predation, competition with hatchery fish, obstructions, channel stability, withdrawals, flow harassment/poaching
Klickitat Canyon	Sediment load, food
Upper Middle Klickitat River	Sediment load, predation, habitat diversity, competition with hatchery fish, channel stability, key habitat quantity, obstructions
West Fork Klickitat River	Obstructions, sediment load

[1] Limiting factors were based on those developed for steelhead

The habitat strategies that will be implemented in each area are presented in Table 6-19. No analysis has been performed on expected improvement in bull trout abundance and survival from the implementation of these habitat strategies. The results of on-going and future research will be used to adjust the strategies and to estimate resulting bull trout response.

Table 6-19: Relationship between bull trout habitat strategies and key geographic areas in the Klickitat River Subbasin

Strategy	Areas For Implementation
Strategy 1: Protect Stream Corridor Structure and Function	Mainstem Klickitat
Strategy 2: Restore Passage and Connectivity between Habitat Areas	upper Klickitat mainstem, West Fork Klickitat, Lyle Falls, Castile Falls
Strategy 3: Restore Floodplain Function and Channel Migration Processes	Mainstem Klickitat and West Fork Klickitat
Strategy 4: Restore Riparian Condition	Klickitat Canyon, Lower Klickitat, Middle Klickitat, Upper Klickitat
Strategy 5: Restore Normative Flow Regimes	Lower Klickitat, Middle Klickitat
Strategy 6: Restore Degraded Water Quality, including Water Temperatures	Mainstem Klickitat and West Fork Klickitat

CHAPTER 7.0 MONITORING AND EVALUATION

The proposed monitoring and evaluation program deals with hatchery, harvest, and habitat components of the Master Plan. Habitat action effectiveness monitoring is discussed but not described in great detail here; it will be conducted using a combination of methods including the Columbia Habitat Monitoring Program (CHaMP), the YKFP-developed Rapid Aquatic Habitat Assessment Protocol (RAHAP), and more focused studies in selected areas. It will also be addressed through regional efforts such as the Coordinated Assessments project, subbasin recovery planning, and the Yakama Nation Status and Trends Report (STAR) project. This will assure that the program proposed for the Klickitat River habitat strategy is consistent with M&E protocols being used throughout the Columbia River Basin.

The results of M&E activities under the Master Plan will be presented in annual reports. A yearly workshop will be held to present study findings to other agencies and interested members of the public. Study results and workshop materials will be stored on the web at www.ykfp.org. Data will also continue to be presented in PISCES status reports and peer-reviewed scientific publications.

YKFP's M&E data collection and reporting protocols will be consistent with the Columbia River Basin regional strategies including Monitoring, Evaluation, Research, and Reporting (MERR); Anadromous Salmonid Monitoring Strategy (ASMS); Collaborative Systemwide Monitoring and Evaluation Project (CSMEP), and Pacific Northwest Aquatic Monitoring Partnership (PNAMP). As habitat actions and cost estimates are refined, results will be included in the Klickitat Subbasin Recovery Plan (NOAA-Fisheries 2009).

The Columbia River Basin Research Plan (NPCC 2006), which was developed with input from the Independent Scientific Advisory Board (ISAB), ISRP, CSMEP, and PNAMP, identified a number of critical uncertainties regarding hatchery management:

> *Conventional Hatchery Production —*
> 1. What is the cost to natural populations from competition, predation (direct and indirect), and disease caused by interactions with hatchery-origin juveniles and from harvest in fisheries targeting hatchery-origin adults?
>
> 2. To what extent can interactions between production-hatchery fish and naturally produced wild fish be reduced — for example with the goal of achieving sustainable long-term productivity and resilience of the wild component of the population by spatial or temporal partitioning of natural and artificial production at the subbasin, province, basin, and regional scale?
>
> *Supplementation —*
> 3. What is the magnitude of any demographic benefit to the production of natural-origin juveniles and adults from the natural spawning of hatchery-origin supplementation adults?

4. What are the range, magnitude, and rates of change of natural spawning fitness of integrated (supplemented) populations, and how are these related to management rules, including the proportion of hatchery fish permitted on the spawning grounds, the broodstock mining rate, and the proportion of natural origin adults in the hatchery broodstock?

5. Can the carrying capacity of freshwater habitat be accurately determined and, if so, how should this information be used to establish the goals and limitations of supplementation programs within subbasins?

All Hatcheries —
6. What is the relationship between basinwide hatchery production and the survival and growth of naturally produced fish in freshwater, estuarine, and ocean habitats?

7. What effect do hatchery fish have on other species in the freshwater and estuarine habitats where they are released?

The M&E plan for the proposed project is intended to address all of the uncertainties at least to some extent. The M&E activities described below focus on determining the success of the hatchery programs, the effects each program has on native stocks, and the critical uncertainties. The M&E programs associated with hatchery facility operation and compliance with state and federal regulations are presented in more detail in each of the programs' respective HGMPs found in Appendix B.

7.1 Hatchery Monitoring and Evaluation

Objective 7.1.1. Operate adult trap(s) at the Lyle and Castile Falls ladders, and at the Klickitat and Wahkiacus Hatchery swim-in ladders to collect brood stock and to sample returning fish for stock composition. Hold and spawn fish maintaining established fish health standards.

Approach: YN biologists and technical staff will operate adult fish traps at the Lyle and Castile Falls ladders and Klickitat and Wahkiacus Hatcheries for local broodstock development. YN staff has been operating similar facilities in the Yakima River Basin for years to sample returning fish and to collect brood stock. Factors such as weir/trap impedance/avoidance, run timing, spawn timing, population demographics, phenotypic and genetic characteristics, and return rates are part of the necessary evaluation that should be conducted to facilitate future development of programs specified in this Master Plan. Evaluation staff is responsible for daily record keeping of all species captured, passed, or hauled for broodstock, along with any biological samples collected. These adult traps are also used for estimating adult returns (see 7.3).

Task 7.1.1.1. Operate adult trap(s) and collect and transport broodstock for the Klickitat hatchery complex programs.

Task 7.1.1.2. Hold broodstock and document mortalities during holding.

Task 7.1.1.3. Compile all data from trapping and spawning, and calculate return rates (using CWT, PIT tag, and mark-recapture analysis) for program evaluation.

Task 7.1.1.4. Utilize USFWS fish health professionals during spawning to collect and analyze appropriate fish health samples. Cull fish as necessary per established USFWS and YKFP fish health protocols (See 7.7 Disease monitoring).

Objective 7.1.2. Determine the origin and stock of salmon and steelhead used as broodstock. Monitor and evaluate changes in the phenotypic and genotypic characteristics of fish used at Klickitat Hatchery complex.

Approach: YN expects to observe an assortment of endemic and non-endemic stocks of salmon and steelhead in the Klickitat Subbasin, especially at Lyle Falls where "dip-ins" are common and most fish used for production at the Klickitat Hatchery complex will be collected. YN, WDFW co-managers and NMFS desire to maintain the integrity of the salmon stocks for use in the program and to minimize the potential negative effects of hatchery operations on ESA listed populations. In addition, the project has goals of protecting the health of natural populations while using these stocks for harvest mitigation production.

Broodstock Management

To monitor the phenotypic and genotypic integrity of populations cultured for the program, YN staff strives to collect and mate adults for broodstock to monitor stock demographics (e.g. run/spawn timing, age structure, sex ratios and size of fish) for gametes retained for production. Ideally this would be accomplished by selecting broodstock from throughout the run/spawning season.

YN will use PIT tags, CWTs, fin clips, scale readings, and DNA sampling to identify and remove stray fish from broodstock. We will estimate the numbers of untagged stray fish associated with decoded CWTs to derive the stray component of fish that were processed.

Since all endemic stock fish are from unmarked/untagged natural origin fish, any external or internal marks that identify them as hatchery origin fish can quickly be identified and enable them to be removed from NOR (integrated) broodstock programs.

Task 7.1.2.1. Collect scale samples on all untagged fish processed at Klickitat Hatchery complex. Scales from each fish will be used to document age-structure and to assist in differentiation of hatchery and naturally produced fish.

Task 7.1.2.2. Examine all salmon and steelhead for marks and tags, and determine sex. Recover and decode all tags from spawned carcasses.

Task 7.1.2.3. Calculate the rate at which natural origin salmon or steelhead are included in broodstock.

Task 7.1.2.4. Estimate the rate at which unmarked/untagged hatchery strays were included in broodstock.

Task 7.1.2.5. Estimate stock composition (e.g., hatchery- or natural-origin) of fish retained for broodstock.

Task 7.1.2.6. Examine salmon and steelhead for marks, wire (CWT), sex, and collect scales to determine age composition after spawning.

Task 7.1.2.7. Collect length and weight samples from hatchery and natural origin spawned females. Estimate fecundity for each and create relationships with body size information to track for long-term changes.

Task 7.1.2.8. Determine length frequency ranges for jack fall Chinook based on CWTs.

Task 7.1.2.9. Enumerate jacks retained in broodstock each week to assist with reporting and to assure jacks are incorporated in broodstock within the spawning protocol guideline.

Task 7.1.2.10. Document brood year specific phenotypic characteristics for salmon and steelhead stocks used at Klickitat Hatchery complex (endemic, conventional production/supplementation), and compare and report changes that have occurred over time. Methods will be similar to those described in Knudsen et al 2006 and Knudsen et al 2008.

Objective 7.1.3. Monitor and evaluate the survival of hatchery salmon and steelhead produced and reared at Klickitat Hatchery complex.

Approach: YN staff will collect data on growth and survival of salmon and steelhead produced and reared at the Klickitat Hatchery complex by life stage, from egg to release as pre-smolts.

Task 7.1.3.1. Using gravimetric methods, estimate the number of eggs spawned.

Task 7.1.3.2. Enumerate live eggs at “shock” time using an egg counter.

Task 7.1.3.3. Document fry mortalities during incubation.

Task 7.1.3.4. Estimate the number of fish ponded as the live egg count less documented fry mortalities.

Task 7.1.3.5. Document mortalities during rearing by pond and month.

Task 7.1.3.6. Document size of fish (length and weight) using sub-sample by rearing pond and month.

Task 7.1.3.7. Document feed type and food conversion (weight gained divided by pounds of food fed) by rearing pond and month.

Task 7.1.3.8. Estimate the number of fish released (e.g., if 100% of the fish are marked, this is the number of fish marked (see 7.1.4) less documented mortalities from ponding to release).

Objective 7.1.4. Comply with HSRG guidelines and program goals for natural stock restoration and local, natural-origin brood stock development.

Approach: Establish and maintain program marking protocols that allow returning fish to be distinguished by origin and stock. Marking strategies (Table 7-1) are still under development and review. Fish in programs targeted for harvest will be adipose-clipped at high rates to facilitate harvest in all fisheries. Currently, fish size, infrastructure, time and funding requirements preclude a greater adipose-clip rate for fall Chinook. The WHAF is required to mark fall Chinook at greater rates than present. The proposed mark rate for coho is 50% to be consistent with *U.S. v Oregon* harvest allocation. For the spring Chinook and steelhead programs, all hatchery-origin fish that could potentially escape to the natural spawning grounds will be 100% marked for identification and evaluation purposes. Passage and handling rates through the Lyle Falls facility have resulted in the following average sample rates: 10% for spring Chinook, 20% for steelhead, and <10% for fall Chinook (although these rates are likely to increase with newly completed improvements in attraction flow at the fishway). Sufficient staff is available to mark-sample all fish passing through the Lyle Falls facility. Fisheries will strive to achieve a 20% mark-sample rate for at least adipose presence or absence. These mark and adult return sample rates are equivalent to or exceed those used in most other Columbia Basin programs with similar purposes. Therefore, we believe they will be sufficient to provide reasonable confidence in the parameters (e.g., fishery contribution, survival to Klickitat river mouth, pHOS, pNOB, etc.) we are attempting to evaluate. We expect to detect and correct any insufficiencies through our annual review process.

Task 7.1.4.1. Mark hatchery-origin salmon and steelhead produced at Klickitat Hatchery complex as documented in Table 7-1.

Task 7.1.4.2. Estimate the total number of fish on hand at marking.

Task 7.1.4.3. Observe marks on returning fish and use these data to manage proportion of natural fish in brood stock (PNoB – Objective 7.1.2) and proportion of hatchery fish on the spawning grounds (PHoS – Objective 7.3.1) per guidelines established by the YKFP Policy Group (as recommended by technical implementation teams).

