Cowlitz River Fisheries and Hatchery Management Plan (FHMP)

Final

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Prepared by Tacoma Power

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Acronyms and Abbreviations.

AEQ	Adult Equivalent Harvest
AHP	Adult handling protocol
AMP	Adaptive management plan
APRE	Artificial production evaluation and review process
BiOp	Biological Opinion
BRAP	Benefit-Risk Assessment Procedure
CTC	Chinook Technical Committee
DIP	Demographically independent populations
EDT	Ecosystem Diagnosis and Treatment model
ESA	Endangered Species Act
ESU	Evolutionarily significant units
FCE	Fish collection efficiency
FERC	Federal Energy Regulatory Commission
FGE	Fish guidance efficiency
FHMP	Fisheries and Hatchery Management Plan
fpp	fish per pound
FPS	Fish passage survival
FR	Federal Register
FTC	Fisheries Technical Committee
HAG	Habitat Advisory Group
HOR	Hatchery origin fish
HR	Total adult equivalent mortality exploitation rate
HSRG	Hatchery Science Review Group
IHN	Infectious hemotopoietic necrosis
MDN	Marine derived nutrients
NFMS	National Marine Fisheries Service, now NOAA-Fisheries
NOR	Natural origin fish
PCC	Population change criteria
PFC	Properly functioning conditions
PFMC	Pacific Fisheries Management Council
PST	Pacific Salmon Treaty
RER	Rebuilding exploitation rate
R/S	Recruits per spawner
SAR	Smolt-to-adult survival
SaSI	Salmon stock inventory
S/S	Smolts-per-spawner
SSHIAP	Salmon and Steelhead Habitat Inventory and Assessment Program
USFWS	U.S. Fish and Wildlife Service
VSP	Viable salmon population
WDFW	Washington Department of Fish and Wildlife
WLCTRT	Willamette/Lower Columbia Technical Recovery Team
YOY	Young-of-the-year

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Executive Summary

This report describes the Fisheries and Hatchery Management Plan (FHMP) submitted by Tacoma Power for the Cowlitz River Hydroelectric Project (FERC No. 2016). The FHMP is required under Section 8 of the Cowlitz River Hydroelectric Project Settlement Agreement (Settlement) dated August 10, 2000, and Appendix A, Article 6 of the license for the Cowlitz River Project 2016, effective July 18, 2003. Article 6 requires the FHMP to identify:

- "the quantity and size of the fish to be produced at the Cowlitz Hatchery Complex;
- rearing and release strategies for each stock, including upward and downward production adjustments to accommodate recovery of indigenous stocks;
- credit mechanisms for production of high quality natural stocks;
- plans for Licensee-funded on-going monitoring and evaluation; and
- a fisheries management strategy consistent with the priority objective of maximizing the natural production of wild indigenous fish stocks and species in the basin."

The FHMP was developed using the concepts and modeling tools inherent in the Ecosystem Diagnosis and Treatment (EDT) methodology and the hatchery production guidelines developed through the Northwest Power Planning Council's Artificial Production Review and Evaluation (APRE) process. The APRE process was initiated in response to a Congressional directive to the Northwest Power Planning Council. Building upon the principles and criteria provided by the Hatchery Science Review Group in the *Scientific Framework for Artificial Propagation of Salmon and Steelhead* (HSRG 2000), the APRE identifies hatchery operating procedures that maximize the benefits of artificial production programs while minimizing the risks to natural populations.

The major strategies proposed in the FHMP are as follows:

Reintroduction and Recovery

The primary objective of the Settlement is ecosystem integrity and the restoration and recovery of wild, indigenous salmonid runs, including ESA-listed and unlisted stocks, to harvestable levels. This objective will be achieved through the reintroduction of Chinook, coho, and steelhead into the upper Cowlitz River and Tilton River basins. Effective downstream fish passage/collection facilities will improved at key locations in the Cowlitz River Basin to increase fish survival through the Project area.

Adult Supplementation

The adult supplementation strategy was deemed the best suited for achieving identified fisheries goals. This decision was based on the following rationale:

1) Natural production is defined as adults successfully spawning in the wild. Therefore, supplementing hatchery adults rather than juveniles in these streams is the quickest way to achieve the primary goal of increasing natural production in the basin.

2) Outplanting hatchery adults rather than juveniles ensures that the entire life-cycle of the fish is completed naturally rather than a portion occurring artificially in the hatchery environment. Consequently, resulting juvenile production is free of hatchery influences.

3) Under the adult supplementation strategy, fish managers will be able to measure spawning success within a single generation. In contrast, in a juvenile supplementation program, the spawning success of returning adults will not be known until one generation later, and only then if fish managers either discontinue stocking hatchery juveniles into the watershed or spend considerable resources to mark all hatchery releases.

4) Using adults to seed the watersheds eliminates many of the management complexities associated with a juvenile supplementation program. These complexities include determining the correct juvenile release size, release timing, number of juveniles to be released and how to distribute the juveniles throughout the watershed.

If this strategy proves ineffective, a second approach using smolts acclimated in facilities located in the Upper Cowlitz and Tilton rivers may be tested in the future.

Productivity Testing and Fish Passage

The Settlement calls for the establishment of volitional passage for upstream migrating adults if certain population characteristics are met. The FHMP describes which Cowlitz Hatchery stocks will be used to test whether or not the productivity criteria can be achieved, the basins where the tests will be implemented, and the time frames for completion. Because the Settlement Agreement calls for an initial decision to be made about fish passage by year 12 of the agreement, year seven of the FHMP will be the last year when an upstream population will be supported by artificial production. The test of self-sustainability must begin by that date unless there are compelling reasons associated with fish passage survival, watershed productivity, marine survival, or other variables that preclude any possibility of success in the test. Such a change will be documented in succeeding iterations of this Plan.

Credit Mechanism For Natural Production

As called for in the Settlement Agreement, a credit mechanism has been developed that reduces hatchery production as natural production increases. The credit mechanism is based on the number of juveniles (by species) collected at Mayfield and Cowlitz Falls

dams and their survival rate to adulthood. Until data on Cowlitz River survival rates are available, for each naturally produced juvenile released alive below the Barrier Dam, hatchery production decreases by two fish. The number was arrived at from survival rates determined for other Pacific Northwest rivers, the average ranged from 4.5 to 22.8. The credit will be based on a 5-year rolling average.

Fish Marking

All hatchery fish will be mass-marked to provide fishing opportunities while limiting exploitation rates on natural stocks.

Artificial Production Management

Hatchery programs for native fish species will be operated based on HSRG protocols for Integrated Type programs; however, an Integrated program cannot be established until the reintroduction efforts prove successful. Non-native fish hatchery programs will follow the Segregated Type strategy. Native fish reared at the Cowlitz Hatchery Complex will be reared to produce high quality smolts. A quality hatchery smolt is defined as a fish that is similar in health status, physiology, morphology, and behavior to a naturally produced smolt originating upstream of Mayfield Dam. Non-native fish species will be reared to produce a smolt that maximizes adult production to the extent possible. These measures will reduce competition and predation risks to naturally produced stocks.

Hatchery Facilities

Hatchery rearing conditions will be improved through hatchery modifications being developed through the Hatchery Remodel and Phase-In Plan that increase overall water quality and reduce rearing density to optimize survival. Hatchery programming will be based on providing optimum rearing conditions for stocks regardless of current or historical rearing and release site. Use of temperature control during incubation and early rearing, species and site-specific loading and density guidelines, mating protocols that maximize genetic variability, enriched rearing environments, and modification of hatchery structures to allow volitional migration will enable hatchery populations to develop the physiological, morphological, and behavioral traits important to long-term fitness.

Innovative Rearing Techniques

The Settlement calls for hatchery managers to develop and test innovative rearing practices. To meet this requirement, hatchery operations will be implemented to incorporate aspects of semi-natural rearing, including constructing ponds to enhance protective coloration and adding overhead and in-water cover on an experimental basis[1]. The focus of this program will be to produce smolts that are similar in size, coloration, run-timing and behavior to natural smolts.

[1] The Yakama Nation Cle Elum Hatchery facility could be used as a template for this effort.

Hatchery Production

The level of hatchery production proposed in the FHMP (7.7 million juveniles) is designed to meet the adult benchmark targets outlined in the Settlement Agreement. These benchmarks are not meant to be mitigation goals, but rather as indicators of hatchery performance.

Nutrient Enhancement

If the Washington Department of Fish and Wildlife chooses to use surplus hatchery adults to enhance the nutrients above Mayfield Dam and if allowed in the approved Disease Management Plan, a productivity enhancement experiment will be undertaken to distribute carcasses from the Cowlitz Salmon Hatchery to the Tilton and upper Cowlitz River basins as appropriate to help restore and maintain ecosystem function. This will also likely contribute to increased habitat productivity.

Early Winter and Summer Steelhead Hatchery Production

Although the continuation of the non-native steelhead programs pose risk to the recovery of native fish species, the Fisheries Technical Committee (FTC) agreed that the harvest benefits from these programs are too great to ignore. Both steelhead programs provide popular and successful sport fisheries in the Cowlitz River that help support local communities. As data are not available to fully determine the risks these programs pose to native fish stocks, a genetics study will be undertaken in the lower Cowlitz River to better define impacts. The results of this study will be used to make changes to the programs that are consistent with wild fish recovery.

Adaptive Management and Monitoring

Sections 6 and 7 of the report describe the adaptive management framework and the monitoring program that will be used to change the strategies described above. The adaptive management plan will be overseen by the FTC and implemented by Tacoma Power. The plan calls for the testing of 13 separate hypotheses, each designed to address specific research or management uncertainties identified by the FTC.

1.0 Introduction

This report describes the Fisheries and Hatchery Management Plan (FHMP) proposed by Tacoma Power for the Cowlitz River Hydroelectric Project (FERC No. 2016). The Final Draft of the FHMP follows the issuance of a Public Review Draft (January 6, 2004), and a Cowlitz Fisheries Technical Team (FTC) Review Draft (November 4, 2003). Comments received on these review drafts are included in Appendix 7 and Appendix 8, along with Tacoma Power's responses.

The FHMP is required under Section 8 of the Cowlitz River Hydroelectric Project Settlement Agreement (Settlement) dated August 10, 2000, and Appendix A, Article 6 of the license for the Cowlitz River Project 2016, effective July 18, 2003. Article 6 of the Settlement requires the FHMP to identify:

a) "the quantity and size of the fish to be produced at the Cowlitz Hatchery Complex;

b) rearing and release strategies for each stock, including upward and downward production adjustments to accommodate recovery of indigenous stocks;

c) credit mechanisms for production of high quality natural stocks;

d) plans for Licensee-funded on-going monitoring and evaluation; and

e) a fisheries management strategy consistent with the priority objective of maximizing the natural production of wild indigenous fish stocks and species in the basin."

The Settlement Agreement calls for the FHMP to be updated every six years.

The FHMP consists of the Introduction and six additional sections. The title and a brief description of the contents of each section are provided below.

- Section 1. Introduction
- Section 2. Settlement Principles and License Articles describes fishery and hatchery production guidelines identified by the parties to the Settlement.
- Section 3. Framework and Analytical Tools provides a summary of the adaptive management framework and analytical tools used to develop the FHMP.
- Section 4. Assessment describes the status of populations, and habitat and harvest conditions.
- Section 5. Objectives and Strategies provides a look at strategies used to manage populations and to achieve the goals of the Settlement and license requirements.

- Section 6. Adaptive Management Plan identifies monitoring and research that will be conducted to address critical uncertainties and plan implementation; it also describes actions that will be taken at key decision points.

- Section 7. Monitoring and Evaluation describes the major hypotheses to be tested and the protocols to be followed.

As will be detailed in Section 2, the primary goal of the restoration programs for the Cowlitz River watershed upstream of the Barrier Dam is to restore natural spawning populations of salmon and steelhead. Achievement of this goal will depend on balancing stock restoration needs and harvest, improving fish collection and passage, restoring ecological function in the watershed and managing other factors that are currently unknown. The species specific management plans detailed in Section 5 are flexible enough to adapt to new information, aggressive enough to achieve success, and include sufficient monitoring to guide this and future projects of this type.

The FHMP was built using the concepts and modeling tools inherent in the Ecosystem Diagnosis and Treatment (EDT) methodology and the hatchery production guidelines developed through the Northwest Power Planning Council Artificial Production Review and Evaluation (APRE) process. The APRE process was initiated in response to a Congressional directive to the Northwest Power Planning Council. Building upon the principles and criteria provided by the Hatchery Science Review Group (HSRG) in the *Scientific Framework for Artificial Propagation of Salmon and Steelhead* (HSRG 2002), the APRE identifies hatchery operating procedures that maximize the benefits of artificial production programs while minimizing the risks to natural populations.

In short, the FHMP used the EDT modeling tools to estimate the potential of existing habitat to support natural production in stream reaches upstream and downstream of Mayfield Dam and the impacts of actions on natural production. In contrast, the HSRG guidelines and hatchery evaluation tools provided the scientific foundation for hatchery operations and fish rearing strategies.

The Settlement calls for the establishment of volitional passage for upstream migrating adults if certain population characteristics are met (see Section 2). The FHMP describes which Cowlitz Hatchery stocks will be used to test whether or not the productivity criteria can be achieved, the basins where the tests will be implemented, and the time frames for completion. Because the Settlement Agreement calls for an initial decision to be made on passage by year 12 of the agreement, year seven of the FHMP will be the last year when an upstream population will be supported by artificial production. The test of self-sustainability must begin by that date unless there are compelling reasons associated with fish passage survival (FPS), watershed productivity, marine survival, or other variables that preclude any possibility of success in the test. Such a change will be documented in succeeding iterations of this Plan.

Finally, recommendations for harvest actions are concentrated within the Cowlitz River, including the upper watersheds. Tacoma Power fully acknowledges the Washington Department of Fish and Wildlife (WDFW), as representatives of the state of Washington,

are the owners of the fish resources in the Cowlitz River. Nothing in the FHMP is meant or intended to usurp or preclude the WDFW from their mandated resource management responsibilities and roles in the Cowlitz River basin.

It is recognized that international treaties and other agreements that are outside the control of the FHMP control harvest rates outside of the basin. As can be seen in Section 4, these fisheries take a considerable percentage of Cowlitz River-origin fish. Fisheries within the lower Cowlitz will be managed to maintain the escapement objectives where productivity is being tested in the Tilton and upper Cowlitz rivers. Selective fisheries requiring the release of naturally produced fish will be the "base rule" in the watershed. Fisheries in the upper watersheds will be directed at hatchery fish until productivity tests required to determine the need for upstream fish passage facilities are implemented, or until such time as the naturally produced stock can sustain consumptive harvest. Additional ESA consultations will be required if fisheries targeting naturally produced fish are proposed.

2.0 Settlement Principles and License Articles

The Settlement and License articles provide significant guidance for the underlying goals and structure of the FHMP. A summary of key references from these documents is provided below to provide context for the remainder of the FHMP.

2.1 Settlement Principles

Section 6 of the Settlement Agreement provides general principles intended to guide implementation of the Settlement terms. The general principles relevant to the FHMP are provided below.

"6.1.1. The emphasis of this Agreement is ecosystem integrity and the restoration and recovery of wild, indigenous salmonid runs, including ESA-listed and unlisted stocks, to harvestable levels."

"6.1.2. Fisheries obligations will be met through a combination of effective upstream and downstream passage, habitat restoration and improvement, an adaptive management program to restore natural production, coupled with continued artificial production to compensate for unavoidable impacts at levels consistent with ESA recovery, and providing fish production for sustainable fisheries."

"6.1.4. ESA constraints will be a factor in determining the upper bound of production at the remodeled hatchery complex. Hatchery production numbers are expected to be adjusted downward as wild stocks recover."

"6.1.5. Fisheries management and hatchery production will be consistent with the overall goal of restoring and recovering wild stocks in the Cowlitz River Basin. The hatchery complex will be designed with flexibility so managers can employ innovative rearing practices, low densities and replication of historic fish out-migration size and timing." {Section 6.1.5. also includes guidance on the monitoring and contracting of hatchery operations.}

"6.1.6. Maintenance of a recreational fishery is important. Implementation of wild salmonid recovery measures shall allow for the continued support of a recreational fishery on the Cowlitz River, including the production of non-indigenous stocks, provided this is consistent with the priority objective to maximize the recovery of wild, indigenous salmonid stocks."

"6.1.7. If hatchery production is decreased in conjunction with wild stock recovery, there will be excess capacity over time at the hatchery. Uses for this excess capacity will be, in order of priority: 1) to reduce rearing densities of listed indigenous stocks which have not yet recovered; 2) to reduce rearing densities of indigenous stocks which have not yet recovered; 3) to provide space for increasing the production of listed indigenous stocks which have not yet recovered; 4) to provide space for increasing the production of indigenous stocks which have not yet recovered; and 5) to produce fish unrelated to

Tacoma's protection, mitigation and enhancement responsibilities for the Project, pursuant to future agreements."

2.2 FERC License Articles

License articles of relevance to the FHMP are summarized below. This summary does not alter the Settlement or license agreements, but is provided to facilitate understanding of subsequent sections of the FHMP. Refer to the FERC license order for the complete text of the articles.

- Article 1. Downstream Fish Passage: Riffe Lake and Cowlitz Falls. This article requires the development of an implementation plan describing the proposed facilities and measures most likely to achieve a 95 percent Fish Passage Survival (FPS)[2]. Survival is measured as fish successfully released from the stress relief ponds at the Cowlitz Salmon Hatchery. Subsequently, Tacoma Power is required to implement, or support implementation of, additional downstream passage and facility improvements and file reports at 18-month intervals until the Fisheries Technical Committee (FTC) has determined that downstream passage survival has been maximized by all reasonable measures and/or that the implementation of these measures has achieved the 75 percent FPS target for all species.

- Article 2. Downstream Fish Passage: Mayfield. This article requires that Tacoma Power implement additional downstream passage facility modifications or measures and file reports until either: 1) a 95 percent downstream fish passage survival is achieved; or 2) the National Marine Fisheries Service and U.S. Fish and Wildlife Service, in consultation with the FTC or agencies, determine that passage effectiveness and survival are high enough to support self-sustaining populations of anadromous fish stocks; that protection of anadromous fish migrating downstream at Mayfield Dam has been maximized by all reasonable measures and that adjustments to hatchery production (using then existing facilities) and/or habitat measures will be required in lieu of further attempts to improve downstream passage at Mayfield Dam.

- Article 3. Upstream Fish Passage: Barrier, Mayfield and Mossyrock. This article defines procedures for determining if the criteria for implementing effective upstream passage through volitional facilities have been achieved. The test for upstream volitional facilities contains three components:

[2] Fish Passage Survival (FPS), as used in the Cowlitz Settlement Agreement (SA) and FERC license and applied to Cowlitz Falls Dam, Riffe Lake, and Mossyrock Dam, means the percentage of smolts entering the upstream end of Lake Scanewa, adjusted for natural mortality, that are collected at Cowlitz Falls Dam, Riffe Lake, and Mossyrock Dam, transported downstream to the stress relief ponds, and subsequently leave the stress relief ponds at Barrier Dam as healthy migrants.

1) Adult fish in Mayfield Lake are able to choose their tributary of origin (Tilton or Upper Cowlitz) and survive Mayfield Lake transit at rates sufficient to achieve effective upstream passage as determined by the National Marine Fisheries Service (NMFS).

2) Spring Chinook and late winter steelhead in the Upper Cowlitz River Basin, and all anadromous salmonids in the Tilton River basin, are identified as candidate stocks to be used in the short-term (up to 15 years) to determine if self-sustaining, naturally recruiting, populations can be established in these basins. Populations would be considered self-sustaining if the number of pre-spawners arriving at the Barrier Dam in at least 3 of 5 consecutive brood years, and based on the 5-year rolling average, exceeds a pre-identified abundance level, **and** if the adult recruits/pre-spawner ratio (R/S), as measured at Barrier Dam or other Cowlitz River fish counting facilities, was greater than 1.0 in 3 of 5 years, and for the 5-year rolling average.

3) A disease management plan has been implemented that defines an acceptable level of risk from *Ceratomyxa shasta* and other diseases, and allows adult fish to be upstream of the Barrier Dam.

- Article 5. Fish Production and Hatcheries. Total hatchery production for all stocks reared at the Cowlitz Hatchery Complex, within the remodeled hatchery, cannot exceed 650,000 pounds unless a decision is made to abandon the construction of volitional upstream passage during the remainder of the license. The 650,000-pound limit does not include upper basin pre-smolts that may be reared and ponded in the hatchery complex to avoid conflicts with listed species.

- Article 6. Fisheries and Hatchery Management Plan. This article requires that Tacoma Power prepares, in collaboration with the FTC, a plan that identifies: 1) the quantity and size of fish to be produced at the Cowlitz Hatchery Complex; 2) rearing and release strategies for each stock, including upward and downward production adjustments to accommodate recovery of indigenous stocks; 3) credit mechanisms for production of high quality natural stocks; 4) plans for Licensee-funded on-going monitoring and evaluation; and 5) a fisheries management strategy consistent with the priority objective of maximizing the natural production of wild indigenous fish stocks and species in the basin.

3.0 Framework and Analytical Tools

The proposed framework for the FHMP recognizes that substantial uncertainty exists in our understanding of factors influencing the potential success of the Cowlitz River reintroduction efforts. Given this uncertainty, the framework was developed to rely upon the principles of adaptive management. Adaptive management is defined as "an adaptive policy that is designed from the outset to test clearly formulated hypotheses about the behavior of the ecosystem being changed by human use" (Lee 1993). Generally, these hypotheses are "predictions about how one or more important species will respond to management actions" (Lee 1993). Because adaptive management is a process that is based on learning by doing, it allows resource managers to take action in the face of scientific uncertainty. Monitoring and decision points for the Adaptive Management Plan (AMP) are discussed in detail in Section 6.

The adaptive management component is driven initially by hypotheses regarding the factors that will ultimately determine the effectiveness of the FHMP in achieving the goals of the Settlement and the License. These hypotheses were developed by compiling relevant data, reviewing guidelines for artificial production programs, developing analytical models, and applying these tools to the Cowlitz River. The following sections summarize the tools used to develop the FHMP with additional information provided in the appendices to this report.

3.1 Population Assessment

The Ecosystem Diagnosis and Treatment Model (EDT) (Mobrand et al. 1997) was the primary tool used for developing, evaluating, and integrating habitat, hatchery, and harvest actions for the Cowlitz River. However, the final decision regarding harvest policy proposed in the FHMP was developed in consultation with the WDFW.

EDT provides a systematic method for developing hypotheses about the effects of each of these factors on the productivity, potential abundance (or capacity), and diversity of a population. The model has been broadly applied throughout the Pacific Northwest by a variety of agencies and planning organizations.

Application of EDT consists of two fundamental steps: 1) characterization of the environment encountered by an individual of the population throughout its entire life-cycle; and 2) an evaluation of the effect of the environment on the performance of the population. The initial step requires assessing 46 environmental characteristics using a protocol that defines each characteristic and provides specific rating criteria (Mobrand Biometrics 2004). In the second step, a documented set of relationships (or rules) is used to develop hypotheses about how the environment will affect the population. For example, survival rates during egg incubation are likely to be affected by several characteristics of the environment, including the percentage of fine sediments present within spawning substrates. The hypothesized relationship provides a means to link environmental characteristics, like fine sediments, to life-stage specific survival rates.

Mathematical models can be categorized in many ways: they may have a mechanistic or correlative structure, utilize deterministic or stochastic algorithms, and provide equilibrium or time variant predictions. EDT is an example of a mechanistic, deterministic, equilibrium model that can be used to construct hypotheses about the interaction of the environment and a fish population under steady-state conditions. With this structure, the types of questions that it can be addressed most effectively include:

- What is the intrinsic productivity and capacity of each population with either a current or alternative set of conditions for aquatic habitat?

- What are the primary factors limiting the performance of each population?

3.2 Smolts Required to Estimate Fish Collection Efficiency

The testing of juvenile fish collection efficiency (FCE) and fish passage survival (FPS) through Project facilities will require that juvenile fish be released at multiple locations above Cowlitz Falls Dam and Mayfield Dam. The juveniles required for this testing program will come from two sources: 1) naturally produced juveniles migrating past the facilities, and 2) hatchery fish from the Cowlitz Hatchery Complex. Because the number of fish needed for this testing program is estimated at less than 5,000 per species, it is envisioned that proposed hatchery production is sufficient to meet testing needs.

Natural fish needed for testing purposes would come from the Cowlitz Falls and Mayfield Dam juvenile collection systems. To reduce impacts to naturally produced populations, testing needed for the FHMP would be coordinated with juvenile evaluations being conducted at Cowlitz Falls Dam.

3.3 Hatchery Assessment

Hatchery operations identified in the FHMP were developed through the application of the Benefit-Risk Assessment Procedure (WDFW 2000) and the hatchery production guidelines developed through the Artificial Production Review and Evaluation (Mobrand Biometrics 2003). Together, these tools facilitate the development of artificial production programs with defined goals consistent with the ecological context of the watershed, state-of-the-art operational procedures, and a comprehensive monitoring program.

The Benefit-Risk Assessment Procedure (BRAP) provides a consistent method for evaluating the artificial production programs. The procedure includes:

- a scientific assessment of the potential risks posed by an artificial production program (developed with the western Washington tribes and NOAA-Fisheries);

- a framework for balancing the potential risks and benefits of the program in the ecological context of the watershed; and

- a planning tool to describe alternative future scenarios and the management actions required to reach each scenario.

The Artificial Production Review and Evaluation (APRE) process was initiated in response to a Congressional directive to the Northwest Power Planning Council. Building upon the principles and criteria provided by the Hatchery Science Review Group (HSRG) in the *Scientific Framework for Artificial Propagation of Salmon and Steelhead* (HSRG 2002), the APRE identifies hatchery operating procedures that maximize the benefits of artificial production programs while minimizing the risks to natural populations.

The hatchery criteria developed by the HSRG vary dependent on whether the hatchery is run as an Integrated or Segregated type program. The HSRG definition of both types is as follows:

- Segregated: A hatchery program is a Segregated Type if the intent is for the hatchery population to represent a distinct population that is reproductively isolated from naturally spawning populations. The principal intent of a segregated program is to create a hatchery adapted population to meet goals such as harvest. Hatchery broodstock (and programs) are considered genetically segregated if the broodstock is maintained only with hatchery origin fish. As a consequence, gene flow from the natural population to the hatchery (broodstock) is prevented in a segregated program. Also, hatchery origin adults are prevented from spawning in the wild to prevent gene flow from the less well-adapted hatchery population to the native population. The segregated approach has been the standard practice at the Cowlitz Salmon Hatchery since its inception.

- Integrated: 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 spawns both in a hatchery and in the wild. In an Integrated Type program, the proportion of natural-origin broodstock in the hatchery and the proportion of hatchery-origin fish in the natural spawning escapement determine the influence of the hatchery and natural environments on the adaptation of the composite population. The larger the ratio of natural/wild fish to hatchery fish in either environment the greater the influence wild fish genetics and adaptation will have on population genetics. In order for the natural environment (wild fish) to dominate selection, this ratio (wild to hatchery) must exceed 50 percent. Furthermore, the greater the difference between the hatchery and natural stock components (e.g., in run timing) and the “less natural” the hatchery environment (e.g., longer hatchery rearing, larger fish, standard rearing practices), the larger the ratio must be to reduce the effects of hatchery selection.

The FHMP proposes to operate all hatchery programs rearing salmonids native to the Cowlitz River as Integrated, and all non-native species as Segregated. However, before it is possible to implement an Integrated Type program, wild fish populations will have to

be re-established in the basin. This objective will be achieved by releasing adult hatchery fish into the upper basin as part of an adult supplementation program.

Because "true" wild populations are not present above Mayfield Dam, a balance must be struck between the number of hatchery adults released each year to jump-start reintroduction and the effects continued hatchery releases will have on the fitness of the resulting natural population. As natural production increases, it is assumed that their fitness to reproduce in the natural environment also improves. According to the HSRG, the more divergent the two populations become in regard to fitness, the fewer hatchery fish you would want spawning in the wild because they reduce the fitness of the natural population. In the FHMP, the release of hatchery origin adults (HOR) is reduced or eliminated once certain fish passage or juvenile productivity triggers are achieved.

In addition to the tools listed above, the reasonable and prudent measures, as well as some of the terms and conditions presented in the 1999 Artificial Propagation BiOP (NMFS 1999) were also used to guide hatchery program development. Those that affect fish hatchery management in the Cowlitz River are listed below.

1) The action agencies should minimize inter-basin stock transfers in any waters that support listed fish.

2) The action agencies should operate artificial propagation programs for fishery augmentation/mitigation in the Columbia River Basin in a manner that emphasizes the production and release of juveniles that are ready to migrate to the ocean and spend a minimum amount of time in the fresh water environment. This should minimize the interactions with, and thus impacts to listed salmon and steelhead, and unlisted natural fish in the migration corridor.

3) The action agencies should adopt measures to improve homing and reduce straying of all hatchery fish releases.

4) Action agencies should evaluate the use of NATURES type rearing designs and strategies, to increase survival and minimize impacts to listed salmon and steelhead.

5) The use of acclimation ponds and volitional release strategies should be considered to reduce potential straying and minimize potential competition between hatchery fish and listed salmon and steelhead.

6) All action agencies should consider monitoring and evaluating ecological interactions between listed salmon and steelhead and hatchery releases in nursery and rearing areas. Evaluating the affects of hatchery fish is prudent because density-dependent effects may occur even when the streams' estimated carrying capacity is not limited.

7) The action agencies should support studies designed to assess carrying capacity and density-dependent effects on listed salmon and steelhead in the migration corridor.

8) The action agencies should consider monitoring and evaluating predation by residualized hatchery steelhead in the Columbia River Basin. Alternative methods/schemes to reduce steelhead residualism should be explored to minimize impacts to listed salmon and steelhead.

9) Spawning ground carcass surveys should be conducted to determine the composition of listed and hatchery fish on the spawning grounds of listed salmon and steelhead.

10) Action agencies should consider using excess hatchery adult returns for instream carcass distribution to increase nutrients, where necessary in the freshwater environment.

11) The action agencies should implement a program to develop a cost-effective externally distinguishable mark(s), which can be applied to all hatchery fish released into the Columbia River Basin. This would allow the discrimination between hatchery fish and those of wild/natural origin, including listed salmon and steelhead. This should assist the action agencies in minimizing adverse effects and assist NMFS in evaluating the effects of hatchery programs on listed salmon and steelhead and unlisted natural fish.

12) When hatchery programs are located in an area where wild fish are listed, the hatchery program should be modified to adopt a conservation role along with an enhancement role.

13) Action agencies should adopt management strategies to separate returning hatchery fish from listed naturally spawning fish including, but not limited to, releasing hatchery fish outside primary spawning and rearing areas and dead-ending returns at weirs.

14) The WDFW should evaluate the potential for adverse effects on naturally-produced winter steelhead, by hatchery summer steelhead spawning areas occupied by naturally-produced winter steelhead in the Cowlitz River Basin. Decreased production of naturally-produced winter steelhead has been reported in rivers where summer steelhead are introduced.

15) The WDFW should evaluate the potential for incorporating naturally-produced summer steelhead into the broodstock at the Cowlitz Trout and Merwin hatcheries. Presently, total temporal separation of hatchery and naturally-produced steelhead is not possible and interbreeding does occur.

16) All action agencies shall manage their programs to minimize the potential interbreeding of hatchery fish and listed salmon and steelhead in the Columbia River Basin.

17) The action agencies shall monitor and evaluate their respective artificial propagation programs in the Columbia River Basin.

18) All action agencies shall reduce potential negative impacts to listed salmon and steelhead in the Columbia River Basin from operation of their respective artificial facilities.

19) All action agencies shall terminate resident trout stocking into listed Chinook salmon, listed sockeye salmon and listed steelhead primary spawning and nursery areas.

20) The action agencies shall discontinue rainbow trout stocking into primary nursery areas of listed salmon and steelhead, unless the action agency can demonstrate that stocking resident trout will not jeopardize the survival or recovery of listed salmon or steelhead. As a condition of stocking resident trout, the action agency shall implement a monitoring and evaluation program to evaluate potential impacts.

21) Protocols shall be developed for fishery augmentation/mitigation programs to return adult hatchery fish to areas where they can be captured and removed to reduce interbreeding and potential genetic introgression with listed salmon and steelhead.

22) The WDFW shall conduct the proposed actions in such a way as to minimize adverse genetic and demographic effects on naturally-producing listed steelhead.

23) The WDFW shall conduct monitoring and evaluation activities for salmon and steelhead releases into the Cowlitz and Lewis river basins that include potential ecological interactions with listed Lower Columbia River steelhead.

24) The WDFW shall conduct an evaluation of the hatchery fish weirs and traps to determine incidental take associated with the removal of hatchery adults.

25) The WDFW shall acclimate and release hatchery steelhead smolts in lower river reaches where possible, where few wild fish spawn and to which returning hatchery adults would be expected to home and have a tendency to hold prior to migrating upstream for spawning.

26) The WDFW shall minimize the number of hatchery adults remaining to potentially spawn with wild fish through removal of hatchery fish at sufficiently high harvest and/or trapping rates.

27) The WDFW shall mark all hatchery steelhead and cutthroat trout populations released into anadromous waters to allow for monitoring of hatchery fish migration, fisheries contribution, and survival, and to allow for ready differentiation between hatchery and wild fish.

28) The WDFW shall comply with all WDFW fish transfer standards to minimize potential negative genetic and fish disease effects on wild fish.

29) The WDFW shall evaluate the use of direct releases of hatchery steelhead from acclimation sites located in small tributaries and from major hatcheries with off-channel fishways to draw returning adults away from natural steelhead production areas in mainstem rivers.

30) The WDFW shall continue to monitor, research and report hatchery smolt migration performance, behavior and intra and interspecific interactions with wild fish to assess, and adjust if necessary, hatchery production, and release strategies to minimize effects on wild fish.

31) The WDFW shall attempt to conduct spawning ground surveys to estimate the number of hatchery steelhead that are spawning naturally in the habitat of listed Lower Columbia River steelhead.

3.4 Fishery Exploitation Rate Assessment

Historical fishery exploitation rates were estimated for coho salmon, spring Chinook, fall Chinook, and steelhead. Rates for spring and fall Chinook were estimated in adult equivalents using the methods of the Chinook Technical Committee of the Pacific Salmon Commission (pers. comm. Jim Scott, WDFW, 2003). Rates for other species were estimated by simply dividing the landed catch by the sum of landed catch plus escapement.

3.5 Population Abundance Levels

The Settlement Agreement states that it is the responsibility of NOAA-Fisheries and USFWS to set the adult abundance values used to determine the sustainability of spring Chinook and late winter steelhead in the upper Cowlitz River and for all anadromous fish species in the Tilton River. These abundance values are used as one of the two criteria for determining when upstream adult fish passage facilities would be constructed at the Project. The rationale provided by NOAA-Fisheries and USFWS is presented below.

3.5.1 Abundance Value Rationale

The target abundance value developed for coastal cutthroat trout, salmon, and steelhead in the Cowlitz River is not a population recovery goal, but rather one of many criteria used in determining whether or not a fish ladder will be built. Nevertheless, for the likely continued persistence of the population in the short term, the abundance target should be greater than or equal to the minimum population size that prevents an unacceptable rate of inbreeding and risk of extinction in the near term. The absolute number of individuals in a population is one indicator of whether the population can sustain itself into the future in the face of environmental fluctuations and small-population stochasticity. This aspect of evaluating extinction risk is related to the concept of minimum viable populations (McElhany et al. 2000).

Conservation biologists have argued that endangerment of a population (its likelihood of extinction) should be defined as the probability of persistence over a period of time. A minimum viable population size might then be defined as the population size *N* at which

the probability of persistence over the next *x* years is *y*%. Quantitative approaches to population viability analysis are categorized into three groups: 1) rules of thumb, 2) analytical approaches, and 3) simulation approaches (Thompson 1991). Abundance estimates, population growth rate, population spatial structure, and diversity parameters are necessary in evaluating population viability (McElhany et al. 2000). Limited information on these parameters for Cowlitz River coastal cutthroat trout, salmon, and steelhead precludes the use of analytical or simulation approaches for assessing population viability and determining a minimum viable population size. Until we have information on these parameters, we propose to use a rule of thumb approach in determining the minimum population size that prevents an unacceptable rate of inbreeding and risk of extinction.

The ”50/500" rule of thumb prescribes a short-term effective population size (N_e) of 50 to prevent an unacceptable rate of inbreeding, and a long-term population size of 500 (N_e) to maintain overall genetic variability and to ensure that critically low numbers do not result from normal variation associated with environmental variation (Soule 1980; Thompson 1991). The effective population size is the ideal number of breeding individuals produced each generation by random union of an equal number of male and females randomly drawn from the previous generation. The effective population is a smaller number of individuals than the minimum viable census population (N), which is the total number of mature fish in the population, including fish that do not successfully spawn in any given year. We propose to use the minimum viable census population size as the abundance value for cutthroat trout, salmon, and steelhead in the Cowlitz River Basin to be used in evaluating the merit of building a fish ladder.

Preliminary abundance targets are provided below for both the Tilton River and upper Cowlitz River Basin. A single abundance target combining these two areas is not proposed due to NOAA-Fisheries= definition of a population to use when assessing population viability. NOAA-Fisheries defines an independent population as a group of fish of the same species that spawns in a particular lake or stream (or portion thereof) at a particular season and which, to a substantial degree, does not interbreed with fish from any other group spawning in a different place or in the same place at a different season@ (McElhany et al. 2000).

When using the 50/500 rule of thumb for the minimum viable effective population, the minimum viable census population (N) can be determined using either: 1) a second rule of thumb, and/or 2) an analytical formula (Thompson 1991). In order to use the analytical formula, data available on sex ratio, progeny produced, and change in population size is needed to translate the minimum viable effective population size (N_e) to the minimum viable census population (N). Lack of information on these data for cutthroat trout, salmon, and steelhead in the Cowlitz River at this time forces us to devise a second rule of thumb when determining abundance targets. An average value for the N_e/N ratio of 10 to 50 percent is often proposed as a rule of thumb, resulting in the minimum viable census population falling within one order of magnitude of the minimum effective population size (Thompson 1991). Tables 3-1 and 3-2 below contain a range of potential abundance targets (minimum viable census population size (N)) over a range of spawning rates using 50 and 100 as the minimum effective population size (N_e).

Spawning rate is defined as the number of successful spawners of the total mature fish in the population. We assume a spawner sex ratio of 1 male:1 female.

Table 3-1. Relationship between an effective population size, Ne, of 50 and census population size, N, given various levels of adult contribution to the next generation (spawner rate) and assuming equal numbers of males and females and equal contribution to the next generation by each adult.

	Spawner Rate (% of total mature fish)					
	10%	**20%**	**30%**	**40%**	**50%**	**60%**
N Abundance Target	500	250	167	125	100	83
N_e Effective Population	50	50	50	50	50	50

Table 3-2. Relationship between an effective population size, Ne , of 100 and census population size, N, assuming a 20% spawner rate success (Waples 1990) and assuming equal numbers of males and females and equal contribution to the next generation by each adult.

	Spawner Rate (% of total mature fish)					
	10%	**20%**	**30%**	**40%**	**50%**	**60%**
N Abundance Target	1000	500	333	250	200	167
N_e Effective Population	100	100	100	100	100	100

Setting a single target abundance level is challenging due to the variety of migratory and life-history patterns observed in coastal cutthroat trout. Anadromous coastal cutthroat trout spawn first at 2-4 years of age and may return 2-5 times to over winter and spawn (Moyle 2002). Furthermore, both adults and juveniles can migrate extensively within a system throughout a year and coastal cutthroat trout can spawn multiple times, making it difficult to determine how many of the downstream and upstream migrants passing a particular location should be attributed to the spawning population of interest in any given year. Some have even returned from coastal waters to their natal rivers as non-spawning fish. This complicated life history confounds abundance estimates and increases the uncertainty in determining population viability.

Due to the difficulty in accurately attributing coastal cutthroat trout captured at the collection facilities within the Cowlitz system to the spawning population for that year, we recommend using the conservative target abundance level of 500 fish each for the Tilton River and upper Cowlitz River populations.

For the short time period and specific circumstances that this target abundance number is to be used, we recommend an N_e of 100 as a threshold for salmon. Additionally, for this indicator of sustainability to be valid, it must take into account the presence of hatchery-origin fish among the spawners. It should be underscored that this is not the level that we believe constitutes recovery, but rather it is a realistic number for the question at hand - a threshold that is indicative of a potentially sustainable population. Since the average ratio of potential spawners to actual spawners for salmon and steelhead is thought to be approximately 20 percent (Waples 1990), we recommend using the abundance level of

500 fish each for the Tilton River and the upper Cowlitz River groups of Chinook salmon, coho salmon, and steelhead. We propose that all fish returning to the Tilton and all fish returning above Cowlitz Falls each would be counted as one population for each species in each location since they are all originating from the same hatchery stocks and have not had long enough to evolve into distinct populations. In other words, the abundance value would be 500 for each salmon and steelhead group (one group each) above Cowlitz Falls and 500 for each Chinook salmon, coho salmon, and steelhead group (one group each) in the Tilton River (Table 3-3).

It should be emphasized that these proposed abundance targets are based on our interpretation of currently available data and literature and should be modified as more rigorous analysis of new data is completed. These are interim abundance targets and ongoing and future planning processes, such as recovery planning, may change the targets and our approach to setting these targets.

Table 3-3. Adult abundance targets by basin and species.

Basin	Species	Adult Abundance Value
Upper Cowlitz	Spring Chinook	500
Upper Cowlitz	Late Winter Steelhead	500
Upper Cowlitz	Sea-run Cutthroat Trout	500
Tilton River	Sea-run Cutthroat Trout	500
Tilton River	Spring Chinook	500
Tilton River	Fall Chinook	500
Tilton River	Late Winter Steelhead	500
Tilton River	Coho	500

3.6 Nutrient Enhancement

3.6.1 History

Prior to the initiation of extractive fisheries in mid to late 19th Century, the Cowlitz River watershed received an annual influx of marine derived nutrients (MDN) that fueled the entire watershed ecosystem. Initiation of extractive fisheries and subsequent construction of dams led to the development of a culturally oligotrophicated system (see Stockner and Ashley 2003 for a discussion). The three reservoirs on the Cowlitz River further exacerbate this situation by acting as nutrient traps that starve not only the reservoirs but also the river downstream (see Pieters et al. 2003). There is little doubt now that MDN are an important component of Pacific Northwest anadromous salmonid ecosystems (Stockner 2003). Ongoing studies of stream-type Chinook in Idaho suggest that juvenile Chinook salmon carrying capacity in a given stream is driven by the nutrient status of the stream (Achord et al. 2003). They suggest, "the density dependence we report may stem from a shortage of nutrients normally derived from decomposing salmon carcasses." If true, the productivity and capacity of watersheds within the Cowlitz River Basin will be

directly tied to the level (ultimately) of spawner-delivered MDN. It may also mean that models with density-dependent parameters estimated from MDN-poor systems would underestimate the productive capacity of the stream/watershed.

Various models have been proposed for determination of what are called Ecosystem-Based Escapement Goals. Beginning with simple additive models developed by Michael (1998) through models which incorporate stable isotope studies (Johnston et al. 1997 and Bilby et al. 2001) to Wipfli's (2003) mesocosm experiments and Slaney et al.'s (2003) whole stream fertilization experiments, tools are now available to provide biologically defensible levels of MDN needed to drive an ecosystem and to develop systems to deliver the desired levels of nutrients.

3.6.2 Biomass Needs

The simplest nutrient delivery pathway proposed to date is the coho spawner to coho smolt model developed by Bilby et al. (2001) that is based on wild coho salmon rearing in various western Washington watersheds. In this model, absorption of marine derived nitrogen delivered by spawning coho reached an asymptote in coho smolts at 0.15 kg/m² spawner density based on bank full area of the stream. Based on available area measures for the Tilton River, Upper Cowlitz River, and Cispus River watersheds (SSHIAP low flow surface area multiplied by 1.6 to obtain bank full width; and a mean weight of 4.5 kg (Cowlitz Salmon Hatchery average) per spawner, this calculates out to a need for 53,000, 154,500, and 66,000 coho in the Tilton, Upper Cowlitz, and Cispus, respectively.

Wipfli et al's (2003) model is based on consumption of carcasses in mesocosm experiments. In the experiments, the aquatic ecosystem (fish, insects, algae, diatoms) absorbed 1.9 kg/m². This factor, applied to the stream areas used above, give biomass needs of 3,032,000, 8,807,382, and 3,764,000 kg for the Tilton, Upper Cowlitz, and Cispus, respectively. Converted to "coho units" for ease of comparison, this gives 674,000, 1,957,196 and 836,000 coho units in the Tilton, Upper Cowlitz, and Cispus, respectively.

Ashley and Stockner (2003) developed a protocol for the introduction of fertilizer into freshwater in order to artificially provide the nutrients not being delivered due to lack of natural spawners. Much of this was based on whole river experiments conducted on Vancouver Island, British Columbia. These experiments targeted the enhancement of wild steelhead. Their protocols require an initial survey of the streams in order to determine the exact nutrient status prior to initiating a fertilization project. Ashley and Slaney (1997) developed a loading rate of 533.2 kg fertilizer/cms flow for a 120-day application that covered several kilometers of river. This is designed to increase phosphorus levels in the stream by about 1 part per billion (ppb). Since it requires (approximately) 54 times as much carcass biomass to deliver the same level of phosphorus, it would require 28,793 kg of carcasses (6,400 coho units) to treat one cubic-meters-per-second (cms) of stream volume. The use of fertilizer allows more water volume to be treated per weight of material applied. At the same time, the fertilizer targets fewer food pathways so, as a treatment, it is not as ecologically complete as natural spawning (Michael 2003).

The wide range of potential loadings (Table 3-4) reflect differences in experimental design, study location, and, more generally, our limited understanding of the role and processing of MDNs in freshwater ecosystems. The range extends from values derived from a single species analysis of MDN uptake (Bilby et al. 2001) to multispecies studies in mecocosms (Wipfli et al. 2003). Although the direct applicability of these studies to the Cowlitz River is unclear, they do provide indications of the potential importance of MDN in achieving the goals of the Settlement Agreement.

Table 3-4. Summary of carcass-delivered nutrient needs, as coho units, for watershed upstream of the Cowlitz River Barrier Dam.

Location	Bank full Surface Area (m^2)	Nutrient Needs (coho units)	
		Bilby et al. (2001) (0.15 kg/m^2 or 0.033 coho/m^2)	Wiplfi et al. (2003) (1.9 kg/m^2 or 0.422 coho/m^2)
Tilton	1,595,726	53,000	674,000
Upper Cowlitz	4,637,435	154,500	1,957,000
Cispus	1,981,040	66,000	836,000
Total	8,214,201	273,500	3,467,000

3.6.3 Nutrient Delivery

WDFW has developed a protocol for the design, implementation, monitoring, and reporting for the distribution of carcasses to restore nutrient levels in streams. A new set of protocols is being developed which will add the distribution of carcass, analogs and inorganic fertilizer to the nutrient recovery toolbox. Any projects seeking to distribute carcasses, analogs, or fertilizer in the watershed will need to obtain approval through the existing process.

Much of the research to date has concentrated on the delivery of specific nutrients such as nitrogen, phosphorus, and carbon. This leads to the misperception that the ecosystem need for nutrients can be met artificially through the addition of phosphorus or nitrogen. Delivery of nutrients by spawning fish also includes micronutrients, penetration of the watershed into reaches inaccessible to humans, gravel cleaning and re-distribution through the act of spawning, and the placement of eggs into the gravel. Studies currently in review are documenting that the presence of carbon in the delivered nutrients (carcasses and analogs) versus N/P appear to have substantially higher impacts on the aquatic ecosystem.

The artificial delivery of nutrients should be viewed as a short-term activity designed to assist in watershed recovery. If the WDFW chooses to use surplus hatchery adults to enhance nutrients above Mayfield Dam, carcasses from the Cowlitz Salmon Hatchery will be distributed to the Tilton and upper Cowlitz River basins as appropriate to restore and maintain ecosystem function. This will also likely contribute to increased habitat productivity. As soon as possible, naturally spawning fish should assume the job of nutrient delivery and distribution.

3.7 Credit Mechanism For Natural Fish Production

The Settlement Agreement requires that the FHMP identify credit mechanisms for the production of high quality natural stocks. The FHMP proposes a credit mechanism that adjusts hatchery production at the Cowlitz Hatchery Complex based on the number of natural juveniles produced from the Tilton River and Upper Cowlitz River. This approach is consistent with principle 6.1.4 of the Settlement Agreement that states hatchery production numbers are expected to be adjusted downward as wild stocks recover (see section 2.1).

The methods used to measure and calculate the credit are presented in section 3.7.1. A brief discussion of the history behind credit development can be found in section 3.7.2.

3.7.1 Credit Mechanism

The credit mechanism will be calculated as follows:

1) For every yearling wild/natural juvenile produced from the upper Cowlitz and Tilton River, hatchery yearling production will be reduced by two fish (2:1 ratio), on a species-specific basis.

2) For every subyearling wild/natural juvenile produced from the Upper Cowlitz and Tilton River, hatchery yearling production will be reduced by 0.5 fish. (0.5:1 ratio), on a species-specific basis. If the hatchery releases only subyearlings, hatchery subyearling production would be reduced at a 2:1 ratio.

The number of juveniles produced from the Upper Cowlitz and Tilton River will be calculated at the Barrier Dam. In this way, the juvenile estimate includes any losses due to transportation or passage through the dams.

The juvenile number used each year to set the credit will be based on the most recent 5-year rolling average of juvenile production from the two basins, by species. The 5-year rolling average is meant to account for any large swings in juvenile production that may occur as a result of variability in freshwater habitat conditions, and also to prevent a large reduction in hatchery production that could be required as a result of a single strong year class.

The 2:1 or 0.5:1 credit ratio will begin in year 1 of the FHMP and will apply to a reduction in the Cowlitz Hatchery Complex production obligation beginning with the next brood year for each species. For example, if 200,000 fall Chinook juveniles were counted in 2005, the credit would be assigned to the 2006 brood year. This will ensure that hatchery managers will have sufficient time to plan and implement future broodstock needs.

The calculated credit ratio will remain in force until smolt-to-adult survival rate (SAR) data are complete for each brood year and then updated. When possible, SARs will be calculated for both the hatchery and wild component and the credit ratio calculated as follows:

Credit Ratio = Wild SAR/ Hatchery SAR

An example of how the credit mechanism could change hatchery production is shown in Table 3-5.

Table 3-5. Example of credit mechanism calculations.

Starting Hatchery Production = 4,000,000				
Year	**Natural Production**	**5 year rolling average**	**Credit (2:1)**	**Hatchery Production**
1	250000			4,000,000
2	500000			4,000,000
3	1000000			4,000,000
4	500000			4,000,000
5	250000	500000	1000000	3,000,000
6	0	450000	900000	3,100,000
7	100000	370000	740000	3,260,000
8	250000	220000	440000	3,560,000
9	0	120000	240000	3,760,000
10	0	70000	140000	3,860,000

Separate credit ratios will be maintained for each native species reared at the Cowlitz Hatchery Complex. The credits can be used to reduce either native hatchery fish production, or if agreed to by the FTC, non-native production.

3.7.2 History of Credit Mechanism Development

In the FHMP Public Review Draft (January 6, 2004), the initially proposed credit mechanism reduced the number of smolts released each year from the Cowlitz Hatchery Complex based on the number of wild/natural smolts produced from stream reaches above Mayfield Dam. The wild fish credit ratio was set at 1:1 and 0.5:1 for smolts and subyearlings, respectively. For example, if 10,000 wild steelhead smolts were produced upstream of Mayfield Dam, hatchery smolt production would be reduced by 10,000 in the next brood year (1:1)[3]. The credit ratio was to be calculated based on a 5-year rolling average of juvenile counts, as measured at the Barrier Dam each year. The credit mechanism would start in year 1 of the FHMP and an adjustment would be applied in the Cowlitz Hatchery Complex production obligation beginning with the next brood year for each species. Juvenile counts are available for at least the last 7 years at both Mayfield Dam and Cowlitz Falls Dam (Table 3-6).

[3] As late winter steelhead natural production increases, the credit mechanism would likely be used to reduce early winter steelhead production.

Table 3-6. Juvenile Counts at Mayfield and Cowlitz Fall Dams (1997-2003)[4].

Year	Mayfield Chinook	Steelhead	Coho
2003	8,700	4,764	34,436
2002	19,282	2,050	11,675
2001	618	7,447	82,215
2000	55	2,781	23,144
1999	86	3,193	9,906
1998	4,657	7,248	16,808
1997	4,456	329	695
5-Year Average 1999-2003	5,748	4,047	32,275

Year	Cowlitz Falls Chinook	Steelhead	Coho
2003	34,773	14,740	173,540
2002	26,328	5,206	55,028
2001	36,450	17,807	334,718
2000	32,587	16,889	106,869
1999	8,702	9,967	15,094
1998	14,917	15,691	109,974
1997	22815	2777	3673
5-Year Average 1999-2003	27,768	12,922	137,050

Adjustments would continue each year based on the 5 year rolling average.

The credit mechanism assumed that the SAR for hatchery and wild fish were equal for yearling fish, and that subyearling wild fish SAR would be approximately 50 percent of a hatchery smolt of the same species. The SAR assumption would be tested each year by calculating SAR values by species for both wild and hatchery fish returning to the separators at the Cowlitz Hatchery Complex.

If it were found that the SAR for wild fish was lower or higher than was observed for hatchery fish, the credit ratio would be adjusted accordingly. The credit ratio adjustment would always be made based on the number of adults produced from both hatchery and natural origin juveniles. The ratio would be adjusted when the adult returns for each brood year were complete for each native species released from the hatchery. A credit ratio would not be calculated for non-indigenous stocks such as early winter and summer steelhead.

Trout Unlimited and American Rivers commented on Tacoma's credit proposal and suggested that the credit mechanism should be changed to 2:1, i.e. for every 1 wild fish produced, hatchery production is decreased by 2-fish (TU/AR 2004).

After reviewing SAR data for both wild and hatchery fish in other basins, the FHMP has been changed to be consistent with the Trout Unlimited/American Rivers

[4] Data from WDFW – Cowlitz evaluation biologist reports and Cowlitz Falls Fish Collection Facility annual reports.

recommendation, and has been set at 2:1. Data to support the credit mechanism change can be found in Tables 3-7 through 3-9 below.

The data in Table 3-7 and Table 3-8 show comparisons of SARs for wild and hatchery Hood River steelhead and Warm Springs spring Chinook, respectively. The data indicate that wild fish SARs for yearling fish can be 4.5 to 22 times higher than hatchery fish. Data collected on subyearling migrants in the Lewis River also support a change in the ratio as these data indicate that wild SARs can be 6.1 times higher than hatchery fish (Table 3-9).

The 2:1 ratio proposed by Trout Unlimited/American Rivers appears very conservative in comparison to the observed data collected in the Hood River, Warm Springs River and Lewis River systems. However, to ensure that adult returns to the basin have a better chance of achieving the adult production benchmarks, the credit ratio for yearling juveniles has been set at 2:1, and the subyearling ratio at 0.5:1. Again, the 0.5:1 ratio means, that for every wild subyearling collected, hatchery yearling production would be reduced by 0.5 fish.

Once fall Chinook are reintroduced into the upper basin, the credit mechanism would be adjusted so that for every wild subyearling fall Chinook produced, hatchery subyearling fall Chinook production would be reduced by 2 fish. The credit ratio would be adjusted at the completion of each brood cycle based on the SARs observed for hatchery and wild fish.

Although the FHMP does not call for releasing hatchery fry/parr into the upper basin as a strategy to reintroduce salmon to this area, if this action did occur, Tacoma Power would receive credit for the smolts produced from these releases. This is deemed justified by the analysis presented in Table 3-10, which shows the release of hatchery fish at the fry/parr stage reduces the amount of natural production occurring in these areas due to competition.

Table 3-7. Comparison of SAR (% smolt-to-adult return rate) data for Hood River wild and hatchery steelhead (Foster Stock).

Year	Wild	Hatchery	Ratio (Wild/Hatchery)
1994	7.05	2.31	3.1
1995	9.45	1.34	7.1
1996	5.93	0.97	6.1
1997	3.66	0.92	4.0
1998	6.09	2.52	2.4
1999	6.28	3.14	2.0
2000	1.05	0.16	6.6
Average	5.6	1.6	4.5

Source: Hood River and Pelton Ladder Evaluation Studies Annual Report 2000-2001

Table 3-8. Comparison of SAR (% smolt-to-adult return rate) data for Warm Springs River wild and hatchery spring Chinook.

Year	Wild Juvenile SAR	Hatchery Juvenile SAR	Ratio
1978	1.52	0.84	1.8
1979	4.11	0.09	45.7
1980	3.3	0.42	7.9
1981	4.12	0.56	7.4
1982	2.82	0.03	94.0
1983	2.25	0.13	17.3
1984	2.41	0.12	20.1
1985	3.01	0.54	5.6
1986	3.19	0.28	11.4
1987	1.46	0.13	11.2
1988	1.78	0.18	9.9
1989	0.69	0.02	34.5
1990	0.44	0.005	88.0
1991	0.37	0.02	18.5
1992	2.57	0.16	16.1
1993	2.68	0.29	9.2
1994	0.46	0.15	3.1
1995	12.95	0.43	30.1
1996	2.27	1.27	1.8
Average	2.8	0.3	22.8

Source: Hatcheries, Harvest and Wild Fish: An Integrated Program at Warm Springs National Fish Hatchery, Oregon. Proceedings of the 52nd Annual Pacific Northwest Fish Culture Conference

Table 3-9. Comparison of Lewis River wild fall Chinook percent juvenile-to-age 2-survival to Cowlitz Hatchery fall Chinook.

Year	Lewis Wild	Cowlitz Hatchery	Ratio (Wild/hatchery)
1977	3.7	1.3	2.8
1978	1.2	0.5	2.4
1982	2.4	0.8	3.0
1983	2.6	2.6	1.0
1984	3.7	2.8	1.3
1985	3.9	0.6	6.5
1986	4.3	0.4	10.8
1987	1.9	0.1	19.0
1988	1.7	0.2	8.5
Average	2.8	1.0	6.1

Table 3-10. Change in the estimated number of natural and hatchery origin late winter steelhead smolts and adults produced with different size releases of hatchery fry.

Hatchery Fry Plants	Natural Fry	Natural Smolts	Natural Adults	% Reduction Natural Adults	Hatchery Smolts	Hatchery Adults	Total Smolts	Total Adults
	280,000	7,192	360	0	0	0	3,596	180
100,000	280,000	6,840	342	-5%	2,443	122	5,863	232
250,000	280,000	6,373	319	-11%	5,690	285	8,877	302
500,000	280,000	5,722	286	-21%	10,218	511	13,079	399
1,000,000	280,000	4,751	238	-34%	16,968	848	19,344	543

Note: Assumes SAR of 5% for both natural and hatchery fry plants; smolt collection efficiency at Cowlitz Falls of 50%.

3.8 Adult Supplementation

The FHMP proposes adult supplementation using hatchery adults to restore fish populations in both the Tilton River and Upper Cowlitz River. The adults would be produced from the release of hatchery smolts below Barrier Dam. This strategy was selected based on the analysis conducted by WDFW on the different approaches (fry, juvenile, adults) that could be used to start the program (Appendix 3). The major benefits of the approach include:

- Outplanting hatchery adults rather than juveniles ensures that the entire life-cycle of the resulting offspring is completed in nature rather than artificially in the hatchery environment. Consequently, resulting juvenile production is free of influences from the hatchery environment.

- Under the adult supplementation strategy, fish managers will be able to measure spawning success within a single generation. In contrast, in a juvenile supplementation program the spawning success of returning adults will not be known until one generation later and only then if fish managers either discontinue stocking hatchery juveniles into the watershed or spend considerable resources to mark all hatchery releases.

- Reduces competition between naturally produced juveniles and hatchery juveniles released into the basin. This action increases the number of naturally produced fish returning to the basin each year.

To illustrate the benefits of adult supplementation, we contrast the benefits and risks of the three different approaches that could be used for restoring fish production in the basin. The objective of each approach is to increase the number of adults returning to the basin. The approaches are:

1) Scenario 1- Hatchery fry/juvenile releases in upper basin. This is the current program used for late winter steelhead above Cowlitz Falls Dam. These fish rear in the basin for an extended period of time. It is assumed that returning adults home to areas where fry survival was highest.

2) Scenario 2- Hatchery smolt releases from acclimation sites. This approach is used by the Yakama Nation to increase adult abundance in the Yakima River basin. Adults return to the acclimation site or stream. The assumption is that acclimated smolts are more likely to find good spawning habitat, and have better spawning success if acclimated before being released into the basin.

3) Scenario 3- Direct adult supplementation. As proposed in the FHMP, returning adults from hatchery smolt releases are used to seed upper basin habitat.

3.8.1 Scenario 1- Hatchery fry/juvenile releases in upper basin

Releasing fry into the Upper Cowlitz River basin has the potential to increase both smolt and juvenile production from the basin. An increase in the number of fry released will result in an increase in smolt production until habitat carrying capacity is reached. This approach provides significant benefits until natural production is established in the stream where the fry were planted. Once this occurs, hatchery fry releases reduce the number of naturally produced juveniles due to competition (density dependent mortality). The effects on Upper Cowlitz late winter steelhead production from the release of different numbers of fry are shown in Table 3-10.

The results in Table 3-10 are based on the Beverton-Holt survival function with a smolt capacity of 50,000 and a fry to smolt productivity of 3 percent (taken from Upper Cowlitz late winter EDT results). The analysis shows that as the number of hatchery fry released into the basin increases, the number of smolts produced from natural spawners decreases. Although total adult production from the upper basin does increase, it is at the expense of the naturally produced population component. As will be seen in Scenario 2 and 3 below, these latter strategies produce significantly more adults than planting fry.

A fry stocking program would be the preferred strategy for reintroduction under the following conditions:

1) Little or no natural production occurs in the stream of interest. This is not the case for steelhead, coho, sea-run cutthroat trout or spring Chinook in the upper basin. Data collected at Cowlitz Falls Dam and Mayfield Dam show significant juvenile production from both natural and hatchery adults released in the Tilton River and Upper Cowlitz River.

2) If natural production does occur, adult returns from the fry plants must either have a higher adult return rate than natural smolts, or have a higher spawning success than natural fish (i.e. produce more offspring) in the next generation. We could find no data to support this hypothesis.

3) For the Cowlitz River, the fry plants must have minimal impact on the productivity experiment being undertaken in the upper basin (see Section 5). As can be seen in Table 3-10, fry releases will reduce the number of natural origin smolts produced from the basin, which affects resulting estimates of

juvenile and adult productivity. Both parameters are used to make critical fish passage decisions at the Project.

Because these conditions were not met, fry plants were not selected as the preferred strategy for the Cowlitz.

3.8.2 Scenario 2- Hatchery Smolt releases from acclimation sites

This strategy involves acclimating hatchery smolts near their spawning areas prior to their release. This strategy is used throughout the Columbia River to increase adult returns to the basin. The Yakama Nation is using this approach in the Yakima River basin to increase abundance of spring Chinook and steelhead. These programs collect broodstock from the wild, rear them in a hatchery environment, and then transport them to acclimation facilities where they are held for a few months, then released.

This concept is based on the hypothesis that acclimation prior to release results in better homing fidelity of returning adults to high quality spawning habitat. Thus, spawning success is improved, which results in higher juvenile production the following year.

The Yakama program was begun with smolt releases rather than fry releases for many of the same reasons discussed for the fry scenario above. In addition, because wild adult abundance was low, rearing wild fish to the smolt stage maximized the survival of the eggs taken from the wild populations. To overcome hatchery impacts on the fitness of the juveniles, the Yakama program rears these fish using enriched environments (i.e. innovative rearing).

Hatchery fish returning from the smolt acclimation program are allowed to spawn naturally. Thus, the Yakama program is relying on returning hatchery origin adults to increase overall natural production in the basin.

The resulting smolt and adult production from a range of smolt releases into the Upper Cowlitz River basin is presented in Table 3-11. The analysis assumes a 2.5 percent SAR and a 50 percent fish collection efficiency at Cowlitz Falls Dam[5].

Table 3-11. Estimated number of smolts and adults produced from hypothetical acclimation facilities located in the Upper Cowlitz River basin.

Smolt Releases	Cowlitz Falls Collection Efficiency	Total Smolts Out	SAR	Returning Adults
50,000	0.5	25,000	0.025	625
100,000	0.5	50,000	0.025	1,250
175,000	0.5	87,500	0.025	2,188
250,000	0.5	125,000	0.025	3,125

[5] Juvenile collection efficiency is less than 50% for all species.

Estimates in Table 3-11 suggest that a release of 250,000 smolts into upper basin acclimation facilities results in a total of 125,000 smolts alive below Barrier Dam (Total Smolts Out), and these smolts produce 3,125 adults. Contrast these results to the 500,000 fry release in the upper basin that produced only 399 adults and it is obvious that the acclimated smolt strategy produces more adults than the fry strategy even when assuming that the SAR for the acclimated fish is 50 percent that of the fry releases.

For the fry strategy to be more effective than the acclimation approach, the 399 adults from the fry plants must produce more juveniles in the next generation than the 3,125 adults produced from acclimation. As both groups start out as hatchery adults, the assumption that releasing fish as fry somehow confers such a large survival advantage at the spawning stage appears unlikely.

Although the acclimation strategy produces more adults than the fry plants, the direct adult supplementation scenario described below produces even more adults than the acclimation scenario.

3.8.3 Scenario 3- Direct Adult Supplementation

In all cases, effective supplementation must result with eggs hatching in the natural environment. Instead of using juvenile life stages to start the program, the FHMP proposes to release hatchery adults directly to the stream.

This approach has several advantages over the others:

1) It provides an outlet for hatchery adults surplus to hatchery broodstock needs.

2) The resulting juvenile production is of natural origin. The production of juveniles indicates that the adults were able to find suitable habitat for spawning, and that future adult returns from these juveniles are more likely to spawn successfully and produce juveniles in the next generation.

3) Outplanting hatchery adults rather than juveniles ensures that the entire life-cycle of resulting offspring is completed in nature (i.e. resulting juvenile production is free of hatchery influences). This approach accelerates local adaptation by one generation in comparison to fry and smolt plants.

Under current conditions in the Cowlitz, the number of hatchery adults available for the supplementation program can be increased in comparison to the acclimated smolt program if they are released below Barrier Dam (Table 3-12).

The estimates in this table suggests that a release of 250,000 smolts below Barrier Dam results in the production of 6,250 adults, given the same assumptions as before. This is twice the number of returning adults produced from the acclimation strategy (3,125). The major reason for this difference is due to juvenile collection efficiency of the Cowlitz Falls Dam juvenile fish system. Currently, less than 50% of the juveniles arriving at Cowlitz Fall Dam are collected and transported to below Barrier Dam. This means that for every two smolts released in the upper basin, only one survives to below Barrier Dam.

Therefore, unless acclimated smolts either, 1) have at least twice the adult return rate, or 2) are twice as effective at producing juveniles in the next generation (higher spawning success), releasing smolts below Barrier Dam produces more adults for supplementation than any other strategy.

Table 3-12. The estimated number of smolts and adult returns from fish released below Barrier Dam.

Smolt Releases (Below Barrier)	Release Survival	Total Smolts Out	SAR	Returning Adults
50,000	100%	50,000	0.025	1,250
100,000	100%	100,000	0.025	2,500
175,000	100%	175,000	0.025	4,375
250,000	100%	250,000	0.025	6,250

Data collected on spring Chinook in the Yakima River have do not currently support the assumption that acclimated smolts have either higher freshwater survival (outmigrants) or adult survival than fish reared conventionally (http://www.ykfp.org/par03/abstracts2.htm).

Because of the difficulty in determining the origin of resulting juvenile production from adults with the same basic genetic make-up, we could find no data to support an assumption that acclimated fish are more successful spawners.

Given the lack of data to support increased production in the next generation from acclimated smolts, the adult strategy using hatchery origin adults appears to be the better approach for restoration: especially until juvenile collection efficiency at Cowlitz Falls is improved.

However, it is envisioned that after fish collection efficiency at Cowlitz Falls Dam achieves the minimum performance criterion (75 percent), the FTC will review the adult supplementation program to see if it should be continued, replaced or supplemented with another strategy. The next likely approach would be to release hatchery smolts from acclimation sites located in the upper Cowlitz River and Tilton River.

4.0 Assessment

4.1 Population Structure

The Willamette/Lower Columbia River Technical Recovery Team (WLCTRT) has identified historical and extant independent populations of Chinook, steelhead, and chum in the Cowlitz River (Meyers et al. 2002). The populations were identified from an extensive review of information on the spatial distribution of spawning habitat, migration rates, genetic attributes, patterns of life history and phenotypic characteristics, population dynamics, and environmental characteristics. Table 4-1 lists each of the historical populations that were thought to have existed in the Cowlitz River as well as any genetic legacy that may exist.

The historical population structure of anadromous salmonids that have not been listed under the Endangered Species Act (ESA) have not been evaluated. However, the Salmonid Stock Inventory (SaSI) (WDFW 2003) identifies four current stocks of coho in the Cowlitz River watershed and two stocks of coastal cutthroat. The historical or current population structure of other species has not been evaluated in the SaSI process, but known information is included here.

Two steelhead stocks in the Cowlitz River watershed are not native. The summer run stock being used at the Cowlitz Trout Hatchery to support sport angling was originally from the Skamania Hatchery. The early winter steelhead population, also non-native, was imported from Chambers Creek, also to support sport angling.

Reviews of Cowlitz River salmonid stocks have not recognized pink salmon as a regular component of the ecosystem. Long-term observations suggest that a small self-sustaining population does exist, spawning in odd-numbered years. The status of pinks in the Cowlitz River will be evaluated under this FHMP. If a self-sustaining populations exists, it will be documented and actions taken to ensure its long-term survival.

Reviews of Cowlitz River salmonid stocks have not recognized sockeye salmon as a regular component of the ecosystem. Long-term observations suggest that a small self-sustaining population does exist. Analysis of scales from fish collected at the Cowlitz Salmon Hatchery suggest that sockeye in the system are part of the coastwide riverine rearing metapopulation. The status of sockeye in the Cowlitz River will be evaluated under this FHMP. If a self-sustaining population exists, it will be documented and actions taken to ensure its long-term survival.

4.2 Cowlitz Salmon and Steelhead Populations and ESA Recovery

Cowlitz Chinook, steelhead and chum were listed as threatened under the Endangered Species Act (ESA) in 1998-1999 (64 FR 14308, 63 FR 13347, and 64 FR 14508, respectively) and Cowlitz coho are a candidate for listing (60 FR 38011). Recovery planning has progressed to the point where interim viability criteria for the Willamette/Lower Columbia domain have been developed by the WLCTRT (McElhany et al. 2003).

Table 4-1. Historical populations of anadromous salmonids in the Cowlitz River and potential remaining genetic legacy.

Historical Population	Potential Genetic Legacy
Upper Cowlitz River Fall Run Chinook	Cowlitz Salmon Hatchery fall Chinook stock is believed to be a mixture of all historical populations of Cowlitz River fall Chinook populations. Between 1953 and 1993, 92 percent of all fall Chinook released in the Cowlitz River were Cowlitz Hatchery stock.
Lower Cowlitz River Fall Run Chinook	
Upper Cowlitz River Spring Run Chinook	Cowlitz Salmon Hatchery spring Chinook stock is believed to be a mixture of all historical populations of Cowlitz River spring Chinook populations. Between 1948 and 1993, 96 percent of all spring Chinook released in the Cowlitz River were Cowlitz Hatchery stock.
Cispus River Spring Run Chinook	
Tilton River Spring Run Chinook	
Toutle River Fall Run Chinook	Current population recolonized the watershed after the eruption of Mount St. Helens. Between 1953 and 1993, 67 percent of all fall Chinook released in the Toutle River were Toutle (Green) Hatchery stock. Since 1980 at least 6.4 million non-Toutle Hatchery-origin fall Chinook have been stocked.
Toutle River Spring Run Chinook	Historically, there was a small naturally occurring spawning population. Through 1984, 2.7 million non-Toutle Hatchery stock spring Chinook were stocked in the Toutle River. There is no record of a hatchery supported spring Chinook stock in the Toutle watershed.
Cispus River Winter Steelhead	Cowlitz Trout Hatchery late winter steelhead stock is assumed a mixture of all historical Cowlitz River winter steelhead populations that migrated to the Upper Cowlitz River.
Tilton River Winter Steelhead	
Upper Cowlitz River Winter Steelhead	
Lower Cowlitz River Winter Steelhead	
North Fork Toutle River Winter Run	Following Mount St. Helens eruption, only small numbers of hatchery origin steelhead have been released.
South Fork Toutle River Winter Run	
Cowlitz River Fall Run/Summer Run Chum	Wild fish only, no hatchery program.
Cowlitz River Pink	
Cowlitz River Sockeye	
Upper Cowlitz River Coho Tilton River Coho Cispus River Coho	Cowlitz Salmon Hatchery coho stock is believed to be a mixture of all historical populations of Cowlitz River coho populations.

Table 4-1 continued. Historical populations of anadromous salmonids in the Cowlitz River and potential remaining genetic legacy.

Historical Population	Potential Genetic Legacy
Toutle Coho	SaSI identifies the stock origin of natural production from the Toutle River as "Mixed."
Green River (Toutle) Coho	
South Fork Toutle Coho	
Cowlitz Coastal Cutthroat	Population present. Cowlitz Trout Hatchery has developed broodstock for an anadromous stock from adult returns to the hatchery.
Toutle Coastal Cutthroat	Population present. No hatchery releases documented.

Sources: WDFW SaSI (2003), WLCTRT (2003)

Individual populations of salmon and steelhead are not listed under the ESA; rather genetically distinct groups of salmon and steelhead populations called evolutionarily significant units (ESUs) are listed. For example, the Cowlitz Chinook populations are listed because they are part of the Lower Columbia Chinook ESU, and this entire ESU is listed. Delisting will occur by ESU as well. For the Lower Columbia Chinook ESU to be delisted, the populations comprising the ESU will have to meet certain viability criteria. All this is applicable to any ESU. The WLCTRT criteria get more specific at this point. ESUs are divided into strata, which are groups of populations representing major ecoregion life history combinations. For an ESU to be considered viable, the strata comprising it all need to be viable. For a stratum to be viable, the historical demographically independent populations within it must meet certain criteria for population health attributes and the healthiest should meet, as much as possible, three other criteria as well: genetic legacy, historical core populations, and safety from catastrophic loss.

The attributes for population health, which are based on an earlier viability document (McElhany et al. 2000), are productivity and abundance, juvenile outmigrants, spatial structure, diversity, and habitat. Scoring is a complex process, but can be summarized quite easily. For a stratum to be viable, at least two populations in the stratum must be in good shape. These populations historically should have been large; they still maintain (if possible) an appreciable portion of their original genetic diversity and are reasonably safe (if possible) from catastrophic loss. It is important to keep in mind that the criteria are based on historical demographically independent populations (DIPs), not present day populations. This means that under the WLCTRT criteria, recovery could well involve the restoration of populations where they have been extirpated.

The WLCTRT has identified 15 historical DIPs, including eight Chinook, six steelhead, and one chum in the Cowlitz basin (Table 4-2) (Myers et al. 2002).

The importance to strata of the Cowlitz populations is shown in Table 4-3. Overall, 43 percent of the DIPs in the strata containing Cowlitz populations are Cowlitz populations: 44 percent of the fall Chinook populations, 57 percent of the spring Chinook, 50 percent of the steelhead, and 14 percent of the chum. The importance of chum is probably understated; if the summer chum is a distinct run, they would also probably be a new stratum.

The combination of the high proportion of Cowlitz DIPs in the Cascade strata, coupled with the fact that the Cowlitz basin historically was an important core for Chinook and steelhead in the strata, makes it likely that Cowlitz Chinook and steelhead, at least, will figure prominently in recovery scenarios based on the WLCTRT criteria.

Table 4-2. Presumed historical demographically independent populations of Chinook, steelhead, and chum (Myers et al. 2002), and core/legacy status (McElhany et al. 2003).

Population	Core (C)	Genetic Legacy (G)
Chinook		
Upper Cowlitz Fall		
Lower Cowlitz Fall	C	
Coweeman Fall		G
Toutle Fall	C	
Upper Cowlitz Spring	C	G*
Cispus Spring	C	
Tilton Spring		
Toutle Spring		
Steelhead		
Cispus Winter	C	G*
Tilton Winter		
Upper Cowlitz Winter	C	
Lower Cowlitz Winter		
N.F. Toutle Winter	C	
S.F. Toutle Winter		
Chum		
Cowlitz Fall/Summer#		
* current Cowlitz hatchery stock # may be distinct summer and fall runs		

Table 4-3. Composition of Strata Containing Historical Cowlitz DIPs (Myers et al. 2002)

Stratum	Cowlitz	Non-Cowlitz
Chinook		
Cascade Fall	4	5
Cascade Spring	4	3
Steelhead		
Cascade Winter	7	7
Chum		
Cascade	1	6

4.3 Fish Passage at Major Dams

Upstream and downstream anadromous fish passage facilities were incorporated into Mayfield Dam when it was constructed in 1962. Passage structures included a fish ladder and tramway for upstream adult fish passage, and a surface bypass system utilizing louver guidance for juvenile salmon and steelhead in the Mayfield Dam forebay. This bypass for downstream migrating fish remains in operation today and serves as the

collection/passage structure for fish exiting Mayfield Reservoir. Fish enumeration and marking facilities are included at the bypass, which allow for handling of individual fish.

Following the filling of Mossyrock Reservoir (Riffe Lake) and the completion of the Cowlitz Salmon and Trout hatcheries in 1968, anadromous adult fish collection shifted to the separator facility at the Cowlitz Salmon Hatchery. The Barrier Dam at river mile 49.5 became the upstream limit of volitional anadromous fish passage on the Cowlitz River. Fish are routed into a ladder and transport channel to a holding pool at the separator facility. All adult salmonids are individually handled and examined for marks at the separator. The adult fish are collected and held for broodstock, recycled downstream, or transported directly to areas upstream of Mayfield and/or Mossyrock dams. The decision to capture and haul adult fish using the separator facilities at the Cowlitz Salmon Hatchery eliminated the need for construction of a fish ladder over Mossyrock Dam.

Fish screens or a collection system for juvenile salmonids were not included at Mossyrock Dam because the state and federal fisheries agencies believed that, due to results from studies conducted on Mayfield Lake, it was likely that juvenile fish would be delayed traveling through the 23.5-mile length of Riffe Lake, thus making fish screens ineffective. The agencies concluded that numerous large lake traps would be more efficient than screening facilities at the dam.

Over a five-year period (1968-1973), Tacoma Power trapped downstream migrating juvenile salmon and steelhead in Riffe Lake for transfer around Mossyrock Dam. Capture success of juvenile fish was poor due to a number of factors. The stratification of water temperatures in the reservoir forced the juveniles into deeper water, placing them out of the reach of the traps. Strong prevailing winds, heavy swells and debris also made lake trapping logistically very difficult. The lake capture program was discontinued in 1974 after the state fisheries agencies determined the capture numbers were too small to meet the mitigation goals. Upstream passage of adult salmon and steelhead was continued as much as possible to augment natural production. The plan continued in this manner until 1981 when the discovery of the *infectious hemotopoietic necrosis* (IHN) virus at the Mossyrock and Cowlitz Trout hatcheries ended the program. Upper basin releases of hatchery and naturally produced adult coho salmon resumed in 1983, steelhead and sea-run cutthroat trout releases resumed in 1992, spring Chinook releases resumed in 1993 and fall Chinook releases resumed in 1996.

The completion of the Cowlitz Falls Hydroelectric Project (FERC No. 2833) in June 1994 offered a new opportunity to collect juvenile anadromous fish migrating downstream from the Upper Cowlitz River Basin. A surface collector and transportation system was incorporated into the operation of Cowlitz Falls Dam. Fish are collected at the dam and trucked downstream to stress relief ponds at the Cowlitz Salmon Hatchery prior to their volitional release into the Cowlitz River. During 1996-2003, the efficiency of collecting downstream migrating juvenile salmonids has ranged from 41 to 68 percent for steelhead, 15 to 45 percent for coho, and 17 to 24 percent for Chinook (Table 4-4). In 2000 a substantial change was made in the Cowlitz Falls surface collector, increasing the 2000-2003 average fish collection efficiency to 60 percent for steelhead and 40 percent for coho. Collector modifications did not change the efficiency of collection for

Chinook. In 2002 a large number of Chinook smolts were captured at the Mayfield trap. If these were, as is presumed, spring Chinook, they successfully passed through Cowlitz Falls Dam, Riffe Lake, Mossyrock Dam, and Mayfield Lake prior to collection in the trap. All of these collection efficiencies are substantially below the target values in the Settlement Agreement.

Table 4-4. Annual fish collection efficiencies for steelhead, coho and Chinook at Cowlitz Falls Dam.

Year	Steelhead			Coho			Chinook		
	Mean	Low	High	Mean	Low	High	Mean	Low	High
1996	**50%**	37%	74%	**15%**	5%	25%	-	-	-
1997	**45%**	17%	76%	**21%**	5%	50%	**17%**	10%	45%
1998	**NA**	3%	38%	**32%**	16%	53%	**18%**	11%	44%
1999	**41%**	20%	63%	**17%**	6%	42%	**24%**	7%	46%
2000	**65%**	55%	79%	**45%**	19%	76%	**24%**	13%	36%
2001	**58%**	41%	75%	**42%**	13%	61%	**23%**	12%	29%
2002	**56%**	45%	65%	**33%**	5%	62%	**22%**	14%	30%
2003	**68%**	57%	82%	**43%**	20%	63%	**13%**	6%	20%

NA- Not available

All adults returning to the separator at the Cowlitz Salmon Hatchery are sorted by origin (hatchery or naturally produced) and mark group. Currently, hatchery-origin fish in excess of hatchery broodstock needs are either trucked to the Upper Cowlitz River Basin or returned to the Cowlitz River below the Barrier Dam. All naturally produced adult salmonids identifiable as to their subbasin of origin are also trucked around the dams and released into their respective subbasin. No adult fish ladders are currently operable on the Cowlitz River dams.

Historical studies conducted at the Mayfield louver system indicate that fish guidance efficiency (FGE) for coho, spring Chinook and steelhead are 66.4 percent, 81.4 percent and 73.6 percent respectively (Thompson and Paulik 1967). Those fish not guided pass through the Project turbines. Juvenile survival through the turbines was estimated at 85-95 percent for juvenile steelhead in 2002 (Normandeau Associates and Skalski, 2003).

4.4 Other Passage Barriers

The U.S. Forest Service and other agencies are conducting surveys of fish passage at culverts and other man-made barriers exclusive of dams in the watersheds upstream of Mayfield Dam, primarily as part of the Forest and Fish plan requirements. Preliminary surveys in the Mayfield Reservoir tributaries suggest that as late as 2000, most of the culverts were in need of replacement to meet current anadromous fish passage requirements.

Only one blocking culvert was identified in the Cispus River watershed but a number of creeks were identified as being flow-limited due to aggregation of streambed material. This situation can be remediated over the long term through restoration of bank stability within the affected watersheds.

A number of barriers to migration were identified on creeks in the Upper Cowlitz watershed. As with the Cispus, there are instances where streambed aggradation has led to low or no-flow situations at certain times. These problems can be corrected through restoration of riparian zone function and stability.