Table 7-1: Hatchery release numbers, number marked, and mark type by species and hatchery component

Species	Component	# Released	# Marked	Tag or Mark
Steelhead	Harvest	90,000	90,000	90,000 AD-Clipped ~17,000 CWT 10,000 PIT
	Conservation[1]	TBD	TBD	TBD
Spring Chinook[2] Progeny of:	Hatchery-Origin	See Chapter 6	100%	100% AD-Clip of which ~17% also have CWT ~5% PIT
	Natural-Origin	See Chapter 6	100%	100% Eye-Elastomer and/or CWT; ad-clip mark rate to be determined ~5% PIT
Coho	Harvest	1 Million[3]	500,000	400,000 AD-Clip (40%) 100,000 AD-Clip + CWT (10%)
Fall Chinook	Harvest	4 Million	660,000	AD-Clip + CWT

[1] If deemed necessary – see Chapter 6.
[2] Total release will be ~800,000. The number of spring Chinook releases from hatchery- and natural-origin parents will vary depending on the number of NOR incorporated into the broodstock, based on run size – see Chapter 6.
[3] See Chapter 6.

Objective 7.1.5. Monitor and evaluate the quality and release of salmon and steelhead produced at Klickitat Hatchery complex.

Approach: Evaluation staff will analyze marking data and releases of juvenile salmon to determine survival rates between life stages and examine potential variables that may influence observed survivals. To document the percent precocious male fish in all of our release groups, visual sampling of salmon juveniles will occur. To document PIT tag loss that occurs between tagging and release of salmon and steelhead, we will install PIT tag arrays in the outlet channels at all release sites.

Task 7.1.5.1. Evaluate mark quality and tag retention before release.

Task 7.1.5.2. Evaluate fish health of a sub-sample of fish at release. Document and report release size and general condition of juvenile salmonids prior to release.

Task 7.1.5.3. Summarize hatchery records for each brood year to document and report green egg-to-fry, fry-to-smolt, and green egg-to-smolt survival rates for each species, and for each release strategy where appropriate (e.g. - yearling/subyearling Chinook releases).

Task 7.1.5.4. Based on above monitoring, recommend changes in rearing, marking, and/or tagging protocols to hatchery and YKFP management.

Task 7.1.5.5. Install and maintain PIT tag antenna array in the outlets of all final rearing and release ponds and raceways.

Task 7.1.5.6. Document the number of PIT tagged fish in the release and calculate the number of PIT tags shed between tagging and release.

Task 7.1.5.7. Document the number of CWT tagged fish in the release and calculate the number of CWT tags shed between tagging and release.

Task 7.1.5.8. Report tagged release data to regional PTAGIS and RMIS data bases.

Objective 7.1.6: Evaluate salmon and steelhead release strategies, release sites, and smolt out-migration timing and survival from Klickitat Hatchery complex releases to downstream detection sites.

Approach: Floating rotary screw traps are operated at various locations in the Klickitat Basin on a year-round or seasonal basis as access and flows allow. At each daily trap check, environmental and trap data is recorded along with biological data on 10 to 30 of each salmonid species represented. The excess and non-salmonid fish are tallied by species. Biodata consists of fork lengths, weights and smoltification stage. Environmental and trap data recorded includes weather conditions, water temperature and clarity, trap cone revolution speed, and debris load in the trap cone and live box.

Task 7.1.6.1. Maintain services of a qualified biometrician with experience in estimating smolt trap efficiency rates for Klickitat Basin fish.

Task 7.1.6.2. Collect fork lengths, weights, and Na+, K+-ATPase samples from the gill tissue of hatchery- and natural-origin from juvenile fish obtained in screw trap operations using the techniques described in McCormick (1993) and Schrock et al. (1994).

Task 7.1.6.3. Document migration timing and magnitude for yearling and subyearling salmon and steelhead on a daily, seasonal and annual basis.

Task 7.1.6.4. Track enzyme levels of hatchery juveniles released from hatchery facilities and acclimation sites to determine their migratory status. Compare with enzyme levels of natural-origin fish. Use this information to refine hatchery rearing practices and the hatchery release schedule.

Task 7.1.6.5. Maintain a database of all biological data for yearling and subyearling releases from Klickitat hatchery complex and for natural-origin fish.

Task 7.1.6.6. PIT tag juvenile fish in screw trap operations for use in entrainment, survival and smolt-to-adult survival rate estimation.

Objective 7.1.7. Assist in the planning, spawning, record keeping, and summarizing data for spawned salmon and steelhead at Klickitat Hatchery Complex.

Approach: YN biologists annually assist in the spawning operations of salmon and steelhead at Klickitat Hatchery complex. The role of the evaluation staff has been and will be to collect the biological data (date of spawning, sex, length, scales, marks/tags, extraction of CWTs, DNA and scale sampling, fecundity estimation, etc.) from all fish retained/spawned for broodstock from each of the species. This collaborative role will be critical for optimizing production strategies. In addition, evaluation staff will work closely with the hatchery staff to provide weekly /monthly /yearly summaries of the data for hatchery reports and ESA compliance.

Task 7.1.7.1. Develop or update spawning protocols as needed for review and approval by YKFP technical teams and Fish Management staffs prior to the onset of spawning for all species.

Task 7.1.7.2. Assist in the spawning of salmon and steelhead at Klickitat Hatchery complex.

Task 7.1.7.3. Collect biological data from all (or representative sample) spawned fish (sex, length, scales, DNA, marks/tags, CWT extraction and verification, PIT tag detection, fecundity estimation).

Task 7.1.7.4. Where applicable, assist or provide hatchery staff with the necessary data summaries for completion of hatchery records from spawning activities.

7.2 Harvest Monitoring and Evaluation

Harvest monitoring of Klickitat River-origin salmonids will be performed by WDFW and the Yakama Nation. The WDFW is responsible for monitoring non-tribal sport and commercial fisheries in the Columbia River, Klickitat River, and ocean. The fisheries monitoring methodologies used by WDFW and other state and federal agencies are outside the scope of this document.

The Tribal harvest monitoring program is designed to achieve project goals through:

- sampling subsistence fisheries below Bonneville Dam and at Cascade Locks, The Dalles Dam, John Day Dam, and McNary Dam on the mainstem Columbia River
- sampling all Tribal fisheries in the Klickitat River

Objective 7.2.1. Monitor Tribal Subsistence Fisheries in the Columbia River

Approach: YN biologists and technicians annually monitor tribal ceremonial and subsistence fisheries in the Columbia River from the newly established tribal fishing area below Bonneville Dam upstream to McNary Dam. Fishing areas are observed to record total effort in a monitored time frame, with a subsample of effort monitored for observed

catch. Biologists expand recorded data for each fishing area and time frame to estimate total catch.

Task 7.2.1.1. Monitor Tribal fisheries below Bonneville Dam and at Cascade Locks, The Dalles, John Day, and McNary dams daily whenever fisheries are conducted.

Task 7.2.1.2. Each fishing day will be divided into three 8-hour periods. A different observer will be used to monitor each 8-hour period.

Task 7.2.1.3. Every 2 hours, the observer will record the number of active gear, the number of fish captured per gear type, and the length of the observation period.

Task 7.2.1.4. Catch estimates will be calculated by expanding the counts for both time and gear.

Task 7.2.1.5. Caught fish will be randomly sub-sampled for marks. Fish species and (if possible) sex will be identified for each fish and each fish will be examined for marks. Length measurements will be taken for each fish caught. Scale samples will be collected on each fish for aging. DNA samples will also be collected on a sub-sample of fish if required as part of genetic studies being undertaken by YN or other research groups.

Task 7.2.1.6. Recovered CWTs will be sent to WDFW for processing. WDFW will report tag recoveries and information to the appropriate regional databases.

Task 7.2.1.7. YN will be responsible for reporting PIT-tag recoveries to PITAGIS (the PIT-Tag Information System) and other regional databases.

Task 7.2.1.8. YN reports estimated harvest in these fisheries through the *U.S. v Oregon* Technical Advisory Committee (TAC). Annual harvest in these fisheries is maintained as part of the TAC record.

Task 7.2.1.9. YN biologists will analyze available data and estimate the number of Klickitat released salmon and steelhead by origin caught in these fisheries.

Objective 7.2.2. Monitor Fisheries in the Klickitat River Basin

Approach: The majority of Tribal fishing activities in the Klickitat River occur mainly at Lyle Falls. This fishery will be monitored in a manner similar to that described in Objective 7.2.1. Non-tribal recreational fisheries also occur in the Klickitat and are monitored by WDFW using standard creel methods.

Task 7.2.2.1. YN staff will monitor tribal subsistence fisheries in the Klickitat Baisn using methods described in Objective 7.2.1.

Task 7.2.2.2. YN staff will conduct interviews with Tribal fishers. Their catch may be subsampled as described in Objective 7.2.1 above.

Task 7.2.2.3. WDFW will monitor recreational fisheries in the Klickitat River using standard creel methods.

Objective 7.2.3. Estimate harvest of Klickitat Basin salmon and steelhead in Marine Fisheries.

Approach: The Regional Mark Information System (RMIS) will be queried regularly for any CWT recoveries of Klickitat hatchery complex releases in ocean or Columbia River mainstem fisheries. The results of these queries will be analyzed to estimate the number of fish harvested in marine and lower Columbia River non-tribal fisheries.

Task 7.2.3.1. YN staff will maintain a database of CWT codes released in Klickitat hatchery complex programs.

Task 7.2.3.2. YN staff will run annual queries of the regional RMIS database, searching for recoveries of Klickitat hatchery complex CWT codes.

Task 7.2.3.3. YN staff will estimate harvest of Klickitat hatchery complex salmon and steelhead in marine and lower Columbia River fisheries and report these estimates in annual reports.

7.3 Escapement Monitoring and Evaluation

Objective 7.3.1. Estimate escapement of salmon and steelhead to the mouth of the Klickitat River by stock and origin.

Approach: YN staff will utilize counts at the Lyle and Castile Falls and hatchery swim-in ladders and maintain a database of counts of fish by date, ladder, and species. In addition, YN biologists and technical staff will operate adult fish traps at these ladders for endemic broodstock development and biological sampling. Adult trap data and PIT and CWT detection data will also be used for estimating adult return composition (stock and origin).

Task 7.3.1.1. Enumerate returning fish using ladder count data, other databases, and present methods.

Task 7.3.1.2. Conduct trapping operations and fish sampling per established protocols.

Task 7.3.1.3. Evaluate trapping operation and tag detection databases to estimate composition of returning fish by stock and origin.

Task 7.3.1.4. Evaluate harvest estimates for Klickitat Basin fisheries and spawning survey data to estimate escapement.

Task 7.3.1.5. Summarize and report above data.

Objective 7.3.2: Estimate adult returns, collect life history characteristics, and document distribution of adults to spawning areas.

Approach: Measuring adult returns to the point of release and to other intermediate areas is necessary to determine program success. YN monitors the returns of salmon and steelhead throughout the Klickitat Basin via ladder counts and adult trap operations at Lyle and Castile Falls and hatchery swim-in ladders, spawning ground surveys, mark-recapture estimation, and harvest monitoring. Trapped and/or spawned broodstock fish

and carcasses provide data concerning origin, stray rates, sex ratios, and composition of each year's run. Spawning surveys provide numbers of redds, spawn timing, and distribution of fish in each of the surveyed reaches and tributaries. These are primary actions to track program performance and progress toward meeting goals.

Task 7.3.2.1. Conduct spawning ground surveys to count redds, determine distribution of spawners, and sample carcasses (sex, length, scales for age composition, and tissue for genetic typing) to document life history characteristics of salmon and steelhead in the Klickitat Basin.

Task 7.3.2.2. Conduct mark-recapture estimation of adult run size to Lyle Falls using floy tags or other marks administered at Lyle Falls adult trap, and recapture/recovery at hatchery ladder and adult holding ponds, via carcass recovery on spawning surveys, or in sport fishery catch.

Task 7.3.2.3. Process scales and CWTs for age composition.

Task 7.3.2.4. Estimate stray rates from the PTAGIS and RMIS regional databases and DNA sampling.

7.4 Productivity Monitoring and Evaluation

Objective 7.4.1. Estimate juvenile smolt production of salmon and steelhead by stock and origin.

Approach: YN staff will maintain and operate rotary screw traps in the Klickitat Subbasin. A number of salmon and steelhead juvenile migrants will be sub-sampled annually. Staff will maintain a database containing length, weight, marks, DNA, etc. information collected from these samples. These and available PIT data will be analyzed to estimate smolt outmigration from the system and smolt-to-adult productivity (return) rates.

Task 7.4.1.1. Operate juvenile monitoring rotary screw traps and collect phenotypic and genotypic data from a subsample of migrating juveniles.