4.5 Aquatic Habitat

The EDT model was used to estimate quantity and quality of stream habitat for each management species within the Cowlitz River Basin. Stream habitat was evaluated through a process of rating 46 environmental attributes on a scale from 0 to 4. Whenever possible, ratings were based on field data or direct observations of each stream or reach. Professional opinion or the results of studies conducted in other areas of this or other basins were used to rate the attributes when field data were not available.[6] Outputs from EDT include estimates of species productivity, diversity, capacity and abundance for both adult and juvenile life stages. Additionally, the model ranks stream habitat based on its potential for restoration and preservation. Streams ranked highly for restoration potential are those where habitat improvement actions have the greatest potential to increase fish abundance. Streams identified as having a high preservation value are those currently producing a large percentage of fish in the basin. Results of the preservation and restoration analyses will be available on the Web at http://www.mobrand.com/edt.

Results of the EDT production by species analysis are presented below. Data are presented for two conditions: Properly Functioning Conditions (PFC) and Current Conditions. PFC is meant to represent habitat conditions that can, if achieved, support healthy populations of anadromous salmonids. PFC does not represent the pristine historical habitat conditions that would have existed in the basin pre-European settlement. PFC is considered to be a long-term habitat objective that may be achievable, whereas attainment of pristine historical conditions is not.

4.5.1 Spring Chinook

EDT estimates of spring Chinook production for the PFC and current condition by geographic area are presented in Table 4-5.

A more complete summary of spring Chinook production by geographic area, including juvenile production, can be found in Appendices 1 and 2.

[6] Habitat ratings developed based on professional opinion were the product of USFWS, NOAA-Fisheries, WDFW, DOE, and other biologists who were members of the Cowlitz Fish Technical Team.

Table 4-5. EDT estimates of historic and current spring Chinook adult production by subbasin.

Basin	PFC Productivity[1]	PFC Capacity[1]	PFC Abundance[1]
Lower Cowlitz	NU	NU	NU
Tilton River	7.5	4,906	4,255
Upper Cowlitz River	5.9	10,578	8,782
Cispus River	4.4	2,580	1,995
	Current Productivity	Current Capacity	Current Abundance
Lower Cowlitz	NU	NU	NU
Tilton River	1.8	1,602	720
Upper Cowlitz River	3.3	6,417	4,469
Cispus River	2.3	1,779	1,008

NU- Not utilized
[1]Based on PFC with dams in place.

4.5.2 Fall Chinook

EDT estimates of fall Chinook production for PFC and current condition by subbasin are presented in Table 4-6.

Table 4-6. EDT estimates of PFC and Current fall Chinook adult production by subbasin.

Basin	PFC Productivity[1]	PFC Capacity[1]	PFC Abundance[1]
Lower Cowlitz	10.9	23,544	21,385
Tilton River	4.5	5,197	4,048
Upper Cowlitz River	3.6	9,006	6,511
Cispus River	2.9	3,130	2,053
	Current Productivity	Current Capacity	Current Abundance
Lower Cowlitz	6.0	10,508	8,745
Tilton River	2.0	2,022	1,025
Upper Cowlitz River	2.5	5,142	3,096
Cispus River	1.8	2,144	934

[1]Based on PFC with dams in place

A more complete summary of fall Chinook production, including juvenile production can be found in Appendices 1 and 2.

4.5.3 Coho

EDT estimates of coho production for PFC and Current condition by subbasin are presented in Table 4-7.

Table 4-7. EDT estimates of PFC and Current coho adult production by subbasin.

Basin	PFC Productivity[1]	PFC Capacity[1]	PFC Abundance[1]
Lower Cowlitz	12.2	16,816	15,436
Tilton River	8.7	9,285	8,215
Upper Cowlitz River	7.3	27,417	23,633
Cispus River	7.5	6,174	5,351
	Current Productivity	Current Capacity	Current Abundance
Lower Cowlitz	3.95	5,868	4,383
Tilton River	2.4	2,916	1,687
Upper Cowlitz River	3.0	21,564	14,463
Cispus River	4.0	5,020	3,752

[1]Based on PFC with dams in place

A more complete summary of coho production, including estimates of juvenile production can be found in Appendices 1 and 2.

4.5.4 Late Winter Steelhead

EDT estimates of adult late winter steelhead production for the historic (PFC) and current condition are presented in Table 4-8.

Table 4-8. EDT estimates of PFC and Current late winter steelhead adult production by subbasin.

Basin	PFC Productivity	PFC Capacity	PFC Abundance[1]
Lower Cowlitz	10.1	1,571	1,417
Tilton River	9.7	1,611	1,445
Upper Cowlitz River	5.5	3,465	2,824
Cispus River	7.1	2,661	2,285
	Current Productivity	Current Capacity	Current Abundance
Lower Cowlitz	2.2	403	223
Tilton River	2.3	393	219
Upper Cowlitz River	3.1	1,432	965
Cispus River	3.7	832	607

[1]Based on PFC with dams in place

A more complete summary of late winter steelhead production, including juvenile production can be found in Appendices 1 and 2.

4.5.5 Chum

EDT estimates of adult chum production for PFC and current condition by subbasin are presented in Table 4-9.

Table 4-9. EDT estimates of PFC and Current chum adult production by subbasin.

Basin	PFC Productivity[1]	PFC Capacity[1]	PFC Abundance[1]
Lower Cowlitz	5.3	49,077	39,852
Tilton River	NU	NU	NU
Upper Cowlitz River	NU	NU	NU
Cispus River	NU	NU	NU
	Current Productivity	Current Capacity	Current Abundance
Lower Cowlitz	1.6	7,038	2,639
Tilton River	NU	NU	NU
Upper Cowlitz River	NU	NU	NU
Cispus River	NU	NU	NU

NU- Not utilized

[1]Based on PFC with dams in place, utilizing only habitat downstream of the Barrier Dam.

4.5.6 Pink

Pink salmon are known to be present in the Cowlitz River downstream of the Barrier Dam. There are no EDT estimates of adult pink production. Studies will be undertaken to locate spawning areas, characterize genetic relationships, and quantify available habitat. As with chum, pink salmon assessment, restoration, and management activities will take place downstream of the Barrier Dam.

4.5.7 Sockeye

Sockeye salmon are present in the Cowlitz River downstream of the Barrier Dam. Analysis of scales suggests that they are riverine-rearing fish. There are no EDT estimates of adult sockeye production. Studies will be undertaken to locate spawning areas, characterize genetic relationships, and quantify available habitat. As with chum and pink, sockeye assessment, restoration, and management activities will take place downstream of the Barrier Dam.

4.5.8 Sea-Run Cutthroat Trout

Sea-run cutthroat trout are found throughout the Cowlitz River Basin. Data collected at Cowlitz Falls and Mayfield Dam show that upwards of 2,000 smolts pass these facilities each year. Sea-run cutthroat trout are also reared at the Cowlitz Salmon Hatchery Complex. The hatcheries release approximately 140,000 smolts each year to provide harvest opportunity in the lower Cowlitz River.

4.5.9 Other Species

Native resident fish species such as rainbow, cutthroat, whitefish, dace and suckers are found throughout the Cowlitz River Basin. Sturgeon, lamprey, and eulachon are found in stream reaches below Barrier Dam.

In addition, non-native fish species such as smallmouth bass, largemouth bass, tiger muskie, Atlantic salmon, and Arctic char are found in Project reservoirs and the Tilton River. The presence of Atlantic salmon and Arctic char can be attributed to fish farming operations in the Tilton River basin.

Actions designed to improve habitat conditions in the basin will directly benefit native species in riverine areas. Currently, no actions are proposed for managing non-native species in Project reservoirs. This may change if fish volitional passage facilities are built at Mayfield Dam. Control or management of fish farming operations in the Tilton River is outside the scope of this analysis.

4.6 Existing Artificial Production Programs

Hatchery fish production in the Cowlitz River, above the mouth of the Toutle River, originates from Tacoma Power's Cowlitz Salmon and Trout hatcheries. FERC license obligations are the basis for the production of hatchery fish by Tacoma in the Cowlitz River basin. The hatcheries, although owned by Tacoma, currently are operated under contract with WDFW. Tacoma employees maintain the hatcheries and transport all anadromous adults and most juvenile fish in the Cowlitz River basin at the times and to the locations specified by the WDFW.

In addition, through 2004, Tacoma funds the production of resident rainbow trout from the Mossyrock Trout Hatchery, and other sources, that are released into various locations in the upper Cowlitz River basin.

Tacoma provides funds to WDFW to monitor and evaluate the success of the hatchery and natural fish programs in the Cowlitz River basin. Currently, the WDFW determines annual hatchery production levels, release goals, planting locations, policies regarding fish disease, harvest and general day-to-day operations.

In 2003 the Cowlitz Hatchery Complex released more than 11 million fish, including 1,267,000 spring Chinook, 5.0 million fall Chinook, 3.21 million coho. The Cowlitz Trout Hatchery released 665,000 late winter steelhead, 550,000 non-indigenous summer steelhead, 300,000 non-indigenous early winter steelhead and 260,000 sea-run cutthroat trout. These releases included both fry and smolts.

All Cowlitz River hatchery programs were reviewed as part of the APRE process. The results of this review are found at http://www.mobrand.com/APRE/home.jsp. The major hatchery concerns identified by APRE reviewers, and the approach taken to address each in the FHMP, are listed below.

- *Hatchery goals are not always clearly defined and appear to be in conflict for some species*. The FHMP identifies clear objectives for the expected adult

production for each program, percent improvement expected in the implementation of innovative rearing facilities, and the number of juveniles released, etc.

- Hatchery fish make up over 30 percent of the natural spawning populations for most species, which may result in decreased fitness of wild populations. HSRG guidelines for managing the proportion of hatchery fish in the wild, and wild fish in the hatchery will be followed to alleviate this concern.

- *The hatchery program needs to utilize more wild fish as hatchery broodstock to maintain local adaptation*. More wild fish will be incorporated into the hatchery population once self-sustaining wild/natural populations are established in the basin.

- *The overall hatchery program does not appear to be sized to the carrying capacity of the watershed*. This objective will be achieved for the upper basin as natural production is emphasized in this portion of the watershed. Until the success of the reintroduction program is known, hatchery releases in the lower river will be sized primarily to meet harvest needs and to produce adults for the adult supplementation program.

- Hatchery operators need better monitoring of performance indicators such recruits-per-spawner, harvest rates, total catch and smolt-to-adult survival rates. All of these performance indicators will be monitored.

4.7 Historical Fishery Exploitation Rates

A brief overview of historical harvest rates, by location, for Cowlitz River origin fish populations is presented below. Data on more recent harvest levels are shown by species in section 5.

4.7.1 Spring Chinook

Cowlitz River spring Chinook are harvested in a variety of sport and commercial fisheries in Southeast Alaska, British Columbia, Oregon and Washington. Total adult equivalent exploitation rates in all fisheries since the 1977 brood have ranged from 11 (1992 brood) to 75 percent (1985 brood), with an average exploitation rate of 52 percent in all years (Table 4-10). Based on coded wire tag analysis of hatchery origin fish (HOR), the majority of the exploitation has historically occurred in ocean fisheries, primarily in Washington and off the west coast of Vancouver Island, with an average total adult equivalent exploitation rate in all ocean fisheries of 34 percent for the 1977 through 1996 broods. Reductions of exploitation rates in these fisheries in recent years, particularly in response to the poor survival rates of many stocks in the early 1990s, resulted in ocean exploitation rates as low as 11 percent (1992 brood).

Table 4-10. Harvest rates for spring Chinook in various fisheries.

Brood Year	Ocean	Freshwater Net	Freshwater Sport	Total
1977	40%	2%	28%	70%
1978				
1979				
1980	47%	1%	24%	71%
1981	38%	4%	22%	64%
1982	42%	2%	15%	60%
1983	42%	2%	16%	60%
1984	55%	3%	17%	74%
1985	49%	5%	20%	75%
1986	47%	2%	20%	69%
1987				
1988				
1989	42%	2%	19%	64%
1990	23%	1%	21%	44%
1991	13%	2%	12%	27%
1992	11%	0%	0%	11%
1993	19%	0%	4%	23%
1994	15%	1%	19%	34%
1995	24%	1%	16%	41%
1996	29%	3%	19%	51%

Local fisheries directed at the harvest of Cowlitz River spring Chinook operate in the lower Columbia River and in the Cowlitz River downstream of the Barrier Dam. Sport fisheries occur in the lower Columbia and Cowlitz from March through July and total adult equivalent exploitation rates have ranged from 16 to 19 percent for the 1994 through 1996 broods.

4.7.2 Fall Chinook

Fall Chinook from the Cowlitz River are harvested in a variety of sport and commercial fisheries in Southeast Alaska, British Columbia, Oregon and Washington. Total adult equivalent exploitation rates in all fisheries since the 1977 brood have ranged from 13 percent (1991 brood) to 78 percent (1977 brood), with an average exploitation rate of 55 percent in all years (Table 4-11). Based on coded wire tag analysis of HOR fish, most exploitation historically occurred in ocean fisheries, primarily in Washington and off the west coast of Vancouver Island, with an average total adult equivalent exploitation rate in all ocean fisheries of 42 percent for the 1977 through 1996 broods. Reductions of exploitation rates in these fisheries in recent years, particularly in response to the poor survival rates of many stocks in the early 1990s, resulted in ocean exploitation rates as low as 11 percent (1991 brood).

Table 4-11. Total adult equivalent mortality exploitation rates for fall Chinook released from the Cowlitz Fish Hatchery.

Brood Year	Ocean	Freshwater Net	Freshwater Sport	Total
1977	64%	13%	1%	78%
1978	62%	8%		70%
1979	62%	9%	1%	72%
1980	50%	11%	2%	63%
1981	42%	12%	2%	58%
1982	45%	22%	4%	71%
1983	38%	27%	9%	74%
1984	41%	21%	9%	71%
1985	52%	8%	14%	74%
1986	42%	6%	3%	51%
1987	37%	9%	<0.1%	46%
1988	47%	4%	<0.1%	51%
1989	64%	1%	4%	69%
1990	24%	3%	13%	40%
1991	11%	0.4%	2%	13%
1992	19%	<0.1%		19%
1993	27%	1%	4%	32%
1994	46%		5%	51%
1995	21%	1%	9%	31%
1996	45%	<0.1%	15%	60%

Local fisheries directed at the harvest of Cowlitz River fall Chinook operate in the lower Columbia River and in the Cowlitz River downstream of the Barrier Dam. Sport fisheries occur in the lower Columbia and Cowlitz during August through October with total adult equivalent exploitation rates ranging from 5 to 15 percent for the 1994 through 1996 broods. Hatchery origin fish are not massed marked. Fisheries for fall Chinook are not selective for hatchery-produced fish. In addition, overall harvest rates in recent years has been set so as not to exceed 49 percent.

4.7.3 Coho

Coho from the Cowlitz River are harvested in a variety of sport and commercial fisheries in British Columbia, Oregon and Washington. Total adult equivalent exploitation rates in all fisheries since the 1972 brood have ranged from 29.0 (1991 brood) to 97.9 percent (1972 brood), with an average exploitation rate of 72.3 percent in all years (Table 4-12). Based on coded wire tag analysis of HOR fish, most exploitation historically occurred in ocean fisheries, primarily in Washington and off the west coast of Vancouver Island, with an average total adult equivalent exploitation rate in all ocean fisheries of 47.8 percent for the 1972 through 1998 broods. Reductions of exploitation rates in these fisheries in recent years, particularly in response to the poor survival of many stocks in the early 1990s, resulted in ocean exploitation rates as low as 17.5 percent (1991 brood).

Table 4-12. Total adult equivalent mortality exploitation rates for coho released from the Cowlitz Fish Hatchery.

Brood Year	Ocean	Freshwater Net	Freshwater Sport	Total
1972	73.8%	24.1%		97.9%
1980	78.9%	0.8%	0.2%	80.0%
1981	33.8%	26.8%	13.7%	74.4%
1982	45.5%	33.8%	2.3%	81.6%
1983	38.0%	45.5%	2.0%	85.4%
1984	46.3%	20.0%	5.6%	80.9%
1985	39.2%	32.4%	10.4%	82.0%
1986	54.6%	28.4%	2.6%	85.5%
1987	66.3%	11.0%	1.4%	78.6%
1988	42.4%	28.2%	10.0%	80.6%
1989	40.1%	10.0%	30.3%	80.3%
1990	64.7%	4.5%	7.1%	76.3%
1991	17.5%	7.7%	3.8%	29.0%
1992	64.9%	1.1%		66.0%
1993	45.2%	7.0%	2.5%	54.6%
1994	29.0%	2.2%	2.3%	33.6%
1997	28.6%	35.5%	1.7%	65.9%
1998	51.4%	10.4%	7.0%	68.8%

Fisheries directed at the harvest of Cowlitz River coho operate in the lower Columbia River and in the Cowlitz River downstream of the Barrier Dam. Sport fisheries occur in the lower Columbia and Cowlitz during August-November, with total adult equivalent exploitation rates ranging from 1.7 to 7.0 percent for the 1994 through 1998 broods.

Hatchery origin coho are now mass marked with an adipose fin clip. Ocean and in-river sport fisheries are selective for hatchery fish.

4.7.4 Steelhead

4.7.4.1. Late Winter Steelhead

Statewide rules for steelhead fisheries have been developed to protect wild salmon and steelhead populations while providing recreational angling opportunities on hatchery stocks. Only fisheries that release wild steelhead are permitted in the Lower Columbia area, including the Cowlitz River, where all anglers are required to release all non-adipose clipped steelhead. Fisheries targeting hatchery winter steelhead in the Lower Cowlitz River occur from November through May, and incidental harvest also occurs during spring Chinook fisheries from February through May.

Estimates of harvest rates on wild winter steelhead are not possible for many streams, including the Cowlitz, because estimates of total escapement and mortality are often not available. One exception is the Kalama River, where an ongoing research program provided evidence of the effectiveness of selective fisheries in reducing fishery harvest

rates. Harvest rates for wild winter and summer steelhead declined from over 50 percent to approximately 6 percent after the imposition of selection regulations.

The WDFW found that encounter rates of wild winter steelhead in selective fisheries were similar to harvest rates that occurred when anglers were permitted to retain wild steelhead. Using this analysis, estimates of harvest rates in the Kalama and Toutle rivers of approximately 70 percent, and a mortality rate of 6 percent for fish released, WDFW estimates a 4 percent harvest rate on wild winter steelhead in the Cowlitz River (WDFW 2001). Some mortality may occur in lower Columbia River sport fisheries and gillnet fisheries directed at spring Chinook. Handling mortality in these fisheries is estimated at less than 10 percent.

4.7.4.2. Early Winter Steelhead

Statewide rules for steelhead fisheries have been developed to protect wild salmon and steelhead populations while providing recreational angling opportunities. Only wild steelhead release fisheries are permitted in the Lower Columbia area, including the Cowlitz River, and all anglers are required to release all non-adipose clipped steelhead. Fisheries targeting hatchery winter steelhead in the Lower Cowlitz River occur from November through May with early winter steelhead caught primarily in December and January. Incidental harvest also occurs during spring Chinook fisheries from February through April in the mainstem Columbia River. Harvest rates on early winter steelhead have been estimated at 70 percent.

4.7.4.3. Summer Steelhead

Summer steelhead are harvested in a variety of sport and commercial fisheries in Washington freshwater fisheries. Steelhead are occasionally harvested in marine fisheries but the number of Cowlitz River fish taken is inconsequential.

Fisheries directed at the harvest of Cowlitz River summer steelhead operate in the lower Columbia River and in the Cowlitz River downstream of the Barrier Dam. Sport fisheries occur in the lower Columbia and Cowlitz year round and total adult equivalent exploitation rates have been estimated at 70 percent. Ocean and freshwater net harvest (lower Columbia) is non-directed and insignificant.

4.7.5 Sea-Run Cutthroat Trout

Sea-run cutthroat are harvested in a variety of freshwater sport fisheries in Washington. Although cutthroat are commonly caught in marine fisheries in Puget Sound, few are harvested from the Pacific Ocean. Therefore, the ocean harvest of Cowlitz River fish taken is inconsequential.

Fisheries directed at the harvest of Cowlitz River sea-run cutthroat operate in the lower Columbia River and in the Cowlitz River downstream of the Barrier Dam. Sport fisheries occur in the lower Columbia and Cowlitz year round. Exploitation rates are not known but could be part of the monitoring program developed for this plan.

All HOR cutthroat are adipose clipped. Only adipose clipped fish can be retained in sport fisheries (i.e. all wild fish are required to be released).

4.7.6 Other Salmonids

Fishery exploitation rates on chum, sockeye, and pink are unknown but are expected to be low due to the lack of commercial fisheries directed at the harvest of these species and the non-retention regulations in place for sport fishing. Exploitation of resident trout are unknown but are expected to be of at least a moderate level as fisheries are specifically designed to target them. Directed fisheries exist on smelt (eulachon) in the Lower Cowlitz River.

4.7.7 Non-salmonids

Fishery exploitation rates on non-salmonids are unknown but are expected to be of at least a moderate level, as fisheries are specifically designed to target them.

5.0 Objectives and Strategies

The development of strategies consistent with the goals laid out in the Settlement principles and the FERC license articles is a key component of the FHMP. To develop the strategies, the Settlement guidelines and license articles were reviewed in the context of the assessments described in Section 4.0, and specific objectives identified for the FHMP. Finally, drawing upon the assessment and objectives, strategies were developed for artificial production and fishery management actions that were as consistent as possible with the Settlement, yet met fisheries policy concerns and objectives of the WDFW.

A brief overview of the key objectives and strategies for all species is discussed below.

Reintroduction and Recovery: The primary objective of the Settlement is ecosystem integrity and the restoration and recovery of wild, indigenous salmonid runs, including ESA-listed and unlisted stocks, to harvestable levels. This objective will be achieved through the reintroduction of hatchery adult Chinook, coho, and steelhead into the upper Cowlitz River and Tilton River basins. Effective fish passage facilities will be constructed or improved at key locations in the Cowlitz River basin to increase fish survival through the Project area.

Artificial Production: Hatchery programs for native fish species will be operated based on HSRG protocols for Integrated Type programs. An Integrated program cannot be initiated until success of the reintroduction effort is realized. Non-native fish hatchery programs will follow the Segregated Type strategy. Native fish reared at the Cowlitz Hatchery Complex will be reared to produce high quality smolts. A quality hatchery smolt is defined as a fish that is similar in health status, physiology, morphology, and behavior to a naturally produced smolt originating upstream of Mayfield Dam. Non-native fish species will be reared to produce a smolt that maximizes adult production to the extent possible.

Hatchery rearing conditions will be improved through hatchery modifications that increase overall water quality and reduce rearing density to optimize survival. Hatchery programming will be based on providing optimum rearing conditions for stocks regardless of current or historical rearing and release site. Use of temperature control during incubation and early rearing, species and site-specific loading and density guidelines, mating protocols that maximize genetic variability, enriched rearing environments, and modification of hatchery structures to allow volitional migration will enable hatchery populations to develop the physiological, morphological, and behavioral traits important to long-term fitness. These measures will reduce competition and predation risks to naturally produced stocks.

The level of hatchery production proposed in the FHMP is designed to meet the adult benchmark targets outlined in the Settlement Agreement (Table 5-1). Hatchery operations and basin fisheries will be managed to meet both hatchery broodstock needs, and to meet escapement goals for the upper basin.

Table 5-1. Cowlitz Hatchery Complex artificial production levels for the draft 2004 Brood Document and After Rebuild (2008)[7].

Species/stock	CURRENT (2004 draft Brood Document)		AFTER REBUILD (>2008)*		NOTES
	Number	*Pounds*	*Number*	*Pounds*	
Spring Chinook	1,267,000	122,414	967,000	141,021	Smolts 4, 8, 16 fpp
Fall Chinook	5,000,000	62,500	4,000,000	50,000	Presmolts 80 fpp
Coho	3,210,000	213,343	2,310,000	154,000	Smolts 15 fpp
Late winter steelhead	590,000	80,000	450,000	56,250	Smolts 8 fpp**
Early winter steelhead	300,000	60,000	200,000	40,000	Smolts 5 fpp
Summer steelhead	550,000	106,666	450,000	90,000	Smolts 5 fpp
Sea-run cutthroat trout	160,000	37,500	50,000	6,250	Smolts 8 fpp
TOTALS	*11,067,000*	*682,423*	*7,732,000*	*571,271*	

* Hatchery numbers proposed for 2007 and after are estimates and would be subject to the results of the credit mechanism analysis.

** Current hatchery late winter steelhead size at release.

Note: Additional presented in Appendix 5.

Habitat: The protection of high quality habitat and the restoration of degraded aquatic and riparian habitat within the Cowlitz River watershed are recognized as key components of the overall recovery process. Part of the Settlement Agreement requires the establishment of the Habitat Advisory Group, whose task is to develop a habitat restoration and protection plan to be implemented downstream of the Barrier Dam. Restoration of degraded habitat upstream of the Barrier Dam will be accomplished through regulatory processes in place, including implementation of the Forest and Fish Agreements.

The presentation for each species begins with a brief overview of the management approach and a synopsis of the objectives and proposed strategies for each species for two time periods, short term (Phase 1<15 years) and long term (Phase 2 >15 years). Additional details on the objectives and strategies are provided in subsequent sections.

5.1 Spring Chinook

The long-term (>15 years) goal of the spring Chinook stock management strategy is to produce locally adapted native spring Chinook populations in the upper Cowlitz, Cispus and the Tilton rivers.

[7] A monitoring program and the credit mechanism will be used to adjust production on a yearly basis. This FHMP proposal is primarily to establish the number of fish released annually.

In Phase 1 of the FHMP, spring Chinook restoration will be emphasized in stream reaches upstream of Cowlitz Falls Dam. Spring Chinook inhabiting both the upper Cowlitz and Cispus river systems will be managed as a single stock, referred to as upper Cowlitz spring Chinook. The single stock management strategy is required due to the inability to correctly identify the stream of origin of juveniles or adults arriving at fish passage collection facilities in the upper basin. NOAA-Fisheries has also recommended, due to genetic reasons, that for now the population be managed and monitored as a single population (see section 3.5.1).

The primary Phase 1 objectives for the upper Cowlitz River population will be to recover this population to levels that ensure its continued existence over time, allow for the testing of the productivity assumption criterion, abundance and recruits-per-spawner (R/S) needed to implement adult fish passage, and to provide sport fishing opportunity once the stock recovers.

The objectives for the upper Cowlitz River spring Chinook stock will be achieved by emphasizing natural production, improving hatchery practices, implementing an Integrated Type hatchery strategy once wild fish production increases, reducing overall hatchery production (all species combined), and tightly controlling in-river harvest opportunities in the upper Cowlitz River basin until such time as studies to estimate stock productivity are completed.

Spring Chinook will not be restored to the Tilton River in Phase 1 due to low intrinsic productivity resulting from poor habitat conditions, high out-of-basin harvest rates, and logistical problems associated with accurately determining R/S values for multiple populations.

The hatchery spring Chinook program will be managed in anticipation that an Integrated Type strategy designed to achieve conservation goals over the short term and both conservation and harvest goals over the long term (>15 years) will be the preferred approach for the basin. This assumption is based on the premise that the proposed spring Chinook restoration program is successful, thus providing the adults needed to implement an Integrated Type hatchery program. If not, then in the future managers will have the flexibility to adapt hatchery practices to best meet management objectives.

Harvest of hatchery fish will continue in the lower river on a yearly basis so long as escapement goals are met for both the hatchery and upper Cowlitz natural populations. Fishing for spring Chinook above Cowlitz Falls Dam will not be allowed while the productivity test is in progress. Fishermen will be required to release all unmarked spring Chinook caught in recreational fisheries. This action is designed to achieve a less than 4 percent sport fishing mortality rate on naturally produced spring Chinook. The actual catch and mortality rate for sport caught natural spring Chinook will be monitored on a yearly basis.

5.1.1 Synopsis of Objectives and Strategies

A brief synopsis of the objectives and the proposed strategies to meet each is presented below.

Phase 1 Objectives. Increase juvenile fish collection efficiency and survival through the Cowlitz River hydropower system; conduct productivity experiments in the upper Cowlitz River to determine if effective upstream volitional passage facilities should be constructed; determine adult migration success through Mayfield Lake; begin development of a locally adapted broodstock for the upper Cowlitz; meet the recovery standard for the lower Columbia Chinook ESU; provide fishing opportunities; improve hatchery fish quality; and achieve the 106,000 adult benchmark target identified in the Settlement Agreement.

The strategies proposed to achieve spring Chinook Phase 1 objectives are as follows:

- Habitat/Fish Passage. Improve juvenile fish passage/collection facilities at Mayfield Dam, Cowlitz Falls Dam and/or a future location above Mossyrock Dam. The facilities will be designed and operated to achieve the 75 to 95 percent survival standard for spring Chinook originating from the upper Cowlitz River basin, and the 95 percent survival standard for juveniles passing Mayfield Dam.

- Reintroduction. Initiate the productivity experiment by releasing a minimum of 2,000 natural origin (NOR) and/or hatchery origin spring Chinook into the upper Cowlitz River for a period of at least three years. The goal is to have a minimum escapement of 2,000 spring Chinook adults (ideally all NOR). Use of adults provides the quickest means to initiate the productivity experiment and promotes the process of local adaptation for the introduced stock. The target number of spring Chinook for release was selected to promote achievement of the linked criteria of abundance and productivity (R/S), which defines, for fish passage decisions, whether a stock is sustainable over time. All juvenile releases of spring Chinook will be discontinued in the upper Cowlitz and Tilton rivers to eliminate confounding of study protocols and results.

- Productivity Enhancement. Distribute adult salmon carcasses from the Cowlitz Salmon Hatchery (if available) to the Tilton and upper Cowlitz rivers as appropriate, which likely will contribute to increased productivity of the watershed.

- Artificial Production Programs. Release approximately 967,000 juvenile spring Chinook smolts from the Cowlitz Hatchery Complex each year to provide the adults needed to meet broodstock, conservation and harvest goals. Conduct a size at release study at the hatchery to determine release size impacts to survival, run-timing, age structure and native fish populations. Update Cowlitz Hatchery Complex facilities and test rearing techniques to produce hatchery juveniles that are similar in physiology, morphology, behavior, and health status to naturally produced fish.

- Fishery Management. Support the WDFW in the implementation of a fishery management regime that protects upper Cowlitz spring Chinook, while at the

same time allowing continued sport harvest of hatchery origin adults in the lower Cowlitz River. Investigate new sport fishing opportunities for surplus hatchery spring Chinook in the river reach extending from Riffe Lake to Cowlitz Falls Dam, once the productivity experiment study is implemented.

Phase 2 Objectives. Phase 2 objectives would depend on the results of Phase 1 strategies, and therefore cannot be described in detail at this time. If Phase 1 objectives could not be achieved, Phase 2 objectives may include:

1) Maintain some level of natural production in stream reaches above Mayfield Dam. This production would not need to be self-sustaining.

2) Implement a juvenile supplementation program in the Tilton River and upper Cowlitz River.

3) Increase hatchery production to the maximum provided in the Settlement Agreement (800,000 lbs).

4) Use the $15 million reserved for fish passage facility construction to improve stream habitat in the basin as outlined in the Settlement Agreement.

5.1.2 Goals and Objectives

Fisheries goals are classified into three categories: conservation, harvest and habitat. For this analysis, conservation goals are presented in terms of biological significance of the stock and its viability. Habitat goals are expressed as the quality of the environment to support anadromous fish production. Harvest goals are expressed as the level and types of fisheries that can be supported from this production.

The simple terminology used in Table 5-2 is meant to convey management goals and direction over time for Cowlitz River spring Chinook. A quick review of the table data indicates that the goal of fisheries managers is to increase stock biological significance, viability and habitat quality over time. Achieving these conservation and habitat goals should lead to increased harvest, thus meeting harvest goals for the basin.

All strategies proposed in the FHMP were designed to be consistent with the conservation, habitat and harvest goals listed in Table 5-2.

5.1.2.1. Stock Reintroduction and Recovery

One of the key objectives of this plan is the reintroduction of spring Chinook in the Upper Cowlitz River and the subsequent testing of the productivity of the system. The Upper Cowlitz was selected for testing productivity instead of the Tilton population in the short term for the following reasons:

- The Settlement specifically calls for testing the R/S and abundance criteria for spring Chinook in the upper Cowlitz.

Table 5-2. Summary of biological significance, habitat quality, fishery exploitation rates, and Phase 1 strategy for each population of spring Chinook.

	Spring Chinook Population			
	Cowlitz Hatchery	**Tilton River**	**Upper Cowlitz**	**Cispus River**
Biodiversity Significance and Genetic Integrity				
Current	Medium	Extirpated	Extirpated	Extirpated
Short-term Objective	Medium	Extirpated	Medium	Medium
Long-term Objective	Medium	Medium	High	Medium
Habitat Quality				
Current	NA		Low	Low
Short-term Objective	NA		Medium (Adults 4,469)	Medium (Adults 1,008)
Long-term Objective	NA	Medium (Adults 4,255)	High (Adults 8,782)	High (Adults 1,995)
Fishing Opportunities				
Current*	Medium (HR = 48%)	None	None	None
Short-term Objective	Medium (HR = 48%)	None	Low (HR = 30%)	Low (HR = 30%)
Long-term Objective	Medium (HR = 48%)	Medium (HR = 36%)	Medium (HR = 36%)	Medium (HR = 36%)

HR= Assumed harvest rates

* Harvest rates on hatchery origin spring chinook were estimated by the Lower Columbia Recovery Board at 53% for the 2001 to 2003 period (NOAA-Fisheries letter dated July 20, 2004)

Adults= EDT adult abundance estimate for current (short-term) and PFC (long-term)

- The population assessment indicates that a successful result from the test of productivity is unlikely in the Tilton River given the current habitat conditions in this basin and high harvest rates primarily in out-of-basin fisheries.

- Attempting to monitor productivity of two populations simultaneously creates fish marking logistical problems that are difficult to overcome, or introduces uncertainty into the analysis that complicates data interpretation.

Ultimately, the spring Chinook objective is to meet the recovery standards developed for the lower Columbia Chinook ESU.

5.1.2.2. Harvest

Overall, WDFW general harvest goals are to provide fishing opportunities consistent with the mandate of the agency *for restoration and recovery of wild indigenous salmonid runs,* the Pacific Salmon Treaty, the Pacific Fisheries Management Council, US v. Oregon, and other state, federal, and international legal obligations. Specific harvest objectives will vary depending on the phase of the reintroduction and recovery program – fishery

exploitation rates are expected to increase as the status of natural populations of spring Chinook improves (Table 5-3).

Harvest of Cowlitz River spring Chinook in marine fisheries in Southeast Alaska and British Columbia is expected to occur through 2008 under the provisions of the 1999 annexes of the Pacific Salmon Treaty (PST). These provisions include a schedule of allowable harvest rates that vary with aggregate stock abundance for fisheries in Southeast Alaska (troll, net, and sport gear), Northern British Columbia (troll and Queen Charlotte sport), and West Coast Vancouver Island (troll and outside sport). Provisions in the PST also require Canada and the United States to reduce by 36.5 percent and 40 percent respectively, the total adult equivalent mortality rates (relative to the 1979-82 base period) in other fisheries that affect the prescribed list of stocks. Although Cowlitz River spring Chinook are not included in that list, reductions in exploitation rates for the stocks remain likely due to their co-mingled status.

Harvest of spring Chinook with an adipose fin in commercial fisheries in the mainstem Columbia River may occur in February and March. Current US v. Oregon agreements and ESA requirements limit this fishery to a maximum of a 0.6 percent harvest rate.

Sport fisheries selective for adipose fin-clipped spring Chinook are expected to occur in the mainstem Columbia River and the lower Cowlitz River from March through July. Assuming a 10 percent mortality rate for the release of unclipped fish, a 6 percent encounter rate in the mainstem Columbia, and a 30 percent encounter rate in the lower Cowlitz River, the WDFW objective for the total freshwater harvest rate in these sport fisheries is 3.6 percent.

Currently, there are selective fisheries operating upstream of Mayfield Dam that are assumed to result in < 1 percent mortality. During testing of the R/S and abundance criteria, harvest upstream of Cowlitz Falls Dam would be eliminated. This fishery may be replaced by the release of hatchery fish into the river reach below Cowlitz Falls Dam.

It should be emphasized that Tacoma Power cannot control actual harvest rates and policy in the state. The harvest actions outlined above were developed cooperatively by the FTC and are meant to provide guidance to the WDFW regarding the harvest actions the FTC believe best meet the goals of the Settlement Agreement. As a member of the FTC, and a signatory to the Settlement Agreement, it is assumed that WDFW will make a good faith effort to implement the recommendations.

5.1.2.3. Habitat

The primary habitat goal for the FHMP is to increase juvenile spring Chinook fish survival through the Cowlitz River hydropower complex. The Settlement Agreement sets a juvenile fish passage survival rate (FPS) of 75 to 95 percent for upper basin stocks, and 95 percent survival for fish stocks passing Mayfield Dam. Long-term, the WDFW has the goal of achieving PFC in the lower Cowlitz, Tilton and upper Cowlitz River. EDT estimates of spring Chinook production under PFC conditions are included in Table 5-2 under the Long-term Objective.

Table 5-3. Stock harvest profile (Treaty and non-Treaty) for Cispus River and Upper Cowlitz spring Chinook populations (natural spawning origin).

Fishery Aggregate	1994-1995 Broods		Phase 1 Productivity Test Period		Phase 2 Long-term Target	
	Description	AEQ Harvest Rate	Description	AEQ Harvest Rate	Description	AEQ Harvest Rate
Freshwater Sport, above Cowlitz Barrier Dam	Selective fishery on hatchery-origin fish during May-June	< 1.0%	Harvest will be allowed on HORs until Trigger 1 is met. No fishery during productivity testing.	0%	Fishery from May-July.	10.0%
Freshwater Sport, Columbia River mouth to Cowlitz Barrier Dam	Fishery operating from March-July.	20.0%	Selective fishery on hatchery-origin fish during March-July.	3.6%	Selective fishery on hatchery-origin fish during March-July.	3.6%
Mainstem Net	Incidental harvest during fisheries directed at other species.	2.0%	Selective fishery on hatchery-origin fish during Feb.-March.	0.6%	Selective fishery on hatchery-origin fish during Feb.-March.	0.6%
Ocean Troll, Net, and Sport	Fisheries managed consistent with PST and PFMC regulations.	26.0%	Fisheries managed consistent with PST and PFMC regulations.	26.0%	Fisheries managed consistent with PST and PFMC regulations.	26.0%
Total AEQ* Exploitation Rate	48%		30%		36%	

AEQ- Adult Equivalent Harvest rate.

*Harvest rates on hatchery origin spring chinook was estimated by the Lower Columbia Recovery Board at 53% for the 2001 to 2003 period (NOAA-Fisheries letter dated July 20, 2004).

5.1.3 Strategies

Achieving the multiple conservation, harvest and habitat goals of this plan will require the development and implementation of innovative strategies, extensive monitoring, and adaptive management. Key strategies are listed below.

- Implement improved juvenile collection facilities at both Mayfield Dam and Cowlitz Falls Dam to increase natural fish production.

- Implement an adult supplementation program to reintroduce spring Chinook into stream reaches above Cowlitz Falls Dam in the short-term and the Tilton River in the long-term.

- Eliminate all juvenile spring and fall Chinook releases in the two basins.

- Mass mark all hatchery origin fish to provide fishing opportunities while limiting exploitation rates on natural stocks. Hatchery staff will quantify drop rate of marked fish in order to calculate a correction factor when estimating natural adult returns to the basin.

- Begin implementing an integrated artificial production program, based on HSRG guidelines, to promote the recovery of spring Chinook in the upper Cowlitz River and the Cispus River. This cannot proceed however until a self-sustaining natural population is established in the upper Cowlitz River basin.

- In the short term, maintain the existing hatchery program to provide fishing opportunities in the lower Cowlitz River while limiting impacts on naturally-produced spring Chinook to levels identified in Table 5-3.

- The basin-wide stock management strategy emphasizes the production of indigenous fish stocks both in the wild and at the hatchery. Non-indigenous salmonid hatchery stocks will not be allowed above Mayfield Dam, and hatchery production of these non-native stocks will be reduced over time as native stocks recover.

- To reduce interactions between hatchery and ESA-listed Chinook stocks, hatchery production for all species combined will not exceed 650,000 pounds in the remodeled facility.

- To restore and maintain ecosystem integrity, salmon carcasses from the Cowlitz Salmon Hatchery may be placed in the Tilton River and upper Cowlitz River basins. This action should also help increase habitat productivity.

5.1.3.1. Collection and Passage

Downstream fish passage collection facilities will be improved at both Mayfield Dam and at Cowlitz Falls Dam. The facilities will be designed and operated to achieve the 75 to 95 percent survival standard for Chinook originating from the upper Cowlitz River basin,

and the 95 percent survival standard at Mayfield Dam. Tacoma Power is currently studying the feasibility and expected effectiveness of several options for the upper Cowlitz Falls juvenile collector.

5.1.3.2. Adult Carcass Distribution

If WDFW chooses to use surplus hatchery fish to enhance the nutrients above Mayfield Dam, and if allowed in the approved Disease Management Plan, a productivity experiment will be undertaken to distribute carcasses of surplus hatchery fish collected at the Cowlitz Salmon Hatchery Complex to the Tilton and upper Cowlitz rivers. This action is designed to increase system productivity, thereby increasing the chance for the successful reintroduction of anadromous fish to key areas in the basin. Whether or not this action is implemented, at what scale and how, will depend on the disease management plan developed for the basin. The carcass distribution program will be implemented consistent with the Disease Management Plan and with WDFW approval to use surplus fish.

5.1.3.3. Stock Reintroduction and Recovery

A summary of the strategies considered for the reintroduction of anadromous fish in the Upper Cowlitz is provided in Appendix 3. Upon review, the adult supplementation strategy was deemed the best suited for achieving identified spring Chinook goals. This decision was based on the following rationale:

- Natural production is defined as adults successfully spawning in the wild. Therefore, supplementing hatchery adults rather than juveniles in these streams is the quickest way to achieve the primary goal of increasing natural production in the basin.