Task 7.4.1.2. Maintain a database of these sample data.

Task 7.4.1.3. Use PIT or acoustic tags and technologies to evaluate flow and entrainment relationships to estimate annual smolt outmigration by stock and origin.

Task 7.4.1.4. Evaluate available PIT data to estimate smolt-to-smolt and smolt-to-adult survival indices (see objective 7.1.6), using analysis techniques such as those in Buchanan and Skalski (2007) or similar.

Objective 7.4.2. Estimate adult-to-adult productivity of salmon and steelhead in the Klickitat Basin.

Approach: YN staff will compile and maintain annual run reconstruction tables using the data collected from the objectives and tasks described above. Available age-at-return data will be used to develop brood/cohort return tables and adult return per spawner productivity.

Task 7.4.2.1. Compile available escapement, harvest, and age-at-return data. Update and maintain these data annually in appropriate databases and spreadsheets.

Task 7.4.2.2. Report these data in annual reports and other appropriate technical fora.

7.5 Predation Monitoring and Evaluation

Objective 7.5.1. Develop a predation index for hatchery-origin fish.

Approach: YN staff will use tagging survival analysis and stomach analysis to derive a predation index. Hatchery juvenile survival estimates to the mouth of the Klickitat River will be evaluated, and if sufficiently precise, will be combined with stomach sampling to develop a predation index.

Task 7.5.1.1. Using PIT or acoustic tagging of hatchery juveniles prior to release, generate travel time and smolt-to-smolt survival estimates to the mouth of the Klickitat River (from objective 7.1.5 and 7.4.1, using PIT tag detections at the lower Klickitat screw trap, Lyle Falls fishway juvenile detections if available, and Bonneville Dam, or alternatively using acoustic tagging and monitoring).

Task 7.5.1.2. Collect migrating hatchery spring Chinook, coho, and steelhead at a screw trap located just upstream of Lyle Falls. The screw trap will be operated from April through late June in order to sample the expected hatchery fish out-migration period. During each week of screw trap operations, a random sample of 10 fish of each hatchery stock of interest will be collected.

Task 7.5.1.3. Remove stomachs of collected fish for analysis.

Task 7.5.1.4. Send stomach samples to a lab for examination and enumeration of the number, size, and species of salmonids present.

Task 7.5.1.5. Use combined stomach and tag survival analysis data to develop the predation index.

Task 7.5.1.6. Use results to adaptively manage release program as necessary.

7.6 Ecological Interactions Monitoring and Evaluation

Objective 7.6.1. Monitor inter- and intra-specific interactions and evaluate potential negative influence on the abundance and productivity of natural populations of steelhead and spring Chinook.

Approach: YN staff will use information from the literature as well as in-basin demographic and migratory data collected from other tasks identified in this chapter as indicators of potential survival or productivity bottlenecks for natural populations.

Task 7.6.1.1. Establish criteria for demographic or migratory parameters that would indicate potential bottlenecks. Criteria development may include risk assessment of competition and other ecological interactions as described in Pearsons and Hopley (1999), Ham and Pearsons (2001), and Kostow (2009).

Task 7.6.1.2. Evaluate data on hatchery juvenile distribution and duration of presence in the subbasin (using tag monitoring data from Tasks 7.1.5.8, 7.4.1.4, and 7.5.1.1, and from expanded fish presence/absence sampling in the mainstem and tributaries).

Task 7.6.1.3 Investigate feasible alternative methods for monitoring certain ecological interactions (such as competition) relative to conditions in the Klickitat subbasin (i.e. direct observations of competition via snorkeling is impractical due to glacially-induced visibility limitations, extensive electrofishing in certain river reaches introduces risk to adult salmonids).

Task 7.6.1.4. Annually review results from Klickitat Subbasin Monitoring and Evaluation activities. Evaluate results relative to established criteria. Work with YKFP policy and technical teams to design and implement changes to Klickitat production programs when criteria are exceeded.

Task 7.6.1.5. Periodically review results from other ongoing Columbia Basin interactions studies for recommendations. Implement recommendations deemed practical and relevant to Klickitat production programs.

7.7 Disease Monitoring and Evaluation

Objective 7.7.1. Maintain Klickitat hatchery operation protocols that minimize potential disease transmission within and outside of the hatchery, assuring that fish reared at the Klickitat Hatchery have high survival rates with little chance of pathogen transmission to naturally-rearing fishes and aquatic organisms.

Approach: YN staff will work with USFWS fish health specialists to implement disease management protocols and monitor hatchery operations for specific fish pathogens in accordance with the Washington Co-Managers Salmonid Disease Control Policy and the USFWS Fish Health Policy and Implementation Guidelines.

Task 7.7.1.1. On at least a monthly basis, both healthy and clinically diseased fish from each fish lot will be given a health exam. The samples will include a minimum of 10 fish per lot.

Task 7.7.1.2. At spawning, a minimum of 150 ovarian fluids and 60 kidney/spleens will be examined for viral pathogens from on-station broodstock. The enzyme linked immunosorbent assay (ELISA) sampling will be performed on

all spawned spring Chinook females to reduce potential vertical transmission of *Renibacterium salmoninarum* (causative agent of bacterial kidney disease) to the progeny. Additional fish health samples will be collected to assess the incidence of other bacterial and parasitic pathogens.

Task 7.7.1.3. Prior to transfer or release, fish will be given a health exam. This exam may be in conjunction with the routine monthly visit. This sample will consist of a minimum of 60 fish per lot.

Task 7.7.1.4. 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, such as optimal fish-rearing densities.

Task 7.7.1.5. Movements of fish and eggs will be conducted in accordance with the Co-Managers Salmonid Disease Control Policy and the USFWS Fish Health Policy and Implementation Guidelines. As needed, fish transferred from other facilities to the Klickitat Basin will be given a health inspection.

Task 7.7.1.6. At spawning, eggs will be water-hardened in iodophor as a disinfectant. All eggs transferred to the facility will be surface-disinfected with iodophor as per the USFWS Fish Health Policy.

Task 7.7.1.7. Juvenile fish will be administered antibiotics orally when needed for the control of bacterial infections.

Task 7.7.1.8. Formalin (37% formaldehyde) will be dispensed into water for the control of fungus on eggs and the control of parasites on juveniles and adult salmon. Treatment dosage and time of exposure may vary with species, life-stage and condition being treated.

Task 7.7.1.9. All equipment (nets, tanks, rain gear) will be disinfected with iodophor between different fish/egg lots.

Task 7.7.1.10. Different fish/egg lots will be kept in separate ponds or incubation units.

Task 7.7.1.11. Tank trucks or tagging trailers will be disinfected when brought onto the station. Foot baths containing iodophor will be strategically located on the hatchery grounds (i.e., entrance to hatchery building) to prevent spread of pathogens.

Task 7.7.1.12. Therapeutants approved by the U.S. Food and Drug Administration or those under Investigative New Animal Drug permits will be used for treatments. Under special circumstances, extra-label usage of other animal drugs may be prescribed by a veterinarian to control resistant disease organisms.

7.8 Genetic Monitoring and Evaluation

Objective 7.8.1. Gain a thorough understanding of the genetic make-up of target stocks in order to maintain long term genetic variability and minimize the impacts of domestication on supplemented stocks (spring Chinook and summer steelhead).

Approach: YN staff will collect genetic samples from adult and juvenile steelhead and salmon. Analysis of genetic markers will be used to evaluate the relationship of steelhead and Chinook populations in the Klickitat River relative to others in the Columbia River Basin and estimate subbasin origin of stray fish found in the Klickitat River. The influence of hatchery programs will be evaluated for each species. Subpopulation structure within the Klickitat subbasin will also be evaluated.

Task 7.8.1.1. Collect genetic samples from adult steelhead and Chinook salmon at the Lyle adult trap on the lower Klickitat River (RM 2.4) and from adult salmon and steelhead taken for broodstock at the Klickitat Hatchery complex.

Task 7.8.1.2. Collect genetic samples from juvenile steelhead/rainbow trout and Chinook salmon at rotary screw traps and via stream electrofishing.

Task 7.8.1.3. Send samples for analysis by CRITFC geneticists with information added to existing databases.

Task 7.8.1.4. Evaluate results with particular interest to the following questions:

1. How have hatchery practices influenced the genetic composition and reproductive success of Klickitat spring Chinook salmon (e.g., see Williamson et al. 2010)?
2. What are the effects of hatchery program reforms on this genetic composition?
3. What are the effects of Skamania Hatchery steelhead on native Klickitat steelhead genetic composition?
4. What are the effects of hatchery program reforms on this genetic composition?
5. Is there evidence for genetically or geographically distinct stocks of winter and summer run steelhead in the Klickitat River?
6. How much out-of-basin straying of steelhead occurs in the Klickitat R. and from what sources do these strays originate?

Task 7.8.1.5. Incorporate information into future reports and management actions through review with YKFP policy and technical teams.

7.9 Habitat Monitoring and Evaluation

Objective 7.9.1. Monitor habitat conditions in the Klickitat subbasin. Evaluate status and trends of habitat conditions in the mainstem Klickitat and key tributaries.

Approach: YN staff will conduct surveys of physical habitat conditions, stream temperature, water quality, and streamflow to monitor and evaluate status and trends in these parameters in the mainstem Klickitat River and selected anadromous fish-bearing tributary watersheds.

Task 7.9.1.1. Conduct surveys of physical stream habitat and riparian conditions using a combination of methods including Columbia Habitat Monitoring Program (CHaMP) protocols and YKFP-developed protocols (parameters include but not limited to: channel habitat unit types and dimensions, substrate composition, large woody debris counts, riparian vegetation types and cover).

Task 7.9.1.2. Collect stream temperature and water quality data. Stream temperatures will be continuously monitored via thermograph at 36 locations within the Klickitat subbasin. Basic water quality parameters will be measured seasonally at the same locations.

Task 7.9.1.3. Monitor streamflow regularly at approximately 7 sites (in selected key tributary watersheds) in the Klickitat subbasin. These data will be used to develop and maintain stage-discharge rating curves and tables, for developing annual hydrographs, and flood peak analyses.

Objective 7.9.2. Monitor and evaluate effectiveness of habitat restoration and enhancement actions in the Klickitat subbasin.

Approach: YN staff will use data from the above habitat surveys (Objective 7.9.1) to evaluate trends in habitat parameters as well as conduct specific focused studies to evaluate fish and ecosystem response at selected habitat improvement sites.

Task 7.9.2.1. Evaluate data from Tasks 7.9.1.1-3 for trends in physical habitat parameters in before-after or before-after-control-impact study designs for selected habitat improvement sites.

Task 7.9.2.2. Collect data and evaluate responses in aquatic invertebrate communities, riparian vegetation, fish abundance, and fish outmigration rates (in conjuction with ongoing PIT tagging and instream tag detection) in before-after and before-after-control-impact study designs at selected habitat improvement sites.

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CHAPTER 8.0 CONCEPTUAL DESIGNS

Improvements and changes are proposed for the existing Klickitat Hatchery (Figure 1-2) and for new construction of the Wahkiacus Hatchery and Acclimation facility. A new summer steelhead acclimation pond at McCreedy Creek is also proposed for construction in the future if needed.

The biological objectives established for this Master Plan are designed to achieve both biological performance of the target species and improve environmental conditions to allow sustainable populations. The goals of the actions proposed under this Master Plan include conservation, habitat, and harvest components (Chapter 2.0). The first step in accomplishing these goals is to reform existing hatchery practices by rehabilitating and expanding the current aging hatchery infrastructure. YN contracted with Harbor Consulting Engineers to inspect hatchery facilities, evaluate existing conditions, develop 30% conceptual designs (Appendices D and E), and develop cost estimates. In addition, YN requested that Harbor evaluate the existing Klickitat Hatchery residences to determine their compliance with existing residential codes and the cost of bringing the structures up to code as well as to determine the possibility of building additional residences. The discussion in the remainder of this chapter summarizes the 30% conceptual design studies for the Klickitat and Wahkiacus hatcheries.

8.1 Klickitat Hatchery

8.1.1 Existing Facilities and Needs Assessment

Construction of the Klickitat Hatchery at RM 42 on the Klickitat River was completed in 1954 (Figure 8-1). This location was chosen due to its proximity to a large groundwater spring. Original construction was financed by the U.S. Department of the Interior through the USFWS. The hatchery has been operated by WDFW. Ownership and operation of the hatchery was transferred to the Yakama Nation in December 2005. Prior to the transfer, the Yakama Nation conducted surveys of the site and facilities.

The main hatchery building was built in 1949 and is approximately 6,853 sq ft. The building includes the main hatchery room (3,339 sq ft), feed room (1,536 sq ft), office and personnel space (1,632 sq ft), and a storage loft (347 sq ft). There are 22 existing hatchery raceways, each approximately 130 ft long. Much of the existing plumbing is original equipment and must be replaced in order to avoid failure and consequent catastrophic mortality during egg incubation or other hatchery life stages.

The office and personnel space, located at the west end of the building, is still in its original configuration. The space is cramped and substandard. The existing facilities are not wheelchair accessible and are poorly lighted. The building is insufficiently insulated. Finally, more space is needed to accommodate additional staff required for the expanded hatchery programs.

The east side of the hatchery building houses the feed room, cold storage, feed mixing room, and dry feed storage. A cold storage room is no longer needed because, since 1993,

the Klickitat hatchery has fed production dry fish food. Cold storage of moist feed is no longer necessary. The rest rooms are not up to code, including a lack of handicap accessibility. A washer and dryer and shower were originally planned for the loft area (plumbing stubs are installed). None of these facilities have been installed despite the use of chemicals and other hazardous substances at the hatchery.

The original buildings used a combination of electric and oil heat; however, only electric heat is used at this time. Upgrades to the hatchery building electrical system were last made in 1983 when two 150 amp panels were installed and the oil-fired boiler was replaced with an electric boiler. At that time, the hatchery lighting system was converted from incandescent to fluorescent.

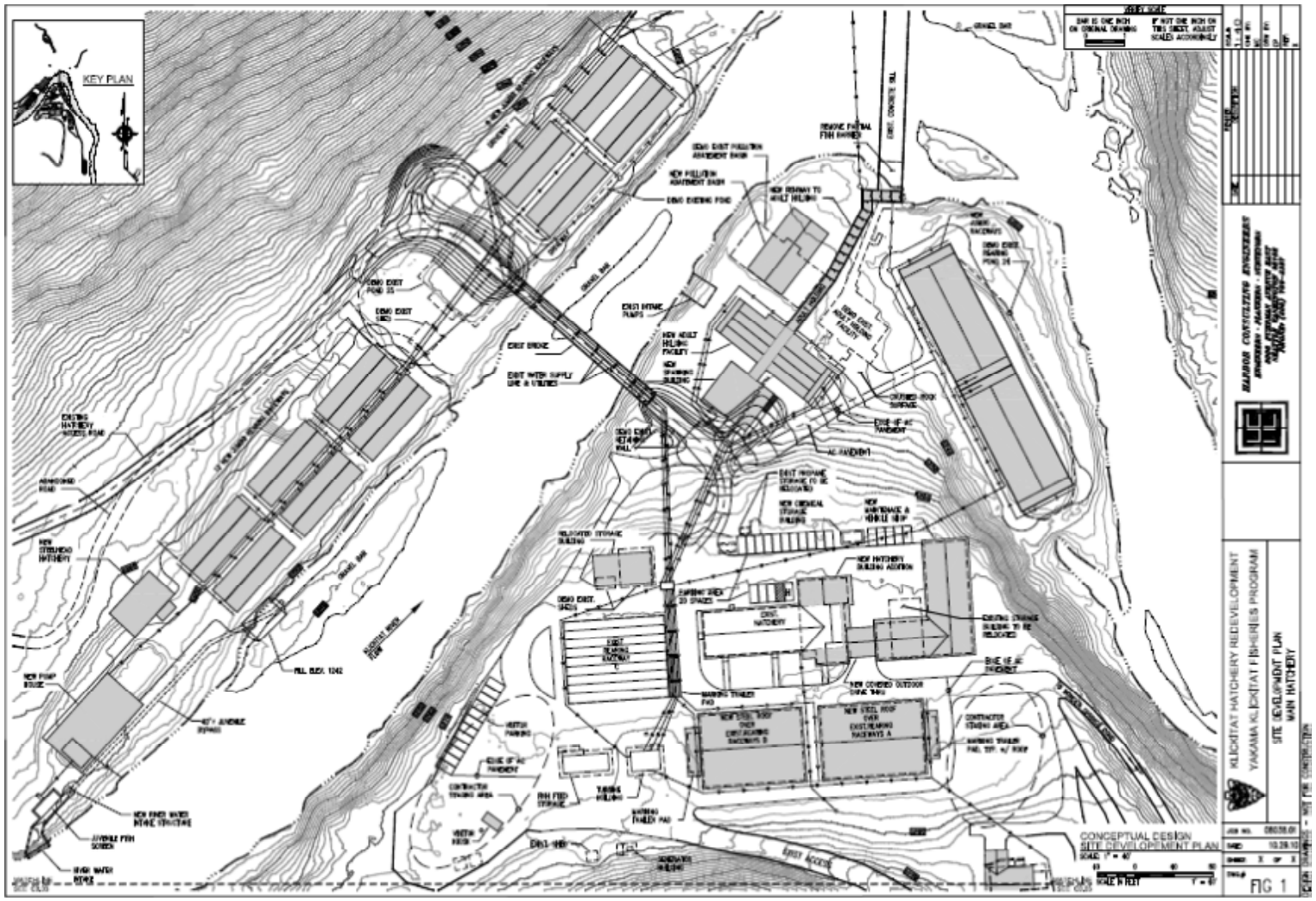
Upgrades to the Klickitat Hatchery are needed in order to implement HSRG and YKFP hatchery reform measures. New and re-constructed facilities will allow proper loading rates during adult fish holding as well as optimal juvenile densities prior to release. Proper loading and optimal densities have been shown to increase pre-spawning and post-release survival. The goals of the proposed upgrades are to provide optimal incubation, rearing, and adult holding facilities in keeping with HSRG guidelines and the standards set by YKFP's Cle Elum Supplementation and Research Facility. The Yakama Nation desires to provide a clean and safe working environment that promotes commitment and ownership.

A river acclimation facility is needed for final rearing of spring Chinook prior to release. A single lane vehicle bridge was completed in late summer 2010 and is sufficient to allow access by heavy equipment to the west bank to reconstruct the Pond #25 river intake which currently does not meet NOAA-Fisheries screening requirements. Excavation of a new sediment extraction and retention system and installation of jumbo raceways are needed to reduce the potential for disease transmission to resident and wild fish. Existing spring water sources will be enhanced and undeveloped spring water that arises from the river banks will be captured and used to augment existing hatchery incubation and for the new steelhead facility. The existing spring water pipeline that is buried under the river will be replaced and relocated through the new hatchery bridge. This existing pipeline is over 60 years old and has experienced near catastrophic failure. As this is the primary water supply for hatchery operations replacement is of paramount importance.

Hatchery reform and expansion would require additional holding capacity prior to spawning. The incubation room is of sufficient size however, additional incubation trays and plumbing are required to satisfy planned capacities. Some expansion of fry-rearing and raceways is also required.

Additional housing is needed due to the expanded scope of the hatchery facility. YN wants to construct new housing that will help encourage families to locate to the facility and will help to retain staff at the site. The existing houses must be upgraded to meet current building codes.

Figure 8-1: Existing and Proposed Facilities



8.1.2 Proposed Modifications for the Klickitat Hatchery Complex

The Klickitat Hatchery has undergone a number of modifications and renovations between 1950 and 2010. Since 1993, only minor improvements have taken place. The hatchery requires significant upgrading to be consistent with scientific and technological advances. Review and recommendations from the HSRG and YKFP scientists as well as, USFWS fish health monitoring has lead to programmatic changes which require new facilities. In addition, existing residences, office spaces, and other work areas need to be reconfigured for greater efficiency and brought into compliance with current building codes. Most of the existing structures need maintenance and repairs to allow continued use.

Hatchery Buildings

The proposed modifications to the hatchery buildings are as follows.

- Rebuild aging water supply systems.
- The building needs to be remodeled to allow better organization and use of the space.
- Glass block "windows" in the Raceway Room need to be either removed or covered with blinds to exclude sunlight in incubation areas.[21]
- The hatchery building will require electrical upgrades to assure worker safety as well as fish health. Upgraded alarm systems are needed to avoid the risk of catastrophic fish loss. The upgraded alarm systems require upgraded electrical systems.
- The inhabited spaces are currently, and will continue to be, heated with electricity. Upgrading to increase energy efficiency is necessary. It is proposed that all new additions and remodels will be constructed to increase thermal efficiency. The ceilings will be insulated to R-38 and the walls will be insulated to R-15.
- Water supply fixtures need to be replaced. Many of the valves and couplings are original equipment and have greatly outlived their life expectancies.
- The rest rooms must be upgraded and remodeled to allow handicap access.
- It is proposed to convert the existing spaces on the east side of the building to a vehicle garage and maintenance shop.

[21] Currently, the glass block windows allow sunlight to enter the incubation room. Exposure to direct sunlight can kill salmon eggs. Sunlight needs to be excluded or re-directed to avoid damage to incubating salmon eggs.

- A secure room to house non-moist feed will be attached to the building. No refrigeration is needed for non-moist feed.

- A washer, dryer, and shower, as well as an eye wash station, will be installed in the loft.

- Upgraded lighting will be required for new hatchery incubation and raceway spaces and occupied personnel spaces. Occupied personnel spaces will also require new energy efficient lighting and additional electrical outlets.

- A central monitoring station, similar to that in use at the Cle Elum Hatchery, is needed to link all alarms and sensing devices. The system will track hatchery conditions such as water level, water temperature, and dissolved oxygen; record alarms; and notify staff when alarms occur. Collected information will be stored and made available to managers.

- It is proposed to build an addition to the office/personnel space to house an isolated incubation room and a wet room/laboratory (Figure 8-1). The lab and isolated incubation facility will be similar to that at Cle Elum Supplementation and Research Facility and will be used to conduct pathogen analysis per USFWS disease protocols. The addition will also contain a locker room and break room for hatchery personnel.

Residences

The Klickitat Hatchery currently has three houses on site for employees and their families. The current houses were built in 1954 and average 1,054 sq ft in living space. They are one story, wood frame houses with a single-car attached garage. The houses have 3 bedrooms and one bath. In each house, one of the bedrooms does not meet current egress codes. House siding is cedar and the roofs are metal. Each contains a masonry fireplace and aluminum windows.

The present condition of the houses is poor. The roofs need replacement as do the bathroom fixtures, and bathroom subflooring. New windows are needed in the third bedroom of each house to bring the houses into compliance with current codes. Proposed upgrades include new vinyl windows throughout, painting, carpeting, other floor coverings, window coverings, and cabinetry. Improved rodent control is also needed.

The proposed expansion will require construction of two more houses. The houses could be either new, “stick built” or modular/pre-fabricated construction. The new houses will occupy spaces that were previously used for housing (Figure 8-1). A 4-bedroom, 3-bathroom house about 2,290 sq ft in size and a 1,725 sq ft house with 3 bedrooms and 2 bathrooms are proposed. New septic systems and site improvements will be required for the houses.

Raceways and Other Facilities

- Existing raceways will need to be modified to accommodate recent innovations in juvenile rearing. The sides and bottoms of the raceways will need to be colored which will most likely require sandblasting and re-coating with epoxy.

- An abandoned adult capture in-river concrete sill must be removed. The 300 ft by 24 ft sill is an impediment to salmonid and lamprey passage, i.e. exposed steel rebar and loose sheet metal cladding have become hazards to migrating adults and juveniles.

- The in-river pumping station and its three pumps will be used only for emergency backup; they will no longer be used on a daily basis.

8.2 Wahkiacus Hatchery and Acclimation Facility

8.2.1 Existing Facilities

The proposed Wahkiacus Hatchery and Acclimation Facilities are new construction. The site, owned by the Yakama Nation, is presently occupied by a house which has been converted to an office and storage space, a starter nursery for native plants used in habitat restoration, a gravel access road, electricity, and septic system. The present electrical service is insufficient to power a hatchery.

8.2.2 Proposed Facilities

The proposed project includes construction of a new hatchery and acclimation facility at the Wahkiacus site (Figure 8-2). The Wahkiacus Hatchery and Acclimation Facility is designed to acclimate up to 1,000,000 coho smolts as well as to rear and release up to 2,000,000 fall Chinook salmon. Ponds and raceways will occupy a large portion of the site; there will be approximately 254,000 cfs of rearing volume. WHAF will also house the Klickitat Watershed Regional Fisheries Office.