- Outplanting hatchery adults rather than juveniles ensures that the entire life-cycle of the fish is completed naturally rather than a portion artificially in the hatchery environment. Consequently, resulting juvenile production is completely free of any hatchery influences.

- Under the adult supplementation strategy, fish managers will be able to measure spawning success within a single generation. In contrast, in a juvenile supplementation program, the spawning success of returning adults will not be known until one generation later and only then if fish managers either discontinue stocking hatchery juveniles into the watershed or spend considerable resources to mark all hatchery releases.

- Using adults to seed the watersheds eliminates many of the management complexities associated with a juvenile supplementation program. These complexities include determining the correct juvenile release size, release timing, number of juveniles to be released and how to distribute the juveniles throughout the watershed.

The number of adults released into the upper basin each year would depend on run composition (hatchery versus natural) and the experimental protocols needed to measure system productivity (see 5.1.3.4 below). Initially, it is anticipated that a minimum of 2,000 spring Chinook would be released each year. The number of adults released each year would vary depending on the composition of the run, that is the percent of hatchery and naturally produced adults returning to the basin and trigger status (see below).

5.1.3.4. Measuring Productivity

The Settlement Agreement requires that the upper Cowlitz basin be managed to determine if a self-sustaining run of spring Chinook can be produced in this basin. In the Settlement Agreement, it is stated that the upper Cowlitz River population would be considered self-sustaining if:

1) the R/S value, measured at the Barrier Dam, was greater than 1.0 in 3 of 5 consecutive brood years, and for a 5-year rolling average, and

2) the number of pre-spawners arriving at the Barrier Dam exceeds the adult abundance level established by NOAA-Fisheries (500 adults) in at least 3 of 5 consecutive brood years and for a rolling 5-year average.

Once these two criteria are met, adult passage may be built at Barrier and Mayfield dams to allow anadromous fish access to both the Tilton River and the Mossyrock tailrace if it has also been shown that adults are able to self-sort in Mayfield Lake. A new trap-and-haul facility would also be constructed near Mossyrock Dam to collect and transport fish bound for the upper Cowlitz River.

Spring Chinook management in the upper Cowlitz River basin will vary depending upon three triggers. A brief description of proposed spring Chinook management for the period before any of the three triggers is achieved (Pre-trigger 1 or 2) and after specific triggers have been observed is presented below.

Pre-Trigger 1 or 2

All NOR adult spring Chinook of upper Cowlitz River origin will be transported and released into the upper Cowlitz River. No restrictions will be placed on the number of surplus hatchery adult spring Chinook that can be released in the basin. This action is expected to maximize, to the extent possible, spring Chinook utilization of all available habitat in the upper Cowlitz River. Harvest will be allowed on adipose fin-clipped (marked) fish only during this time period so long as the minimum escapement goal of 2,000 fish (hatchery and natural) has been achieved.

Trigger 1: FPS ≥ 40 percent

Once the 40 percent FPS trigger is met for upper Cowlitz River origin spring Chinook passing Barrier Dam, hatchery fish stocking in the upper basin will be limited to the number needed to maintain a minimum adult population of 2,000 fish. If NOR fish returns are greater than 2,000, no HOR fish will be released into the upper Cowlitz River

basin. All upper Cowlitz River basin NOR fish arriving at Barrier Dam will be transported and released into Lake Scanewa. If the number of NOR adults is less than 2,000, hatchery fish may be used to make up the difference. Harvest will not be allowed on spring Chinook in the upper basin once this trigger is achieved. This action is designed to ensure an accurate count of the number of spawners released in the watershed so that Trigger 2 can be measured with precision.

Trigger 2: S/S ≥ 30 yearling Smolts or ≥ 70 juveniles (subyearling or yearling)

Currently spring Chinook juveniles arriving at Cowlitz Falls Dam consist of both subyearling (dominate type) and yearling migrants. In addition, yearling spring Chinook are also being collected at Mayfield Dam. The smolts-per-spawner (S/S) criteria require that accurate estimates of both types of migrants be calculated each year.

For each brood year, biologists will calculate the number of smolts produced per spawner. The estimate will be made at the Barrier Dam, as required by the Settlement Agreement, to account for handling mortality such as transport and juvenile marking (if any).

The S/S criterion for smolts is based on the assumption that in the long term, an SAR of ~3.3 percent is needed for the population to be self-sustaining. In contrast, the S/S criteria for all migrants assumes that an SAR of ~1.4 percent achieves the same objective. The S/S criteria for both migrant types are calculated by simply dividing 1 by the assumed SAR value. It should be noted that the S/S values are modeled assumptions that will be tested by collecting juvenile and adult data at Barrier Dam. If spring Chinook SARs are higher than modeled, the S/S criterion could be reduced, and vice-versa. However, because complete adult returns will not be available until up to four years after the juveniles emigrate from the system, the opportunity to adjust the S/S assumption is limited given the timeframe needed for decision-making regarding fish passage (12-15 years). It is for this reason that the SAR values were set conservatively, i.e. relatively high, so that fewer smolts-per-spawner are needed to begin the productivity test.

When the S/S value(s) is achieved, it is assumed that population productivity is sufficient to maintain itself over time. Once this occurs, hatchery adults will no longer be stocked into the upper Cowlitz River unless total NOR run-size drops below the NOAA-Fisheries abundance target criterion of 500 adults. At that time, the FTC may choose to supplement the population with hatchery adults. Regardless of the decision made, the FTC will produce a document describing the rationale behind the decision.

Trigger 3: Year 7 of the FHMP

If the S/S triggers are not achieved by year 7 of the FHMP, hatchery fish will no longer be stocked in the upper Cowlitz and the productivity test continued with NOR fish only. This action is needed to ensure that sufficient time is available to measure R/S values, one of the fish passage criteria identified in the Settlement Agreement, for at least five brood years during the timeframe needed for decision-making regarding fish passage (12-15 years).

If this trigger is achieved, harvest of spring Chinook adults will not be allowed in the upper Cowlitz River until a decision is made by the FTC to abandon the productivity test.

5.1.3.5. Artificial Production

Hatchery Management

The hatchery spring Chinook program will be managed under the assumption that an Integrated Type program will best achieve the conservation and harvest goals identified for this population over the long term (Phase 2).

Building an Integrated Type population will require that a locally adapted natural spawning stock be developed from the stock currently adapted to the hatchery environment. This will be accomplished by re-introducing adult spring Chinook of hatchery origin into the upper Cowlitz River. Initially, it is assumed that up to 2,000 hatchery adult spring Chinook may be needed for this effort. The exact number released would depend on the number of naturally produced adults returning to the basin, and whether the S/S trigger has been met.

Naturally produced adults will not be incorporated into the hatchery population so long as the upper basin productivity experiment is being conducted. However, experiments will be undertaken to look at differences in survival and life history traits for spring Chinook released at 4, 8 and 16 fpp from the hatchery. In years 12-15 of the program, the results of the upper basin productivity experiment will be used to select a preferred management approach (Segregated versus Integrated) for hatchery production in the basin.

Over the short term (Phase 1), it is assumed that the number of juveniles required to meet the 106,000-adult benchmark will be produced at the Cowlitz Hatchery Complex. The benchmark is not meant to be a mitigation goal, but will act as a performance indicator to measure hatchery performance.

Based on the data presented in Cramer (2002), 708,000 hatchery smolts would need to be released each year to achieve the benchmark. However, because additional adult production will be needed for the upper basin supplementation program, hatchery production will be increased to 967,000 hatchery smolts. The number of juveniles released is based on the assumption that hatchery spring Chinook age-2 survival was 15 percent for the benchmark time period (Cramer 2002)[8].

Spring Chinook at the Cowlitz Hatchery Complex will be reared to produce high quality smolts. A quality hatchery smolt is defined as a fish that is similar in health status, physiology, morphology, and behavior to a naturally produced smolt originating upstream of Mayfield Dam. It is recognized that due to the different rearing conditions present in the hatchery versus the wild, to increase adult returns, fish released from the hatchery may not mimic wild fish precisely.

[8] The 15% survival value is based on the rate observed for the benchmark time period, not the overall survival rate observed for hatchery production since inception of the program.

Hatchery rearing conditions will be improved through hatchery modifications that increase overall water quality and reduce rearing density to optimize survival. Hatchery programming will be based on providing optimum rearing conditions for stocks regardless of current or historical rearing and release site. Use of temperature control during incubation and early rearing, species and site-specific loading and density guidelines, mating protocols that maximize genetic variability, enriched rearing environments, and modification of hatchery structures to allow volitional migration will enable hatchery populations to develop the physiological, morphological, and behavioral traits important to long-term fitness. These measures will reduce competition and predation risks to naturally produced stocks. It is hypothesized that these actions will increase average smolt-to-adult return rate (SAR) by 25 percent[9].

Innovative Rearing

The Settlement Agreement calls for hatchery managers to develop and test innovative rearing practices. To meet this requirement, hatchery operations will be implemented to incorporate aspects of semi-natural rearing, including constructing ponds to enhance protective coloration and adding overhead and in-water cover on an experimental basis[10]. The focus of this program will be to produce smolts that are similar in size, coloration, run-timing and behavior to natural smolts. Exact criteria for each parameter will not be available however until more juveniles are collected from the upper Cowlitz River basin.

Adult Escapement Management

To properly operate an Integrated Type hatchery program, managers must track adult returns from both the natural and hatchery components of the run. Sufficient numbers of naturally produced fish are needed to both seed available spawning habitat and to provide genetic material for the hatchery. The concept is that local adaptation is driven by the natural, not the hatchery component of the run. The adult escapement goals for both the natural and hatchery components are presented below. The adult handling protocols and the Cowlitz Complex Production Table are provided in the Appendices 4 and 5**.**

Natural Escapement Goal

The escapement goal for upper Cowlitz River basin NOR spring Chinook adults is the total number of adults arriving at the mouth of the Columbia River minus the assumed loss due to sport fisheries from this same point to Barrier Dam (~3.6 percent).

Hatchery Escapement Goal

Based on historical hatchery practices, approximately 712 adults are required to produce the 967,000 spring Chinook smolts needed to achieve the adult benchmark value and ensure enough adults return to implement the adult supplementation program in the upper Cowlitz River. The total adult escapement target for the hatchery will be 2,712 adult spring Chinook. As noted, 712 adults are required to meet hatchery broodstock, and up to 2,000 for the adult supplementation program. It is recognized that 2,000 hatchery

[9] Monitoring program could be designed to detect a 25 percent difference in survival between test groups.
[10] The Yakama Nation Cle Elum Hatchery facility would be used as a template for this effort.

adults may not be needed in any given year, but they need to be planned for in case NOR returns are less than the 2,000 adult target.

Production Adjustment and Credit Mechanisms

The Settlement Agreement requires that the FHMP identify methods to a) adjust hatchery production upward or downward to accommodate recovery of indigenous stocks, and b) develop credit mechanisms for production of high quality natural stocks. The actions proposed to meet these requirements for spring Chinook are listed below.

- Spring Chinook hatchery production will start at 967,000 smolts to ensure achievement of the adult benchmark, and to produce the adults needed for the upper Cowlitz basin adult supplementation program.

- The number of spring Chinook yearling smolts produced naturally in the upper Cowlitz river basin will be used to reduce the number of hatchery smolts released the next brood year on a 2:1 basis. Subyearling migrants produced from the basin will be used to reduce hatchery spring Chinook smolt production in the next brood year on a 0.5:1 basis. The production adjustment will be based on a 5-year rolling average[11]. The assumption that hatchery origin and naturally produced spring Chinook juveniles produce similar number of adults will be tested over time. The results of this analysis would provide the data needed to adjust the juvenile credit ratio upward or downward.

- The proposed changes in hatchery rearing practices are hypothesized to increase hatchery fish survival by 25 percent. The difference in adult survival between the two test groups will be monitored over time. If this hypothesis is correct, hatchery production would be decreased a commensurate amount, unless juvenile fish are needed for a future juvenile supplementation program.

5.1.3.6. Fishery Harvest

The primary harvest strategies that are needed to achieve the reintroduction, recovery, and harvest objectives of this plan are as follows:

- WDFW will work in the Pacific Salmon Treaty, Pacific Fisheries Management Council, and US v. Oregon forums to promote selective fisheries in appropriate areas to reduce exploitation on depressed naturally produced stocks, thereby continuing to provide fishing opportunities.

- Sport fisheries in the Cowlitz River below the Barrier Dam will be managed according to a schedule that links escapement goals and the S/S trigger to harvest policy in the Cowlitz River. Harvest in the lower portion of the basin (below Barrier Dam) would be reduced if; 1) the 2,000 fish escapement goal

[11] The data needed to make the adjustment are currently being collected at Cowlitz Falls Dam and Mayfield Dam. Adjustments will be made in Year 1 of the FHMP.

(NOR + HOR) cannot be met for the upper basin, or 2) the results of monitoring studies indicate fishing mortality on naturally produced fish exceeds 3.6 percent.

- When either spring Chinook Trigger 1 (FPS of 40 percent) or Trigger 2 is achieved, sport fisheries for spring Chinook in the upper Cowlitz River above Cowlitz Falls Dam would be suspended until the productivity test is completed. A new fishery for spring Chinook might be established in the river reach below Cowlitz Falls Dam to allow sport harvest of hatchery origin fish.

- Adult spring Chinook escapement to the basin will be managed based on the following priorities; 1) hatchery broodstock needs, 2) upper basin reintroduction needs, 3) lower river harvest, and 4) upper river harvest.

5.2 Fall Chinook

The long-term (>15 years) goal of the fall Chinook stock management strategy is to produce native locally adapted fall Chinook populations in the lower Cowlitz (below Mayfield Dam), Upper Cowlitz (Cispus and Upper Cowlitz), and Tilton rivers.

In Phase 1 of the FHMP, fall Chinook restoration will be emphasized in the lower Cowlitz River and Tilton River. The primary Phase 1 objective for both populations will be to recover these populations to levels that ensure their continued existence over time and provide sport-fishing opportunity on hatchery fish as the natural component recovers. In addition, tests will be conducted on the Tilton population to determine if the productivity criteria (R/S and abundance) needed to implement a volitional upstream fish passage system can be met. NOAA-Fisheries has set a 500 adult run size target for Tilton River fall Chinook and a 500 target for upper Cowlitz River fall Chinook.

Fall Chinook would not be restored to the upper Cowlitz in Phase 1 due to logistical problems associated with accurately determining R/S values for upper Cowlitz spring Chinook. In addition, testing of productivity in the Tilton River would be delayed for three years in order to determine the timing, abundance and origin of Chinook juveniles arriving at Mayfield Dam.

The objective for both the Tilton River and lower Cowlitz River fall Chinook populations will be achieved by emphasizing natural production, improving hatchery practices, reducing overall hatchery production (all species combined), reducing the percent of hatchery fish spawning in the wild, and eliminating in-river harvest opportunities in the Tilton River basin until such time as studies to estimate stock productivity are completed.

The hatchery fall Chinook program will be managed in anticipation that an Integrated Type strategy designed to achieve conservation and harvest goals over the long term (>15 years) will be the preferred approach for the basin. This assumption is based on the two premises:

1) That the proposed fall Chinook restoration program is successful, thus providing the adults needed to implement an Integrated Type hatchery program, and

2) Hatchery fall Chinook are mass marked.

Hatchery production of fall Chinook will initially be set 4.0 million juveniles. This level of production should achieve the adult benchmark target of 73,940 adults[12]. This decrease in hatchery production from the current level of 5.0 million should also reduce the number of hatchery fish spawning in the river below Barrier Dam and thus help achieve the HSRG guideline for percent hatchery fish contributing to natural production[13].

Harvest of hatchery fish will continue in the lower river on a yearly basis so long as escapement goals are met for the hatchery, lower Cowlitz and Tilton River populations. This plan recommends that WDFW close Tilton River fall Chinook fisheries once the productivity experiment begins for this stock. Fishermen will be required to release all unmarked fall Chinook caught in recreational fisheries. Studies will be implemented to quantify hooking and release mortality on fall Chinook.

5.2.1 Synopsis of Objectives and Strategies

A brief synopsis of the fall Chinook objectives and the proposed strategies to meet each is presented below.

Phase 1 Objectives. Increase juvenile fish collection efficiency and survival through the Cowlitz River hydropower system; conduct productivity experiments in the Tilton River to determine if effective volitional passage facilities should be constructed; determine adult migration success through Mayfield Lake; begin development of a locally adapted broodstock for the Tilton River and lower Cowlitz populations; meet the recovery standard for the lower Columbia Chinook ESU; provide fishing opportunities; improve hatchery fish quality; and achieve the 77,735 adult benchmark target identified in the Settlement Agreement.

The strategies proposed to achieve fall Chinook Phase 1 objectives are as follows:

- Habitat. Improve juvenile fish passage facilities at Mayfield Dam. The facility will be designed and operated to achieve the 95 percent survival standard for fall Chinook passing Mayfield Dam. Purchase or obtain easements to protect critical juvenile rearing habitat in the Lower Cowlitz River. Maintain the new flow regime below Mayfield Dam to protect fall Chinook production (See Settlement Agreement License Article 13).

[12] The adult benchmark is not meant to be an absolute number, but rather is used as an indicator of hatchery performance.

[13] The HSRG guidelines suggest that hatchery fish contribution (Integrated program) to natural spawning populations should not exceed the number of natural fish incorporated as hatchery broodstock. Currently, the percent of the broodstock consisting of natural fish is unknown as hatchery fall Chinook are not marked.

- Reintroduction. Initiate the productivity experiment for the Tilton River by annually releasing 1,000 adults for a period of up to seven years to measure productivity. The use of adults provides the quickest means to initiate the productivity experiment and promotes the process of local adaptation for the introduced stock. The target number of fall Chinook for release was selected to promote achievement of the linked criteria of abundance and productivity (R/S), which defines whether a stock is sustainable over time.

- Productivity Enhancement. Distribute adult salmon carcasses from the Cowlitz Salmon Hatchery (if available) to the Tilton and upper Cowlitz rivers as appropriate, which will likely contribute to increased watershed productivity.

- Artificial Production Programs. Release approximately 4 million juvenile fall Chinook from the Cowlitz Salmon Hatchery each year to provide the adults needed to meet both conservation and harvest goals. Update Cowlitz Hatchery Complex facilities and test rearing techniques to produce hatchery juveniles that are similar in physiology, morphology, behavior, and health status to naturally produced fish.

- Fishery Management. Implement a fishery management regime that, protects Tilton River and lower Cowlitz River fall Chinook, while at the same time allowing continued sport harvest of hatchery origin adults. Investigate new sport fishing opportunities for hatchery fall Chinook in the river reach extending from Mossyrock Dam to Cowlitz Falls Dam.

Phase 2 Objectives. Phase 2 objectives would depend on the results of Phase 1 strategies, and therefore cannot be described in detail at this time. If Phase 1 objectives could not be achieved, Phase 2 objectives may include:

1) Maintain some level of natural production in stream reaches above Mayfield Dam. This production would not need to be self-sustaining.

2) Implement a juvenile supplementation program in the Tilton River and upper Cowlitz River.

3) Increase hatchery production to the maximum provided in the Settlement Agreement (800,000 lbs).

4) Use the $15 million reserved for fish passage facility construction to improve stream habitat in the basin.

5.2.2 Goals and Objectives

For this analysis, fisheries goals are classified into three categories: conservation, harvest and habitat. Conservation goals are presented in terms of biological significance of the stock and its viability. Habitat goals are expressed as the quality of the environment to

support fall Chinook fish production, and harvest goals as the level and types of fisheries that can be supported.

The simple terminology used in Table 5-4 is meant to convey management goals and direction over time for Cowlitz River fall Chinook. A quick review of the table data indicate that the goal of fisheries managers is to maintain stock biological significance, and increase both viability and habitat quality over time. Achieving these conservation and habitat goals should lead to increased harvest, thus meeting harvest goals for the basin.

Table 5-4. Summary of biological significance, habitat quality, fishery exploitation rates, and Phase 1 strategy for each population of fall Chinook.

	Fall Chinook Population			
	Cowlitz Hatchery	**Lower Cowlitz**	**Tilton**	**Upper Cowlitz Cispus River**
Biodiversity Significance & Genetic Integrity				
Current	Medium	Low	Extirpated	Extirpated
Short-term Objective	Medium	Medium	Medium	Low
Long-term Objective	Medium	Medium	High	Medium
Habitat Quality				
Current	NA	Medium (adults 8,745)	Low	Low
Short-term Objective	NA	Medium (8,745)	Low (adults 1,025)	Low (adults 4,030)
Long-term Objective	NA	High (adults 21,385)	High (adults 4,048)	High (adults 8,563)
Fishing Opportunities				
Current	High (HR = 43%)	High (HR = 43%)	None	None
Short-term Objective	High (HR = 49%)	High (HR = 49%)	High (49%)	High (49%)
Long-term Objective	High (HR = 65%)	High (HR = 65%)	High (65%)	High (65%)

HR= Assumed harvest rates

Adults= EDT adult abundance estimate for current (short-term) and PFC (long-term)

* Harvest rates on hatchery origin fall Chinook were estimated by the Lower Columbia Recovery Board for the 2001 to 2003 period (NOAA-Fisheries letter dated July 20, 2004).

The long-term objective of achieving a 65 percent harvest rate may be optimistic, but is the defined goal of the WDFW. It is anticipated that this level of harvest would not be implemented without consulting NOAA-Fisheries and conducting an extinction risk analysis.

The strategies proposed in the FHMP are designed to be consistent with the conservation, habitat and harvest goals presented in this table.

5.2.2.1. Stock Reintroduction and Recovery

The overarching fall Chinook conservation goal is the recovery of fall Chinook populations in the Cowlitz River. This goal would be achieved in two phases. In Phase 1, fall Chinook would be reintroduced into the Tilton River, and actions would be implemented to reduce hatchery impacts on fall Chinook rearing in the lower Cowlitz River. In Phase 2, fall Chinook would be reintroduced into the upper Cowlitz River. This decision would be revisited in the next iteration of the FHMP.

Ultimately, the objective is to meet the recovery standards developed for the lower Columbia Chinook ESU. Achieving this objective is likely to require habitat, hatchery, and harvest actions outside of the scope of this plan.

5.2.2.2. Fishery Harvest

General harvest objectives are to provide fishing opportunities consistent with the mandate of WDFW, the Pacific Salmon Treaty, the Pacific Fisheries Management Council, US v. Oregon, and other state, federal, and international legal obligations.

Specific harvest objectives will vary depending on the phase of the reintroduction and recovery program – fishery exploitation rates are expected to increase as the status of natural populations of fall Chinook improves (Table 5-5).

Marine fisheries in Southeast Alaska, British Columbia, and Washington that harvest Cowlitz River fall Chinook are expected to operate through 2008 under the provisions of the 1999 annexes of the PST. These provisions include a schedule of allowable harvest rates that vary with aggregate stock abundance for fisheries in Southeast Alaska (troll, net, and sport gear), Northern British Columbia (troll and Queen Charlotte sport), and West Coast Vancouver Island (troll and outside sport).

Provisions in the PST also require Canada and the United States to reduce by 36.5 percent and 40 percent respectively, the total adult equivalent mortality rates (relative to the 1979-82 base period) in other fisheries that affect a prescribed list of stocks. Although Cowlitz River fall Chinook are not included in that list, reductions in exploitation rates of this magnitude remain likely due to the commingled status of Cowlitz and other prescribed stocks.

Current commercial non-selective fisheries in the mainstem Columbia River may occur in August and September to harvest fall Chinook.

Sport fisheries selective for adipose fin-clipped fall Chinook may be implemented in the future in the mainstem Columbia River and the lower Cowlitz River from August through October. Assuming a 10 percent mortality rate for the release of unclipped fish, a six percent encounter rate in the mainstem Columbia, and a 44 percent encounter rate in the lower Cowlitz, the WDFW objective for the total freshwater harvest rate in these sport fisheries would be 5 percent**.**

Harvest rates on this stock will be reduced if it exceeds the 49 percent Rebuilding Exploitation Rate (RER) for Chinook (see Table 5-5).

Currently, there are non-selective fisheries operating upstream of Mayfield Dam that result in less than one percent mortality. Eventually recreational harvest will expand to near ten percent, stock strength allowing.

5.2.2.3. Habitat

In the FHMP, habitat goals are two-fold. The first goal is to increase juvenile fall Chinook fish survival through the Cowlitz River hydropower complex, and second is to protect and improve juvenile rearing habitat in the lower Cowlitz River. Long-term, the WDFW has the goal of achieving PFC in the lower Cowlitz, Tilton and upper Cowlitz rivers. EDT estimates of fall Chinook production under PFC conditions are included in Table 5-4 under Long-term Objective.

5.2.3 Strategies

The key strategies proposed to meet fall Chinook goals are as follows:

- In Phase 1, adult supplementation will be the primary management tool used to restore natural fall Chinook production in the Tilton River. This approach is assumed to be the quickest and most effective approach for increasing natural production in the upper basin. If adult supplementation fails, a juvenile supplementation effort may be undertaken following the guidelines developed by the Yakama Nation's Cle Elum Project.

- Adult escapement to the Tilton River will be limited to the number of adults required to measure the R/S and abundance criteria used as fish passage triggers in the Settlement. NOAA-Fisheries has established a 500 adult abundance target for Tilton River fall Chinook.

- To restore and maintain ecosystem integrity, salmon carcasses from the Cowlitz Salmon Hatchery may be placed in the Tilton River and upper Cowlitz River basins. This action should also help increase habitat productivity.

- The basin-wide stock management strategy emphasizes the production of indigenous fish stocks both in the wild and at the hatchery. Non-indigenous salmonid hatchery stocks will not be allowed above Mayfield Dam, and hatchery production of these non-native stocks will be reduced over time as native stocks recover.

- To reduce predation on NOR fall Chinook juveniles in the lower Cowlitz River, the hatchery sea-run cutthroat trout program will be decreased to 50,000 smolts and managed as an Integrated Type program. Hatchery coho production will also be reduced.

Table 5-5. Stock harvest profile (Treaty and non-Treaty) for Tilton River and Upper Cowlitz River fall Chinook populations (natural spawning origin).

Fishery Aggregate	1994-1995 Broods		Phase 1 Productivity Test Period		Phase 2 Long-term Target	
	Description	AEQ Harvest Rate	Description	AEQ Harvest Rate	Description	AEQ Harvest Rate
Freshwater Sport, above Cowlitz Barrier Dam	Non-Selective fishery on hatchery-origin fish during September-October	< 1.0%	Fishery on hatchery-origin fish during August-October.	< 1.0%	Fishery from August-October.	10.0%
Freshwater Sport, Columbia River Mouth to Cowlitz Barrier Dam	Fishery operating from August-October.	7%	Non-Selective fishery on hatchery-origin fish during August-October.	5%	Selective fishery on hatchery-origin fish during August-October.	7.5%
Mainstem Net	Incidental harvest during fisheries directed at other species.	1%	Non-Selective fishery on hatchery-origin fish during August-October.	5%	Selective fishery on hatchery-origin fish during August-October.	7.5%
Ocean Troll, Net, and Sport	Fisheries managed consistent with PST and PFMC regulations.	34%	Fisheries managed consistent with PST and PFMC regulations.	38%	Fisheries managed consistent with PST and PFMC regulations.	40%
Total AEQ *Exploitation Rate	43%		*49%		65%	

AEQ- Adult Equivalent Harvest Rate.

* The 49% value is the current Rebuilding Exploitation Rate developed by NOAA-Fisheries and the Pacific Marine Fisheries Council.

- Land purchases or easements will be used to protect and restore critical side-channel rearing habitat for fall Chinook in the lower Cowlitz River. The new flow regime below Mayfield Dam will be implemented to protect fall Chinook natural production in the lower Cowlitz River.

- Downstream fish passage/collection facilities will be improved at both Mayfield Dam and at Cowlitz Falls Dam. The facilities will be designed and operated to achieve the 75 to 95 percent survival standard for Chinook originating from the upper Cowlitz River basin, and the 95 percent survival standard at Mayfield Dam.

- All juvenile fall Chinook captured at Mayfield Dam will be uniquely marked to identify them upon their return as adults unless hatchery fall Chinook are mass-marked.

- Implement an Integrated Type artificial production program, based on HSRG guidelines, to promote the recovery of fall Chinook in the Tilton and Lower Cowlitz rivers. If successful, this same approach would be used in Phase 2 for the upper Cowlitz River population. This program cannot be fully implemented however, until all hatchery fish are mass-marked.

- Release approximately 4.0 million hatchery juvenile fall Chinook each year to provide the adults needed to meet the conservation and harvest goals identified for this stock.

- To reduce interactions between hatchery and ESA-listed Chinook stocks, hatchery production for all species combined will not exceed 650,000 pounds in the remodeled facility.

- Implement mass marking of hatchery fall Chinook beginning with brood year 2006. After mass marking of hatchery fall Chinook is implemented, sport fishers will be required to release unharmed all unmarked fall Chinook caught in Lower Cowlitz River sport fisheries. This action is designed to protect wild fish to the extent possible while at the same time allowing for the harvest of hatchery fish.

- If Tilton River fall Chinook are uniquely marked, fishermen will be required to release these marked fish.

- Sport fisheries for fall Chinook will be closed in the Tilton River during the productivity testing period.

5.2.3.1. Collection and Passage

Downstream fish passage/collection facilities will be improved at both Mayfield Dam and at Cowlitz Falls Dam. The facilities will be designed and operated to achieve the 75 to 95 percent survival standard for Chinook originating from the upper Cowlitz River basin, and the 95 percent survival standard at Mayfield Dam. Tacoma Power is currently

studying the feasibility and expected effectiveness of several options for the Cowlitz Falls juvenile collector.

5.2.3.2. Carcass Distribution

If the WDFW chooses to use surplus hatchery fish to enhance the nutrients above Mayfield Dam and if allowed in the approved Disease Management Plan, a productivity experiment will be undertaken to distribute carcasses of surplus hatchery fish collected at the Cowlitz Hatchery Complex to the Tilton and upper Cowlitz rivers. This action is designed to increase system productivity, thereby increasing the chance for the successful reintroduction of anadromous fish to key areas in the basin. Whether or not this action is implemented, at what scale and how, will depend on the Disease Management Plan developed for the basin. The carcass distribution program will be implemented consistent with the approved Disease Management Plan and with WDFW approval to utilize the surplus fish.

5.2.3.3. Stock Reintroduction and Recovery

Tilton River and Upper Cowlitz River

An adult supplementation strategy was selected as the best means for re-establishing fall Chinook populations in areas where they have been extirpated. The decision to use the adult supplementation strategy was based on the same rationale as was presented for spring Chinook.

In Phase 1, fall Chinook will be reintroduced into the Tilton River, but not in the upper Cowlitz River basin unless productivity tests indicate that spring Chinook are self-sustaining. This strategy was needed to reduce interference with the productivity experiment being conducted on spring Chinook in this portion of the basin. The number of adults released into the Tilton River each year will depend on run composition (hatchery versus natural) and the experimental protocols needed to measure system productivity (see Section 5.2.3.4). Initially, it is anticipated that 1,000 adult fall Chinook will be released each year to implement the productivity test.

Lower Cowlitz River

This section describes actions designed to assist in the recovery of fall Chinook in the lower Cowlitz River.

Reduction in Hatchery Steelhead, Coho and Sea-run Cutthroat Trout Production

Studies conducted in both the Lewis River (Hawkins and Tipping 1999) and Cowlitz River (Vander Haegen et. al. 1998) show that these species (both juveniles and adults) consume large numbers of Chinook fry. Stomach samples collected on the Lewis River indicated that each coho, steelhead, and cutthroat trout stomach examined contained an average of one fry. Because data were not available on stomach evacuation, hatchery smolt residency time, number of wild Chinook present, or their vulnerability over time, the total number of fry consumed by hatchery fish was not estimated. Given that the

current hatchery program releases approximately 5 million coho, steelhead, and sea-run cutthroat trout smolts each year, impacts to fall Chinook could be severe.

As an outcome of actions to meet the benchmark adult production values in the Settlement Agreement, hatchery releases of coho, steelhead and sea-run cutthroat trout have been reduced from 5 million to 3.52 million (30 percent reduction). This action—in combination with the implementation of a volitional release strategy and the rearing of hatchery smolts that better mimic the size, physiology, and behavior of wild fish—should reduce predation impacts on fall Chinook fry considerably.

Reduction in Hatchery Fall Chinook Production

A total of 3.36 million fall Chinook smolts are required to achieve the adult benchmark value of 73,940. This number has been increased to 4.0 million to provide adults for supplementation. A reduction in fall Chinook production should reduce the number of hatchery fish spawning with wild/natural fish in the lower Cowlitz River.

Based on HSRG guidelines for an integrated hatchery program, hatchery origin fish should not exceed the percent of naturally produced fish taken for hatchery broodstock. Data collected in the Cowlitz River between 1999 and 2001 show that hatchery fish (multiple hatcheries) make up between 73 and 93 percent of the fall Chinook spawners in the lower river (Harlan 2000, 2002, and 2003). Recent unpublished data indicate that hatchery fish numbers on the Cowlitz River spawning grounds have dropped to below 20 percent. However, the percentage of natural fall Chinook taken into the Cowlitz Salmon Hatchery is unknown. This information will not be available until all hatchery origin fish are mass marked.

Protect and Restore Lower Cowlitz River side-channel Habitat

Although not described in the FHMP, the Settlement establishes a $3.0 million habitat fund to protect and enhance stream habitat in the Cowlitz River Basin. Because the Settlement prioritizes habitat actions that protect side-channel habitat in the Lower Cowlitz River for funding, benefits should accrue to fall Chinook spawning and rearing in these areas.

5.2.3.4. Measuring Productivity

Fall Chinook productivity tests will be conducted in the Tilton River in Phase 1. Fall Chinook will not be restored to the upper Cowlitz River basin in Phase 1 due to logistical problems associated with accurately determining R/S values for upper Cowlitz River spring Chinook.

Fish monitoring at the Cowlitz Falls juvenile collector indicates that large numbers of spring Chinook juveniles migrate past this project as subyearlings. Since it is impossible to distinguish a fall from spring Chinook subyearling, a decision was made to release only spring Chinook in the upper basin, as it is the priority species identified in the Settlement Agreement. In addition, because monitoring at Mayfield Dam shows that some spring Chinook juveniles successfully migrate from Cowlitz Falls to Mayfield Dam, the Tilton River fall Chinook productivity test will be delayed for three years based on a similar rationale. During this three year period, biologists will continue to collect

data on the run timing and number of upper basin spring Chinook arriving at Mayfield Dam. Testing of fall Chinook productivity would only be conducted if it can be shown that it would not compromise the results of upper basin productivity tests.[14]

The triggers to be used for managing Tilton River fall Chinook are described below.

Pre-Trigger 1 or 2

Beginning in Year 3, a minimum of 1,000 hatchery adult fall Chinook will be released yearly into the Tilton River. Risks to Tilton River fall Chinook recovery are assumed to be low due to the low productivity of the habitat, coupled with the high harvest rates in ocean and freshwater fisheries (49 percent), which result in a situation where it is unlikely that fall Chinook can achieve self-sustaining levels.

Trigger 1: Subyearling per Spawner ≥ 70

Because data collected at Mayfield Dam on turbine survival and louver guidance efficiency indicate that FPS is likely greater than 90 percent for this species, only the Subyearling/Spawner trigger will be used to determine when hatchery fish would not be stocked in this basin. Once the trigger is achieved, hatchery fish would only be stocked in the Tilton River if Tilton River-origin NORs fall below the NOAA-Fisheries abundance target of 500 adults. All fall Chinook juveniles arriving at Mayfield Dam would be marked so that they could be distinguished upon their return as adults to the Barrier Dam. This action would not be needed when fall Chinook hatchery juveniles are mass marked.

For each brood year, biologists will calculate the number of smolts produced per spawner. The estimate will be made at the Barrier Dam, as required by the Settlement Agreement, to account for handling mortality such as transport and juvenile marking (if any).

Trigger 2: Year Seven of the FHMP

If the Subyearling/Spawner trigger is not achieved by year seven of the FHMP, hatchery fish will no longer be stocked in the Tilton River, and the productivity test will be implemented with NORs only, if available. This action is needed to ensure that sufficient time is available to measure R/S values, which is one of the fish passage criteria identified in the Settlement Agreement, for at least five brood years.

If this trigger is achieved, harvest of fall Chinook adults will not be allowed in the Tilton River until a decision is made by the FTC to abandon the productivity test.

5.2.3.5. Artificial Production

Based on available data and management objectives, it is assumed that in the long term, an Integrated Type hatchery program will best achieve the conservation and harvest goals

[14] The decision to emphasize spring Chinook testing over fall Chinook in the Tilton is consistent with the guidelines in the Settlement Agreement, which require Tacoma to conduct spring Chinook productivity tests above Cowlitz Falls Dam.

identified for fall Chinook. This type of program will be implemented once all hatchery origin fall Chinook are mass-marked.

It is assumed that the number of juveniles required to meet the 73,940-adult benchmark will be produced at the Cowlitz Hatchery Complex. Based on the data presented in Cramer (2002), 3.36 million hatchery smolts would need to be released each year to achieve the benchmark. The number of juveniles released is based on the assumption that fall Chinook age-2 survival for the benchmark time period was 2.2 percent.

Building an integrated population will require that a locally adapted natural spawning stock be developed from the stock currently adapted to the hatchery environment. Since there is no short-term plan to attempt to re-introduce fall Chinook into the upper watershed, this will require that the hatchery be operated to allow this adaptation to take place in the lower river. Based on HSRG guidelines, the proportion of hatchery produced fish from an Integrated Type program that spawn naturally should not exceed the number of naturally produced adults taken as broodstock. The hatchery program will be operated to achieve this objective. This action is needed to allow local adaptation to the natural environment.

Based on the need to limit the impact that hatchery fish have on the natural populations, hatchery production will be limited to approximately 4.0 million subyearlings to achieve the HSRG stock composition guidelines for hatchery fish on the spawning grounds and allow local adaptation to occur for a minimum of fifteen years (three brood cycles)[15]. To distinguish hatchery origin fish upon their return as adults, all fall Chinook juveniles released from the Cowlitz Hatchery Complex will be marked by the removal of their adipose fin beginning with brood year 2006.

After an initial period of allowing for local adaptation (five brood cycles), natural origin broodstock will be collected from the lower river population to be a part of the hatchery releases. This stock will be differentially marked from the hatchery origin broodstock to allow for gradual replacement of the current hatchery stock. In addition, 10 to 20 percent of the natural origin broodstock used annually at the hatchery will be made up of naturally produced fall Chinook adults. This action is needed to minimize potential for genetic divergence between the hatchery and natural stock in the lower watershed and to reduce domestication risks and genetic changes caused by artificial rearing.

Since hatchery strays from this program make up a significant portion of the naturally spawning population, fall Chinook at the Cowlitz Hatchery Complex will be reared to produce high quality smolts. A quality hatchery smolt is defined as a fish that is similar in health status, physiology, morphology, and behavior to a naturally produced smolt originating upstream of Mayfield Dam.

Hatchery rearing conditions will be improved through hatchery modifications that increase overall water quality and reduce rearing density to optimize survival. Hatchery

[15] Once all hatchery fall Chinook are marked, the composition of wild fish returning to the hatchery will be quantified. If it is found that considerable numbers of wild fish are being used for broodstock, the 5 brood cycle criteria may be altered to integrate the program at a faster rate.

programming will be based on providing optimum rearing conditions for stocks regardless of the current or historical rearing and release site. Use of species and site specific loading and density guidelines, mating protocols that maximize genetic variability, and modification of hatchery structures to provide for volitional migration will reduce competition risks to naturally produced stocks.

Innovative Rearing

The Settlement calls for hatchery managers to develop and test innovative rearing practices. For fall Chinook, innovative rearing practices initially will not be incorporated into the program as fall Chinook spend the least amount of time in the hatchery environment. Testing of innovative rearing such as the use of enriched environments and growth modulation will be used in spring Chinook, coho, and late winter steelhead programs. Based on the results of this testing on other species, selected practices may become part of the fall Chinook program at a later time.

Adult Escapement Management

To properly run an integrated hatchery program, hatchery managers must track adult returns from both the natural and hatchery components of the run. Sufficient numbers of naturally produced fish are needed to both seed available spawning habitat and to provide genetic material for the hatchery. The concept is that local adaptation is driven by the natural, not the hatchery, component of the run. Proposed escapement numbers for both components of the run are presented below.

Hatchery Escapement

Approximately 2,245 hatchery origin adults are needed to produce 4.0 million juvenile fall Chinook. In addition, another 1,000 fall Chinook hatchery adults may be needed to conduct the productivity experiment in the Tilton River. Thus, fisheries in the Lower Cowlitz River are recommended to be managed to meet an escapement target of 3,245 adults.

Natural Escapement

No specific numeric target has been set for naturally produced fall Chinook in the lower Cowlitz or Tilton rivers. In the future, with the implementation of the mass marking of fall Chinook, lower river anglers will be required to release all unmarked fall Chinook adults caught. The FHMP assumes that catch-and-release fisheries in the lower Cowlitz River will result in four percent or less mortality on naturally produced fall Chinook. Fisheries would be monitored to verify the mortality assumption. Fisheries would be scaled back if losses exceeded the four percent target.

Production Adjustment and Credit Mechanisms

The Settlement Agreement requires that the FHMP identify methods to 1) adjust hatchery production upward or downward to accommodate recovery of indigenous stocks, and 2) develop credit mechanisms for production of high quality natural stocks. The actions proposed for fall Chinook to meet these requirements are listed below.

- Fall Chinook hatchery production will be reduced to 4.0 million juveniles in order to reduce genetic interactions with naturally spawning adults in the lower Cowlitz River.

- The number of wild fall Chinook subyearlings produced in the Tilton River Basin will be used to reduce the number of subyearlings released each year from the hatchery on a 2:1 basis, beginning in the next brood year. The adjustment will be made based on a five-year rolling average of juvenile fish passing the Barrier Dam. The assumption that hatchery and natural fall Chinook produce similar numbers of adult returns would be tested over time. The results of this analysis will provide the data needed to adjust the ratio upward or downward.

5.2.3.6. Fishery Harvest

The following harvest strategies will be used to achieve the reintroduction, recovery, and harvest objectives of this plan:

- WDFW will work in the Pacific Salmon Treaty, Pacific Fisheries Management Council, and US v. Oregon forums to promote selective fisheries in appropriate areas to reduce exploitation on depressed naturally produced stocks while providing fishing opportunities.

- Management of sport fisheries in the Cowlitz River below the Barrier Dam will be linked to the productivity of the Tilton River population. This linkage recognizes that meeting the conservation and harvest goals of the Settlement Agreement will not be feasible until substantial improvements in fish passage survival and/or aquatic habitat enhance the productivity of the population. As previously discussed in the section on artificial production, the population is not likely to have a positive growth rate until 70 smolts are produced per spawner. Active management measures are recommended to WDFW to be taken to achieve the guideline when the Trigger 2 S/S criterion has been met.

- Sport fisheries for fall Chinook will not occur in the Tilton River during the productivity test period.

- Adult escapement to the basin will be prioritized as follows, 1) hatchery broodstock, 2) lower Cowlitz River natural production, 3) Tilton River, 4) lower Cowlitz River harvest, and 5) Tilton River harvest.

5.3 Late Winter Steelhead

The long-term (>15 years) conservation goal of the steelhead stock management strategy is to produce native, locally adapted late winter steelhead populations in the upper Cowlitz (above Cowlitz Falls Dam) and Tilton rivers. In Phase 1 of the FHMP, steelhead populations in the Cispus and upper Cowlitz rivers would be managed as a single population. The single stock management strategy is required due to the inability to

correctly identify the stream of origin of juveniles or adults arriving at fish passage collection facilities in the upper basin.

In Phase 1 of the FHMP, late winter steelhead restoration would be emphasized in the upper Cowlitz and Tilton rivers. The primary Phase 1 objective for both populations would be to recover these populations to levels that ensure their continued existence over time and to provide sport fishing opportunities as the stock recovers.

In addition, tests will be conducted on both populations to determine if the productivity criteria needed to implement a volitional upstream fish passage system can be met for the upper Cowlitz River population and the abundance only criterion in the Tilton River.

The objective for both the Tilton and upper Cowlitz river populations would be achieved by emphasizing natural production, improving hatchery practices, reducing overall hatchery production (all species combined), not releasing non-indigenous steelhead above Mayfield Dam, eliminating resident trout releases in anadromous waters, and eliminating harvest opportunities in the upper Cowlitz until such time as studies to estimate stock productivity are completed.

Hatchery production of all steelhead combined will be limited to 1.1 million juveniles. This level of production is designed to achieve the adult benchmark target of 20,000 adults and reduce impacts on native steelhead.[16] Late winter steelhead production will be 450,000 smolts. This level of production is expected to produce 8,550 adults.

In the short term (<15 years), harvest goals for the basin would be met primarily through the continued production of hatchery origin, non-indigenous early winter, summer steelhead and indigenous late winter steelhead in the lower Cowlitz River. The possible impacts these non-indigenous fish may have on native late winter steelhead will be monitored over time.

Harvest of hatchery fish will continue in the lower river on a yearly basis as long as escapement goals are met for the hatchery, upper Cowlitz River, and Tilton River populations. Late winter steelhead fisheries will be allowed in the Tilton River but are recommended to be closed in the upper Cowlitz River once productivity tests begin. Anglers will be required to release all unmarked steelhead caught in recreational fisheries.

5.3.1 Synopsis of Objectives and Strategies

A brief synopsis of the late winter steelhead objectives and the proposed strategies to meet each is presented below.

Phase 1 Objectives. Increase juvenile fish collection efficiency and survival through the Cowlitz River hydropower system; conduct productivity experiments in the Tilton River and upper Cowlitz River to determine if effective upstream fish passage facilities should be constructed; determine adult migration success through Mayfield Lake; begin

[16] The 20,000 adult benchmark includes fish caught in all fisheries, natural as well as hatchery spawners. The value is not a mitigation goal but is instead used as a performance indicator.

development of a locally adapted broodstock for the Tilton River and upper Cowlitz River populations; meet the recovery standard for the lower Columbia River Steelhead ESU; provide sport fishing opportunities for early winter, summer and late winter steelhead; improve hatchery fish quality; and achieve the 20,000 adult benchmark target.

The strategies proposed to achieve steelhead Phase 1 objectives are as follows:

- Habitat. Improve juvenile fish passage facilities at Mayfield Dam, Cowlitz Falls Dam and/or a future location above Mossyrock Dam. The facilities will be designed and operated to achieve the 75 to 95 percent survival standard for steelhead smolts originating from the upper Cowlitz River basin, and the 95 percent survival standard for juveniles passing Mayfield Dam.

- Reintroduction. Initiate the productivity experiment by releasing, a minimum of 500 hatchery adult winter steelhead (Cowlitz Hatchery late winter stock) above Lake Scanewa, and 500 into the Tilton River. Continue to place all NOR fish, and the minimum number of hatchery fish until escapement goals are reached into the Tilton and upper Cowlitz rivers until either Trigger 1 or 2 described below is achieved. Using adults provides the quickest means to initiate the productivity experiment and promotes the process of local adaptation for the introduced stock. The target number of late winter steelhead released was selected to promote achievement of the linked criteria of abundance (NOAA-Fisheries target of 500 adults each in the Tilton and upper Cowlitz rivers) and productivity (R/S), which defines whether a stock is sustainable over time.

- Productivity Enhancement. Distribute adult steelhead carcasses from the Cowlitz Salmon Hatchery (if available) to the Tilton and upper Cowlitz rivers as appropriate, which likely will contribute to increased watershed productivity.

- Artificial Production Programs. Release approximately 1.1 million juvenile early winter, summer, and late winter steelhead from the Cowlitz Hatchery Complex each year to provide the adults needed to meet identified conservation and harvest goals. Upgrade Cowlitz Hatchery Complex facilities to improve rearing conditions and test rearing techniques to produce hatchery juveniles that are similar in physiology, morphology, behavior, survival and health status to naturally produced fish.

- Fishery Management. Implement a fishery management regime that protects wild late winter steelhead, while at the same time allows continued sport harvest of hatchery origin steelhead in the lower Cowlitz River and upper Cowlitz River until the start of the productivity experiment.

Phase 2 Objectives. Phase 2 objectives would depend on the results of Phase 1 strategies, and therefore cannot be described in detail at this time. If Phase 1 objectives could not be achieved, Phase 2 objectives may include:

1) Maintain some level of natural production in stream reaches above Mayfield Dam. This production would not need to be self-sustaining.

2) Implement a juvenile supplementation program in the Tilton River and upper Cowlitz River.

3) Increase hatchery production to maximum provided in Settlement Agreement (800,000 lbs).

4) Use the $15 million reserved for fish passage facility construction to improve stream habitat in the basin.

5.3.2 Goals and Objectives

For this analysis, fisheries goals are classified into three categories: conservation, harvest and habitat. Conservation goals are presented in terms of the biological significance of the stock and its viability. Habitat goals are expressed with respect to the quality of the environment to produce late winter steelhead; harvest goals with respect to the level and types of fisheries that can be supported.

The simple terminology used in Table 5-6 is meant to convey management goals and direction over time for Cowlitz River late winter steelhead. A quick review of the table data indicates that the goal of fisheries managers is to maintain the biological significance of the stock and increase both viability and habitat quality over time. Achieving these conservation and habitat goals should lead to increased harvest, thus meeting harvest goals for the basin.

All strategies proposed in the FHMP are designed to be consistent with the conservation, habitat, and harvest goals presented in Table 5-6.

5.3.2.1. Stock Reintroduction and Recovery (Conservation)

The primary steelhead conservation goal of the FHMP is the establishment of self-sustaining runs of late winter steelhead in the Upper Cowlitz and Tilton rivers. Ultimately, the objective of the FHMP is to meet the recovery standards developed for the Lower Columbia Steelhead ESU, which are yet to be finalized. Achieving the latter objective is likely to require habitat, hatchery, and harvest actions outside of the scope of this plan.

5.3.2.2. Fishery Harvest

General harvest objectives are to provide fishing opportunities consistent with the mandate of WDFW, US v. Oregon, and other state and federal legal obligations. Specific harvest objectives will vary depending on the phase of the reintroduction and recovery program. The management strategy is to maximize harvest opportunity on hatchery origin late winter steelhead throughout the Cowlitz River basin while protecting NOR. Fishery exploitation rates are expected to increase as the status of natural populations of late winter steelhead improves (Table 5-7).

Table 5-6. Summary of biological significance, habitat quality, fishery exploitation rates, and Phase 1 strategy for late winter steelhead.

	Late Winter Steelhead Population			
	Cowlitz Hatchery	**Lower Cowlitz**	**Tilton**	**Upper Cowlitz Cispus River**
Biodiversity Significance & Genetic Integrity				
Current	Medium	Medium	Low	Low
Short-term Objective	Medium	Medium	Medium	Medium
Long-term Objective	Medium	Medium	High	High
Habitat Quality				
Current	NA	Medium	Low	Low
Short-term Objective	NA	Medium (adults 223)	Low (adults 219)	Medium (adults 1,512)
Long-term Objective	NA	High (adults 1,417)	High (adults 1,445)	High (adults 5,109)
Fishing Opportunities*				
Current	High (HR = 70%)	Low (HR = 8%)	Low (<1%)	Low (<1%)
Short-term Objective	High (HR = 70%)	Low (HR = 8%)	*Low* (HR= 8%)	None
Long-term Objective	High (HR = 70%)	Low (HR = 8%)	*Low* (HR = 10%)	*Low* (HR = 10%)

NA- Not Applicable
HR- Assumed harvest rates
Adults- EDT adult abundance estimate for current (short-term) and PFC (long-term)
* Harvest rates on hatchery origin late winter steelhead were estimated by the Lower Columbia Recovery Board for the 2001 to 2003 period (NOAA-Fisheries letter dated July 20, 2004).

Commercial fisheries in the mainstem Columbia River may occur in February and March with incidental harvest of both natural and hatchery winter steelhead with an adipose fin clipped. It is currently unlawful to retain any steelhead taken in this fishery. Use of selective commercial fisheries should be expanded to reduce incidental mortality of steelhead. Currently, there are no commercial steelhead fisheries in the ocean.

Sport fisheries selective for Cowlitz River late winter steelhead stock that are adipose fin-clipped are expected to occur in the mainstem Columbia River and the lower Cowlitz River from January through May. WDFW, through the Fisheries Management and Evaluation Plan for the lower Columbia River, has estimated that naturally spawned Cowlitz River late winter steelhead will have an estimated mortality of approximately four percent in winter steelhead fisheries and an approximate three percent mortality in sport fisheries directed at resident trout. Overall, the take is estimated at less than seven percent.

Table 5-7. Stock harvest profile for Upper Cowlitz late winter steelhead population (natural spawning origin).

Fishery Aggregate	1994-1995 Broods		Phase 1 Productivity Test Period		Phase 2 Long-term Target	
	Description	AEQ Harvest Rate	Description	AEQ Harvest Rate	Description	AEQ Harvest Rate
Freshwater Sport, above Cowlitz Barrier Dam	Selective fishery on hatchery-origin adults during January-February and selective fishery during the summer which targets juveniles	4.0%	Tilton: Selective fishery on hatchery late winter adults and juveniles (native resident fishery), until Trigger 1 achieved. Upper Cowlitz: No fishery during productivity testing.	4.0% 0%	Fishery from November-April.	10.0%
Freshwater Sport, Columbia River Mouth to Cowlitz Barrier Dam	Selective fishery operating year around.	6.0%	Selective fishery on hatchery fish operating year around.	6.0%	Selective fishery on hatchery fish operating year around.	6.0%
Mainstem Net	Incidental harvest during fisheries directed at other species.	< 1.0%	Incidental harvest in selective fisheries on hatchery-origin fish during February-March.	< 1.0%	Incidental harvest in selective fisheries on hatchery-origin fish during February-March.	< 1.0%
Ocean Troll, Net, and Sport	Fisheries managed consistent with PST and PFMC regulations.	Negligible	Fisheries managed consistent with PST and PFMC regulations.	Negligible	Fisheries managed consistent with PST and PFMC regulations.	Negligible
Total AEQ Exploitation Rate	<11. %		<7%, higher for Tilton		<17%	

AEQ- Adult Equivalent Harvest Rate.

Currently, there are selective fisheries for unmarked adult steelhead upstream of Mayfield Dam that result in less than one percent mortality. Because of productivity experiments proposed for late winter steelhead above Cowlitz Falls Dam in Phase 1, harvest in this area will be eliminated in the Upper Cowlitz River Basin with achievement of Trigger 1 (see below). Eventually, the goal is to expand the harvest to near ten percent in the Upper Cowlitz River Basin, stock strength allowing.

5.3.2.3. Habitat

The main habitat goal of the FHMP is to increase juvenile late winter steelhead survival through the Cowlitz River hydropower complex. The Settlement Agreement sets a juvenile fish passage survival (FPS) of 75 to 95 percent for the upper Cowlitz River stock and 95 percent for fish stocks passing Mayfield Dam. WDFW's long term habitat goal is to achieve PFC in the lower Cowlitz, Tilton and upper Cowlitz rivers. EDT estimate of PFC late winter steelhead production is included in Table 5-6 under Long-term Objectives for habitat quality.

5.3.3 Strategies

The following strategies will be used to achieve identified late winter steelhead objectives:

- Adult supplementation will be the primary management tool used to restore natural late winter steelhead production in streams above Mayfield Dam. This is assumed to be the quickest and most effective approach for increasing natural production in the upper basin.

- Adult escapement to the upper Cowlitz River will be limited to the number of adults required to measure the R/S and abundance criteria used as fish passage triggers in the Settlement Agreement. Minimum adult escapement to the upper Cowlitz River basin and Tilton River will be set at 500 adults per basin.

- To restore and maintain ecosystem integrity, carcasses from the Cowlitz Salmon Hatchery may be placed in the Tilton River and upper Cowlitz River basins. This action should also help increase habitat productivity.

- The late winter steelhead stock management strategy emphasizes the production of indigenous anadromous fish stocks both in the wild and at the hatchery. Non-indigenous salmonid stocks will not be allowed above Mayfield Dam, and hatchery production of these stocks will be reduced over time as native stocks recover.

- Juvenile fish passage facilities will be improved at both Mayfield Dam and at a future location above Mossyrock Dam. The facilities will be designed to achieve the 75 to 95 percent survival standard for late winter steelhead migrating from the Tilton, upper Cowlitz, and Cispus rivers and the 95 percent FPS for fish passing Mayfield Dam.

- Implement an Integrated Type artificial production program, based on HSRG guidelines, to promote the recovery of late winter steelhead in the Tilton and Upper Cowlitz rivers. This will not occur however until self-sustaining populations are established above Mayfield Dam.

- Approximately 450,000 juvenile hatchery late winter steelhead will be released each year to provide the adults needed to meet the escapement goal for this stock. Late winter steelhead adult hatchery production in excess of those needed to meet escapement goals may also provide harvest opportunity.

- Summer (450,000 smolts) and early winter steelhead (200,000 smolts) will continue to be released in the lower Cowlitz River basin over the short term to provide harvest opportunity. This level of production will be maintained, unless genetic or harvest conflicts with late winter steelhead recovery efforts identified by NOAA-Fisheries indicate that this program needs to be modified.

- To achieve the 20,000 adult steelhead return benchmark, a total of 1.1 million late winter, early winter, and summer steelhead hatchery smolts will be released each year in the basin. It is assumed that these releases will produce 20,000 adults (Cramer 2002).

- Anglers will be required to release unharmed all unmarked steelhead caught in any sport fishery. This action is designed to protect wild fish to the extent possible while at the same time allowing the harvest of hatchery fish.

- Cowlitz Hatchery Complex facilities will be updated and rearing techniques implemented to produce hatchery juveniles that are similar in physiology, morphology, behavior, survival and health status to naturally produced fish.

- The number of naturally-produced late winter steelhead yearlings in the upper Cowlitz River basin will be used to reduce the number of hatchery yearlings released each year on a 2:1 basis, beginning in the next brood year. The production adjustment will be based on a five-year rolling average of the number of yearlings estimated to have passed the Barrier Dam. The assumption that hatchery origin and naturally produced late winter steelhead produce similar numbers of adults will be tested over time. The results of this analysis would provide the data needed to adjust the juvenile credit ratio upward or downward.

- Hatchery production for all species combined will not exceed 650,000 pounds after hatchery rebuild to reduce interactions between hatchery and ESA-listed fish stocks.

5.3.3.1. Collection and Passage

Downstream fish passage/collection facilities will be improved at both Mayfield Dam and at Cowlitz Falls Dam. The facilities will be designed and operated to achieve the 75

to 95 percent survival standard for steelhead originating from the upper Cowlitz River basin, and the 95 percent survival standard at Mayfield Dam. Tacoma Power is currently studying the feasibility and expected effectiveness of several options for the Cowlitz Falls juvenile collector.

5.3.3.2. Carcass Distribution

If the WDFW chooses to use surplus hatchery fish to enhance the nutrients above Mayfield Dam and if allowed in the approved Disease Management Plan, a productivity experiment will be undertaken to distribute carcasses of surplus hatchery fish collected at the Cowlitz Hatchery Complex to the Tilton and upper Cowlitz rivers. This action is designed to increase system productivity, thereby increasing the chance for the successful reintroduction of anadromous fish to key areas in the basin. Whether or not this action is implemented, at what scale and how, will depend on the Disease Management Plan developed for the basin. The carcass distribution program will be implemented consistent with the approved Disease Management Plan and with WDFW approval to use the surplus fish.

5.3.3.3. Stock Reintroduction and Recovery

Late winter steelhead will be reintroduced into the upper Cowlitz and Tilton river basins using an adult supplementation strategy. This was deemed the best strategy for achieving the identified conservation goals for this species. This decision was based on the following rationale:

- Natural production is defined as adults spawning successfully in the wild. Therefore, supplementing hatchery adults rather than juveniles in these streams is the quickest way to achieve the primary goal of increasing natural production in the basin.

- The outplanting of hatchery adults rather than juveniles ensures that the entire life-cycle of the fish is completed naturally rather than artificially in the hatchery environment. Therefore, the resulting juvenile production is completely free of any hatchery influences.

- Under the adult supplementation strategy, fish managers will be able to measure spawning success within a single generation. In contrast, in a juvenile supplementation program the spawning success of returning adults will not be known until one generation later and only then if fish managers either discontinue stocking hatchery juveniles into the watershed or spend considerable resources to mark all hatchery releases.

- Using adults to seed the watersheds eliminates many of the management complexities associated with a juvenile supplementation program. These complexities include determining the correct juvenile release size, release timing, number of juveniles to be released, and how to distribute the juveniles throughout the watershed.

- The number of adults released into the upper basin each year would depend on run composition (hatchery versus natural) and the experimental protocols needed to measure system productivity (see Section 5.3.3.4). Initially, it is anticipated that a minimum of 500 late winter steelhead HOR adults would be released in the upper Cowlitz and Tilton rivers, respectively (i.e. 1,000 fish).

5.3.3.4. Measuring Productivity

Late winter productivity tests will be conducted in the Tilton River and upper Cowlitz River in Phase 1 of the FHMP. Because experimental protocols vary between the two basins, each is discussed separately below.

Upper Cowlitz River

Procedures for testing late winter productivity in the upper Cowlitz River are similar to those described for spring Chinook. The major difference in the testing protocols for the two species is that significant numbers of adult late winter steelhead are currently being produced from the upper Cowlitz River basin. Adult production is the result of natural spawning and hatchery fry plants in the upper basin. Thus, instead of starting the productivity test with hatchery fish, protocols call for transporting and releasing a combination of both natural and hatchery origin adults.

The triggers that will be used to manage the upper Cowlitz River late winter steelhead population are described below.

Pre-Trigger 1 or 2

Late winter steelhead fry will no longer be stocked in stream reaches above Cowlitz Falls Dam. As fry were planted in 2003, smolts produced from these plantings will emigrate from the system in years 2004 through 2006. Because migration year 2006 will be the last year influenced by these plants, the productivity test may begin with the 2005 brood year, if fry plants are not made in 2004.

All upper Cowlitz origin NOR late winter steelhead adults will be transported and released into Lake Scanewa. To maximize use of available habitat, no restrictions would be placed on the number of hatchery adults released into the upper basin in 2004.

Trigger 1: FPS ≥ 50 percent and NOR Abundance Greater than 500

According to data collected at Cowlitz Falls Dam in 2003, this FPS criterion may already have been achieved (Serl and Morrill 2003). Biologists working at Cowlitz Falls estimate that the average collection efficiency of steelhead smolts at Cowlitz Falls Dam from 2000 through 2003 was 62 percent. If this is the case, then the productivity experiment can begin in year 1 of the FHMP (assumed 2005), or one year later if unmarked fry plants are made in 2004. Note that approximately 523 NOR late winter steelhead adults were transported and released into the upper Cowlitz River in 2002-2003.

Once the 50 percent FPS (Trigger 1) and the adult abundance criteria are achieved, only upper Cowlitz origin NOR fish will be stocked in the upper Cowlitz River basin. HOR adult steelhead will not be released into the upper Cowlitz from this point forward unless

NOR fish escapement falls below 500. At that time, hatchery fish may be released at numbers sufficient to increase adult escapement levels to above the 500 target. The decision to stock hatchery adults would be made by the FTC.

Harvest will not be allowed on late winter steelhead to enable accurate estimates of initial spawners. An accurate account is needed to determine when Trigger 2 is met.

For each brood year, biologists will calculate the number of smolts produced per spawner. The estimate will be made at the Barrier Dam, as required by the Settlement Agreement, to account for handling mortality such as transport and juvenile marking (if any).

Trigger 2: S/S ≥ 17

When the S/S value is achieved, it is assumed that population productivity is sufficient to maintain itself over time. The adult productivity experiment would then commence.

The S/S criterion for smolts is based on the assumption that for the long term, an SAR of six percent is needed for the population to be self-sustaining. The S/S criterion is calculated by simply dividing one by the assumed SAR value. It should be noted that the S/S values are modeled assumptions that are based on existing literature that will be tested by collecting juvenile and adult data at Barrier Dam.

If late winter steelhead SARs are higher than modeled, the S/S criterion could be reduced, and vice-versa. However, because complete adult returns will not be available until up to three years after the juveniles emigrate from the system, the opportunity to adjust the S/S assumption is limited given the timeframe needed for decision making regarding fish passage (12-15 years). It is for this reason that the SAR values were set conservatively, i.e., relatively high, so that fewer smolts-per-spawner are needed to begin the productivity test.

Trigger 3: Year Seven of the FHMP

If Trigger 2 is not achieved by year seven of the FHMP, hatchery fish will no longer be stocked in the Upper Cowlitz and the productivity test will continue with NOR fish only (i.e. hatchery adults will no longer be stocked in either basin). This action is needed to ensure that sufficient time is available to measure R/S values, one of the fish passage criteria identified in the Settlement Agreement, for at least five brood years.

If this trigger is achieved, harvest of steelhead adults will not be allowed in the upper Cowlitz River until a decision is made by the FTC to abandon the productivity test.

Tilton River

Results of EDT modeling indicate that late winter steelhead production in the Tilton River is likely quite low due to poor habitat conditions in this basin (see Section 4). EDT estimates that late winter steelhead run size to the Tilton River will be approximately 219 adults. This data is supported by trap counts at Mayfield Dam showing low numbers of adult returns measured at the Barrier Dam.

Because of the assumed low productivity of the Tilton River system, the protocols for testing productivity will be different than those proposed for the Upper Cowlitz River population. During the first six years of the experiment, restrictions will not be placed on the number of hatchery late winter steelhead adults that can be released in the Tilton River basin. Such an approach will allow researchers to test EDT estimates of smolt production from the basin, while at the same time providing harvest opportunity for local communities. All data needed to estimate R/S would still be collected during this interim period.

At the end of the six year period, the data collected will be reviewed and a determination made as to the likely level of late winter steelhead production from this basin. If study results confirm EDT estimates of smolt production (~4,000 smolts), then surplus hatchery fish may continue to be released into this basin. If EDT significantly underestimates smolt production in the Tilton River, the productivity experiment described previously for the Upper Cowlitz River population would be implemented. The decision to proceed with the productivity test would be made by the FTC.

The above approach for measuring Tilton River late winter steelhead production was selected based on the following rationale:

- If EDT estimates of adult production (219 adults) are accurate, this is significantly less than the 500 fish abundance target set by NOAA-Fisheries for determining population sustainability. Thus, the abundance criterion would not be achieved, negating the need to continue the productivity experiment until habitat was improved in the Tilton River.

- The release of small numbers of adults each year poses a risk that fish may be unsuccessful in finding mates, resulting in poor spawning success and reducing overall survival. This risk can be reduced significantly by simply releasing larger numbers of hatchery adults into the basin each year.

- Because little, if any, natural production of late winter steelhead is occurring in this basin, the release of large numbers of hatchery fish poses little risk to the population.

- Because of the inability of anglers to catch a large portion of late winter hatchery adults returning to the basin, in most years there is a surplus of hatchery late winter steelhead available at the Cowlitz Salmon Hatchery. Transporting and releasing these surplus fish in the Tilton River will provide several benefits, including, 1) adults for testing system productivity, 2) increased natural production from the system, 3) harvest opportunity, and 4) nutrient enhancement.

5.3.3.5. Artificial Production

The indigenous late winter steelhead program will be managed under the assumption that, for the long term, an Integrated Type strategy best achieves the conservation and harvest goals identified for this species in the basin. The non-indigenous hatchery programs

(early winter and summer run) will be managed using a Segregated Type strategy to achieve harvest and help meet conservation goals for the indigenous stock.

Over the short term, it is assumed that the number of juvenile steelhead of all races required to meet the 20,000 adult benchmark will be produced at the Cowlitz Hatchery Complex. Based on the data presented in the Cowlitz Hatchery Program Evaluation Report for 2000, 1,100,000 hatchery smolts (early, late, and summer) would need to be released each year to achieve the benchmark. The total steelhead program would be comprised of 450,000 indigenous winter steelhead, 200,000 non-indigenous early winter steelhead, and 450,000 non-indigenous summer steelhead raised to a release size ranging from 5 to 8 fish per pound. The number of juveniles released to meet the adult benchmark is based on the assumption that the composite hatchery steelhead survival will average 1.9 percent.

Building an Integrated Type population for the indigenous late winter steelhead will require that a locally adapted natural spawning stock be developed from the stock currently adapted to the hatchery environment. This will be accomplished through the re-introduction of adult late winter steelhead from the Cowlitz Hatchery Complex into the upper Cowlitz River and the Tilton River.

If the late winter steelhead reintroduction effort is successful, natural origin broodstock will be collected in Phase 2 and used for hatchery broodstock needs. If sufficient natural origin fish are available to meet both broodstock requirements and natural escapement goals, the conversion could be accomplished in one brood cycle. If not, offspring of natural origin recruits used in the hatchery will be differentially marked from the hatchery origin juveniles to allow for gradual replacement of the current hatchery stock with subsequent adult returns. Under this scenario, 10 to 20 percent of the hatchery broodstock used annually will be made up of naturally produced steelhead adults. This action is needed to minimize potential for genetic divergence between the hatchery and natural stocks and to reduce domestication risks caused by artificial rearing.

Since the goal of this program is to develop an Integrated Type stock over time, late winter steelhead at the Cowlitz Hatchery Complex will be reared to produce high quality smolts. A quality hatchery smolt is defined as a fish that is similar in health status, physiology, morphology, and behavior to a naturally produced smolt originating upstream of Mayfield Dam.

Hatchery rearing conditions will be improved through hatchery modifications that increase overall water quality and reduce rearing density to optimize survival. Hatchery programming will be based on providing optimum rearing conditions for stocks regardless of current or historical rearing and release site. Use of species and site specific loading and density guidelines, mating protocols that maximize genetic variability, enriched rearing environments, and modification of hatchery structures to enable volitional migration will allow hatchery populations to develop the physiological, morphological, and behavioral traits important to long-term fitness. These actions should reduce hatchery fish competition and predation risks to naturally produced stocks. It is hypothesized that these actions will increase average SAR by 25 percent.

Innovative Rearing

The Settlement Agreement calls for hatchery managers to develop and test innovative rearing practices. To meet this requirement for indigenous winter steelhead, hatchery operations will be implemented to incorporate aspects of semi-natural rearing, including constructing ponds to enhance protective coloration and the addition of overhead and in-water cover on an experimental basis. The number of juveniles reared in this manner will be dependent on the experimental protocols developed by researchers in the Yakima River basin and by NOAA-Fisheries staff.

In addition to using enriched rearing environments, production of two-year-old smolts will be evaluated as a means to reduce residualism and predation risks on lower river fish populations. Finally, approximately ten percent of the late winter adults used for hatchery broodstock will be live-spawned, reconditioned, and then released to the river. The objective of this program is to develop a repeat spawner life history pattern similar to those observed in wild populations.

Adult Escapement Management

Adult escapement targets for the natural and hatchery components of the run are described below.

Natural Escapement

No specific numeric target has been set for naturally produced steelhead in the Tilton River or upper Cowlitz River Instead, lower river anglers will be required to release all unmarked steelhead adults. The FHMP assumes that wild fish fisheries in the lower Cowlitz River will result in six percent or less mortality on naturally produced steelhead. Fisheries would be monitored to verify the mortality assumption. Steelhead fisheries are recommended to be scaled back if losses exceed the six percent target.

Hatchery Escapement

It is estimated that 387 adults are needed to produce 450,000 juvenile late winter steelhead smolts. An additional 1,000 hatchery adults may be needed for the upper Cowlitz River and Tilton River productivity tests. Thus, the total hatchery adult escapement target is 1,387. The 1,000 adult escapement goal for natural production would be considered a minimum value.

The lower Cowlitz River steelhead fisheries would be managed to achieve this minimum escapement target. Surplus hatchery late winter steelhead may be recycled to the lower Cowlitz River to increase harvest rates so long as spawning impacts do not exceed the HSRG guideline for Segregated hatchery programs of 10 percent hatchery contribution to the natural spawning population. For the first six years of the FHMP, no limits would be placed on the number of HOR late winter steelhead released in the Tilton River. Because of this, a higher priority would be given to increasing adult releases in the Tilton River rather than recycling fish to the lower river.

Production Adjustment and Credit Mechanisms

The Settlement Agreement requires that the FHMP identify methods to 1) adjust hatchery production upward or downward to accommodate recovery of indigenous stocks, and 2) develop credit mechanisms for production of high quality natural stocks. The actions proposed to meet these requirements for late winter steelhead are listed below.

- Total hatchery yearling steelhead production will decrease slightly to 1,100,000 juveniles.

- The number of naturally produced late winter steelhead smolts in the upper Cowlitz and Tilton river basins will be used to reduce the number of yearlings released each year from the hatchery on a 2:1 basis for future brood years. The adjustment will be based on a five-year rolling average of the number of naturally produced yearlings passing the Barrier Dam each year. The assumption that hatchery and natural steelhead produce similar numbers of adult returns will be tested over time. The results of this analysis will provide the data needed to adjust the ratio upward or downward.

- The size and operation of the non-indigenous steelhead program will depend on the success of maintaining genetic segregation among the stocks, especially in the lower Cowlitz River. Future production of non-indigenous steelhead would only be reduced if required by NOAA Fisheries or through the recommendation of the FTC. A study on the genetic make-up of the wild steelhead population below Mayfield Dam would be undertaken to help inform this decision.

- The proposed changes in hatchery rearing practices are hypothesized to increase hatchery fish survival by 25 percent. The difference in survival between the two test groups would be monitored over time. If this hypothesis is correct, hatchery production would be decreased by a commensurate amount.

5.3.3.6. Fishery Harvest

The primary harvest strategies will be used to achieve the reintroduction, recovery, and harvest objectives of this plan:

- Management of sport fisheries in the Cowlitz River below the Barrier Dam will continue to focus on hatchery origin steelhead selective fisheries.

- No sport fisheries on late winter steelhead will occur in the upper Cowlitz River while the productivity experiment is being conducted. The sport fishery in the Tilton River will continue at least for the first six years of the productivity experiment. Angler will still be required to release all unmarked steelhead caught in any sport fishery.

5.4 Early Winter Steelhead

The long-term (>15 years) goal of the early winter steelhead stock management strategy is to support a consumptive sport fishery in the lower Columbia River and Cowlitz River downstream of the Barrier Dam, based on the intensive harvest of marked hatchery-produced fish. Further, the goal is to develop rearing, release, and harvest strategies that reduce and ideally eliminate natural spawning by this stock.[17]

In Phase 1 of the FHMP, early winter steelhead management would be limited to the lower Cowlitz River. No early winter steelhead would be released upstream of Mayfield Dam. The primary Phase 1 objective is to support a consumptive sport fishery in such a manner as to provide an early season intensive fishing opportunity with limited impacts on native steelhead populations. Studies of naturally reproducing early winter steelhead will be conducted in the lower Cowlitz River downstream of the Barrier Dam to describe the population and to determine areas for action to reduce reproductive influence of early winter fish.

Two hundred thousand hatchery produced early winter juvenile steelhead will be released as smolts from the Cowlitz hatcheries. Based on a 1.9 percent survival rate, average adult early winter steelhead production should be approximately 3,800 adults.

Harvest of hatchery fish will continue in the lower river as long as 1) the exploitation rate remains high enough to prevent significant spawning by early winter steelhead, and 2) the incidental harvest of wild steelhead is less than the six percent overall mortality expected from sport fisheries. Anglers will be required to release all unmarked steelhead caught in recreational fisheries.

5.4.1 Synopsis of Objectives and Strategies

A brief synopsis of the early winter steelhead objectives and the proposed strategies to meet each is presented below.

Phase 1 Objectives. Develop and implement rearing and release strategies that maximize return of early winter steelhead to the creel and to the hatchery while minimizing conflicts with naturally produced steelhead.

Proposed actions for early winter steelhead in the lower Cowlitz River to achieve Phase 1 objectives are summarized below.

- Program Studies. Conduct genetic evaluation of early winter steelhead impacts on the native late winter stock. Based on this work, implement changes to the program that reduce early winter straying and residualism, increase survival, increase harvest, and decrease impacts on late winter steelhead caused by the presence of early winter steelhead in the watershed.

- Artificial Production Programs. Release approximately 200,000 early winter steelhead from the Cowlitz hatcheries each year to provide the adults needed

[17] Possible investigation of releasing sterile fish.

to meet harvest goals. Upgrade Cowlitz Hatchery Complex facilities and test rearing techniques to produce hatchery juveniles that maximize survival to creel and escapement while minimizing conflicts with naturally produced salmonids.

- Fishery Management. Implement a fishery management regime that provides maximum harvest opportunities for early winter steelhead while maintaining limited impacts to native late winter steelhead. Eliminate the recycling program that return early winter steelhead arriving at the Cowlitz Hatchery separator to stream reaches below Barrier Dam. If genetic study results indicate no impact to late winter steelhead, the recycling program could, at the direction of the FTC, be reinitiated in years of low returns.

Phase 2 Objectives. It is anticipated that early winter steelhead will continue to be released in the basin in Phase 2. The total number released will be dependent on hatchery rearing space availability, NOAA-Fisheries conclusions regarding impacts to native steelhead populations, and whether or not adult volitional fish passage facilities are constructed at the Project. In addition, it is expected that as late winter adult steelhead run-timing expands into December and January, early winter steelhead production would be reduced.

5.4.2 Goals and Objectives

For this analysis, fisheries goals are classified into three categories: conservation, harvest and habitat. Conservation goals are presented in terms of the biological significance of the stock and its viability. Habitat goals are expressed as the quality of the environment to produce early winter steelhead, and harvest goals as the level and types of fisheries that can be supported.

The simple terminology used in Table 5-8 is meant to convey management goals and direction over time for non-indigenous early winter steelhead. A review of the table data indicates that the goal of fisheries managers is to maintain the biological significance and harvest opportunity, while reducing impacts on late winter steelhead.

All strategies proposed in the FHMP are designed to be consistent with the conservation, habitat and harvest goals for late winter steelhead presented in Table 5-6.

5.4.2.1. Stock Reintroduction and Recovery

Early winter steelhead are an introduced stock and there is no intent to establish naturally reproducing populations in the Cowlitz River. Production of early winter steelhead will continue in a manner consistent with the restoration programs for other species.

Table 5-8. Summary of biological significance, habitat quality, fishery exploitation rates, and Phase 1 strategy for early winter steelhead (Chambers Creek).

	Early Winter Steelhead Population (Chambers Creek)			
	Cowlitz Hatchery	**Lower Cowlitz**	**Tilton**	**Upper Cowlitz Cispus River**
Biodiversity Significance & Genetic Integrity				
Current	Low	Low	NA	NA
Short-term Objective	Low	Low	NA	NA
Long-term Objective	Low	Low	NA	NA
Habitat Quality				
Current	NA	NA	NA	NA
Short-term Objective	NA	NA	NA	NA
Long-term Objective	NA	NA	NA	NA
Fishing Opportunities				
Current	High (HR = 90%)	NA	NA	NA
Short-term Objective	High (HR = 90%)	NA	NA	NA
Long-term Objective	High (HR = 90%)	NA	NA	NA

Abbreviations: NA – not applicable; HR – total adult equivalent mortality exploitation rate.

5.4.2.2. Fishery Harvest

General harvest objectives are to provide fishing opportunities consistent with the mandates of WDFW, US v. Oregon, and other state and federal legal obligations. This management strategy is to maximize harvest opportunity of hatchery origin early winter steelhead in the lower Cowlitz River, while providing protection of natural origin fish. Fishery exploitation rates are expected to remain relatively constant over time (Table 5-9).

Marine fisheries harvest negligible numbers of steelhead; no marine management objectives are developed other than to continue to encourage management actions to reduce or eliminate high seas harvest of any steelhead.

Table 5-9. Stock harvest profile (Treaty and non-Treaty) for the early winter steelhead population (hatchery origin).

Fishery Aggregate	1994-1995 Broods		Phase 1 Productivity Test Period		Phase 2 Long-term Target	
	Description	AEQ Harvest Rate	Description	AEQ Harvest Rate	Description	AEQ Harvest Rate
Freshwater Sport, above Cowlitz Barrier Dam	None	<1%	None	0	None	0
Freshwater Sport, Columbia River Mouth to Cowlitz Barrier Dam	Selective fishery operating November-February.	70%	Selective fishery operating November-February.	90%	Selective fishery operating November-February.	90%
Mainstem Net	Incidental release mortality during fisheries directed at other species.	< 1%	Incidental release mortality during fisheries directed at other species.	< 1%	Incidental release mortality during fisheries directed at other species.	< 1%
Ocean Troll, Net, and Sport	Fisheries managed consistent with PST and PFMC regulations.	Negligible	Fisheries managed consistent with PST and PFMC regulations.	Negligible	Fisheries managed consistent with PST and PFMC regulations.	Negligible
Total AEQ Exploitation Rate	72%		90%		90%	

AEQ- Adult Equivalent Harvest Rate.

Commercial fisheries in the mainstem Columbia River are precluded from retaining incidentally encountered steelhead. Expansion of selective fisheries designed to protect naturally produced salmon should result in an increased level of protection for all steelhead.

Sport fisheries selective for adipose fin-clipped steelhead are expected to occur in the mainstem Columbia River and the lower Cowlitz River on a year round basis with a goal of maximum removal of hatchery origin fish.

5.4.2.3. Habitat

In the FHMP, habitat goals for early winter steelhead will be to improve survival of migrating smolts following release from the hatchery.

5.4.3 Strategies

The key strategies proposed for early winter steelhead are as presented below.

- Continue to mass mark fish of hatchery origin to provide fishing opportunities while limiting exploitation rates on natural stocks.
- Segregate the hatchery program to provide fishing opportunities in the lower Cowlitz River while limiting impacts on naturally produced salmonids to acceptable levels.
- Eliminate early winter steelhead adult stocking in the Tilton River.
- Eliminate the early winter steelhead adult recycling program unless results of the genetic analysis shows no impact to the native late winter population.

5.4.3.1. Stock Reintroduction and Recovery

No introduction of early winter steelhead is planned because the stock is not native to the Cowlitz River. However, because early winter steelhead may prey upon and compete with listed steelhead and Chinook populations in the lower Cowlitz River, the WDFW completed a benefit-risk assessment procedure (BRAP) analysis to identify the risks to late winter steelhead from the continuation of the early winter program (Table 5-10). The major risks identified by the WDFW included:

1) Genetic risks due to interbreeding
2) Ecological risks from predation and competition
3) Ecological risks from disease transmission
4) Facility risks

To reduce the risks, the early winter steelhead program poses to both Chinook and native late winter steelhead, the following actions are proposed.

Table 5-10. Results of early winter steelhead BRAP analysis.

Risk	Risk Rating	Comments
1) Genetic	MEDIUM TO HIGH	Based on studies of lower Columbia steelhead populations, interbreeding between hatchery and native winter steelhead likely occurs at a moderate to high rate.
2a) Predation	LOW	Hatchery smolts may consume fish up to 42-44% of their length. During migration of smolts, wild juveniles should generally be too large to eat. Depending on level of residualization of smolts, predation risk could be higher as they could consume emerged fry.
2b) Competition	HIGH	Juveniles resulting from natural spawning of unharvested adults will compete with juvenile native winter steelhead. Abundance of adults or juveniles is currently unknown, but has the potential to be significant relative to winter steelhead abundance.
3) Disease	HIGH	Standard fish health practices are followed during hatchery winter steelhead rearing. However early winter steelhead are highly susceptible to the parasite *C. shasta*. This results in an increase in disease load in the basin.
4) Facility	LOW	Structures associated with winter steelhead production were not known to impede passage or movements of wild winter steelhead.

Reduction in Hatchery Production

Hatchery production of early winter steelhead has been reduced from 300,000 smolts to 200,000 smolts. This action is designed to reduce possible predation impacts on listed lower river Chinook populations (see fall Chinook section for more detail).