WHAF will be located on the Klickitat River at RM 17 just downstream from Swale Creek. The elevation of the proposed site is 512 to 525 ft; the site is located in the floodplain of both Swale Creek and the Klickitat River. Components to be built on the site include:

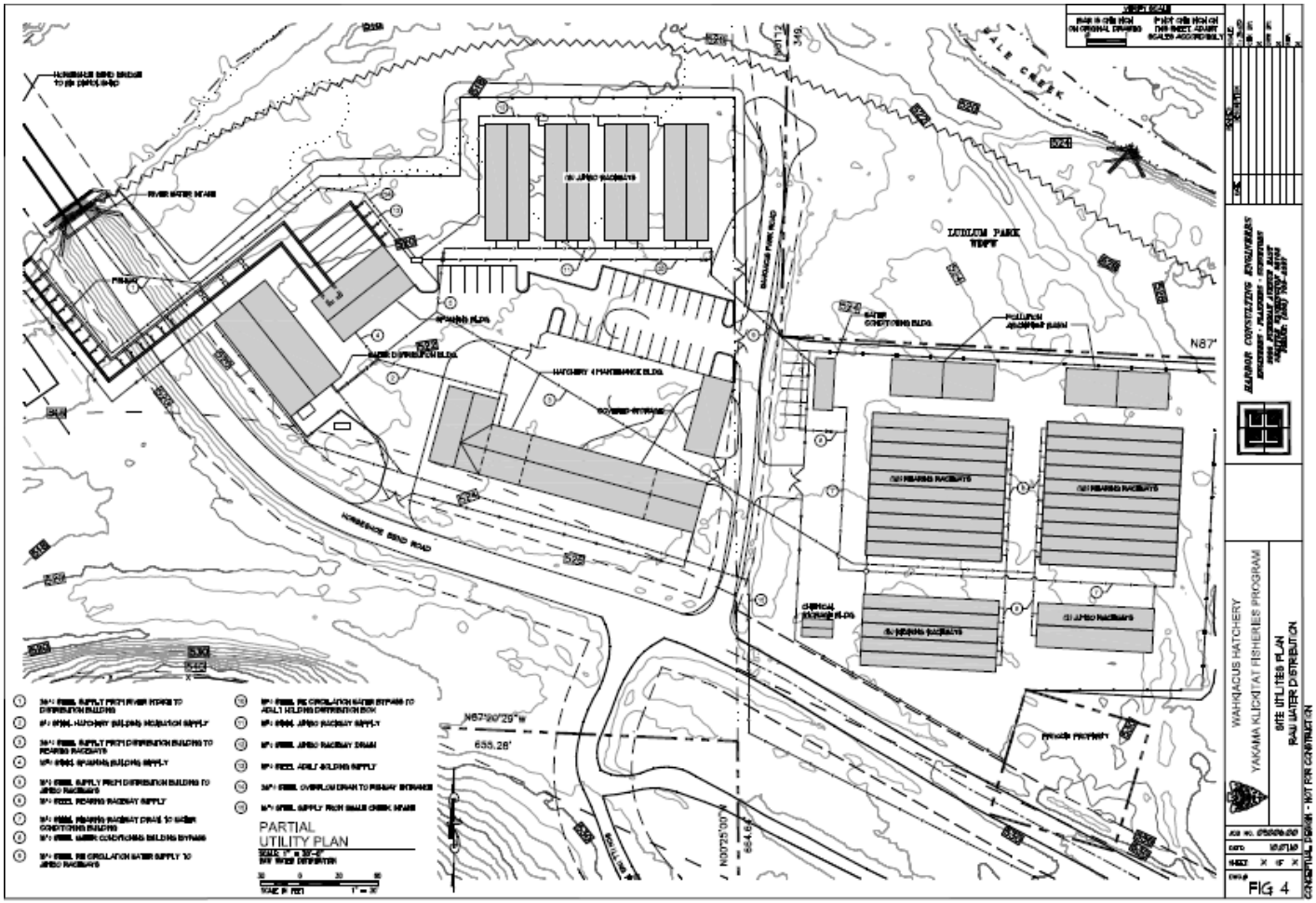
- Main Hatchery Building- total square feet 15,600 SF
    - First floor office / personnel spaces 4,350 SF
    - Second floor office / personnel spaces 3,000 SF
    - Incubation room 2,250 SF
    - Vehicle storage 3,500 SF
    - Maintenance shop 2,500 SF
- Vehicle Storage and Maintenance Building
- Chemical Storage
- Sorting and Spawning Facility

- Fish LadderAdult Holding - four concrete bays (7'-6" wide, 41 ft. long and 10 ft. high).
- Water Distribution Building - pumped Klickitat River intake with diesel power back-up.
    - 30 CFS of water for fish production.
- Juvenile Rearing Raceways
    - 10 Jumbo Raceways (10' wide, 90' long, and 8 ft. high)
    - 25 Rearing Raceways (6' wide, 90' long, and 6 ft. high)
- Pollution Abatement Facilities
- Staff Housing - two or three stick-framed, two story, 4 BR, 2 Bath, 2 car garage.

An existing house has already been converted to a regional fisheries office; several outbuildings are used for storage. The new hatchery residences will necessitate site improvements for water supply, fire protection, and waste disposal. Hatchery power supply will be upgraded to three-phased power by Klickitat County Public Utilities District and supplemented by stand-by generators.

The hatchery and its ancillary structures will be built within the 100-year floodplain. Facility design will take this into account. The facilities will be designed to withstand some amount of flooding each year. The county is expected to build a new bridge over the Klickitat River concurrently with hatchery construction. The new bridge will not constrict the floodplain as severely as the current bridge. This is expected to reduce flood potential at the hatchery.

Figure 8-2: Proposed Wahkiacus Hatchery and Acclimation Facility



Water Supply and Quality

Water will be obtained from the Klickitat River through a large concrete intake structure. The intake will be located on a stable channel of the Klickitat, though a deep scour pool is not present. The water depth at the intake site is considered "moderate" (about 4 to 6 ft deep). Lack of a deep scour pool may mean that water will be difficult to obtain at this site during severe low flow conditions which would negatively affect only late summer rearing programs. The programs proposed at this time involve only spring releases which would not be affected by low flow conditions. The site's stability is dependent upon the abutments of a bridge over the river. The abutments confine the channel and maintain its fixed position.

The screened intake structure will be made of concrete and will be built below ground level to prevent flood scour damage. All components will be completely submersible. Axial-flow pumps will deliver water to the ponds. An air-blast system will periodically flush debris from the screens back into the river. Three-phase line power will run the pumps and generators will provide back-up.

Water quality at this point on the Klickitat River is considered acceptable for spring acclimation, though high turbidity could impact feeding activity and, consequently, fish growth. Ice formation could be a problem in the winter and high summer temperatures could add to stress-related disease problems. These factors will be examined in more detail if future releases are planned in seasons other than spring.

Water may also be obtained from ground water springs with artesian pressure which exist at the site. It is proposed to use the ground water to incubate fall Chinook. The water will be de-gassed before use. In addition to incubating fall Chinook, using groundwater may alleviate some of the turbidity, freezing, and low water problems mentioned above. Use of local groundwater would provide an additional water signature to entrain fall Chinook and Coho into the facility.

Acclimation Ponds

Acclimation ponds of various sizes are proposed for the site. Jumbo raceways will be clustered in a group of 8, and the 25 rearing raceways will be clustered in close proximity to each other with two banks of 10 each and a bank of 5. It is proposed that the rearing raceways be covered with metal roof covers, approximately 33 ft. tall at the highest point. Rearing vessel outlet structures will have dam boards to control water levels and will be screened to prevent fish from escaping prematurely. These structures will be built below the riverbed and will be designed to withstand submersion during flood events. The traveling screens will be cleaned with water spray. Sediment will be removed with blasts of compressed air.

Other Hatchery Facilities

Support components include water distribution systems and a generator/electrical building. An alarm system will be installed to notify personnel of power and water interruptions. If electricity is lost, a transfer switch will automatically turn on the back-up diesel generators.

Site work will include extending existing gravel roads to the acclimation ponds as well as grading and landscaping. River banks will be planted with native vegetation following completion of construction activities.

Fish wastes will be settled in the acclimation ponds (which are low velocity) and will be periodically vacuumed off the pond bottom and diverted to off-line aerated settling basins. There, the wastes will be dried and removed.

8.3 McCreedy Creek Juvenile Fish Acclimation Site

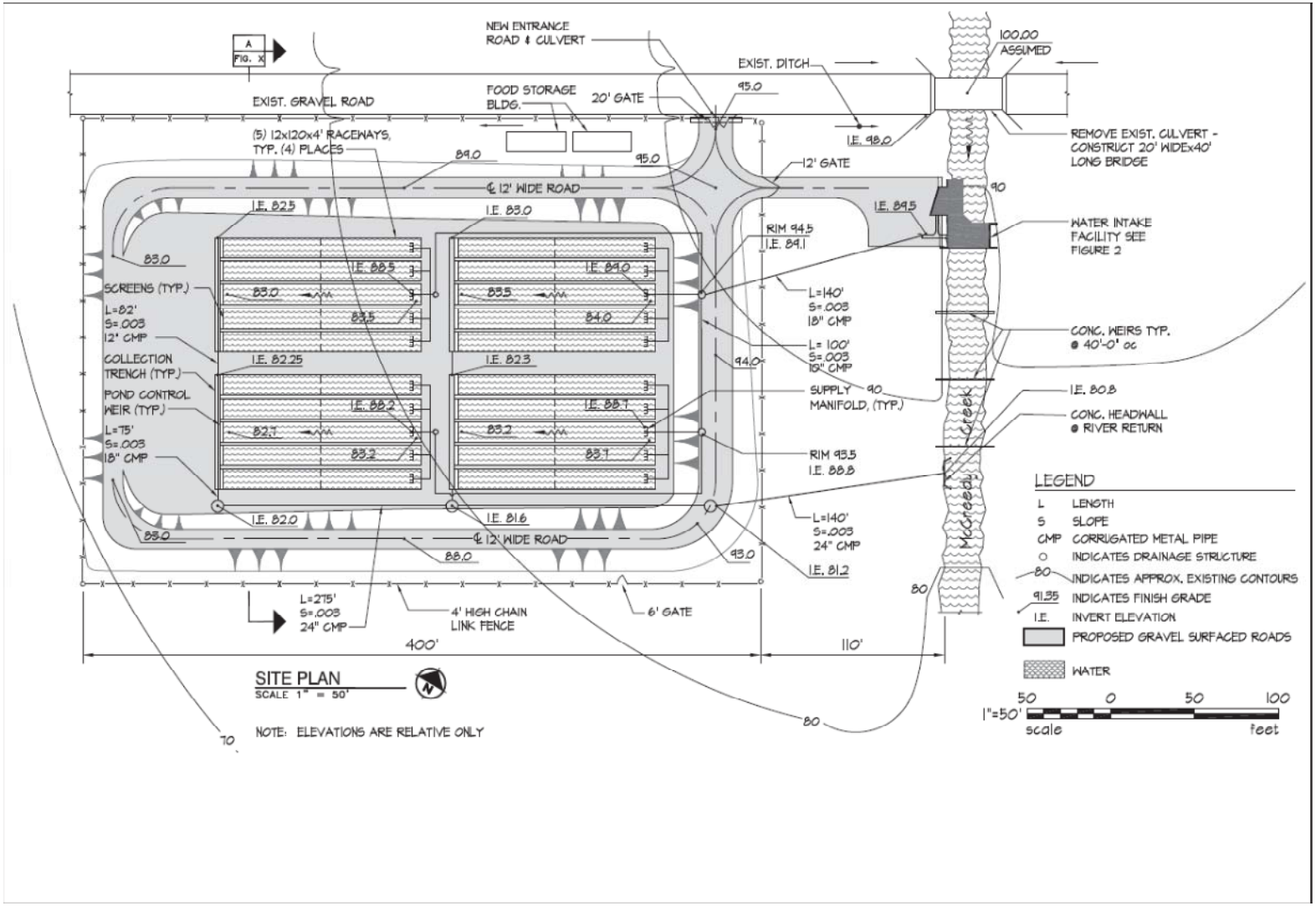
McCreedy Creek has been identified as a potential water source for a juvenile fish acclimation site. Chapter 6 discusses ongoing evaluation of the need for this site. If the site is needed, it is anticipated that it would be used to rear 70,000 steelhead smolts in the spring. Initial studies show that water quality and volume are adequate for this use.

There are no facilities in existence at this site. The site is accessible from the Klickitat River Road and is currently a forested bench with a gentle slope toward the Klickitat River. A multi-plate, corrugated metal culvert carries McCreedy Creek under the road. At the downstream end of the culvert, there is a large scour hole with an excavated water drop of approximately 18 inches which constitutes a barrier to fish passage. Above the road, McCreedy Creek's gradient becomes very steep.