In addition to possibly reducing predation on Chinook juveniles, a decrease in early winter steelhead production is likely to reduce the number of early winter adults straying into late winter steelhead spawning areas in the lower river. Studies conducted on adult winter steelhead in the Cowlitz River showed that winter steelhead recycled into the lower Cowlitz River entered key tributaries where they may have spawned (Tipping 1998). These data provide support to the BRAP Medium/High rating for genetic impacts.

Finally, because early winter steelhead are highly susceptible to *ceratomyxosis* these fish are reared for a portion of their time in the hatchery on pathogen free water (ozone treated). A reduction in early steelhead production would make available pathogen free water for rearing native late winter steelhead and Chinook and decrease disease load in the basin.

Implement Volitional Release Strategy

Early winter steelhead smolts will be released volitionally from the Cowlitz Trout Hatchery. This action is consistent with the 1999 hatchery Biological Opinion (NMFS 1999) that encourages the use of volitional release strategies to reduce residualism of hatchery smolts. Fish that do not volitionally migrate from the hatchery may be released

into non-anadromous waters to provide sport fishing opportunity at the direction of the WDFW.

Eliminate Hatchery Adult Recycling Program

Currently, hatchery early winter steelhead surpluses to hatchery broodstock needs are recycled to the lower Cowlitz River to provide increased sport catch. This recycling program will be eliminated. This action should help reduce the number of non-native early winter steelhead adults present on the spawning grounds. This program may be reinitiated if results of genetic testing indicate there are no impacts on late winter steelhead.

5.4.3.2. Artificial Production

The early winter steelhead program will be managed using a Segregated Type hatchery program designed to achieve stock harvest goals and reduce interactions with native fish species.

Over the short term, it is assumed that the number of juvenile steelhead required to meet the 20,000 adult benchmark will be produced at the Cowlitz Hatchery Complex. Based on the data presented in the Cowlitz Hatchery Program Evaluation Report for 2000 (Tacoma Power 2002), 1,100,000 hatchery smolts (early, late, and summer) would need to be released each year to achieve the benchmark. The early winter component of the program will be 200,000 smolts.

Hatchery rearing conditions will be improved through hatchery modifications that increase overall water quality and reduce rearing density to optimize survival. Hatchery programming will be based on providing optimum rearing conditions for stocks regardless of current or historical rearing and release sites. Use of species and site specific loading and density guidelines, mating protocols that maximize genetic variability, and modification of hatchery structures for volitional migration will allow hatchery populations to develop the physiological, morphological, and behavioral traits important to long-term fitness. Juvenile steelhead that do not volitionally leave the rearing vessels will not be released into anadromous waters. These actions should reduce hatchery fish competition and predation risks to naturally produced stocks.

Innovative Rearing

For non-indigenous stocks such as early winter steelhead, innovative rearing practices initially will not be incorporated into the program. Testing innovative rearing, such as the use of enriched environments and growth modulation, will be used in Chinook, coho, and indigenous winter steelhead programs. Based on the results of this testing, selected practices may become part of the other future steelhead programs.

Adult Escapement Management

Early winter steelhead harvest in the lower Cowlitz River will be managed to achieve broodstock needs for the hatchery. It is estimated that approximately 172 adults are needed to produce 200,000 smolts. These adults will be collected at the Cowlitz Salmon Hatchery separator.

Production Adjustment and Credit Mechanisms

The Settlement Agreement requires that the FHMP identify methods to 1) adjust hatchery production upward or downward to accommodate recovery of indigenous stocks, and 2) develop credit mechanisms for production of high quality natural stocks. The actions proposed for early winter steelhead to meet these requirements are listed below.

- Total hatchery steelhead production will be decreased slightly to 1,100,000 yearlings.

- The number of naturally produced late winter steelhead smolts in the upper Cowlitz and Tilton river basins will be used to reduce the number of hatchery early winter, summer, or late winter yearlings released each year from the hatchery on a 2:1 basis for future brood years. The adjustment will be based on a five-year rolling average of the number of late winter naturally produced smolts passing the Barrier Dam. The assumption that hatchery and natural steelhead produce similar numbers of adult returns would be tested over time. The results of this analysis will provide the data needed to adjust the ratio upward or downward.

- The size and operation of the non-indigenous steelhead program will depend on the success of maintaining genetic segregation among the stocks. Future production of non-indigenous steelhead would be reduced if NOAA Fisheries concludes the program produces unacceptable risks to native steelhead.

- The proposed changes in hatchery rearing practices are hypothesized to increase hatchery fish survival by 25 percent. The difference in survival between the two test groups would be monitored over time. If this hypothesis were correct, hatchery production would be decreased by a commensurate amount.

5.4.3.3. Fishery Harvest

The primary harvest strategy will be used to achieve the reintroduction, recovery, and harvest objectives of this plan:

- Anglers will be required to release all unmarked steelhead caught in sport fisheries.

5.5 Summer Steelhead

The long-term (>15 years) goal of the summer steelhead stock management strategy is to support a consumptive sport fishery in the lower Columbia River and Cowlitz River downstream of the Barrier Dam based on the intensive harvest of marked hatchery produced fish. Further, the goal is to develop rearing, release, and harvest strategies that reduce or eliminate natural spawning by summer steelhead.

In Phase 1 of the FHMP, summer steelhead management will be limited to the lower Cowlitz River. The primary Phase 1 objective is to support a consumptive sport fishery.

Phase 1 hatchery production of summer steelhead will be 450,000 juveniles released as smolts from the Cowlitz River hatcheries. This level of production will achieve significant harvest opportunities from late spring through fall. Based on a 1.9 percent survival rate, average adult summer steelhead production from a release of 450,000 fish should be approximately 8,550 adults.

Harvest of hatchery fish will continue in the lower river as long as the exploitation rate remains high enough to prevent significant spawning by summer steelhead, and the incidental harvest of wild steelhead is at acceptable levels consistent with conservation goals of that stock. Anglers will be required to release all unmarked steelhead caught in recreational fisheries.

Studies of naturally reproducing summer steelhead will be conducted in the lower Cowlitz River downstream of the Barrier Dam to describe the population and to determine areas for action to reduce reproductive influence of summer steelhead.

5.5.1 Synopsis of Objectives and Strategies

A brief synopsis of the summer steelhead objectives and the proposed strategies to meet each is presented below.

Phase 1 Objectives. Develop and implement rearing and release strategies that maximize return of summer steelhead to the creel and to the hatchery while minimizing conflicts with naturally produced steelhead and other native species.

Phase 2 Objectives. Continue to fine tune goals from Phase 1. Ensure that the smolt migration and resultant adult fishery do not create biological or behavioral problems for naturally occurring salmonid populations in the Cowlitz River.

Proposed actions for summer steelhead in the Lower Cowlitz River to achieve Phase 1 objectives are summarized below.

- Program Studies. Conduct genetic evaluation of summer steelhead effects on the native late winter stock. Based on this work, implement changes to the program that reduce summer steelhead straying and residualism, increase survival, increase harvest, and decrease impacts on late winter steelhead caused by the presence of summer steelhead in the watershed.

- Artificial Production Programs. The Phase 1 release will be approximately 450,000 summer steelhead from the Cowlitz hatcheries each year to provide the adults needed to meet harvest goals. Update Cowlitz Hatchery Complex facilities and test rearing techniques to produce hatchery juveniles that maximize survival to the creel and escapement while minimizing conflicts with naturally produced salmonids.

- Fishery Management. Implement a fishery management regime that provides harvest opportunities for summer steelhead in the lower Columbia and Cowlitz rivers below Barrier Dam.

It is anticipated that summer steelhead will continue to be released in the basin in Phase 2. The total number released will be dependent on hatchery rearing space availability, NOAA-Fisheries conclusions regarding impacts to native steelhead populations and whether or not adult volitional fish passage facilities are constructed at the Project.

5.5.2 Goals and Objectives

For this analysis, fisheries goals are classified in three categories: conservation, harvest and habitat. Conservation goals are presented in terms of biological significance of the stock and its viability. Habitat goals are expressed as the quality of the environment to produce summer steelhead, and harvest goals as the level and types of fisheries that can be supported.

The simple terminology used in Table 5-11 is meant to convey the management goals and direction over time for non-indigenous summer steelhead. A review of the table data indicates that the goal of fisheries managers is to maintain stock biological significance and harvest opportunity, while reducing impacts on summer steelhead.

Table 5-11. Summary of biological significance, habitat quality, fishery exploitation rates, and Phase 1 strategy for summer steelhead (Skamania Stock).

	Summer Steelhead Population (Skamania)			
	Cowlitz Hatchery	**Lower Cowlitz**	**Tilton**	**Upper Cowlitz Cispus River**
Biodiversity Significance & Genetic Integrity				
Current	Low	Low	NA	NA
Short-term Objective	Low	Low	NA	NA
Long-term Objective	Low	Low	NA	NA
Habitat Quality				
Current	NA	NA	NA	NA
Short-term Objective	NA	NA	NA	NA
Long-term Objective	NA	NA	NA	NA
Fishing Opportunities				
Current	High (HR = 72%)	NA	NA	NA
Short-term Objective	High (HR = 90%)	NA	NA	NA
Long-term Objective	High (HR = 90%)	NA	NA	NA

Abbreviations: NA – not applicable; HR – total adult equivalent mortality exploitation rate.

5.5.2.1. Stock Reintroduction and Recovery

As summer steelhead are not native to the Cowlitz River, there is no intent to establish a naturally reproducing population. In fact, an objective of the FHMP is to prevent summer steelhead from spawning naturally in the basin.

5.5.2.2. Fishery Harvest

General harvest objectives are to provide fishing opportunities consistent with the mandates of WDFW, US v. Oregon, and other state and federal legal obligations.

The management strategy is to maximize harvest opportunities for hatchery summer steelhead in the lower Cowlitz River, while protecting natural origin fish. Fishery exploitation rates are expected to remain relatively constant over time (Table 5-12).

Marine fisheries harvest negligible numbers of steelhead; no marine management objectives are developed other than to continue to encourage management actions to reduce or eliminate high seas harvest of any steelhead.

Commercial fisheries in the mainstem Columbia River are precluded from retaining incidentally encountered steelhead. Expansion of selective fisheries designed to protect naturally produced salmon should result in an increased level of protection for all steelhead.

Sport fisheries selective for adipose fin-clipped steelhead are expected to occur in the mainstem Columbia River and the lower Cowlitz River on a year round basis with a goal of maximum removal of hatchery origin fish.

Summer steelhead will not be released into waters upstream of Mayfield Dam for harvest purposes.

5.5.2.3. Habitat

In the FHMP, habitat goals for summer steelhead will be to maximize survival of migrating smolts following release from the hatchery.

Table 5-12. Stock harvest profile (Treaty and non-Treaty) for the summer steelhead population (hatchery origin)

Fishery Aggregate	1994-1995 Broods		Phase 1 Productivity Test Period		Phase 2 Long-term Target	
	Description	AEQ Harvest Rate	Description	AEQ Harvest Rate	Description	AEQ Harvest Rate
Freshwater Sport, Columbia River mouth to Cowlitz Barrier Dam	Selective fishery operating year around.	70%	Selective fishery operating year around.	90%	Selective fishery operating year around.	90%
Mainstem Net	Incidental release mortality during fisheries directed at other species.	1.7%	Incidental release mortality during fisheries directed at other species.		Incidental release mortality during fisheries directed at other species.	
Ocean Troll, Net, and Sport	Non-directed incidental harvest only.	Negligible	Non-directed incidental harvest only.	Negligible	Non-directed incidental harvest only.	Negligible
Total AEQ Exploitation Rate	~72%		90%		90%	

AEQ- Adult Equivalent Harvest Rate.

5.5.3 Strategies

Key summer steelhead strategies are as follows:

- Continue to mass mark hatchery origin fish and selective fisheries to provide fishing opportunities while limiting exploitation rates on natural stocks.
- Segregate the hatchery program to provide fishing opportunities in the lower Cowlitz River while limiting impacts on naturally produced salmonids to acceptable levels.
- No stocking of summer steelhead adults above Mayfield Dam.
- Eliminate the summer steelhead adult recycling program. If genetic study results indicate no impact to late winter steelhead, the recycling program could, at the direction of the FTC, be reinitiated in years of low returns.

5.5.3.1. Stock Reintroduction and Recovery

No introduction or reintroduction of summer steelhead is planned as the stock is not native to the Cowlitz River.

However, because summer steelhead may prey and compete with listed steelhead and Chinook populations in the lower Cowlitz River, the WDFW completed a simplified BRAP analysis to identify the risks to late winter steelhead from the continuation of the summer steelhead program (Table 5-13). The major risks identified by the WDFW included:

1) Genetic risks due to interbreeding
2) Ecological risks from predation and competition
3) Ecological risks from disease transmission
4) Facility risks

Reduction in Hatchery Production.

Hatchery production of summer steelhead has been reduced to 450,000 smolts. This action is designed to reduce possible predation impacts on listed lower river Chinook populations (see fall Chinook section for more detail).

In addition to possibly reducing predation on Chinook juveniles, a decrease in summer steelhead production is likely to reduce the number of summer steelhead adults straying into late winter steelhead spawning areas in the lower river. Studies conducted on adult summer steelhead in the Cowlitz River showed that fish recycled into the lower Cowlitz River were observed in Cowlitz River tributaries, in the North Fork Lewis River, Kalama River, and at the North Fork Toutle River trap (Tipping 1999).

Table 5-13. Results of the summer steelhead BRAP analysis.

Risk	Risk Rating	Comments
1) Genetic	LOW	Based on a few studies of lower Columbia steelhead populations, interbreeding between hatchery summer and native winter steelhead likely occurs at a very low level.
2a) Predation	LOW	Hatchery smolts may consume fish up to 42-44% of their length. During migration of smolts, wild steelhead juveniles should generally be too large to eat. Depending on level of residualization of smolts, predation risk to fall Chinook could be higher as they could consume emerged fry.
2b) Competition	HIGH	Summer juveniles resulting from natural spawning of unharvested adults will compete with juvenile native winter steelhead. Abundance of summer adults or juveniles is currently unknown, but has the potential to be significant relative to winter steelhead abundance.
3) Disease	HIGH	Standard fish health practices are followed during hatchery summer steelhead rearing. However, Skamania summer steelhead are highly susceptible to the parasite *C. shasta* and thus increase disease load in the basin.
4) Facility	LOW	Structures associated with summer steelhead acclimation were not known to impede passage or movements of winter steelhead.

Finally, because summer steelhead are highly susceptible to *ceratomyxosis,* these fish are reared for a portion of their time in the hatchery on pathogen free water (ozone treated). A reduction in summer steelhead production would make available pathogen free water for rearing native late winter steelhead and Chinook and decrease disease load in the basin.

Implement Volitional Release Strategy

Summer steelhead smolts will be released volitionally from the Cowlitz Hatchery Complex. This action is consistent with the 1999 hatchery Biological Opinion (NMFS 1999) that encourages the use of volitional release strategies to reduce residualism of hatchery smolts.

Eliminate Hatchery Adult Recycling Program

Currently, hatchery summer steelhead surplus to hatchery broodstock needs are recycled to the lower Cowlitz River to provide increased sport catch. This program will not be continued in order to reduce possible interactions with all life history stages of natural-origin late winter steelhead. If genetic study results indicate no impact to late winter steelhead, the recycling program could, at the direction of the FTC, be reinitiated in years of low returns.

Genetic Testing of Natural Steelhead Spawners in the Lower Cowlitz River

Although data indicate that early winter and summer steelhead may be spawning in the lower Cowlitz River, their successes and resulting impacts to listed late winter steelhead is not known. To determine if introgression has occurred between these three stocks, genetic samples will be collected from unmarked steelhead spawning in the lower Cowlitz River and compared to the late winter hatchery stock. The data collected from this study will be used to adjust both the early winter and summer steelhead program as appropriate, based on consultation with NOAA-Fisheries staff and the FTC.

5.5.3.2. Artificial Production

The summer steelhead program will be managed using a Segregated Type hatchery program designed to achieve stock harvest goals and reduce interactions with native fish species.

Over the short term, it is assumed that the number of juvenile steelhead required to meet the 20,000-adult benchmark will be produced at the Cowlitz Hatchery Complex. Based on the data presented in the Cowlitz Hatchery Program Evaluation Report for 2000, 1,100,000 hatchery smolts (early, late, and summer) will need to be released each year to achieve the benchmark. The summer component of the program will be 450,000 smolts.

Hatchery rearing conditions will be improved through hatchery modifications that increase overall water quality and reduce rearing density to optimize survival. Hatchery programming will be based on providing optimum rearing conditions for stocks regardless of the current or historical rearing and release site. Use of species and site specific loading and density guidelines, mating protocols that maximize genetic variability, and modification of hatchery structures to provide for volitional migration will allow hatchery populations to develop the physiological, morphological, and behavioral traits important to long term fitness. These actions should reduce hatchery fish competition and predation risks to naturally produced stocks.

Innovative Rearing

For non-indigenous steelhead stocks such as summer steelhead, innovative rearing practices initially will not be incorporated into the program. Testing of innovative rearing practices such as the use of enriched environments and growth modulation will be used in spring Chinook, coho, and indigenous late winter steelhead programs. Based on the results of this testing, selected practices may become part of the other steelhead programs at a later time.

Adult Escapement Management

Summer steelhead harvest in the lower Cowlitz River will be managed to achieve broodstock needs for the hatchery. It is estimated that approximately 411 adults are needed to produce 450,000 smolts.

Production Adjustment and Credit Mechanisms

The Settlement Agreement requires that the FHMP identify methods to 1) adjust hatchery production upward or downward to accommodate recovery of indigenous stocks, and 2)

develop credit mechanisms for production of high quality natural stocks. The actions proposed for summer steelhead to meet these requirements are listed below.

- Total hatchery summer steelhead production will be decreased to 450,000 juveniles. This action is designed to reduce competition effects on native fish species in the lower Cowlitz River without sacrificing an important recreational fishery.

- No summer steelhead will be released upstream of Mayfield Dam.

- The size and operation of the non-indigenous steelhead program will depend on the success of maintaining genetic segregation among the stocks. Future production of non-indigenous steelhead will be reduced if NOAA-Fisheries concludes their continued production has unacceptable impacts to native species.

5.5.3.3. Fishery Harvest

The primary harvest strategy will be used to achieve the reintroduction, recovery, and harvest objectives of this plan:

- Angler will be required to release all unmarked steelhead caught in sport fisheries.

5.6 Coho

The long-term goal (>15 years) is the restoration and recovery of wild, indigenous coho salmon in the upper Cowlitz, Cispus, and Tilton rivers to harvestable levels. Achieving this goal will require a multi-faceted approach that includes improved fish passage survival, improved aquatic habitat conditions, and potentially an integrated artificial production program to supplement the production of the natural stock.

Because this stock has been recently proposed for listing as Threatened under ESA, the restoration of wild coho production will be emphasized in the upper Cowlitz and Tilton rivers. The primary objective would be to recover both populations to levels that ensure their continued existence over time, and provide sport-fishing opportunity as the stock reaches sustainable levels.

Conservation goals for Cowlitz River coho would be achieved by emphasizing natural production, improving hatchery practices, reducing overall hatchery production (all species combined), and controlling harvest rates on naturally produced fish in the upper Cowlitz River.

The productivity test will be conducted on the Tilton River population to determine if the R/S, and abundance criteria needed to implement a volitional upstream fish passage system can be achieved. All juvenile coho arriving at Mayfield Dam (Tilton origin) will continue to be given a unique mark so that they may be distinguished upon their return as adults. Juveniles arriving at Cowlitz Falls Dam or other upper basin collectors will not be

given a physical mark, as the presence of an adipose fin will distinguish them from either Tilton River or hatchery origin fish.

Productivity testing for coho will not occur in the upper Cowlitz River basin, as it is not a requirement of the FHMP. Instead, coho will be managed in a manner that emphasizes natural production and stock recovery, while at the same time providing the ecological benefits (gravel cleaning, nutrient delivery) large adult returns provide to a healthy watershed.

In addition, upper Cowlitz River coho management will be tied to spring Chinook recovery in this same portion of the basin. When either the FPS or S/S trigger is met for upper basin origin spring Chinook smolts passing the Barrier Dam, adult coho releases into the upper Cowlitz River will be established. The escapement goal will take into account how well empirical data support the EDT hypothesis of coho juvenile and adult production for the upper basin. This action (i.e., revisiting the adult stocking strategy) is needed to ensure that juvenile coho competition with, and predation rates on, young-of-the-year (YOY) spring Chinook fluctuate in a manner consistent with the variability expected in a natural system. Ideally, the size of both populations would fluctuate in synchrony with environmental conditions, and not create conditions where one species is favored over the other.

Approximately 2.31 million hatchery juvenile coho yearlings will be marked by the removal of their adipose fin and released each year to provide the adults needed to meet identified conservation and harvest goals. The hatchery coho program will be run as an Integrated Type following HSRG guidelines once a natural self-sustaining population of coho is established in the Tilton River or upper Cowlitz River.

Harvest of hatchery coho will continue in the lower river on a yearly basis as long as escapement goals are met for the hatchery, upper Cowlitz, and Tilton River populations. Anglers will be required to release all unmarked coho caught in recreational fisheries in the lower Cowlitz River.

5.6.1 Synopsis of Objectives and Strategies

A brief synopsis of the coho objectives and the proposed strategies to meet each is presented below.

Phase 1 Objectives. Increase juvenile fish collection efficiency and survival through the Cowlitz River hydropower system; conduct productivity experiments in the Tilton River to determine if effective volitional passage facilities should be constructed; determine adult migration success through Mayfield Lake; begin development of a locally adapted broodstock for the Tilton River and upper Cowlitz River populations; provide significant sport fishing opportunities for hatchery coho in stream reaches below the Barrier Dam; improve hatchery fish quality; and achieve the 124,277 adult coho benchmark target.

The strategies proposed to achieve coho Phase 1 objectives are as follows:

- Habitat. Downstream fish passage/collection facilities will be improved at both Mayfield Dam and at Cowlitz Falls Dam. The facilities will be designed and operated to achieve the 75 to 95 percent survival standard for coho originating from the upper Cowlitz River basin, and the 95 percent survival standard at Mayfield.

- Reintroduction. Continue the coho reintroduction program in the upper Cowlitz River. Also, initiate the productivity experiment for the Tilton River by releasing a minimum of 500 adults each year into this basin. The use of adults provides the quickest means to initiate the productivity experiment and promotes the process of local adaptation for the introduced stock. The number of coho targeted for release was selected to promote achievement of the linked criteria of abundance (500 from NOAA-Fisheries) and productivity (R/S), which defines whether a stock is sustainable over time.

- Productivity Enhancement. Distribute carcasses from the Cowlitz Salmon Hatchery to the Tilton and upper Cowlitz river basins as appropriate to help restore and maintain ecosystem function, or until specific criteria are met, release surplus hatchery adults into the upper Cowlitz River basin to provide similar benefits. At no time will hatchery coho constitute more than 50 percent of the total spawning population. Implement a harvest management plan to reduce the upper basin hatchery coho adult population levels to no more than 30 percent of the total spawning population.

- Artificial Production Programs. Upon establishment of a self-sustaining population, begin development of an Integrated Type hatchery program for coho. Release approximately 2.31 million juvenile coho from the Cowlitz Fish Hatchery Complex each year to provide the adults needed to meet identified conservation and harvest goals, as well as to provide fish for stream nutrient enhancement. Update Cowlitz Hatchery Complex facilities to improve rearing conditions, and test rearing techniques to produce hatchery juveniles that are similar in physiology, morphology, behavior, and health status to naturally produced fish.

- Fishery Management. Implement a fishery management regime to protect naturally produced coho, while at the same time allowing continued sport harvest of hatchery origin coho in the lower Cowlitz River and above Cowlitz Falls Dam.

Phase 2 Objectives. Phase 2 objectives would depend on the results of Phase 1 strategies and therefore cannot be described in detail at this time. Possible future objectives include:

1) Maintain some level of natural coho production in stream reaches above Mayfield Dam. This production would not need to be self-sustaining.

2) Implement a juvenile supplementation program in the Tilton River and upper Cowlitz River.

3) Increase total hatchery production to maximum provided in Settlement Agreement (800,000 lbs). This may mean an increase in hatchery coho production.

4) Use the $15 million reserved for fish passage facility construction to improve coho habitat in the basin.

5.6.2 Goals and Objectives

Fisheries goals are classified into three categories: conservation, harvest, and habitat. Conservation goals are presented in terms of the biological significance to the stock and its viability. Habitat goals are expressed as the quality of the environment to produce coho, and harvest goals as the level and types of fisheries that can be supported.

The simple terminology used in Table 5-14 is meant to convey management goals and direction over time for Cowlitz River coho. The data in this table indicates that the goal of fisheries managers is to increase stock biological viability and habitat quality over time. Achieving these conservation and habitat goals should lead to increased harvest, thus meeting harvest goals for the basin.

All strategies proposed in the FHMP are designed to be consistent with the conservation, habitat, and harvest goals presented above.

5.6.2.1. Stock Reintroduction and Recovery

Cowlitz River coho is a candidate species for listing under the ESA, thus recovery is an important management goal. However, as current basin coho production relies heavily on hatchery fish, the major conservation goal of the FHMP is to increase natural production and reduce hatchery production when possible. To achieve this goal, the FHMP calls for the establishment of self-sustaining coho populations in both the Tilton River and upper Cowlitz River, and eventually the integration of the hatchery and natural components of the run if it can be shown that natural production can be sustainable over time.

Table 5-14. Summary of biological significance, habitat quality, fishery exploitation rates, and Phase 1 strategy for each population of coho.

	Coho Population			
	Cowlitz Hatchery	**Lower Cowlitz**	**Tilton**	**Upper Cowlitz Cispus River**
Biodiversity Significance & Genetic Integrity				
Current	Medium	Low	Extirpated	Low
Short-term Objective	Medium	Medium	Medium	Medium
Long-term Objective	Medium	Medium	High	High
Habitat Quality				
Current	NA	Medium (adults 4,383)	Medium	Low - Medium
Short-term Objective	NA	Medium (adults 4,383)	Low (adults 2,916)	Medium (adults 18,215)
Long-term Objective	NA	High (adults 15,436)	High (adults 8,215)	High (adults 28,984)
Fishing Opportunities				
Current*	High (HR = 69%)	Medium (HR = 35%)	None	None
Short-term Objective	High (HR = 69%)	Medium (HR = 35%)	Medium (HR = 35%)	Medium (HR = 35%)
Long-term Objective	High (HR = 69%)	Medium (HR = 35%)	Medium (HR = 44%)	Medium (HR = 44%)

NA- Not Applicable
HR- Assumed harvest rates
Adults- EDT adult abundance estimate for current (short-term) and PFC (long-term)
* Hatchery coho harvest rates were estimated at 51% for 2001-2003 (NOAA-Fisheries letter dated July 20, 2004).

5.6.2.2. Fishery Harvest

General harvest objectives are to provide fishing opportunities consistent with the mandates of WDFW, the Pacific Salmon Treaty (PST), the Pacific Fisheries Management Council, US v. Oregon, and other state, federal, and international legal obligations. Specific harvest objectives will vary depending on the phase of the reintroduction and recovery program. Fishery exploitation rates are expected to increase as the status of natural populations of coho increase in the basin (Table 5-15).

Marine fisheries in British Columbia, Oregon, and Washington that harvest Cowlitz River coho are expected to operate through 2008 under the provisions of the 1999 annexes of the PST. In recent years, the ocean fisheries have been harvested at a 40 percent rate. This is expected to drop to around 15 percent in the future in order to protect wild coho.

Table 5-15. Stock harvest profile (Treaty and non-Treaty) for Upper Cowlitz watershed coho populations (natural spawning origin).

Fishery Aggregate	1994-1995 Broods		Phase 1 Productivity Test Period		Phase 2 Long-term Target	
	Description	AEQ Harvest Rate	Description	AEQ Harvest Rate	Description	AEQ Harvest Rate
Freshwater Sport, above Cowlitz Barrier Dam	Selective fishery on hatchery-origin fish during August-December	< 1.0%	Selective fishery on hatchery-origin fish during August-November.	< 1.0%	Selective Fishery on hatchery-origin fish from August-December.	10.0%
Freshwater Sport, Columbia River Mouth to Cowlitz Barrier Dam	Fishery operating from August-November.	3.6%	Selective fishery on hatchery-origin fish during August-November.	3.6%	Selective fishery on hatchery-origin fish during August-November.	3.6%
Mainstem Net	Directed harvest during August-October.	25%	Directed harvest during August-October.	15%	Directed harvest during August-October.	15%
Ocean Troll, Net, and Sport	Fisheries managed consistent with PST and PFMC regulations.	40%	Fisheries managed consistent with PST and PFMC regulations.	15%	Fisheries managed consistent with PST and PFMC regulations.	15%
Total AEQ Exploitation Rate	**69%		35%		44%	

AEQ- Adult Equivalent Harvest Rate.

** Hatchery coho harvest rates were estimated at 51% for 2001-2003 (NOAA-Fisheries letter dated July 20, 2004).

Commercial fisheries in the mainstem Columbia River may occur in August and September. Currently, this is a non-selective fishery and operates in recent years at about a 25 percent rate. The non-selective aspect of this fishery is expected to continue, at least through Phase 1 of the FHMP, however at reduced rates (~15 percent).

Sport fisheries selective for adipose fin-clipped coho are expected to occur in the mainstem Columbia River and the lower Cowlitz River from August through October. Assuming a ten percent mortality rate for the release of unclipped fish, a six percent encounter rate in the mainstem Columbia, and a 30 percent encounter rate in the lower Cowlitz, the WDFW objective for the total freshwater incidental harvest rate on wild coho in these sport fisheries is 3.6 percent.

Currently, there are selective fisheries operating upstream of Mayfield Dam that result in less than one percent mortality on NORs. It is intended to eventually expand this to allow a directed harvest of naturally produced fish at a rate near ten percent (long-term), stock strength allowing. This also assumes that coho are not listed by NOAA-Fisheries.

5.6.2.3. Habitat

The major habitat goal of the FHMP is to increase juvenile coho survival through the Cowlitz River hydropower complex. The Settlement Agreement sets a juvenile fish passage survival (FPS) of 75 to 95 percent for the upper Cowlitz River stock and 95 percent for coho passing Mayfield Dam. In addition, the WDFW has a long-term objective of achieving properly functioning habitat conditions in the lower Cowlitz River, Tilton River and upper Cowlitz River. EDT estimates of PFC coho production in each area are shown in Table 5-14 under Long-term Habitat Quality Objectives.

5.6.3 Strategies

The strategies proposed to meet coho conservation, harvest, and habitat goals are as follows:

- Adult supplementation would be the management tool used to restore natural coho production in streams above Mayfield Dam.

- Minimum adult escapement to the Tilton River would be set at 500 fish, the number needed to measure the R/S and abundance criteria used as fish passage triggers in the Settlement.

- To restore and maintain ecosystem integrity, carcasses from the Cowlitz Salmon Hatchery may be placed in the Tilton River and the upper Cowlitz basins. This action should help increase habitat productivity.

- The coho stock management strategy emphasizes the production of indigenous fish stocks both in the wild and at the hatchery. Non-indigenous salmonid stocks will not be allowed above Mayfield Dam, and hatchery production of these stocks in the lower basin will be reduced over time as native stocks recover.

- To reduce interactions between hatchery and ESA-listed fish stocks, hatchery production of all stocks will not exceed 650,000 pounds following hatchery complex reconstruction.

- Downstream fish passage/collection facilities will be improved at both Mayfield Dam and at Cowlitz Falls Dam. The facilities will be designed to achieve the 95 percent survival standard for coho migrating from the upper Cowlitz and Cispus rivers, and those passing Mayfield Dam.

- Approximately 2.31 million juvenile coho will be released each year to provide the adults needed to meet both conservation and harvest goals.

- Proposed coho hatchery production levels are designed to produce the adult benchmark guideline of 124,277 identified in the Settlement Agreement. This level of hatchery coho production will provide significant sport and commercial fisheries.

- Juvenile coho releases from the hatchery have decreased to 2.31 million to reduce competition with naturally produced juvenile fall Chinook and other native species.

- Surplus coho adults of hatchery origin will be released above Cowlitz Falls Dam to provide sport-fishing opportunities in the upper Cowlitz River and the nutrients needed to increase habitat productivity.

- Cowlitz Hatchery Complex facilities will be updated and spawning and rearing techniques implemented to improve genetic diversity of the hatchery stock and produce a hatchery coho juvenile that is similar in physiology, morphology, behavior, survival and health status to naturally produced fish.

- The production of hatchery coho juveniles will be reduced each year based on the credit mechanism from the number of natural origin juveniles produced in stream reaches upstream of Mayfield Dam.

5.6.3.1. Collection and Passage

Downstream fish passage/collection facilities will be improved at both Mayfield Dam and at Cowlitz Falls Dam. The facilities will be designed and operated to achieve the 75 to 95 percent survival standard for coho originating from the upper Cowlitz River basin, and the 95 percent survival standard at Mayfield Dam. Tacoma Power is currently studying the feasibility and expected effectiveness of several options for the Cowlitz Falls juvenile collector.

5.6.3.2. Carcass Distribution

If the WDFW chooses to use surplus hatchery fish to enhance the nutrients above Mayfield Dam and if allowed in the approved Disease Management Plan, a productivity experiment will be undertaken to distribute carcasses of surplus hatchery fish collected at

the Cowlitz Hatchery Complex to the Tilton and upper Cowlitz rivers. This action is designed to increase system productivity, thereby increasing the chance for the successful reintroduction of anadromous fish to key areas in the basin. Whether or not this action is implemented, at what scale and how, will depend on the Disease Management Plan developed for the basin. The carcass distribution program will be implemented consistent with the approved Disease Management Plan and with WDFW approval to use the surplus fish.

5.6.3.3. Stock Reintroduction and Recovery

Coho will be reintroduced into the upper Cowlitz and Tilton river basins using an adult supplementation strategy. The adult supplementation strategy was deemed the best approach for achieving the identified conservation goals for this species.

The coho reintroduction program differs depending on the basin examined. Because the Settlement Agreement calls for measuring coho R/S and abundance criteria in the Tilton River and not the upper Cowlitz River, the recovery approach proposed for this stock, with respect to the number of adults released, is more similar to that of upper Cowlitz River spring Chinook. The protocols for measuring Tilton River coho productivity are discussed in the next section.

The number of adults released into the upper Cowlitz River basin each year will depend on run composition (hatchery versus natural) and results from spring Chinook monitoring studies. Coho management will vary depending on the status of the triggers used for managing the upper Cowlitz spring Chinook population.

Pre-Trigger 1 or 2

During this time period, all naturally produced upper Cowlitz River adult coho (NORs) returning to Barrier Dam will be transported and released into the upper Cowlitz River (Lake Scanewa). Hatchery coho may be released at a level not to exceed 50 percent of the total spawning population. This action is designed to reduce genetic risks to the natural population, increase habitat utilization, provide increased nutrients to the ecosystem, and maintain sport-fishing opportunity for local communities. Anglers will be required to release all unmarked adult coho caught. The WDFW will provide a schedule of proposed harvest rates and the number of adults needed to meet nutrient targets on an annual basis for FTC review.

Trigger 1: Spring Chinook FPS ≥ 40 percent, or Trigger 2: S/S ≥30 smolts or ≥ 70 juveniles

Surplus hatchery coho can be released, at the previously defined percentage, into the upper Cowlitz River until one of the two spring Chinook triggers is achieved. Once a trigger is observed, the total number of hatchery coho adults released into the upper Cowlitz will constitute less than 30 percent of the successful coho spawners[18]. This action is designed to reduce juvenile coho competition and predation rates on spring Chinook; one of two key analysis species being used for determining the need for adult

[18] Coho plants can exceed the 30% level so long as sport fisheries are able to reduce the number of actual spawners to below the 30% criterion.

upstream fish passage facilities. Additionally, the action is designed to ensure that local adaptation is driven by the natural and not the hatchery component of the run. The 30 percent value was deemed to be an acceptable risk given that a true wild population of coho does not exist in the basin. This level of hatchery escapement to the wild will achieve goals dealing with nutrient enhancement and harvest, while reducing genetic concerns to the natural population.

Currently, the majority of surplus hatchery fish are transported and released into the upper Cowlitz River. Data collected at Cowlitz Falls Dam indicate that coho smolt production from the adult releases has averaged ~293,000, and ranged from 17,000 to ~800,000 since 1997 (Table 5-16). In contrast, spring Chinook juvenile production has averaged ~111,000, with the majority of this production being subyearling migrants from hatchery juveniles.

Table 5-16. Annual number of juveniles collected, fish collection efficiencies (FCE), and estimated number of steelhead, coho and spring Chinook arriving at Cowlitz Falls Dam (1997-2003).

	Steelhead			Coho			Spring Chinook		
	Captured	FCE	Total	Captured	FCE	Total	Captured	FCE	Total
1997	2,777	**45%**	6,171	3,673	**21%**	17,490	22,964	**17%**	135,082
1998	15,691	**19%**	82,584	109,974	**32%**	343,669	14,966	**18%**	83,144
1999	9,967	**41%**	24,310	15,094	**17%**	88,788	8,703	**24%**	36,263
2000	16,889	**65%**	25,983	106,869	**45%**	237,487	32,587	**24%**	135,779
2001	17,807	**58%**	30,702	334,718	**42%**	796,948	36,475	**23%**	158,587
2002	5,206	**56%**	9,296	55,028	**33%**	166,752	26,328	**22%**	119,673
2003	10,602	**68%**	15,523	173,530	**43%**	400,762	32,475	**13%**	244,173
Mean	11,277	**50%**	27,796	114,127	**33%**	293,128	23,671	**20%**	111,421

Data collected on coho smolt predation on fall Chinook fry in the Lewis River showed that wild coho stomachs averaged 0.23 Chinook fry per smolt (Hawkins and Tipping 1999). The authors noted that because data were not available on stomach evacuation rates, smolt residency times, the number of wild Chinook salmon fry produced each year, or their vulnerability over time, estimates of the total number of fry consumed in a given year were not possible. Thus, the numbers presented by the authors with respect to impacts were considered minimum values for the time sampled.

Regardless, the 0.23 Chinook fry consumed per smolt value indicates that coho smolts in the upper Cowlitz may on average consume a minimum of ~63,000 Chinook fry (275,189*0.23) each year. Based on the estimates of yearly coho smolt production presented in Table 5-16, coho smolts may consume anywhere from ~4,000 (1997) to ~184,000 (2001) Chinook fry each year.

The object of the above predation analysis is to emphasize that a strategy to maximize coho smolt production by releasing large numbers of hatchery coho adults in the upper Cowlitz River basin poses risks to other species that may effect study results for these species. In this case, artificially inflating coho production may result in increased predation on Chinook fry that prevent, for example, the obtainment of the S/S value used

as Trigger 2 for starting the spring Chinook productivity test. This points out the need to revisit the adult coho stocking strategy once either of the two spring Chinook trigger criteria is observed.

5.6.3.4. Measuring Productivity

In Phase 1, a coho productivity experiment will be conducted in the Tilton River but not in the upper Cowlitz River. According to the criteria listed in the Settlement Agreement, the Tilton River coho population would be considered self-sustaining if the R/S value, measured at Barrier Dam, is greater than 1.0 in 3 out of 5 consecutive brood years (and the five-year rolling average), and the five-year rolling average exceeds an adult abundance level identified by NOAA-Fisheries (i.e., 500 fish). Once these criteria are met, an adult ladder may be built at Barrier and Mayfield dams to allow anadromous fish access to both the Tilton River and Mossyrock tailrace. A new trap-and-haul facility would also be constructed to collect and transport fish bound for the upper Cowlitz River basin.

The management strategy for Tilton River coho will change depending on the status of two triggers: S/S or year seven of the FHMP. The proposed Tilton River coho management strategy is described below.

Pre-Trigger 1 or 2

All NOR adult coho of Tilton River origin will be transported and released into the Tilton River. Surplus hatchery coho will be used to increase the total escapement to at least 500 adults per year. Sport fisheries that target adipose clipped hatchery fish will be allowed during this period. Total harvest of hatchery fish may not reduce total spawners to below 500 adults.

Trigger 1: SS≥ 25 and NOR abundance = 500

Currently FPS at Mayfield Dam exceeds 90 percent for coho. Thus, the FPS trigger used for decision making in the upper Cowlitz River is not used for managing Tilton River stocks. Instead, the S/S trigger, in combination with the NOAA-Fisheries abundance value, is used to determine when hatchery adult coho will no longer be stocked in the Tilton River.[19] When the S/S value of 25, and adult abundance value of 500, are achieved, it is assumed that population productivity is sufficient to maintain itself over time. At this point, the productivity test will begin for this stock. It should be noted, however, that the 25 FPS value is a modeled assumption that will be tested by collecting juvenile and adult data at both Mayfield and Barrier dams.

Trigger 2: Year Seven of the FHMP

If Trigger 1 is not achieved by year seven of the FHMP, hatchery adults will no longer be stocked in the Tilton River and the productivity test implemented with NOR fish only. This action is needed to ensure that sufficient time is available to measure R/S values for at least five brood years, one of the criteria identified in the Settlement Agreement.

[19] The S/S value of 25 was developed by simply dividing one by the expected SAR for coho (four percent).

5.6.3.5. Artificial Production

The hatchery coho program initially will be managed under the assumption that long-term, identified conservation and harvest goals will best be met by developing an Integrated Type hatchery program. This assumption is based on EDT modeling results showing that a self-sustaining run of coho can be established above Cowlitz Falls Dam from which to construct such a program. The EDT model estimates that coho equilibrium abundance in the upper basin is approximately 18,000 adults.[20]

Building an Integrated Type population will require that a locally adapted natural spawning stock be developed from the stock currently adapted to the hatchery environment. This will be accomplished by continuing the existing upper Cowlitz River basin coho reintroduction program. Currently, natural production of coho juveniles and adults from streams above Cowlitz Falls Dam is averaging about 293,000 juveniles and 8,000 adults, respectively. This level of production is occurring despite the fact that Cowlitz Falls juvenile collection efficiency (FCE) for this species has averaged less than 45 percent (see Section 5.6.3.1), and harvest rates may be as high as 51-69 percent in ocean and lower river fisheries. As harvest rates are reduced to meet the 35 percent target, the number of both wild and hatchery coho returning to the basin should increase.