The acclimation site project will replace the culvert with a bridge and take advantage of the reconstructed stream profile to build a seasonal streamside water intake (Figure 8-3). The intake will consist of a pool containing 2 ft high "flash" (dam) boards and a denil fish ladder. The structure will provide fish passage and re-connection of habitat allowing resident fish to move freely up- and downriver.

The steelhead will be reared at 8 fpp. At full capacity a total of volume of 14,400 sq ft of rearing space will be needed. Steel mobile acclimation raceways (5' wide, 20' long, and 5' high) will be set up and plumbed with inflow and return flow/fish release ports. Raceways will be maintained with an average water depth of 4 ft based on the recommended volume density of 0.40 lb/cf and a low density of 8 lbs/gal/min. A water supply of 7 cfs will be required; studies show that McCreedy Creek is capable of delivering this volume of water.

Figure 8-3: Proposed McCreedy Creek Juvenile Fish Acclimation Facility



During the rearing season (April-May), McCreedy Creek appears to be able to deliver the 7 cfs necessary for fish rearing. This water is of high quality and can be returned to the stream very close to the withdrawal point. Supply water will be discharged evenly across the raceways from horizontal headers. This arrangement will allow the water to flow freely and minimize the possibility of the system plugging up. The drains will be oversized to assure safe passage of juvenile fish to McCreedy Creek and the Klickitat River. The drains will be screened and "stoplog" weir construction will be used to maintain pond depth and to facilitate volitional migration of juveniles at release time. Pond water will be discharged as close to the point of withdrawal as possible to minimize in-stream impacts. Cleaning water will be discharged to an earthen pond to dissipate into the soil. Any remaining solid residue will be disposed as approved by the appropriate regulatory agencies.

The steelhead will be placed in up to 20 portable aluminum raceways. The raceways will be configured to facilitate cleaning and fish feeding. Temporary supports to erect bird netting to cover the raceways will be installed. Access to the raceways, drain boxes, and screens for maintenance will be provided by temporary placement of catwalk material.

Seasonally placed stoplogs will be used during the rearing period (approximately 14 weeks). The stoplogs will be approximately 2 ft high and will create a water intake pool sufficient to screen 12 cfs which is consistent with NOAA-Fisheries criteria. Fish passage will be maintained through use of an aluminum denil fishway. A concrete slab will be place across the full width of the stream and a screened water collection box will be installed along the right bank of the stream. The concrete slab will accumulate stream bedload which will then be scoured away by the river, keeping the intake clean.

The natural stream gradient is expected to be restored through replacement of the culvert with a bridge and placement of downstream V-shaped weirs or sills. Elevations should return to pre-erosion levels.

During the spring rearing season, a fish culturist will reside on-site in a self-contained mobile residence. A cargo container will be used to store equipment and fish food.

The McCreedy acclimation site is proposed to be used only during the acclimation season. In-stream equipment and facilities will be removed after use each year. Mobile buildings and storage containers will be transported to a secured off-site storage location. The aluminum raceways will be stacked and stored until the next year off site. All of the seasonal facilities will be in compliance with YN land use regulations for non-permanent structures.

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CHAPTER 9.0 PROJECT COSTS

9.1 Overview of Project Cost Estimates

The costs contained in this chapter are based on the conceptual designs presented in Chapter 8.0 and the programs presented in chapters 6.0 and 7.0. Costs detailed in Appendix D (Klickitat Hatchery Conceptual Design Study - November 16, 2010; Table 9.1) and Appendix E (Wahkiacus Hatchery Conceptual Design Study – December 10, 2010; Table 9.2) are presented here at the 30% conceptual design level. Included in the chapter are cost estimates for finalization of facility planning and design (30% - 100% design, permitting, construction oversight, and as-built drawings) (Sections 9.1 and 9.2), capital construction cost estimates (Section 9.3), ten-year cost estimates for operations and maintenance (Section 9.4), and ten-year cost estimates for monitoring and evaluation (Section 9.8).

The proposed work was broken into defined components and relative costs were taken into consideration. The accuracy of cost estimates is a function of completeness of project planning. These estimates have been prepared for a project at the conceptual level; cost estimates will be refined further at the NPCC Step III level (final design).

9.2 Cost Estimates for Facilities Planning and Design

As major projects in the Klickitat Subbasin evolve from conceptual to finished products, increasingly detailed plans to meet operation, facility, or programmatic requirements are developed. In order to reduce potential late-stage design or programmatic changes, the Yakama Nation assembled a Steering and Design Committee to provide review and input during the Step 1 conceptual planning. The objective was to validate the program, design criteria, and cost estimates to the maximum extent possible through comprehensive early review.

Comprehensive input in the early planning stages is important to meeting the project proponent's requirements, thus ensuring that the facility can be constructed to meet program expectations and goals and remain consistent with cost projections. Such detailed cooperative planning also yields an improved understanding of future operations and associated maintenance as well as monitoring and evaluation. The Yakama Nation and BPA plan to conduct value engineering at the 60% stage to receive review from a broad team of knowledgeable individuals at this stage of the 3-Step processes.

Step 1 Conceptual Planning and Design

Conceptual planning and design work for the Klickitat Anadromous Fisheries Program was initiated in winter 1996.

Step 2 Preliminary Planning and Design

The preliminary planning and design stage is intended to complete the Council's Step 2 requirements. This phase is designed to identify any major difficulties or concerns with the program or facility design. Step 2 design work should provide sufficient detail and

specifics to assure the intent and scope of Step 2 conceptual design work can be met and to further refine the anticipated cost estimates. Step 2 will include completed NEPA and ESA reviews. Project detail will be presented at the preliminary (Step 2) design level. At the completion of this stage, major difficulties with the design and proposed project will be identified.

Initiation of design and value engineering work is proposed for FY 2012 and FY2013. Details of the Step 2 design budget has been developed, while the remaining balance of capital Accord funds available for the Klickitat Subbasin is being finalized. We are also seeking additional capital funding from a variety of sources. At the time of this writing, Lyle Falls and Castile Falls construction is completed and BPA and YN are calculating the capital inflation adjustment that will be used. BPA has stated that during this Accord period (2009 – 2017) they will not contribute additional funds for the WHAF (p.13 Accord Agreement). Project staff estimates the available BPA capital funds for the actions identified within this Master Plan are between $11,000,000 and $13,000,000. Obviously this is an insufficient amount of funds to complete all actions identified in the two conceptual design studies. The cost developed in the two conceptual design studies is presented within this Master Plan to demonstrate entire need. The YKFP anticipates a prioritized phased approach to funding critical elements identified in the conceptual plans, EIS, HGMPs and HSRG review documents.

To ensure comprehensive input, the Yakima Nation will continue to rely on a team approach during the final stages of Step 2 planning and design. The team composition will be similar to the Steering and Design Committee assembled and will include planners, hatchery managers, fish biologists, scientists from other disciplines, and individuals with architectural engineering and construction expertise. Each committee member will contribute knowledge and expertise in an effort to reduce levels of uncertainty, identify opportunities for cost reductions, identify new research or state-of-the-art equipment that should be considered, and to carefully review all aspects of the final design and related cost estimates. This approach will support a well-developed project plan and will reduce risks related to future project cost control. A refined level of detail and associated relative certainty will be particularly valuable during the bid solicitation and bid break down processes.

In addition, the Yakama Nation will implement value analysis (also known as value engineering) at the 60% design stage during the Step 2 preliminary planning and design work for the Klickitat as required by the NPCC Step process (NPCC 2001). Value analysis methods are currently applied across many disciplines and project types during design and development stages of large projects. A thorough value analysis study may result in identification of cost effective alternatives that still meet the goals and objectives of the project.

Step 3 Final Planning and Design

Upon completion of Step 2, Step 3 final planning and construction oversight costs will be developed. Initiation of this work is proposed for late FY 2013 and FY 2014. Details of the Step 3 budget planning and design budget will be presented to NPCC as soon as they

become available. Yakama Nation will continue to rely on an interdisciplinary team approach described above to finalize design and cost estimates.

9.3 Capital Construction Cost Estimates

Estimating construction costs by tracking inflation alone is no longer an accurate method of predicting costs. Construction estimates in today's global economy are often affected by cost spikes caused by the amount of construction and energy costs taking place in other countries. It is hard to accurately predict for long range purposes, what will trigger the next increases or how those increases will impact a specific project. A useful approach under the current construction climate is to estimate costs based upon a rationale marketplace, add contingency funds based upon a best estimate of the current costs, and have a qualified contractor check all prices.

Predicting construction costs requires careful consideration of current cost for labor, material, and equipment. Each of these cost elements are influenced by local, national, and world markets. Historical construction cost escalations are not always good indicators of future costs. Fuel prices and the consumption of raw material such as copper, aluminum, steel, cement, and wood fiber have significant short-term influences. The construction costs supplied by Harbor Consulting Engineers of Seattle use standard sources and were evaluated with direct costs quoted by materials suppliers. They are also based on local project costs and vendor locations.

Klickitat Hatchery assumed the following:

- December 2010 dollars
- 10% estimating contingency
- Three phases of construction with winter shutdowns
- 2.5% annual escalation

Wahkiacus Hatchery & Acclimation Facility assumed the following:

- December 2010 dollars
- 10% estimating contingency
- No winter stoppage once construction commences
- 2.5% annual escalation

The current estimate for capital construction includes new facilities as well as modification of existing facilities. The costs presented in this chapter are preliminary estimates based on conceptual designs. Due to the level of certainty, a 10% contingency is applied to the overall cost. However, contingency is largely dependent on the quantity of uncertainties associated with the project and the amount of pre-investigation work completed. It is expected that the estimated construction costs represent a maximum range and that cost reductions would be identified in future planning stages through analysis of alternative and elimination of many uncertainties.

Labor rate forecasts are also obtained from bidding contractors, familiar with the types or work in question. Native American-owned contractors are included in the labor search.

Lodging and per-diem adjustments are made to the base labor rates depending upon travel time from the population center to the work site. Recent labor-intensive fisheries projects completed in 2011 at Castile Falls in the upper Klickitat have proved to be a reliable cost basis for remote Klickitat River projects. The cost basis is especially appropriate for concrete vendors, steel and wood suppliers, concrete testing companies, and crane delivery, for according to Harbor Consulting Engineers.

Sources of information for the costs included Native American and non-Native American construction contractors, RS Means (www.rsmeans.com), Washington State Department of Transportation, the Small Business Administration database for minority and women-owned construction enterprises (www.sba.gov), and costs associated with the YN Castile Falls fisheries projects completed in 2011.

Transportation costs for manufactured items such as valves, gates, pipe, and pre-cast concrete were adjusted for the difficulty of delivering such items to remote construction sites.

Modification of the Klickitat Hatchery and construction of the proposed Wahkiacus Hatchery and rearing facilities are needed to meet the biological objectives of the Master Plan (Chapter 8). It is estimated that maintenance and operations costs can be reduced if these facilities are built. The McCreedy Creek acclimation facilities would be needed only if evaluation reveals that natural colonization of steelhead is insufficient to fully "seed" the available habitats in the Klickitat River upstream of Castile Falls. We have established that this facility will not be required for at least 5-10 years, if ever (see Chapter 6); nonetheless, the preliminary project costs are presented here.

The Yakama Nation has established a priority for implementing the proposed capital projects:

1. Klickitat Hatchery upgrade
2. Wahkiacus Hatchery and rearing facilities
3. McCreedy Creek Acclimation Facilities

Tables 9-1 through 9-3 provide estimated construction costs for full buildout of the proposed facilities. As discussed in Chapter 8.0, the Klickitat Hatchery upgrades are needed for improved maintenance, building code corrections, energy efficiency, improved salmon culture, and hatchery program regulatory requirements.