Over the short term, it is assumed that the number of juveniles required for meeting the 124,277 adult benchmark will be produced at the Cowlitz Hatchery Complex. Based on the data presented in Cramer (2002), 1.55 million hatchery smolts would need to be released each year to achieve the benchmark. The number of juveniles released is based on the assumption that hatchery coho age-2 survival for the benchmark time period was 8 percent. However, the number of juveniles to be released in the FHMP is increased to 2.31 million to provide adults for ocean and freshwater harvest, reintroduction efforts in the Tilton River and upper Cowlitz River, and nutrients to stream reaches above Mayfield Dam.

Coho will be reared at the Cowlitz Hatchery Complex to produce high quality smolts. A quality hatchery smolt is defined as a fish that is similar in health status, physiology, morphology, and behavior to a naturally produced smolt originating upstream of Mayfield Dam. The program will be run as an Integrated Type once a self-sustaining natural run is established in the basin.

Hatchery rearing conditions will be improved through hatchery modifications that increase overall water quality and reduce rearing density to optimize survival. Hatchery programming will be based on providing optimum rearing conditions for stocks regardless of the current or historical rearing and release site. Use of species and site specific loading and density guidelines, mating protocols that maximize genetic variability, growth modulation, enriched rearing environments, and modification of hatchery structures to allow volitional migration will enable hatchery populations to develop the physiological, morphological, and behavioral traits important to long-term fitness and will reduce competition and predation risks to naturally produced stocks. It is hypothesized that these actions will increase the average SAR by 25 percent.

[20] The EDT estimate is an estimate of run size with harvest set to zero.

It is assumed that after five brood cycles (approximately 15 years), naturally produced coho will have adapted sufficiently to be defined as a locally adapted stock. At that time, based on such factors as juvenile production, fish collection efficiency, total adult production from both components of the run, and results from the innovative rearing experiment, the FTC will need to determine if the Integrated approach for hatchery management still makes sense. If it does, then naturally produced fish would be incorporated into the hatchery at rates consistent with HSRG guidelines or new thinking developed over the interim. The 15-year schedule identified above would be revisited in the next version of the FHMP (i.e., in seven years).

If sufficient natural origin fish return, allowing collection of the entire hatchery broodstock component as well as meeting natural escapement goals, the integration process can be accomplished in one brood cycle. Otherwise, offspring of natural origin recruits used in the hatchery will be differentially marked from the hatchery origin juveniles to allow for gradual replacement of the current hatchery stock with subsequent adult returns. For each brood thereafter, 10 to 20 percent of the broodstock used annually at the hatchery will be made up of naturally produced coho adults. This action is needed to minimize potential for genetic divergence between the hatchery and natural stock in the upper Cowlitz River and to reduce domestication risks and genetic changes caused from artificial rearing.

Innovative Rearing

The Settlement Agreement calls for hatchery managers to develop and test innovative rearing practices. To meet this requirement, hatchery operations will be implemented to incorporate aspects of semi-natural rearing, including constructing ponds to enhance protective coloration and adding overhead and in-water cover on an experimental basis. In addition to using enriched rearing environments, growth modulation will be evaluated as a means to produce actively migrating smolts that are similar in size to natural smolts.

Adult Escapement Management

To properly run an integrated hatchery program requires that hatchery managers track adult returns from both the natural and hatchery components of the run. Sufficient numbers of naturally produced fish are needed to both seed available spawning habitat and to provide genetic material for the hatchery. The concept is that local adaptation is driven by the natural, not the hatchery, component of the run. The escapement goals for both the hatchery and natural components of the adult coho run are presented below.

Natural Escapement Goal

Coho fisheries in the lower Cowlitz River below the Barrier Dam will be managed so that harvest rates on natural fish would be less than four percent (see below). All naturally produced coho escaping from the fishery would be collected at the Barrier Dam and transported and released to their stream of origin. If harvest impacts exceed this level of loss (four percent), this plan recommends the WDFW reduce fisheries to meet natural escapement needs.

Hatchery Escapement Goal

Fisheries in the lower Cowlitz River will be managed so that the minimum escapement goal of 2,750 hatchery coho adults is met each year (1,750 for broodstock, 1,000 for Tilton River and Upper Cowlitz reintroduction).

Production Adjustment and Credit Mechanisms

The Settlement Agreement requires the FHMP identify methods to 1) adjust hatchery production upward or downward to accommodate recovery of indigenous stocks, and 2) develop credit mechanisms for production of high quality natural stocks. The actions proposed for coho salmon to meet these requirements are listed below.

- Initial coho salmon hatchery production will be decreased from 3.1 million to 2.31 million smolts. Although only 1.55 million are needed to meet the adult benchmark target of 124,277, the additional production will provide fish for harvest, reintroduction, and potentially carcasses to increase stream productivity.

- A five-year rolling average of the number of naturally produced coho salmon yearlings in the upper Cowlitz and Tilton rivers will be used to reduce the number of yearlings released each year from the hatchery on a 2:1 basis beginning in the next brood year. The assumption that hatchery and natural coho produce similar numbers of adult returns would be tested over time. The results of this analysis will provide the data needed to adjust the juvenile ratio value upward or downward.

- The proposed changes in hatchery rearing practices are hypothesized to increase hatchery fish survival by 25 percent. The difference in survival between the two test groups will be monitored over time. If this hypothesis were correct, hatchery production will be decreased by a commensurate amount.

5.6.3.6. Fishery Harvest

Three primary harvest strategies will be used to achieve the reintroduction, recovery, and harvest objectives of this plan:

- WDFW will work in the Pacific Salmon Treaty, Pacific Fisheries Management Council, and US v. Oregon forums to continue to promote selective fisheries in appropriate areas to reduce exploitation on depressed naturally produced stocks while providing fishing opportunities.

- Management of sport fisheries in the Cowlitz River below Barrier Dam will be linked to the productivity of the Tilton River population. The linkage recognizes that meeting the conservation and harvest goals of the Settlement Agreement will not be feasible until substantial improvements in fish passage survival and/or aquatic habitat enhance the productivity of the population. As previously discussed in Section 5.6.3.5, the population is not likely to have a

positive growth rate until more than 25 smolts are produced per spawner. This plan recommends to WDFW that active management measures be taken to achieve the guideline when the smolt/spawner criteria has been achieved.

- Coho sport fishing will not be allowed in the Tilton River while the productivity test is being conducted. Fishing will be allowed on adipose fin-clipped coho above Cowlitz Falls Dam. Anglers will be required to release all unmarked coho caught in all fisheries.

- Adult escapement priorities for coho are, 1) hatchery broodstock, 2) upper Cowlitz River natural production, 3) hatchery fish for Tilton River and upper Cowlitz reintroduction, 4) lower river harvest, 5) above Mayfield Dam harvest.

5.7 Chum

The long-term (>15 years) conservation goal of the chum stock management strategy, an ESA listed species, is to produce a native locally adapted population in the lower Cowlitz River below the Barrier Dam.

In Phase 1 of the FHMP, habitat improvement actions targeting the protection and restoration of side-channel habitat in the lower Cowlitz River will be emphasized. Proposed actions will be sent directly to the Habitat Advisory Group (HAG) for their consideration and review to obtain necessary funds.

Currently, chum are not reared at the Cowlitz Hatchery, and hatchery production is not proposed in this plan.

No productivity experiments will be undertaken for chum salmon as this was not a requirement of the Settlement Agreement. Additionally, as adult production benchmarks were not established for chum, monitoring to calculate chum R/S values will not be implemented. However, spawning surveys will be conducted yearly to estimate chum abundance in stream reaches upstream of the Toutle River.

Adult chum arriving at the Barrier Dam will be returned to the areas in the lower river where field surveys indicate the presence of good quality spawning habitat. Adult chum will not be transported and released in stream reaches above Mayfield Dam, as it is unlikely that juvenile chum fry would successfully migrate through Project reservoirs.

5.7.1 Synopsis of Objectives and Strategies

A brief synopsis of the objectives and the proposed strategies to meet each is presented below.

Phase 1 Objectives. Determine the distribution and abundance of chum spawners, develop and implement specific projects consistent with the Settlement Agreement to improve the quality of the spawning area, and determine the efficacy of implementing a short term Integrated Type hatchery program to increase adults returns. As chum salmon

generally do not naturally occur upstream of lakes, chum captured at the Cowlitz Hatcheries will be returned to the river downstream of Mayfield Dam.

The strategies proposed to achieve chum Phase 1 objectives are:

- Population definition. Work collaboratively with WDFW and other agencies to collect biological information and genetic samples from natural spawners, locate spawning areas, enumerate spawner numbers, track egg incubation, determine time of emergence, and migration pattern. Biological data and genetic samples will continue to be collected from a subset of chum captured at the Cowlitz Hatcheries prior to their return to the river.

- Artificial Production Programs. Review artificial production techniques implemented for lower Columbia River chum and Puget Sound summer chum recovery programs for applicability to the Cowlitz River.

- Fishery Management. Work with WDFW to implement a fishery management regime that has a goal of less than one percent fishery-induced mortality.

Phase 2 Objectives. Phase 2 objectives would depend on the results of Phase 1 strategies and therefore cannot be described in detail at this time. However, the long-term objective of this plan would be to continue to develop and implement habitat, harvest, and hatchery actions that result in achieving recovery goals for the lower Columbia Chum ESU and chum natural production in the Cowlitz River basin.

5.7.2 Goals and Objectives

For this analysis, fisheries goals are classified into three categories: conservation, harvest and habitat. Conservation goals are presented in terms of the biological significance of the stock and its viability. Habitat goals are expressed as the quality of the environment to produce chum salmon, and harvest goals as the level and types of fisheries that can be supported.

The terminology used in Table 5-17 conveys the management goals and direction over time for chum. A review of the table data indicates that the goal of fisheries managers is to maintain stock biological significance, increase habitat quality, and provide some fishing opportunity over time.

5.7.2.1. Stock Definition and Recovery

The initial objective of this plan is to determine chum stock status in the Cowlitz River followed by appropriate recovery activities. Ultimately, the goal is to recover the stock to levels that meet the ecosystem needs and to provide sport and commercial fisheries if appropriate.

Table 5-17. Summary of biological significance, habitat quality, fishery exploitation rates, and Phase 1 strategy for chum salmon.

	Chum Salmon populations			
	Cowlitz Hatchery	**Lower Cowlitz**	**Tilton**	**Upper Cowlitz Cispus River**
Biodiversity Significance & Genetic Integrity				
Current	NA	High	NA	NA
Short-Term Objective	NA	High	NA	NA
Long-term Objective	NA	High	NA	NA
Habitat Quality				
Current	NA	Low	NA	NA
Short-term Objective	NA	Low (adults 2,639)	NA	NA
Long-term Objective	NA	Medium (adults 39,852)	NA	NA
Fishing Opportunities				
Current	NA	None	NA	NA
Short-term Objective	NA	Low	NA	NA
Long-term Objective	NA	Medium	NA	NA

NA- Not applicable

Adults- EDT estimates of adult production under Current conditions and PFC (long-term objective).

5.7.2.2. Fishery Harvest

General harvest objectives are to provide fishing opportunities consistent with the mandates of WDFW, the Pacific Salmon Treaty, the Pacific Fisheries Management Council, US v. Oregon, and other state, federal, and international legal obligations. Specific harvest objectives will vary depending on the phase of the recovery program – fishery exploitation rates are expected to increase as the status of natural populations of chum improves (Table 5-18).

No marine fisheries are known to harvest Cowlitz River chum. Columbia River commercial and sport fisheries have had minimal harvests of Cowlitz chum in recent years. Sport anglers will be required to release all chum until such time as the stocks can sustain a harvest.

5.7.3 Strategies

The key strategies proposed to achieve chum objectives are discussed below and include:

- Define chum stock abundance, genetic structure, distribution, and productivity;
- Determine spawning locations and potential for habitat enhancement;

Table 5-18. Stock harvest profile (Treaty and non-Treaty) for Cowlitz River chum populations.

Fishery Aggregate	1994-1995 Broods		Phase 1 Productivity Test Period		Phase 2 Long-term Target	
	Description	AEQ Harvest Rate	Description	AEQ Harvest Rate	Description	AEQ Harvest Rate
Freshwater Sport, Columbia River Mouth to Cowlitz Barrier Dam	Fishery closed to chum retention	0%	Closed to chum harvest all year.	<%	Fishery on recovered stocks during July-November.	10.0%
Mainstem Net	Incidental harvest during fisheries directed at other species.	0%	Incidental harvest during fisheries directed at other species.	0%	Incidental harvest during fisheries directed at other species.	
Total AEQ Exploitation Rate	0%		<1%		10%	

AEQ- Adult Equivalent Harvest Rate.

5.7.3.1. Stock Reintroduction and Recovery

Before a restoration strategy can be developed, it will be necessary to determine the status of the chum population(s) in the Cowlitz River and how they relate to other lower Columbia River populations. Restoration of Cowlitz chum populations will be coordinated with current chum restoration in the lower Columbia ESU. Restoration will follow NOAA-Fisheries recovery planning in the region. Specific restoration activities will be detailed in the next iteration of this FHMP (year 6).

5.7.3.2. Artificial Production

No artificial production program is proposed at this time.

5.7.3.3. Fishery Harvest

Two primary harvest strategies will be used to achieve the restoration, recovery, and harvest objectives of this plan:

- WDFW will work in the Pacific Salmon Treaty, Pacific Fisheries Management Council, and US v. Oregon forums to promote fisheries that reduce exploitation of depressed, naturally produced stocks while providing fishing opportunities.

- During Phase 2, the management of sport fisheries in the Cowlitz River below the Barrier Dam may be linked to the productivity of the Cowlitz River chum. Essentially, these fisheries will be required to release all chum until such time as this stock meets recovery objectives.

5.8 Sockeye

5.8.1 Synopsis of Objectives and Strategies

A brief synopsis of sockeye objectives and strategies is presented below.

Phase 1 Objectives. Determine the distribution, abundance and genetic structure of spawners, develop and implement specific projects consistent with the Settlement Agreement to improve quality of spawning area; and determine feasibility and efficacy of implementing a short-term integrated hatchery program to increase adults returns.

Proposed actions for sockeye in the Cowlitz River to achieve Phase 1 objectives are summarized below.

- Population definition. Work collaboratively with WDFW and other agencies to collect biological information and genetic samples from spawners, locate spawning areas, enumerate spawner numbers, track egg incubation, determine time of emergence, and migration pattern. Biological data and genetic samples will be collected from a subset of the sockeye captured at the Cowlitz Hatcheries prior to their return to the river.

- Artificial Production Programs. No artificial production is proposed during the first six years of the FHMP.

- Fishery Management. Implement a fishery management regime that has a goal of less than one percent fishery-induced mortality.

Phase 2 Objectives. Develop and implement habitat, harvest, and hatchery actions that result in expansion of Cowlitz sockeye stock into all available spawning areas. Details will be based on information developed during Phase 1 and will be outlined in the next iteration of this FHMP.

5.8.2 Goals and Objectives

For this analysis, fisheries goals are classified into three categories: conservation, harvest and habitat. Conservation goals are presented in terms of the biological significance of the stock and its viability. Habitat goals are expressed as the quality of the environment to produce sockeye salmon, and harvest goals as the level and types of fisheries that can be supported.

Table 5-19 conveys management goals and direction over time for sockeye. A review of the table data indicates that the goal of fisheries managers is to maintain stock biological significance, increase habitat quality and provide some fishing opportunity over time.

Table 5-19. Summary of biological significance, habitat quality, fishery exploitation rates, and Phase 1 strategy for sockeye salmon.

	Sockeye Salmon populations			
	Cowlitz Hatchery	**Lower Cowlitz**	**Tilton**	**Upper Cowlitz Cispus River**
Biodiversity Significance & Genetic Integrity				
Current	NA	High	NA	NA
Short-term Objective	NA	High	NA	NA
Long-term Objective	NA	High	NA	NA
Habitat Quality				
Current	NA	Low	NA	NA
Short-term Objective	NA	Low	NA	NA
Long-term Objective	NA	Medium	NA	NA
Fishing Opportunities				
Current	NA	None	NA	NA
Short-term Objective	NA	None	NA	NA
Long-term Objective	NA	Low (10%)	NA	NA

Abbreviations: NA – not applicable.

5.8.2.1. Stock Definition and Recovery

The initial objective of this plan is the definition of the status of sockeye in the Cowlitz River followed by appropriate recovery activities. Ultimately, the objective is to recover the stock to levels that meet the ecosystem needs and to provide for appropriate sport and commercial fisheries.

5.8.2.2. Fishery Harvest

General harvest objectives are to provide fishing opportunities consistent with the mandates of WDFW, the Pacific Salmon Treaty, the Pacific Fisheries Management Council, US v. Oregon, and other state, federal, and international legal obligations. Specific harvest objectives will vary depending on the phase of the recovery program – fishery exploitation rates are expected to increase as the status of natural populations of sockeye improves (Table 5-20).

It is likely that Cowlitz River sockeye are harvested in commercial fisheries targeting more abundant populations such as those originating in the Fraser River. The extreme rarity of Cowlitz fish in comparison to these stocks precludes any directed action. Should genetic profiles show sufficient distinctness, WDFW will encourage managers to account for the presence of Cowlitz River fish in their fisheries. Columbia River commercial and sport fisheries have had minimal harvests of Cowlitz sockeye in recent years. Anglers will be required to release all sockeye until such time as the stocks can sustain a harvest.

5.8.3 Strategies

Achieving the multiple conservation and harvest objectives of this plan will require the development and implementation of innovative strategies, extensive monitoring, and adaptive management. Key strategies discussed below include:

- Define sockeye stock structure, distribution, and productivity;
- Investigate the applicability and need for developing an integrated artificial production program to promote the recovery of sockeye in the Cowlitz River; and

5.8.3.1. Restoration

Before a restoration strategy can be developed, it will be necessary to determine the status of the sockeye population in the Cowlitz River and how it relates to other populations. Specific restoration activities will be detailed in the next iteration of this FHMP (year seven).

5.8.3.2. Artificial Production

No artificial production of sockeye is proposed at this time.

Table 5-20. Stock harvest profile (Treaty and non-Treaty) for Cowlitz River sockeye population

Fishery Aggregate	1994-1995 Broods		Phase 1 Productivity Test Period		Phase 2 Long-term Target	
	Description	AEQ Harvest Rate	Description	AEQ Harvest Rate	Description	AEQ Harvest Rate
Freshwater Sport, Columbia River mouth to Cowlitz Barrier Dam	Fishery closed to sockeye retention	0%	Closed to sockeye harvest all year.	< 1%	Fishery on recovered stocks during July-November.	10.0%
Mainstem Net	Incidental harvest during fisheries directed at other species.	0%	Incidental harvest during fisheries directed at other species.	0%	Incidental harvest during fisheries directed at other species.	0%
Total AEQ Exploitation Rate	0%		<1%		10%	

AEQ- Adult Equivalent Harvest Rate.

5.8.3.3. Fishery Harvest

Two primary harvest strategies will be used to achieve the restoration, recovery, and harvest objectives of this plan:

- WDFW will work in the Pacific Salmon Treaty, Pacific Fisheries Management Council, and US v. Oregon forums to promote fisheries that reduce exploitation of depressed naturally produced stocks while providing fishing opportunities.

- Management of sport fisheries in the Cowlitz River below the Barrier Dam will be linked to the productivity of the Cowlitz River sockeye. Essentially, these fisheries will be required to release all sockeye until such time as it can be determined that the stock can withstand consumptive harvest.

5.9 Pink

5.9.1 Synopsis of Objectives and Strategies

Phase 1 Objectives. Determine the distribution and abundance of pink spawners, develop and implement specific projects to improve quality of spawning area, and determine the efficacy of implementation of a short term integrated hatchery program to increase adult returns. Pink salmon generally do not occur upstream of lakes. Consequently, all pinks captured at the Cowlitz River Hatcheries will be returned to the river downstream of Mayfield Dam.

Proposed actions for pink in the Cowlitz River to achieve Phase 1 objectives are summarized below.

- Population definition. Work collaboratively with WDFW and other agencies to collect biological information and genetic samples from spawners, locate spawning areas, enumerate spawner number, track egg incubation, determine time of emergence, and migration patterns. Biological data and genetic samples will be collected from a subset of pinks captured at the Cowlitz Hatcheries prior to their return to the river.

- Artificial Production Programs. Work collaboratively with WDFW and other agencies to review the Dungeness River summer pink recovery program for applicability to the Cowlitz River.

- Fishery Management. Implement a fishery management regime that has a goal of less than one percent fishery-induced mortality.

Phase 2 Objectives. Develop and implement habitat, harvest, and hatchery actions that result in expansion of Cowlitz pink stock into all available spawning areas. Details will be based on information developed during Phase 1 and will be outlined in the next iteration of this FHMP (year 6).

5.9.2 Goals and Objectives

Fisheries goals are classified in three categories: conservation, harvest, and habitat. Conservation goals are presented in terms of biological significance of the stock and its viability. Habitat goals are expressed as the quality of the environment to produce pink salmon, and harvest goals as the level and types of fisheries that can be supported.

Table 5-21 conveys the management goals and direction over time for pink salmon. A review of the table data indicates that the goal of fisheries managers is to maintain stock biological significance, increase habitat quality, and provide some fishing opportunity over time.

Table 5-21. Summary of biological significance, habitat quality, fishery exploitation rates, and Phase 1 strategy for pink salmon.

	Pink Salmon Populations			
	Cowlitz Hatchery	**Lower Cowlitz**	**Tilton**	**Upper Cowlitz Cispus River**
Biodiversity Significance & Genetic Integrity				
Current	NA	High	NA	NA
Short-Term Objective	NA	High	NA	NA
Long-term Objective	NA	High	NA	NA
Habitat Quality				
Current	NA	Low	NA	NA
Short-term Objective	NA	None	NA	NA
Long-term Objective	NA	Medium	NA	NA
Fishing Opportunities				
Current	NA	None	NA	NA
Short-term Objective	NA	None	NA	NA
Long-term Objective	NA	Low (10%)	NA	NA

Abbreviations: NA – not applicable;.

5.9.2.1. Stock Definition and Recovery

The initial objective of this plan is to better define the status of pinks in the Cowlitz River followed by appropriate recovery activities. Ultimately, the objective is to recover the stock to levels that meet the ecosystem needs and to provide for sport and commercial fisheries if appropriate.

5.9.2.2. Fishery Harvest

General harvest objectives are to provide fishing opportunities consistent with the mandate of WDFW, the Pacific Salmon Treaty, the Pacific Fisheries Management Council, US v. Oregon, and other state, federal, and international legal obligations. Specific harvest objectives will vary depending on the phase of the recovery program;

fishery exploitation rates are expected to increase as the status of natural populations of pinks improves (Table 5-22).

It is likely that Cowlitz River pinks are harvested in marine sport and commercial fisheries targeting more abundant populations, such as those originating in the Fraser River. The extreme rarity of Cowlitz River pinks in comparison to these stocks precludes directed action. Should genetic profiles show sufficient distinctness, WDFW would encourage managers to account for the presence of Cowlitz River fish in their fisheries. Columbia River commercial and sport fisheries have had minimal harvests of Cowlitz River pinks in recent years. Anglers will be required to release all pink salmon until such time as the stocks can sustain a harvest.

5.9.3 Strategies

The key strategy for improving pink performance is discussed below:

- Define pink stock structure, distribution, and productivity

5.9.3.1. Stock Reintroduction and Recovery

Before a restoration strategy can be developed, it will be necessary to determine the status of the pink population in the Cowlitz River and how it relates to other lower Columbia River populations. Specific restoration activities will be detailed in the next iteration of this FHMP (year six).

5.9.3.2. Artificial Production

No artificial production program is proposed at this time.

5.9.3.3. Fishery Harvest

Two primary harvest strategies will be used to achieve the restoration, recovery, and harvest objectives of this plan:

- WDFW will work in the Pacific Salmon Treaty, Pacific Fisheries Management Council, and US v. Oregon forums to promote fisheries that reduce exploitation on depressed naturally produced stocks while providing fishing opportunities.

- Management of sport fisheries in the Cowlitz River below the Barrier Dam will be linked to the productivity of the Cowlitz pink salmon. Essentially, these fisheries will be required to release all pinks until such time as it can be determined that consumptive harvest is appropriate.

Table 5-22. Stock harvest profile (Treaty and non-Treaty) for the Cowlitz River pink population.

Fishery Aggregate	1994-1995 Broods		Phase 1 Productivity Test Period		Phase 2 Long-term Target	
	Description	AEQ Harvest Rate	Description	AEQ Harvest Rate	Description	AEQ Harvest Rate
Freshwater Sport, Columbia River Mouth to Cowlitz Barrier Dam	No retention	0%	Closed to pink harvest all year.	< 1%	Fishery on recovered stocks during July-November.	10.0%
Mainstem Net	Incidental harvest during fisheries directed at other species.	0%	Incidental harvest during fisheries directed at other species.	0%	Incidental harvest during fisheries directed at other species.	0%
Total AEQ Exploitation Rate	0%		<1%		10%	

AEQ- Adult Equivalent Harvest Rate.

5.10 Sea-Run Cutthroat Trout

Juvenile monitoring at Cowlitz Falls and Mayfield dams indicates that significant numbers of anadromous sea-run cutthroat trout are still being produced in these basins. For example, during migration years 2000 to 2003, smolt collection numbers at Cowlitz Falls ranged from 967 to 1,323. Thus, based on the low FCE (<50 percent) at Cowlitz Falls Dam, it is likely that the number of smolts passing this project is probably double this range[21]. The production of large numbers of smolts from above the dams is extraordinary given that adult sea-run cutthroat trout were prevented from using these areas for over 30 years.

In the short term, the FHMP calls for increasing the survival rate of sea-run cutthroat trout juveniles and adults migrating through the hydroelectric system. Juveniles collected at both Mayfield and Cowlitz Falls dams will continue to be uniquely marked so they may be identified when they return as adults, transported and released into their basin of origin. The run size of both populations will be monitored over time to determine if these populations can be recovered to sustainable levels without human intervention.

The sea-run cutthroat trout hatchery program at the Cowlitz Trout Hatchery will be converted to an Integrated Type program as defined by the HSRG. The long-term objective of this program would be to produce 50,000 smolts to meet both conservation and self-sustaining run goals. The hatchery program will terminate upon achieving the self-sustaining run size of 500 adults.

5.10.1 Synopsis of Objectives and Strategies

A brief synopsis of the sea-run cutthroat objectives and the proposed strategies to meet each is presented below.

Phase 1 Objectives. Increase juvenile fish collection efficiency and survival through the Cowlitz River hydropower system and eliminate competition with hatchery fish.

The strategies proposed to achieve cutthroat trout Phase 1 objectives are as follows:

- Habitat/Fish Passage. Downstream fish passage/collection facilities will be improved at both Mayfield Dam and at Cowlitz Falls Dam. The facilities will be designed and operated to achieve the 75 to 95 percent survival standard for sea-run cutthroat trout originating from the upper Cowlitz River basin and the 95 percent survival standard for juveniles passing Mayfield Dam.

- Reintroduction. Uniquely mark all migrating juveniles collected at Mayfield and Cowlitz Falls dams so they can be returned to their basin of origin once they return as adults.

[21] Downstream migrant cutthroat trout not captured at Cowlitz Falls Dam enter Riffe Lake. However, as upstream fish passage is not present at Cowlitz Falls Dam these fish are unable to return to natal streams.

- Productivity Enhancement. Distribute adult carcasses from the Cowlitz Salmon Hatchery and Trout Hatcheries (if available) to the Tilton and upper Cowlitz rivers as appropriate, which likely will contribute to increased productivity of the watershed.

- Artificial Production Programs. Convert the existing program to an Integrated Type program.

- Fishery Management. Continue to implement a fishery management regime to protect naturally produced sea-run cutthroat trout throughout the lower and upper basins.

Phase 2 Objectives. Phase 2 objectives would depend on the results of Phase 1 strategies and therefore cannot be described in detail at this time. The long-term objective of this plan would be to continue to implement habitat, harvest, and hatchery actions that result in increased natural sea-run cutthroat trout abundance.

5.10.2 Goals and Objectives

Fisheries goals are classified into three categories: conservation, harvest, and habitat. Conservation goals are presented in terms of biological significance of the stock and its viability. Habitat goals are expressed as the quality of the environment to produce sea-run cutthroat trout, and harvest goals as the level and types of fisheries that can be supported.

Table 5-23 conveys the management goals and direction over time for sea-run cutthroat trout. A review of the table data indicates that the goal of fisheries managers is to maintain stock biological significance, increase habitat quality, and provide some fishing opportunity over time.

5.10.2.1. Stock Reintroduction and Recovery

The primary goal in Phase 1 is to increase sea-run cutthroat trout abundance in the Tilton River and upper Cowlitz River (upper Cowlitz and Cispus rivers). This will primarily be achieved by reducing impacts from hatchery releases (after conversion to an Integrated Type Program) and improving fish passage survival through the system.

5.10.2.2. Fishery Harvest

General harvest objectives are to provide fishing opportunities consistent with the mandates of WDFW, US v. Oregon, and other state and federal legal obligations.

Marine fisheries in the Pacific Ocean harvest negligible numbers of cutthroat; no marine management objectives are developed other than to continue to encourage management actions to reduce or eliminate high seas harvest of any cutthroat.

Table 5-23. Summary of biological significance, habitat quality, fishery exploitation rates, and Phase 1 strategy for each population of sea-run cutthroat trout.

	Sea-run Cutthroat Trout Populations			
	Cowlitz Hatchery	**Lower Cowlitz**	**Tilton**	**Upper Cowlitz Cispus River**
Biodiversity Significance & Genetic Integrity				
Current	Low	Medium	Medium	Medium
Short-term Objective	NA	Medium	Medium	Medium
Long-term Objective	NA	Medium	Medium	Medium
Habitat Quality				
Current	NA	Medium	Low	Medium
Short-term Objective	NA	Medium	Low	Medium
Long-term Objective	NA	High	Medium	High
Fishing Opportunities				
Current	High (HR = 70%)	Low (HR = 8%)	Low	Low
Short-term Objective	High (HR = 70%)	Low (HR<6%)	Low (HR <6%)	Low (HR <6%)
Long-term Objective	High (HR = 70%)	Low (HR 17%)	Low (HR 17%)	Low (HR 17%)

Abbreviations: NA – not applicable; HR – total adult equivalent mortality exploitation rate.

Commercial fisheries in the mainstem Columbia River are precluded from retaining incidentally encountered cutthroat. Expansion of selective fisheries designed to protect naturally produced salmon should result in an increased level of protection for all cutthroat. Further, most returning cutthroat are too small to be retained in commercially fished nets.

Sport fisheries selective for adipose fin-clipped cutthroat is expected to occur in the mainstem Columbia River and the lower Cowlitz River on a year round basis with a goal of maximum removal of hatchery origin fish. The current artificial production program supports a fishery as evidenced by comments from the public when reductions in production are proposed. Harvest goals for Cowlitz River sea-run cutthroat trout are presented in Table 5-24.

5.10.2.3. Habitat

The objective of the FHMP is to increase both adult and juvenile fish passage survival as they migrate through the hydroelectric complex.

Table 5-24. Stock harvest profile for the Cowlitz sea-run cutthroat trout population (natural spawning origin).

Fishery Aggregate	1994-1995 Broods[1]		Phase 1 Productivity Test Period		Phase 2 Long-term Target	
	Description	AEQ Harvest Rate	Description	AEQ Harvest Rate	Description	AEQ Harvest Rate
Freshwater Sport, above Mayfield Dam	Incidental take from steelhead and resident fish fisheries.	4.0%	Tilton: No fishery on adults; incidental loss from resident fisheries. Upper Cowlitz- No fishery on adults; incidental loss from resident fisheries.	<1%	Fishery from November-April.	10.0%
Freshwater Sport, Columbia River Mouth to Cowlitz Barrier Dam	Selective fishery operating year around.	1.0%	Catch-and-release fishery	<4%	Selective fishery	< 6.0%
Mainstem Net	Incidental harvest during fisheries directed at other species.	1%	Incidental harvest in selective fisheries on hatchery-origin fish during February-March.	< 1.0%	Incidental harvest in selective fisheries on hatchery-origin fish during February-March.	< 1.0%
Ocean Troll, Net, and Sport	Fisheries managed consistent with PST and PFMC regulations.		Fisheries managed consistent with PST and PFMC regulations.		Fisheries managed consistent with PST and PFMC regulations.	
Total AEQ Exploitation Rate	<6 %		<6%		<17%	

AEQ- Adult Equivalent Harvest Rate.

5.10.3 Strategies

Achieving the multiple conservation and harvest objectives of this plan will require the development and implementation of innovative strategies, extensive monitoring, and adaptive management. Key strategies discussed below include:

- Conversion of the sea-run cutthroat production at the Cowlitz River Hatchery Complex to an Integrated Type program.
- Require a 30 percent integration rate; that is, 30 percent of the brood stock must be wild or natural origin adults from populations above Mayfield Dam[22].
- Differential marking of juveniles originating from the upper Cowlitz River and Tilton River.
- Improve juvenile passage survival through the hydroelectric complex.

5.10.3.1. Collection and Passage

Downstream fish passage/collection facilities will be improved at both Mayfield Dam and at Cowlitz Falls Dam. The facilities will be designed and operated to achieve the 75 to 95 percent survival standard for sea run cutthroat trout originating from the upper Cowlitz River basin, and the 95 percent survival standard at Mayfield Dam. Tacoma Power is currently studying the feasibility and expected effectiveness of several options for the Cowlitz Falls juvenile collector.

5.10.3.2. Carcass Distribution

If the WDFW chooses to use surplus hatchery fish to enhance the nutrients above Mayfield Dam and if allowed in the approved Disease Management plan, a productivity experiment will be undertaken to distribute carcasses of surplus hatchery fish collected at the Cowlitz Hatchery Complex to the Tilton and upper Cowlitz rivers. This action is designed to increase system productivity, thereby increasing the chance for the successful reintroduction of anadromous fish to key areas in the basin. Whether or not this action is implemented, at what scale and how, will depend on the Disease Management Plan developed for the basin. The carcass distribution program will be implemented consistent with the approved Disease Management Plan and with WDFW approval to use the surplus fish.

5.10.3.3. Stock Reintroduction and recovery

The FHMP calls for an approach where sea-run cutthroat trout are allowed to re-establish an anadromous life history form with minimal human intervention. Fish passage survival through the hydropower system will be increased to protect migrating fish to the extent possible. All juvenile migrants collected at fish passage facilities will be uniquely marked so that they may be collected as adults and transported to their basin of origin.

[22] The 30% value was selected based on input from the FTC. Initially, Tacoma Power had suggested a 100% Integration rate to eliminate hatchery influences quickly.

5.10.3.4. Measuring Productivity

In Phase 1, a sea-run cutthroat trout productivity experiment will be conducted in both the Tilton and upper Cowlitz rivers. However, only the results from the Tilton River would be used for determining the need for adult fish passage facilities.

According to the criteria listed in the Settlement Agreement, either population will be considered self-sustaining if the R/S value, measured at the Barrier Dam, is greater than 1.0 in three out of five consecutive brood years and the five-year rolling average exceeds an adult abundance level identified by the USFWS. The USFWS has set an interim adult abundance value of 500 (yearly run-size) for both the Tilton River and upper Cowlitz River (1,000 fish total).

Once the criteria are met for the Tilton River, and upper river populations, an adult ladder may be built at Barrier and Mayfield dams to allow anadromous fish access to both the Tilton River and Mossyrock tailrace[23]. A new trap-and-haul facility would also be constructed at or above Mayfield Dam to collect and transport fish bound for the upper Cowlitz River basins.

5.10.3.5. Artificial Production

Currently, the Cowlitz Hatchery Complex releases 160,000 (4 fpp) sea-run cutthroat trout smolts annually into the lower Cowlitz River. The hatchery sea-run population over time has consisted of a mixture of native Cowlitz stock and Beaver Creek stock imported from the Elochoman River.

In Phase 1, sea-run cutthroat trout hatchery production would be converted to a smaller Integrated Type program for the following reasons:

Stock History. The sea-run cutthroat population consists of a combination of both indigenous and non-indigenous stocks. Hatchery practices at the Cowlitz Trout Hatchery have dramatically changed the run-timing of this stock in comparison to historical conditions (Tipping and Springer 1980).

Natural Production. Fish passage monitoring at Cowlitz Falls and Mayfield dams show that upper basin streams continue to produce wild sea-run cutthroat trout smolts, despite the absence of fish passage facilities for over 30 years. In 2003, approximately 1,300, and 350 smolts were collected at Cowlitz Falls and Mayfield Dam, respectively. In 2003, 25 adult sea-run cutthroat trout were transported and released in the Upper Cowlitz River. The presence of these fish reduces the need to maintain the hatchery program at its current size to meet conservation goals.

Competition. Cutthroat trout in general are voracious predators of juvenile salmonids. For example, a study of sea-run cutthroat trout predation on fall Chinook fry in the Lewis River showed that each cutthroat trout consumed a minimum of one Chinook fry. This estimate was based on stomach sampling. The authors did not provide estimates of the

[23] The ladder construction criteria also requires that adult fish are able to self-sort in Mayfield Lake, and spring Chinook or steelhead need to be self-sustaining above Cowlitz Falls Dam.

total number of fry consumed in a season as they lacked data on total fry abundance and residence time of cutthroat trout in the basin. Tipping (1982) reported that sea-run cutthroat trout released in the Cowlitz River in April were still being caught in significant numbers in August and September as initial migrants. These fish were likely residing in the river throughout the typical rearing period for juvenile fall Chinook (April through August). Given these data, hatchery fish are likely consuming significant numbers of ESA-listed Chinook in the lower Cowlitz River and Columbia River. A reasonable precaution to protect fall Chinook in the lower river would be to reduce the size of the program, and convert the program to an Integrated Type that emphasizes natural production

Disease. The sea-run population in the hatchery is susceptible to *Ceratomyxa shasta*. Thus, hatchery managers must rear these fish on disease-free water during a portion of their rearing cycle. Because disease-free water is limited, the reduction in program size would increase the amount available for rearing listed native late winter steelhead.

Lower River Natural Production

Tipping (1982) reported that at least 20 percent of the cutthroat trout caught in the lower Cowlitz River were wild. These fish would continue to provide sport-fishing opportunity even with the elimination of the hatchery program.

The Integrated Type program would be implemented by collecting wild fish for use as a portion of the hatchery broodstock. Currently, it is anticipated that no more than 25 percent of the wild population could be used in this manner in any given year. Hatchery broodstock would consist of 70 percent existing HOR fish and 30 percent NOR fish. The initial size of the program will be dependent on the number of wild fish returning to the basin each year. The program would begin when sufficient numbers of wild fish are available for incorporation as broodstock for the hatchery. The hatchery program would terminate upon achieving the self-sustaining run size of 500 adults.

5.10.3.6. Fishery Harvest

All sea-run cutthroat trout with an intact adipose fin would have to be released in all fisheries throughout the Cowlitz River basin.

5.11 Other Species

This section of the FHMP is structured differently than others due to the large number of species that could be listed and discussed. For ease of use, this section has been simplified so that the information is classified into two categories:

1) Anadromous Species (e.g., eulachon and lamprey)
2) Resident Species
    A. Resident Salmonids
    B. Resident Non-Salmonids

5.11.1 Anadromous Species

The long-term (>15 years) goal for other anadromous species such as eulachon and lamprey is to protect these species to the extent possible while achieving the priority objectives of the Settlement Agreement.

In Phase 1, the primary management strategy will be to work collaboratively with the WDFW and other agencies to identify and characterize the stocks, define spawning and rearing areas, determine the status and long-term survival potential, and to develop fishery management plans sustainable by natural production of these stocks.

In Phase 1 of the FHMP, artificial production will not be used to increase the abundance of these species in the basin.

5.11.2 Resident species

5.11.2.1. Resident salmonids

Fluvial Resident Salmonids

The long-term (>15 years) goal for resident fluvial salmonids will be to increase the survival of these fish as they pass through Project fish passage facilities and reservoirs.

No hatchery origin resident salmonids will be stocked in waters where anadromous fish recovery is being implemented. However, it is a license requirement that Lewis County P.U.D. stock catchable rainbow trout in Lake Scanewa behind Cowlitz Falls Dam (FERC No. 2833).

The elimination of resident fish stocking programs in the key spawning areas of listed species was identified in the 1999 Hatchery Biological Opinion (NMFS 1999) as a reasonable and prudent measure to reduce impacts to listed stocks. The impact catchable trout fisheries have on steelhead populations was summarized by Filbert (2002), as part of the relicensing proceedings for the North Fork Clackamas River Hydroelectric Project:

> *"One factor contributing to the decline in native salmonid production is over-harvest of wild fish in mixed-stock fisheries (Brannon et al. 1998). The phenomenon is most pronounced in the inadvertent harvest of steelhead in catchable rainbow trout fisheries. Stocking of catchable trout attracts anglers, and harvest rates of juvenile steelhead are generally proportional to angler effort (Cramer and Willis 1998).*
>
> *Chapman (1989; after Cramer et al. 1997) studied the fate of juvenile salmonids in streams where catchable trout were stocked during summer and bait fishing was permitted. Anglers removed between 61% and 87% of wild steelhead longer than 125 mm and killed up to 28% of steelhead greater than 100 mm by catch-and-release. Chapman also noted that steelhead were faster to react to lures and bait, making them more susceptible to angling. Exacerbating the problem was that stocked trout were depleted rapidly in the study streams, leaving steelhead as the only targets. Pollard and Bjorn (1973) also noted that large juvenile steelhead were more susceptible to angling than hatchery trout living in the same section of*

> *the stream. Fisher (1961; after Cramer et al. 1997) studied stocked trout streams in California and found that the number of juvenile steelhead harvested was seven times greater than the number that emigrated from the system—and the study was conducted in spring, during the peak period of steelhead smolt emigration."*

Further justification for the elimination of the resident fish stocking program can be found in the technical document *Impacts of Resident Trout Fisheries on Anadromous Fish Populations, June 25, 2004* prepared for the Cowlitz FTC. .