Table 9-1: Klickitat Hatchery modification construction cost estimate[a]

KLICKITAT HATCHERY REDEVELOPMENT		*Date:* November 18, 2010	
YAKIMA/KLICKITAT FISHERIES PROJECT			
KLICKITAT COUNTY, WASHINGTON			
30% Design Estimate			
MAIN COST SUMMARY			
DESCRIPTION OF PAVING WORK	DIRECT CONSTRUCTION COST CURRENT November 2010	TOTAL CONSTRUCTION COST CURRENT [Including GC Mark-Ups & 10% Contingency]	TOTAL CONSTRUCTION COST ESCALATED TO MID CONSTRUCTION MARCH 2012
HATCHERY SECTIONS			
Residential Building	655,161	804,210	829,543
Hatchery Building	1,516,627	1,861,659	1,920,302
Vehicle Maintenance	1,341,963	1,647,260	1,699,148
Adult Capture Building	1,166,667	1,432,084	1,477,195
Fish Feed Storage Building	25,596	31,419	32,409
Energy Dissipation Building	1,201,425	1,474,750	1,521,204
Chemical Storage Building	70,544	86,593	89,321
Storage Building	106,637	130,897	135,021
Water Distribution Building	1,186,604	1,456,556	1,502,437
Existing Rearing Raceways A,B&C	2,378,481	2,919,585	3,011,552
Rearing Raceway	2,962,650	3,636,652	3,751,207
Rearing Ponds	1,360,624	1,670,166	1,722,777
Adult Holding Facility	427,076	524,236	540,749
Fishway to Adult Holding	450,746	553,291	570,719
Indian Ford Spring 'A' Upper Intake	347,236	426,233	439,659
Indian Ford Spring ;A' Upper Supply	1,487,398	1,825,781	1,883,293
Indian Ford Spring ;A' Lower Supply	291,455	357,760	369,030
Indian Ford Spring 'B' Intake	15,529	19,062	19,663
Indian Ford Spring ;B' Supply	441,660	542,137	559,215
Shared Trench Raceway	89,027	109,280	112,723
Water Supply Vaults	128,061	157,195	162,147
Water Distribution System	757,047	929,275	958,547
Water Power Electrical Generator	704,500	864,774	892,014
River Water Intake	678,733	833,145	859,389
Site Drainage System	512,832	629,501	649,330
Site Preparation & Site Demolition	473,165	580,810	599,106
Site Development including roads	1,627,931	1,998,285	2,061,231
Site Electrical	1,300,000	1,595,750	1,646,016
Total Construction Cost	$23,705,374	$29,098,347	$30,014,945

a. Costs provided by Harbor Consulting Engineers, Seattle, WA. This estimate is based on the Klickitat Hatchery Conceptual Design Study (Harbor Consulting Engineers 2010) and should be considered conceptual.

Table 9-2: Wahkiacus Hatchery Construction Cost Estimate[a]

Wahkiacus Fish Hatchery	*Date:* December 15, 2010		
YAKIMA/KLICKITAT FISHERIES PROJECT			
KLICKITAT COUNTY, WASHINGTON			
30% Design Estimate			
	MAIN COST SUMMARY		
DESCRIPTION OF PAVING WORK	**DIRECT CONSTRUCTION COST CURRENT December 2010**	**TOTAL CONSTRUCTION COST CURRENT [Including GC Mark-Ups & 10% Contingency]**	**TOTAL CONSTRUCTION COST ESCALATED TO MID CONSTRUCTION October 2011**
HATCHERY SECTIONS			
Residential Buildings (3 Each)	**585,340**	**718,504**	**733,478**
Hatchery/Vehicle Maint. Building	**2,759,108**	**3,386,805**	**3,457,386**
Spawning Building	**986,193**	**1,210,552**	**1,235,780**
Chemical Storage Building	**70,897**	**87,026**	**88,840**
Water Distribution Building	**1,221,617**	**1,499,535**	**1,530,785**
Water Conditioning Building	**238,831**	**293,165**	**299,274**
10 Unit Rearing Raceways Cover	**2,325,877**	**2,855,014**	**2,914,512**
Rearing Raceway 10 unit [2No]	**1,820,000**	**2,234,050**	**2,280,608**
Rearing Raceway 5 unit [1No]	**515,000**	**632,163**	**645,337**
Jumbo Raceway Pair [5Pair]	**1,480,132**	**1,816,862**	**1,854,725**
Adult Holding Facility	**185,714**	**227,964**	**232,715**
Fishway to Adult Holding	**465,421**	**571,304**	**583,210**
Pollution abatement basin [2] 80' x 28'	**369,778**	**453,902**	**463,362**
Covered storage [1] 60' x 24'	**81,080**	**99,526**	**101,600**
Swale Creek Intake	**485,606**	**596,082**	**608,504**
Swale Creek Water Supply	**455,467**	**559,085**	**570,736**
River Water Intake	**550,810**	**676,120**	**690,210**
River Water Supply	**259,295**	**318,284**	**324,917**
Water Distribution System	**418,478**	**513,681**	**524,386**
Water Supply Vaults	**33,771**	**41,454**	**42,318**
Site Drainage System	**343,993**	**422,252**	**431,051**
Site Preparation & Site Demolition	**394,346**	**484,060**	**494,147**
Site Development including roads, etc	**665,252**	**816,596**	**833,614**
Site Electrical	**360,000**	**441,900**	**451,109**
Total Construction Cost	**$17,072,004**	**$20,955,885**	**$21,392,605**
General Contractors Mark-Ups & Contingency			
General Contractors General Conditions		**8.50%**	
General Contractors Profit OH & Fee		**4.25%**	
Sub-Total		**12.75%**	

a. Costs provided by Harbor Consulting Engineers, Seattle, WA. This estimate is based on the Wahkiacus Hatchery Conceptual Design Study (Harbor Consulting Engineers 2010) and should be considered conceptual.

Table 9-3: Capital construction estimated costs by fiscal year

Capital Construction Cost Estimate	Current Design Status	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	TOTAL
Klickitat Hatchery Design, Permitting & Const Mgmt (13.5% of Construction)	30% Conceptual	$560,948	$600,000	$1,182,000	$1,470,000	$374,000		$4,186,948
Klickitat Hatchery Construction & Upgrades			$2,500,000	$10,000,000	$15,000,000	$3,514,945		$31,014,945
Wahkiacus Hatchery Design, Permitting & Const Mgmt (20%)	30 % Conceptual		$1,100,260	$2,503,900	$360,000	$160,000	$154,361	$4,278,521
Wahkiacus Hatchery Construction					$10,000,000	$9,000,000	$2,392,605	$21,392,605
McCreedy Cr. Mobile Acc. Design, Permitting, & Const Mgmt (20%)	Preliminary						$175,000	$175,000
McCreedy Cr. Fabrication and install/construction							$875,000	$875,000
Annual Estimate		*$560,948*	*$4,200,260*	*$13,685,900*	*$26,830,000*	*$13,048,945*	*$3,596,966*	*$61,923,019*

9.4 Ten-Year Cost Estimate for Operations and Maintenance

Operations, maintenance, and monitoring and evaluation estimates are based on FY11 salary, operating, and equipment costs.

9.4.1 Operations and Maintenance

Operation and Maintenance (O&M) cost estimates are presented in Table 9-4. It is assumed that the existing BPA Klickitat O&M project (Number 199910336) will be revised and expanded according to accommodate changes in O &M needs.

Table 9-4: Operation and Maintenance (O&M) Cost Estimates

Operation & Maintenance Costs	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021
Castile Falls Fishway	121,100	124,128	127,231	130,411	133,672	137,014	140,439	143,950	147,549	151,237
Lyle Falls Fishway	242,130	248,183	254,388	260,748	267,266	273,948	280,797	287,816	295,012	302,387
Klickitat Hatchery		94,922	215,551	310,000	504,090	516,692	529,610	542,850	556,421	570,332
Wahkiacus Hatchery				200,559	335,000	343,375	351,959	360,758	369,777	379,022
Klickitat Field Office	37,972	38,921	39,894	40,892	41,914	42,962	44,036	45,137	46,265	47,422
McCreedy Creek Acclimation						78,731	80,699	82,717	84,784	86,904
Annual Total	$401,202	$506,154	$637,064	$942,610	$1,281,942	$1,392,721	$1,427,539	$1,463,228	$1,499,808	$1,537,303

9.5 Ten-Year Cost Estimate for Monitoring and Evaluation

Monitoring and evaluation activities must be instituted early in the proposed hatchery reform project to determine if the new facilities and programs are meeting the project goals and objectives (Chapter 2.0). Most of the activities in the M&E program will be carried out by currently existing staff positions; additional staff and resources will be brought in as needed. Activities with finite timelines may be carried out by contracted staff. In addition, YKFP will work with BPA and regional managers to identify cost savings such as leasing or borrowing equipment. The cost estimates, including identification of specific cost saving strategies, will be presented in the Step 2 document.

9.5.1 On-going M&E Activities

On-going M&E activities include continuing existing efforts to monitor status and trends and to gather information on abundance, distribution, demographics, life history, and habitat of Klickitat spring Chinook salmon, steelhead, and other species of interest. The effectiveness of hatchery and habitat actions are also on-going. Expanded M&E activities are being implemented and are aimed at accurately assessing the hatchery reform measures. Monitoring will involve the following activities:

- Spawning ground surveys (redd counts)
- Adult salmonid monitoring at Lyle Falls Fishway
- Juvenile outmigration monitoring
- Juvenile and resident salmonid population surveys
- Scale analysis
- Sediment monitoring
- Water quality monitoring
- Habitat surveys
- Pathogen sampling
- Genetic data collection, analysis, and synthesis
- Brood stock composition
- Juvenile and adult-to-adult survival
- Spring Chinook and steelhead PIT tagging

Monitoring is currently being carried out under contract. In addition to monitoring activities, the contract scope of work includes project management, administration, coordination, data analysis, participation by the local technical review group, and production of status and final reports.

Table 9-5 presents a summary of the staffing and research materials needed to conduct the expanded M&E program. The expanded M&E costs include increased staffing required to effectively monitor the proposed Castile Falls and Lyle Falls counting and trapping facilities and other specific tasks identified in Chapter 7.0. The new staff members will conduct daily M&E activities such as escapement monitoring, biodata collection, video trap reading, and data entry. As presented in Chapter 7.0, there will be an increased need for PIT, elastomer, and floy tagging; DNA analysis; predation index

studies; and implementation of new studies using radio telemetry on both adults and juveniles.

9.5.2 Summary of Estimated Costs for All Project Areas

Table 9-6 provides a 10-year summary of estimated costs for all project areas. Note that operational costs are from 2012-2017 identify Accord budgets. Operational costs post-2017 reflect an inflation rate of 2.5% per year.

Table 9-5: Summary of expanded M&E cost estimates

Task		FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY2017	FY2018	FY2019	FY2020	FY2021
7.1	Hatchery Operations	$227,026	$232,702	$238,519	$244,482	$250,594	$256,859	$263,281	$269,863	$276,609	$283,524
7.2	Harvest[a]										
7.3	Escapement	$340,538	$349,051	$357,778	$366,722	$375,890	$385,287	$394,920	$404,793	$414,912	$425,285
7.4	Productivity	$340,538	$349,051	$357,778	$366,722	$375,890	$385,287	$394,920	$404,793	$414,912	$425,285
7.5	Predation	$113,513	$116,351	$119,260	$122,241	$125,297	$128,430	$131,640	$134,931	$138,305	$141,762
7.6	Ecological Interactions	$113,513	$116,351	$119,260	$122,241	$125,297	$128,430	$131,640	$134,931	$138,305	$141,762
7.7	Disease[b]	$5,551	$5,690	$5,832	$5,978	$6,127	$6,280	$6,437	$6,598	$6,763	$6,932
7.8	Genetics	$97,138	$99,566	$102,056	$104,607	$107,222	$109,903	$112,650	$115,467	$118,353	$121,312
7.9	Habitat	$152,646	$156,462	$160,374	$164,383	$168,493	$172,705	$177,023	$181,448	$185,984	$190,634
	Total	$1,390,463	$1,425,225	$1,460,855	$1,497,377	$1,534,811	$1,573,181	$1,612,511	$1,652,824	$1,694,144	$1,736,498

Costs should be considered as conceptual
Costs provided by Yakama Nation
[a] Harvest monitoring is covered under contract with the Bureau of Indian Affairs.
[b] A Mitchell Act contract provides additional funding for fish health services with the USFWS.

Table 9-6: Ten-Year summary of future costs

Cost Area	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021
A. Capital Construction, Design and Permitting	$560,948	$4,200,260	$13,685,900	$26,830,000	$13,048,945	$3,596,966				
B. Operations and Maintenance Costs	$401,202	$506,154	$637,064	$942,610	$1,281,942	$1,392,721	$1,427,539	$1,463,228	$1,499,808	$1,537,303
C. Monitoring and Evaluation Costs	$1,390,463	$1,425,225	$1,460,855	$1,497,377	$1,534,811	$1,573,181	$1,612,511	$1,652,824	$1,694,144	$1,736,498
Total Estimated Costs	$2,352,613	$6,131,639	$15,783,819	$29,269,987	$15,865,698	$6,562,868	$3,040,050	$3,116,052	$3,193,952	$3,273,801
Capital Total	$560,948	$4,200,260	$13,685,900	$26,830,000	$13,048,945	$3,596,966	$0	$0	$0	$0
O &M and M&E Total	$1,791,665	$1,931,379	$2,097,919	$2,439,987	$2,816,753	$2,965,902	$3,040,050	$3,116,052	$3,193,952	$3,273,801

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CHAPTER 10.0 REFERENCES

Bonneville Power Administration. 1996. Final Environmental Impact Statement: YKFP Yakima Basin Activities, DOE/EIS-0169; DOE/BP-2784. Portland, OR.

Bosch, B. 2011. Summary of Data Collected by the Yakama Nation relative to Yakima River Spring Chinook Salmon and the Cle Elum Spring Chinook Supplementation and Research Facility. Appendix A in Yakima/Klickitat Fisheries Project Monitoring and Evaluation, Final Report for the Performance Period May 1, 2010 through April 30, 2011. Bonneville Power Administration, Portland, Oregon. Available online at: https://pisces.bpa.gov/release/documents/documentviewer.aspx?doc=P122475

Bryant, F.G. 1949. A survey of the Columbia River and its tributaries with special reference to its fishery resources, 2. Washington streams from the mouth of the Columbia River to and including the Klickitat River (Area I). U.S. Fish and Wildlife Service Special Scientific Report 62.

Buchanan, R.A. and J.R. Skalski. 2007. A migratory life-cycle release-recapture model for salmonid PIT-tag investigations. Journal of Agricultural, Biological, and Environmental Statistics 12: 325-345.

Cederholm, C. J., D. H. Johnson, R. E. Bilby, L.G. Dominguez, A. M. Garrett, W. H. Graeber, E. L. Greda, M. D. Kunze, B.G. Marcot, J. F. Palmisano, R. W. Plotnikoff, W. G. Pearcy, C. A. Simenstad, and P. C. Trotter. 2000. Pacific Salmon and Wildlife - Ecological Contexts, Relationships, and Implications for Management. Special Edition Technical Report, Prepared for D. H. Johnson and T. A. O'Neil (Managing directors), Wildlife-Habitat Relationships in Oregon and Washington. Washington Department of Fish and Wildlife, Olympia, WA.

Chapman, D., and eight co-authors. 1994. Status of summer/fall chinook salmon in the Mid-Columbia Region. Don Chapman Consultants, Boise, ID. 412 pp.

Columbia River Inter-Tribal Fish Commission. 1995. WY-KAN-USH-MI WA-KISH-WIT Spirit of the Salmon. The Columbia River Anadromous Fish Restoration Plan, Vol. I and II. Portland, OR.

_____. 2000. WY-KAN-USH-MI WA-KISH-WIT Spirit of the Salmon. The Columbia River Anadromous Fish Restoration Plan Update, Vol. I and II. Portland, OR.

_____. 2011. Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin. Final Draft Decision Document, December 16, 2011. Portland, OR.

Ham, K.D., and T.N. Pearsons. 2001. A practical approach to containing ecological risks associated with fish stocking programs. Fisheries 26: 15-23.

Hatchery Scientific Review Group. 2005. Hatchery Reform in Washington State: Principles and Emerging Issues. *Fisheries* **30** (6).

Hatchery Scientific Review Group, Washington Department of Fish and Wildlife, and Northwest Indian Fisheries Commission. 2004a. Technical Discussion Paper #1: Integrated Hatchery Programs. June 21 2004.

_____. 2004b. Technical Discussion Paper #2: Segregated Hatchery Programs. June 21 2004.

Hess, J.E., A.P. Matala, J.S. Zendt, C.R. Frederiksen, B. Sharp, and S.R. Narum. 2011. Introgressive hybridization among major Columbia River Chinook salmon (*Oncorhynchus tshawytscha*) lineages within the Klickitat River due to hatchery practices. Canadian Journal of Fisheries and Aquatic Sciences 68: 1876-1891.

Hudson, J.M., J.R. Johnson, and B. Kynard. 2011. A portable electronarcosis system anesthetizing salmonids and other fish. North American Journal of Fisheries Management 31: 335-339.

Independent Economic Analysis Board. 2005. Economic Effects from Columbia River Basin Anadromous Salmonid Fish Production. NPCC document IEAB -2005-1. Portland, OR.

Interior Columbia Basin Technical Review Team (ICTRT). 2007. Viability Criteria for Application to Interior Columbia Basin Salmonid ESUs (Review Draft March 2007). Prepared by the Interior Columbia Basin Technical Recovery Team. Portland, OR, and Seattle, WA.

Joint Natural Resources Cabinet. 2002. Reference Guide to Salmon Recovery, Governor's Salmon Recovery Office. Olympia, WA. http://www.governor.wa.gov/gsro/publications/watershed/reference.pdf (accessed Feb. 21, 2008).

Klickitat County. 2010. Klickitat Lead Entity Region Salmon Recovery Strategy. August 2010. http://klickitatcounty.org/NaturalR/FilesHtml/SalmonHabitatRecovery/LEstrategy2010Final.pdf. Accessed May 4, 2012.

Knudsen, C. M., S. L. Schroder, C. A. Busack, M. V. Johnston, T. N. Pearsons, W. J. Bosch, and D. E. Fast. 2006. Comparison of Life History Traits between First-Generation Hatchery and Wild Upper Yakima River Spring Chinook Salmon. Transactions of the American Fisheries Society 135:1130–1144.

Knudsen, C.M., S.L. Schroder, C. Busack, M.V. Johnston, T.N. Pearsons, and C.R. Strom. 2008. Comparison of Female Reproductive Traits and Progeny of First-Generation Hatchery and Wild Upper Yakima River Spring Chinook Salmon. Transactions of the American Fisheries Society 137:1433-1445.

Kostow, K. 2009. Factors that contribute to the ecological risks of salmon and steelhead hatchery programs and some mitigating strategies. Rev. Fish Biol. Fisheries 19: 9-31.

Marshall, A.R. Unpublished. Genetic analysis of Chinook populations in the Klickitat River. Unpublished draft report to Yakima Klickitat Fisheries Project, WDFW Genetics Unit. Olympia, WA.

McCormick, S. D. 1993. Methods for nonlethal gill biopsy and measurement of Na+,K+-ATPase activity. Can. J. Fish. Aquat. Sci. 50: 656 -658.

Narum S. R., M. Powell, R. Evenson, B. Sharpe and A. Talbot. 2006. Microsatellites Reveal Population Substructure of Klickitat River Native Steelhead and Genetic Divergence from an Introduced Stock. North American Journal of Fisheries Management 26:147-155.

Narum, S.R., J.S. Zendt, C. Frederiksen, and W.R. Sharp. 2007. Substructure of native steelhead in the Klickitat River and genetic identification of spawning populations. In Carline, R.F.; LoSapio, C., eds. 2007. Sustaining wild trout in a changing world; proceedings of Wild Trout IX symposium; 2007 October 9-12; West Yellowstone, Montana. 308 pages. (available at www.wildtroutsymposium.com)

Narum, S.R., J.S. Zendt, D. Graves, and W.R. Sharp. 2008. Influence of landscape on resident and anadromous life history types of *Oncorhynchus mykiss*. Canadian Journal of Fisheries and Aquatic Sciences 65: 1013-1023.

NOAA-Fisheries. 2009. Recovery Plan for the Klickitat River Population of the Middle Columbia River Steelhead Distinct Population Segment. Appendix B in Middle Columbia River Steelhead Distinct Population Segment ESA Recovery Plan. National Marine Fisheries Service, Northwest Region. Portland, OR. See: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Interior-Columbia/Mid-Columbia/Mid-Col-Plan.cfm

_____. 2011a. Proposed ESA Recovery Plan for the White Salmon River Watershed. December 2011. National Marine Fisheries Service, Northwest Region. Portland, Oregon.

_____. 2011b. 5-Year Review: Summary & Evaluation of Lower Columbia River Chinook, Columbia River Chum, Lower Columbia River Coho, and Lower Columbia River Steelhead. National Marine Fisheries Service, Northwest Region. Portland, OR. See: http://www.nwr.noaa.gov/ESA-Salmon-Listings/upload/5-yr-LCR.pdf.

Northwest Power and Conservation Council. 2000. Columbia River Fish and Wildlife Program: A multi-species Approach for Decision Making. NPPC Document 2000-19. Portland, OR.

_____. 2001. Three-Step Review Process as approved by Northwest Power Planning Council on October 18, 2001. NPCC Document 2001-29 (http://www.nwcouncil.org/library/2001/2001=29.pdf). Portland OR.

_____. 2004. Draft Klickitat Anadromous Fishery Master Plan. Prepared by Yakama Nation, Toppenish, WA.

_____. 2006. Columbia River Basin Research Plan. NPCC Doc. 2006-3. Portland, OR.

_____. 2009. Columbia River Basin Fish and Wildlife Program, 2009 Amendments. NPCC Doc. 2009-9. Portland, OR.

Olsen, E.A. 2006. Hood River and Pelton Ladder Evaluation Studies, Annual Report 2004 (October 2003-September 2004). Project No. 1988-053-04, Contract No. 00004001, Prepared for Bonneville Power Administration, Portland, OR.

Oregon Dept. of Fish and Wildlife (ODFW) and Washington Dept. of Fish and Wildlife (WDFW). 2002. Status Report, Columbia River Fish Runs and Fisheries, 1938-2002. Available at: http://wdfw.wa.gov/fish/columbia/2002_status_table.pdf.

Pacific Salmon Commission (PSC). 1994. 1993/94 ninth annual report. Pacific Salmon Commission, Vancouver, British Columbia, Canada.

Pearsons, T.N., and C.W. Hopley. 1999. A practical approach to assessing ecological risks associated with fish stocking programs. Fisheries 24: 16-23.

Regional Assessment of Supplementation Project (RASP). 1992. Final Report - Supplementation in the Columbia River Basin: summary report series. DOE/BP-01830-14, Bonneville Power Administration, Portland, OR.

R.W. Beck and Associates, Bonneville Power Administration, Yakama Nation, and Fish Management Consultants. 1990. Klickitat Salmon and Steelhead Hatchery Preliminary Design Report. BPA, Portland, OR.

Schrock, R. M., J. W. Beeman, D. W. Rondorf, and P. V. Haner. 1994. A microassay for gill sodium, potassium-activated ATPase in juvenile Pacific salmon. Transactions of the American Fisheries Society 123:223-229.

Technical Advisory Committee (TAC). 1997. Columbia River Fish Management Plan, All Species Review 1996. Parties to *U.S. v Oregon*, Technical Advisory Committee. Inter-Tribal Fish Commission. Portland, OR.

Thrower, F. P., J. J. Hard, and J. E. Joyce. 2004. Genetic architecture of grown and early life history transitions in anadromous and freshwater-derived populations of steelhead. Journal of Fish Biology **65**:286-307.

U.S. Fish and Wildlife Service (USFWS). 2002. Chapter 20, Lower Columbia Recovery Unit, Washington. In: U.S. Fish and Wildlife Service. Bull Trout (*Salvelinus confluentus*) Draft Recovery Plan. Portland, OR.

U.S. v Oregon Parties. 2008. 2008-2017 *United States v. Oregon* Management Agreement, May 2008. Available at:

http://www.fws.gov/Pacific/fisheries/hatcheryreview/Reports/snakeriver/SR--079.2008-2017.USvOR.Management.Agreement_042908.pdf

Washington Department of Fish and Wildlife. 2005. Salmonid Stock Inventory: Mid-Columbia Klickitat Spring Chinook. Olympia, WA. See: http://wdfw.wa.gov/webmaps/salmonscape/sasi/full_stock_rpts/1672.pdf

Washington Department of Fish and Wildlife and Oregon Department of Fish and Wildlife. 2007. Stock status and fisheries for spring Chinook, summer Chinook, sockeye, steelhead, and other species and miscellaneous regulations. Joint Columbia River Management staff, Portland, OR.

Williamson, K.S., A.R. Murdoch, T.N. Pearsons, E.J. Ward, and M.J. Ford. 2010. Factors influencing the relative fitness of hatchery and wild spring Chinook salmon (*Oncorhynchus tshawytscha*) in the Wenatchee River, Washington, USA. Canadian Journal of Fisheries and Aquatic Sciences 67: 1840-1851.

Yakama Nation, Klickitat County, and Washington Department of Fish and Wildlife. 2004. Klickitat Subbasin Plan. Prepared for the Northwest Power and Conservation Council. Portland, OR.

Zendt, J., N. Romero, S. Keep, and M. Babcock. 2010. Yakima/Klickitat Fisheries Project – Klickitat Monitoring and Evaluation, 2009 Annual Report. Project No. 199506335, Contract No. 42481. Document ID P119626. Prepared for Bonneville Power Administration (available at https://pisces.bpa.gov/release/documents/documentviewer.aspx?doc=P119626)