Lacustrine Resident Salmonids

The long-term (>15 years) goal for resident lacustrine salmonids will be the identification of stocks, rearing, and release strategies that allow for fishery opportunity in the reservoirs.

Due to low fish collection efficiency at Cowlitz Falls Dam, large numbers of anadromous salmonids are passing into Riffe Lake. Because these fish support a significant recreational fishery, it is not deemed necessary to stock hatchery fish of any species in Project reservoirs at this time. This decision would be revisited in year seven of the FHMP, when this document is next updated.

5.11.2.2. Resident Non-salmonids

The long-term (>15 years) WDFW goal of the resident non-salmonid management strategy is to promote the harvest of centrarchids (bass) and esocids (perch) present in the reservoirs. Plans to manage for or eliminate these species from Project reservoirs will depend on the results of monitoring of juvenile anadromous fish passage success through the reservoirs and site selection of proposed juvenile collection systems above Mossyrock Dam.

Under the FHMP, it is recommended that non-salmonids not be stocked upstream of Mayfield Dam.

5.11.3 Synopsis of Objectives and Strategies

The two primary management objectives of the FHMP for resident and other fish species is to implement actions that protect native fish species, while at the same time to reduce the abundance of non-native fish species in the basin.

Phase 1 Objectives. Eliminate hatchery fish competition on native fish species; improve fish passage survival through Project structures; and reduce abundance of non-native fish species.

Proposed actions for other species upstream of Mayfield Dam to achieve Phase 1 objectives are summarized below.

- Collection and Passage. Improve fish collection efficiency and passage survival by improving juvenile collection systems at Project structures.

- Artificial Production Programs. No artificial production is proposed in Phase 1.

- Stock Characterization Studies. Work collaboratively with WDFW and other agencies to conduct studies deemed necessary by the Cowlitz FTC to characterize the status, distribution, habitat needs, and management needs for the "other species."

Phase 2 Objectives. Continue to fine tune goals from Phase 1. Ensure that reservoir fisheries do not create problems for naturally occurring salmonid populations in the Cowlitz River.

5.11.4 Goals and Objectives

5.11.4.1. Stock Reintroduction and Recovery

In Phase 1 of the FHMP, there are no plans to reintroduce other species such as lamprey or sturgeon to reaches upstream of Mayfield Dam. Reintroduction would be re-considered in Phase 2 of the FHMP depending on the results of fish passage and productivity experiments undertaken in Phase 1.

5.11.4.2. Fishery Harvest

General harvest objectives are to provide fishing opportunities in streams and reservoirs consistent with the mandate of the WDFW and other state and federal legal obligations. The actual extent of fisheries and the impact of their harvest will need to be determined.

5.11.4.3. Habitat

In the FHMP, habitat goals for anadromous stock restoration are presumed to be sufficient to meet the needs of the other species groups until such time as specific studies demonstrate otherwise.

5.11.5 Strategies

Achieving the multiple conservation and harvest objectives of this plan will require the development and implementation of innovative strategies, extensive monitoring, and adaptive management. Key strategies include mass marking of hatchery origin fish, use of reproductively incompetent fish, and selective fisheries to provide fishing opportunities while limiting exploitation rates on natural stocks.

5.11.5.1. Reintroduction

For Phase 1, no reintroduction is contemplated for these species.

5.11.5.2. Artificial Production

No hatchery production of resident, non-resident or other anadromous species, other than those described previously, is proposed in Phase 1.

5.11.5.3. Fishery Harvest

Two primary harvest strategies will be used to achieve the reintroduction, recovery, and harvest objectives of this plan:

- Reservoir fisheries will target hatchery origin fish.
- Management of fluvial sport fisheries upstream of Mayfield Dam will emphasize protection of juvenile salmonids.

6.0 Adaptive Management Plan

The Settlement Agreement requires that an Adaptive Management Plan (AMP) be incorporated into the FHMP. The purpose of the AMP is to provide a logical performance-based method for addressing the proposed fish passage, habitat, hatchery, and harvest issues identified in the FHMP.

Adaptive Management is defined as an "adaptive policy that is designed from the outset to test clearly formulated hypotheses about the behavior of the ecosystem being changed by human use" (Lee 1993). Generally, these hypotheses are predictions about how one or more species would respond to management actions.

Adaptive management is a process that is based on *learning by doing*. This can imply that resource managers need to take action in the face of scientific uncertainty. However, the actions taken through adaptive management are not selected at random. Rather, action is prescribed through the thoughtful and disciplined application of the scientific method.

The AMP is described in detail under the following headings:

- FHMP Goals
- AMP Management Structure
- Analytical Tools and Institutional Support
- Major Hypothesis (Critical Uncertainties)

6.1 FHMP Goals

The overall objective of the AMP is to change project facilities and operations over time to achieve the following goals as identified in the Settlement:

- Maintain ecosystem integrity and the restoration and recovery of wild indigenous salmonid runs, including ESA-listed and unlisted stocks, to harvestable levels.
- Fisheries management and hatchery production will be consistent with the overall goal of restoring and recovering wild stocks in the Cowlitz River basin.
- Wild salmonid recovery measures shall allow for the continued support of a recreational fishery on the Cowlitz River, including the production of non-indigenous stocks, provided this is consistent with the priority objective to maximize the recovery of wild indigenous salmonid stocks.

6.2 AMP Management Structure

The overall objective of the AMP is to implement initial strategies and actions specified in the FHMP with a methodology that allows for scientific evaluation of results, and to provide for development of modified strategies should initial ones fail to achieve desired results. The flow chart presented in Figure 6-1 shows a generalized AMP management structure for the FHMP. The AMP requires the formation of both a technical and a policy team to address scientific and policy issues, respectively. The technical and policy teams would be responsible for developing study plans, conducting research, selecting treatments, and evaluating study results.

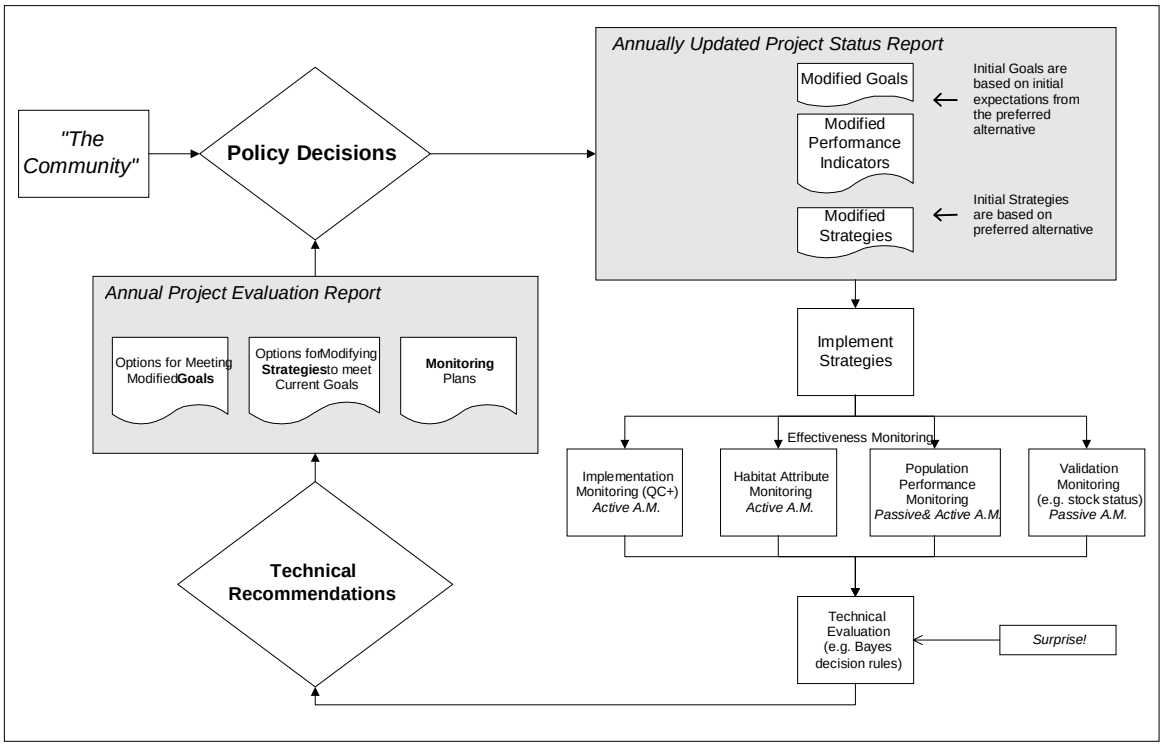

Figure 6-1. AMP flow chart for the Cowlitz River Project. The diagram displays the annual cycle of activities proposed to support informed policy decisions and technical evaluations.

The technical team will be assembled by Tacoma Power and will consist of scientists from state, tribal, and federal agencies, as well as Tacoma staff and contractors. The contractors may include staff from other agencies, consultants, private organizations, and academic institutions. This group will be responsible for conducting research, analyzing and summarizing study results, and producing the annual Project Evaluation and Status Report. This report will summarize all FHMP-related activities conducted in the basin each year. The document will include sections detailing the Adult Handling Protocol (AHP), hatchery production as outlined in the Cowlitz Complex Production Table (See Appendix 5), Cowlitz River basin juvenile fish marking plan, benchmark analysis, and results of fish passage, productivity, and other studies as outlined in the FHMP. This document will then be submitted for FTC review and comment.

The FTC will constitute the policy team for the FHMP. A description of their role in the process is discussed under Section 6.2.2, Institutional Support. Implementation of a successful adaptive management plan requires both analytical tools for developing and evaluating strategies and institutional support for decision-making. These topics are discussed in the following sections.

6.2.1 Analytical Tools

For the Cowlitz River AMP, the following analytical tools were used to build the FHMP strategies:

- Population Assessment—EDT
- Artificial Production—BRAP, HSRG and APRE Guidelines
- Adult Benchmark—Cramer Analysis

These same tools would be used in the AMP to organize data, develop hypotheses, analyze results, and estimate future outcomes. A more detailed description of these tools, with the exception of Cramer, can be found in Section 3 of this report.

6.2.2 Institutional Support

The FERC license would be the vehicle used for developing the institutional support providing policy oversight. As part of the Settlement Agreement, a fisheries technical committee (FTC) consisting of staff from the various signatories was assembled to assist in the development, review and oversight of both the FHMP and the AMP. The FTC will be the body making recommendations to Tacoma with regard to changes in the FHMP over time.

6.3 Major Hypotheses, Performance Criteria, and Timeframe

The major hypotheses that will be tested to determine whether basin goals and objectives are achievable are classified into four categories:

- Fish Passage
- Species Productivity
- Artificial Production
- Harvest

The major hypothesis that will be tested under each of the categories is presented below. A description of proposed performance criteria are presented for each hypothesis.

6.3.1 Fish Passage

The Settlement calls for the testing of three fish passage hypotheses. The three hypothesis are described below.

6.3.1.1. Fish Passage Hypothesis 1— Upper Cowlitz River FPS

Hypothesis Statement:
The FPS of juvenile anadromous fish emigrating from the upper Cowlitz River basin to below Barrier Dam can be increased to 75 percent or greater.

Performance Criterion:
Obtain a greater than 75 percent FPS as measured at the Barrier Dam.

Timeframe:
Achieve the 75 percent or greater criterion by March 2007. Yearly evaluation will be conducted until FPS is met or the best technology has been employed.

6.3.1.2. Fish Passage Hypothesis 2—Mayfield Dam FPS

Hypothesis Statement:
The FPS of juvenile anadromous fish emigrating past Mayfield Dam can be 95 percent or greater.

Performance Criterion:
Obtain a 95 percent FPS as measured below Mayfield Dam.

Timeframe:
Yearly evaluation will be conducted until FPS is achieved or a decision is made to substitute hatchery and/or habitat production for short-fall in FPS.

6.3.1.3. Fish Passage Hypothesis 3—Adult Behavior and Survival Through Mayfield Lake

Hypothesis Statement:
Adult spring Chinook and late winter steelhead released into Mayfield Lake are able to find their stream of origin and survive at a rate as determined by NOAA-Fisheries.

Performance Criterion:
NOAA-Fisheries will develop the criterion. The interim goal is more than 98 percent survival from release point to the mouth of the Tilton River or the base of Mossyrock Dam. The survival criterion was set at greater than 98 percent, similar to that observed for transported adults.

Timeframe:
The study will be repeated for two years. The study will not impact natural-origin spring Chinook spawner needs, and begin once sufficient upper Cowlitz and Tilton River origin adults are available for testing without causing undue impacts to on-going productivity experiments.

6.3.2 Species Productivity

Estimates of species productivity in the Tilton and upper Cowlitz River are required by the Settlement Agreement to 1) determine whether upstream fish passage facilities should

be constructed at Barrier, Mayfield, and Mossyrock dams; and 2) determine total adult production in stream reaches upstream of the Toutle River. The hypotheses dealing with species productivity are presented below.

6.3.2.1. Species Productivity Hypothesis—Late Winter Steelhead and Spring Chinook R/S and Abundance Testing in the Upper Cowlitz River

Hypothesis Statement:
Habitat productivity, fish passage facilities, and harvest rates are sufficient to establish self-sustaining runs of spring Chinook and late winter steelhead in stream reaches upstream of Cowlitz Falls Dam.

Performance Criterion:
Three performance criteria were identified in the Settlement:

- Adult fish in Mayfield Lake are able to choose their tributary of origin (Tilton or Upper Cowlitz) and survive Mayfield Lake transit at rates sufficient, as defined by the NOAA-Fisheries and USFWS, to achieve effective upstream passage. An interim survival value has been set at 98 percent.

- The spring Chinook and late winter steelhead populations would be considered self-sustaining if the number of pre-spawners arriving at the Barrier Dam in at least three of five consecutive brood years (and 5-year average) exceeds 1.0, and based on the five-year rolling average, exceeds abundance levels set for each species listed in Section 5.0.

- A disease management plan has been implemented that defines an acceptable level of risk from *Ceratomyxa shasta* and other diseases, and allows adult fish to be present upstream of the Barrier Dam.

Timeframe:
The productivity study will be conducted for a minimum of 12 years starting in 2005.

6.3.2.2. Species Productivity Hypothesis 2–Late Winter Steelhead, Coho, and Sea-run Cutthroat Trout R/S and Abundance Testing in the Tilton River

Hypothesis Statement:
Habitat productivity and fish passage designs are sufficient to establish self-sustaining runs of late winter steelhead, coho and sea-run cutthroat trout in the Tilton River.

Performance Criterion:
Three performance criteria were identified in the Settlement Agreement:

- Adult fish in Mayfield Lake are able to choose their tributary of origin (Tilton or upper Cowlitz) and survive Mayfield Lake transit at rates sufficient, as defined by the NOAA-Fisheries and USFWS, to achieve effective upstream passage. An interim survival value has been set at 98 percent.

- Anadromous fish populations in the Tilton River would be considered self-sustaining if the number of pre-spawners arriving at the Barrier Dam in at least three of five consecutive brood years (and 5-year average) exceeds 1.0, and based on the five-year rolling average, exceeds abundance levels for each species listed in Section 5.0.

- A disease management plan has been implemented that defines an acceptable level of risk from *Ceratomyxa shasta* and other diseases and allows adult fish upstream of the Barrier Dam.

Timeframe:
The productivity study will be conducted for a minimum of 12 years starting in 2005.

6.3.2.3. Species Productivity Hypothesis 3—Adult Production Benchmarks

Hypothesis Statement:
The adult benchmarks presented in the FHMP can be achieved with a combination of hatchery and natural production.

Performance Criterion:
Chinook and coho benchmarks are defined as the initial adult ocean population and are produced from coded wire tag modeling (Cramer 2002). The steelhead benchmark is calculated by summing adults captured in all fisheries, hooking mortality, natural spawning, and hatchery escapement. The benchmarks, by species, are spring Chinook 106,000; fall Chinook 73,900; coho 124,277; and steelhead 20,000.

Timeframe:
Annually for the term of the license.

6.3.2.4. Species Productivity Hypothesis 4: Natural Fish Survival

Hypothesis Statement:
Smolt-to-adult return rates for naturally produced fish are greater than or equal to those for hatchery fish.

Performance Criterion:
Equal smolts-to-adult survival rates for natural and hatchery produced fish.

Timeframe:
Annually for the term of the FERC license.

6.3.3 Artificial Production

Artificial production will play an important role in meeting basin fisheries goals for the foreseeable future. Hatchery (and natural) fish are needed for both reintroduction and recovery purposes, and to provide adults for commercial and recreational fisheries. The major hypotheses that will be tested in the AMP are listed below.

6.3.3.1. Artificial Production Hypothesis 1—Hatchery Rearing Protocols

Hypothesis Statement:
Hatchery rearing practices that utilize lower rearing densities will increase hatchery fish survival rates.

Performance Criterion:
Increase survival of fall and spring Chinook, coho, and late winter steelhead by 25 percent.

Timeframe:

The study will be replicated for five brood years.

6.3.3.2. Artificial Production Hypothesis 2—Innovative Rearing

Hypothesis Statement:
Innovative hatchery rearing practices that replicate wild fish physiology and behavior will improve survival to the adult stage.

Performance Criterion:
Increase survival of spring Chinook, coho, and late winter steelhead by 25 percent.

Timeframe:
This study will be replicated for five brood years.

6.3.3.3. Artificial Production Hypothesis 3—Spring Chinook Size at Release Study-A

Hypothesis Statement:
Spring Chinook smolts released at natural-origin smolt size will contribute at the highest rate.

Performance Criterion:
Adult contribution rates of natural-origin sized smolts will be higher than other test groups.

Timeframe:
This study will be replicated for four brood years.

6.3.3.4. Artificial Production Hypothesis 4—Spring Chinook Size at Release Study-B

Hypothesis Statement:
Spring Chinook smolts released at natural-origin smolt size will have the smallest mini-jack rate.

Performance Criterion:
Mini-jack rates of natural-origin sized smolts will be lower than other test groups.

Timeframe:
This study will be replicated for four brood years.

6.3.4 Harvest

The success of the anadromous fish reintroduction effort is heavily dependent on assumptions regarding total exploitation rates and hooking mortality from catch-and-release fisheries. The major harvest hypotheses to be tested in the FHMP are listed below.

6.3.4.1. Harvest Hypothesis 1—Incidental Harvest for Lower Cowlitz

Hypothesis Statement:
Incidental harvest impacts to naturally produced adults in lower Cowlitz River fisheries designed to target hatchery fish will be within the required mortality assumptions listed below.

Performance Criterion:
Incidental harvest mortality will be as follows: steelhead six percent; spring Chinook four percent; fall Chinook less than four percent; coho less than four percent; and pink, chum and sockeye less than one percent.

Timeframe:
Studies will be conducted every six years. Initial studies to begin within one year of FHMP implementation.

6.3.4.2. Harvest Hypothesis 2—Harvest for Upper Cowlitz and Tilton River

Hypothesis Statement:
Coho harvest will not negatively affect productivity experiments being conducted in the basin.

Performance Criterion:
Harvest rates for coho are less than four percent.

Time Frame:
Studies will be conducted yearly for the first three years of the FHMP implementation.

7.0 Monitoring and Evaluation

The monitoring and evaluation program needed to test the major hypothesis described in Section 6.0 is presented in this section of the report.

7.1 OBJECTIVE: Monitor natural and hatchery fish production from all populations upstream of Toutle River.

7.1.1 Tasks

- Monitor and document harvest rates for all species in all in-basin fisheries. Conduct creel surveys in the lower Cowlitz, Tilton, and upper Cowlitz rivers to estimate total catch and effort. Mass mark Cowlitz hatchery production groups.

- Coded wire tag Cowlitz Salmon Hatchery index groups.

- Implement coded wire tag recovery efforts in Cowlitz River basin.

- Enumerate all adult salmonid returns to Cowlitz River facilities above the mouth of the Toutle River.

- Monitor stream flow in lower Cowlitz River to ensure that conditions are consistent with Project operations outlined in the Settlement Agreement.

- Conduct lower Cowlitz River tributary steelhead spawning surveys.

- Conduct lower Cowlitz River (Barrier Dam to Toutle River) spawning surveys for Chinook, coho, chum, pink and sockeye salmon. Develop an annual report of adult contributions.

7.2 OBJECTIVE: Implement a juvenile fish tagging and marking program for the Cowlitz River Basin.[24]

7.2.1 Tasks

- Develop Cowlitz Complex juvenile fish marking protocols.Develop Mayfield downstream migrant facility juvenile fish marking protocols.

[24] Juvenile marking plan is provided in Appendix 6.

7.3 OBJECTIVE: Further refine credit mechanisms for reducing hatchery production as natural production increases.[25]

7.3.1 Tasks

- Calculate Cowlitz River basin hatchery smolt production versus natural smolt production annually.In conjunction with Cowlitz Falls Fish Collection facility develop Cowlitz River basin juvenile fish marking protocols.

- Evaluate survival and contribution to fisheries of hatchery versus natural smolt production from above the Barrier Dam.

- Report annually on the origin of juvenile production from the Cowlitz River basin above the Barrier Dam.

7.4 OBJECTIVE: Develop protocols for incorporating naturally produced fish into hatchery populations.

7.4.1 Tasks

- Develop adult escapement goals for management and assure adequate broodstock escapement via fishery management planning and implementation.
- Develop annual Cowlitz Complex Production Table (see Appendix 5).Develop adult handling protocols (AHP) and upstream transportation program.Develop juvenile incubation and rearing protocols.

- Monitor percent hatchery and natural fish contributions at both the hatchery and on selected spawning grounds.

7.5 OBJECTIVE: Measure and monitor FPS for Mayfield and Cowlitz Falls (or other) fish collection systems.

7.5.1 Tasks

- Annually operate and evaluate the Mayfield downstream migrant collection facility.

- Annually assist with the operations and evaluation of the Cowlitz Falls Fish Collection Facility.

- Continue operation of stress relief ponds at Cowlitz Salmon Hatchery.

- Annually evaluate juvenile smolt mortality due to transportation and handling.

[25] The Cowlitz Hatchery Complex production table and adult handling protocols that apply to this FHMP are provided in the Appendices.

7.6 OBJECTIVE: Measure R/S and abundance criteria in Upper Cowlitz River Basin for spring Chinook and late winter steelhead.

7.6.1 Tasks

- Track adult salmonid returns to Cowlitz River facilities.
- Re-run Cramer (April 2002) analysis annually using PSMFC data.
- Develop an annual report of adult contributions.

7.7 OBJECTIVE: Measure abundance and R/S criteria for anadromous species in the Tilton River basin.

7.7.1 Tasks

- Track number of adults released into the Tilton River system.
- Continue operation of Mayfield downstream migrant facility.Develop an annual report of adult contributions.

7.8 OBJECTIVE: Conduct adult passage studies in the Cowlitz River Basin.

7.8.1 Tasks

- Continue operation of existing adult trap-and-haul system.
- Radio-track anadromous fish through Mayfield Lake.
- Conduct survival studies of adults transported using existing trap-and-haul facility.

7.9 OBJECTIVE: Implement and test innovative rearing and release practices at the Cowlitz hatcheries.

7.9.1 Tasks

- Rear all species at low density rates.Test rear a portion of the hatchery production in enhanced environments. Rear all species at turnover rates less than 1.0 vessel volume per hour.
- Attempt to mimic naturally produced smolt sizes and migration times for indigenous fish released from the hatcheries.
- Develop research plan for data collection and analysis for each new rearing or release strategy tested.

7.10 OBJECTIVE: Develop a Disease Management Plan for the Cowlitz hatcheries

7.10.1 Task

- Incorporate elements of existing plans to develop site-specific best management practices.

7.11 OBJECTIVE: Obtain all necessary permits.

7.11.1 Tasks

- Obtain ESA-related permits.
- Obtain fish collection and sampling permits.

7.12 OBJECTIVE: Conduct Lower Cowlitz River habitat assessments

7.12.1 Tasks

- Gravel distribution studies.
- Gravel addition plan.
- Channel maintenance studies.
- Large woody debris distribution studies.

7.13 OBJECTIVE: Conduct genetic interactions studies among listed and hatchery steelhead in the lower Cowlitz River basin.

7.13.1 Tasks

- Fund genetic analysis study on steelhead.

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Appendix 1. Tilton River EDT Results

Table 1-1. EDT Population Performance Data For Tilton River.

Population Performance data - Fall Chinook - 6/29/2004

Species	Alternative	Pop_Name	DI	SmoltRName_1	SmoltProd_1	SmoltCapacity_1	SmoltNeq Abundance_1	AdultRName	Productivity	Capacity	Abundance
Fall Chinook	P	Tilton Fall Chinook	35.0%	Lower Cowlitz-1	165.2	201,761	92,080	Spawning	2.0	2,020	1,025
Fall Chinook	PFC	Tilton Fall Chinook	90.0%	Lower Cowlitz-1	293.5	435,414	318,638	Spawning	4.5	5,197	4,048

Species	Alternative	Pop_Name	DI	SmoltRName_1	SmoltProd_1	SmoltCapacity_1	SmoltNeq Abundance_1	Spawning	Productivity	Capacity	Abundance
Spring Chinook	P	Tilton River Spring	20.0%	Lower Cowlitz-1	50.7	54,569	21,881	Spawning	1.8	1,602	720
Spring Chinook	PFC	Tilton River Spring	75.0%	Lower Cowlitz-1	132.5	128,856	104,879	Spawning	7.5	4,906	4,255

Species	Alternative	Pop_Name	DI	SmoltRName_1	SmoltProd_1	SmoltCapacity_1	SmoltNeq Abundance_1	Spawning	Productivity	Capacity	Abundance
Coho	P	Tilton Coho	24.0%	Lower Cowlitz-1	58.8	88,986	46,916	Spawning	2.4	2,916	1,687
Coho	PFC	Tilton Coho	86.0%	Lower Cowlitz-1	160.8	204,407	177,021	Spawning	8.7	9,285	8,215

Species	Alternative	Pop_Name	DI	SmoltRName_1	SmoltProd_1	SmoltCapacity_1	SmoltNeq Abundance_1	Spawning	Productivity	Capacity	Abundance
Winter Steelhead	P	Tilton River Steelhead	21.0%	Lower Cowlitz-1	40.2	7,469	4,037	Spawning	2.3	393	219
Winter Steelhead	PFC	Tilton River Steelhead	91.0%	Lower Cowlitz-1	161.8	28,377	25,306	Spawning	9.7	1,611	1,445

Appendix 2. Upper Cowlitz EDT Results

Table 2-1. EDT Population Performance Data For Upper Cowlitz.

Population Performance data - Fall Chinook - 6/30/2004

Species	Alternative	Pop_Name	DI	SmoltRName_1	SmoltProd_1	SmoltCapacity_1	SmoltNeq Abundance_1	Spawning	Productivity	Capacity	Abundance
Fall Chinook	P	Cowlitz Fall Chinook	60.0%	Lower Cowlitz-1	185.0	444,612	250,278	Spawning	2.5	5,142	3,096
Fall Chinook	P	Cispus Fall Chinook	49.0%	Lower Cowlitz-1	130.7	180,105	72,747	Spawning	1.8	2,144	934
Fall Chinook	PFC	Cowlitz Fall Chinook	70.0%	Lower Cowlitz-1	222.2	687,779	466,183	Spawning	3.6	9,006	6,511
Fall Chinook	PFC	Cispus Fall Chinook	70.0%	Lower Cowlitz-1	184.5	230,596	143,322	Spawning	2.9	3,130	2,053

Species	Alternative	Pop_Name	DI	SmoltRName_1	SmoltProd_1	SmoltCapacity_1	SmoltNeq Abundance_1	Spawning	Productivity	Capacity	Abundance
Spring Chinook	P	Cowlitz Spring	45.0%	Lower Cowlitz-1	64.4	156,226	101,276	Spawning	3.3	6,417	4,469
Spring Chinook	P	Cispus River Spring	23.0%	Lower Cowlitz-1	45.6	45,438	22,861	Spawning	2.3	1,779	1,008
Spring Chinook	PFC	Cowlitz Spring	58.0%	Lower Cowlitz-1	99.7	224,635	178,768	Spawning	5.9	10,578	8,782
Spring Chinook	PFC	Cispus River Spring	50.0%	Lower Cowlitz-1	78.1	58,409	42,488	Spawning	4.4	2,580	1,995

Species	Alternative	Pop_Name	DI	SmoltRName_1	SmoltProd_1	SmoltCapacity_1	SmoltNeq Abundance_1	Spawning	Productivity	Capacity	Abundance
Coho	P	Cispus Coho	33.0%	Lower Cowlitz-1	77.0	109,696	79,519	Spawning	4.0	5,020	3,752
Coho	P	Cowlitz Coho	57.0%	Lower Cowlitz-1	64.4	508,391	328,955	Spawning	3.0	21,654	14,463
Coho	PFC	Cispus Coho	37.0%	Lower Cowlitz-1	140.2	625,516	526,495	Spawning	7.5	27,375	23,729
Coho	PFC	Cowlitz Coho	61.0%	Lower Cowlitz-1	143.2	1,282,722	1,080,000	Spawning	7.3	55,375	47,734

Species	Alternative	Pop_Name	DI	SmoltRName_1	SmoltProd_1	SmoltCapacity_1	SmoltNeq Abundance_1	Spawning	Productivity	Capacity	Abundance
Winter Steelhead	P	Cowlitz Steelhead	55.0%	Lower Cowlitz-1	64.1	14,861	10,753	Spawning	3.7	832	607
Winter Steelhead	P	Cispus Steelhead	61.0%	Lower Cowlitz-1	52.5	25,283	16,866	Spawning	3.1	1,432	965
Winter Steelhead	PFC	Cowlitz Steelhead	59.0%	Lower Cowlitz-1	117.1	46,173	39,377	Spawning	7.1	2,661	2,285
Winter Steelhead	PFC	Cispus Steelhead	68.0%	Lower Cowlitz-1	89.4	59,611	48,221	Spawning	5.4	3,465	2,824

Appendix 3. Reintroduction Strategies

Table 3-1. Strategies Examined for Reintroducing Anadromous Fish to the Cowlitz River.

Reintroduction Strategies	**Implications for:** *Evaluating wild juvenile survival and productivity*	**Implications for**: *Accounting returning offspring at Barrier Dam*	**Implications for**: *Establishing separate tributary populations*	**Implications for**: *'Ecosystem Health'*
1) Release CH spring Chinook stock adults upstream of Cowlitz Falls Dam, but not into Tilton R.	Can begin in year 1. Offspring cannot be distinguished from other Chinook offspring. No Tilton benefits.	Can begin 3 years after release. UC/CI offspring ID'd as 1 unit; no separate Tilton ID needed.	Adults choose spawning site in UC or CI; need spawner surveys to evaluate. No Tilton pop.	Benefits from redd construction, carcasses, begin in year 1. No Tilton benefits.
2) Release CH spring Chinook stock adults upstream of Cowlitz Falls Dam, and into Tilton R.	Can begin in year 1. Offspring cannot be distinguished from other Chinook. Tilton offspring not distinguished among non-transported juveniles.	Can begin 3 years after release. UC/CI and Tilton offspring ID'd as 1 unit for productivity ratio.	Adults choose spawning sites; need spawner surveys to evaluate. Problem of Tilton stock ID for appropriate transfer of returning adults.	Benefits from redd construction, carcasses, begin in year 1.
3) Acclimate CH spring Chinook stock juveniles in 2 or more locations upstream of Cowlitz Falls Dam, but not in Tilton R.	Evaluation delayed until adults return and spawn, 4+ years out. Offspring cannot be distinguished from other Chinook. No Tilton benefits.	Evaluation delayed until adults return and spawn, & their offspring return as adults 8+ years out. No Tilton benefits.	Returning adults more likely to home to release site than from smolt releases. No Tilton benefit.	Benefits from redd construction, carcasses, delayed until 3+ years out. No Tilton benefit.
4) Acclimate CH spring Chinook stock juveniles in 2 or more locations upstream of Cowlitz Falls Dam, and in Tilton R.	Evaluation delayed until adults return and spawn, 4+ years out. Offspring not distinguished from other Chinook or stream-origin.	Evaluation delayed until adults return and spawn, & their offspring return as adults 8+ years out. Single unit evaluation.	Returning adults more likely to home to release site. Problem of Tilton stock ID for transfer of adults.	Benefits from redd construction, carcasses, delayed until 3+ years out.
5) #1 and release uniquely marked CH spring Chinook stock juveniles in Tilton River	See box 1 but with Tilton benefit of identifiable returning adults that can be transported to Tilton & subsequent juveniles evaluated in-stream	Partial evaluation can begin 2 years after release. For Tilton see box 4 above. Eventual single unit evaluation.	See boxes 1 and 4 above.	See boxes 1 & 4 above.
6) Acclimate pre-smolts in UC, CI & Tilton, then truck below Mayfield for release; no natural migration; must be uniquely marked per site for retuning adult transfer.	Evaluation delayed until adults return and spawn, 4+ years out. Offspring not distinguished from other Chinook or by stream-origin.	See box 4 above	1st adult returns could be transferred to 'home' R. & then chose spawning site, but progeny origin will not be distinguishable at adult return.	Benefits from redd construction, carcasses, delayed until 3+ years out.

Table 3-1 continued. Strategies Examined for Reintroducing Anadromous Fish to the Cowlitz River.

Reintroduction Strategies	**Implications for**: *CH annual broodstock needs*	**Implications for**: *Genetic risk reduction*	**Implications for**: *Maximizing total adult returns*	**Implications for**: *Juvenile life history patterns and diversity*
1) Release CH spring Chinook stock adults upstream of Cowlitz Falls Dam, but not into Tilton R.	Fewer adults needed from returns to CH without Tilton program. CH must supply enough adults to allow measurable production.	Reduction of domestication due to mate choice and natural selection on fry & pre-smolts.	Removes production from the hatchery, unless adults are surplus; without Tilton releases may not be maximized.	* Due to juvenile trapping and trucking, *all* UC/CI strategies prevent normal use of former migration and rearing zones. If this is detrimental to spring Chinook success, 0+ age fish could be facility-reared to 1+ for release downstream.
2) Release CH spring Chinook stock adults upstream of Cowlitz Falls Dam, and into Tilton R.	CH must supply enough adults for both locations to allow measurable production.	Reduction of domestication due to mate choice and natural selection on fry & pre-smolts.	Removes production from the hatchery, unless adults are surplus.	*
3) Acclimate CH spring Chinook stock juveniles in 2 or more locations upstream of Cowlitz Falls Dam, but not in Tilton R.	A small to moderate increase in broodstock take may supply enough fry for acclimation.	Lack of mate choice. Juveniles may be related to hatchery releases. Natural selection during stream phase.	Minimum reduction of hatchery production. Potential to increase adult returns in early years to lesson hatchery fish needs. Not maximized w/o Tilton.	*
4) Acclimate CH spring Chinook stock juveniles in 2 or more locations upstream of Cowlitz Falls Dam, and in Tilton R.	A small to moderate increase in broodstock take may supply enough fry for acclimation.	Lack of mate choice. Juveniles may be related to hatchery releases. Natural selection during stream phase.	Minimum reduction of hatchery production. Potential to increase adult returns in early years to lesson hatchery fish needs.	*
5) #1 and release uniquely marked CH spring Chinook stock juveniles in Tilton River.	CH must supply enough adults and juveniles to allow measurable production in both locations.	See boxes 1 & 3 above.	Removes production from the hatchery, unless adults are surplus; Tilton releases improve maximization.	*

Table 3-1 continued. Strategies Examined for Reintroducing Anadromous Fish to the Cowlitz River.

Reintroduction Strategies	**Implications for**: *CH annual broodstock needs*	**Implications for**: *Genetic risk reduction*	**Implications for**: *Maximizing total adult returns*	**Implications for**: *Juvenile life history patterns and diversity*
6) Acclimate pre-smolts in UC, CI & Tilton, then truck below Mayfield for release; no natural migration; must be uniquely marked per site for retuning adult transfer.	A small to moderate increase in broodstock take may supply enough pre-smolts for acclimation.	Lack of mate choice. Pre-smolts be related to hatchery releases. Natural selection during stream phase starts post-trucking.	Potential to increase adult returns in early years; lessens the need for 'normal' hatchery adults required for reintroduction phase. Minimum reduction of hatchery production. Bypasses current mortality levels at Cowlitz Falls Dam.	*

Appendix 4. Adult Handling Protocols

Table 4-1. 2004 Adult Handling Protocol for the Cowlitz Complex.

2004 ADULT HANDLING PROTOCAL - COWLITZ SALMON HATCHERY

Disposition of adult salmonids that arrive at the Cowlitz Salmon Hatchery

BY 2004	ORIGIN[26]	LOWER COWLITZ	TILTON RIVER	UPPER COWLITZ OR CISPUS[27]	LAKE SCANEWA	HATCHERY ESCAPEMENT GOAL
Spring Chinook	H	0	0	33% of returns AHN[28]	67% of returns AHN	2,671[29]
	W	0	0	0	100% AHN	0
Fall Chinook	H	0	0	0	0	1,900
	W –Tilton	0	100%	0	0	0
Coho – N run	H	0	500 AHN	33% of returns AHN	67% of returns AHN	1,750
	W – upper Cowlitz	0	0	0	100%	0
	W – Tilton	0	100%	0	0	0
Early winter steelhead[30]	H	100% AHN	0	0	0	172
	W – Tilton	0	100%[31]	0	0	0
	W – upper Cowlitz	0	0	0	100%	0
Late winter steelhead	H	100% AHN	0	150	200	415
	W – upper Cowlitz	0	0	0	100%	0
	W - Tilton	0	100%	0	0	0
Summer steelhead	H	100% AHN	0	0	0	415
	W	100%	0	0	0	0
Sea-run cutthroat	H	AHN	0	0	0	70% of broodstock needs for each stock.
	W - Tilton	0	AHN	0	0	Limited to 30% of broodstock needs.
	W – upper Cowlitz	0	0	0	AHN	Limited to 30% of broodstock needs.
	W-	0	0	0	AHN	Limited to 30% of broodstock needs.
Chum	W	100%	0	0	0	0
Sockeye	W	100%	0	0	0	0
Pink	W	100%	0	0	0	0

[26] H = hatchery-origin, W = natural-origin
[27] Releases to upper Cowlitz or Cispus are designed to increase natural production.
[28] AHN = above hatchery brood stock needs.
[29] 2,000 hatchery spring Chinook for upper basin natural production (see Section 5.0).
[30] Run timing prior to March 15.
[31] Early winter fish will not be stocked in the Tilton.

Table 4-2. 2004 Adult Handling Protocol for the Cowlitz Complex.

2004 ADULT HANDLING PROTOCAL - COWLITZ TROUT HATCHERY

Disposition of adult salmonids that arrive at the Cowlitz Trout Hatchery

BY 2004	ORIGIN[32]	LOWER COWLITZ	TILTON RIVER	UPPER COWLITZ OR CISPUS[33]	LAKE SCANEWA	HATCHERY BROODSTOCK
Spring Chinook	H	0	0	33%	67%	0
	W	0	0	0	100%	0
Fall Chinook	H	100%	0	0	0	0
	W	100%	0	0	0	0
Coho – N run	H	0	0	33%	67%	0
	W – upper Cowlitz	0	0	0	100%	0
	W – Tilton	0	100%	0	0	0
Early winter steelhead[34]	H	100% AHN[35]	0	0	0	0[36]
	W – Tilton	0	100%	0	0	0
	W – upper Cowlitz	0	0	0	100%	0
Late winter steelhead	H	100% AHN	0	0	0	0[11]
	W – upper Cowlitz	0	0	0	100%	0
	W - Tilton	0	100%	0	0	0
Summer steelhead	H	100%	0	0	0	0[11]
	W	100%	0	0	0	0
Sea-run cutthroat	H	AHN	0	0	0	70% of broodstock needs for each stock.
	W - Tilton	0	AHN	0	0	Limited to 30% of broodstock needs.
	W – upper Cowlitz	0	0	0	AHN	Limited to 30% of broodstock needs.
	W-	0	0	0	AHN	Limited to 30% of broodstock needs.
Chum	W	100%	0	0	0	0
Sockeye	W	100%	0	0	0	0
Pink	W	100%	0	0	0	0

[32] H = hatchery-origin, W = natural-origin
[33] Releases to upper Cowlitz or Cispus are designed to increase natural production.
[34] Run timing prior to March 15.
[35] No early winter stocked upstream of Mayfield dam with implementation of FHMP.
[36] All steelhead broodstock will be collected at the Cowlitz Salmon Hatchery separator.

Appendix 5. Cowlitz Complex Production Table[37]

Post-remodel Production Table

[37] Defines Tacoma Power's annual hatchery production obligation. Subject to adjustment by FTC up to maximum limit in place at time of review and credit mechanism.

Table 5-1. Post remodel Cowlitz Complex Production Table

COWLITZ SALMON HATCHERY

		DATE	SIZE	POUNDS
CHINOOK, FALL, COWLITZ RIVER (26.0002)				
EGG TAKE GOAL	4,136,657			
Cowlitz stock only				
PLANTING GOAL	4,000,000	1-May	80	50,000
Release size of 80 fpp				
On station release at Cowlitz Salmon Hatchery				
COWLITZ, SPRING CHINOOK, COWLITZ RIVER (26.0002)				
EGG TAKE GOAL	1,122,807			
No retention of adults after August 1				
PLANTING GOAL	332,000	1-Apr	4	80,583
Release size of 4 fpp				
PLANTING GOAL	332,000	1-Apr	8	40,292
Release size of 8 fpp				
PLANTING GOAL	332,000	1-Apr	16	20,146
Release size of 16 fpp				
Average release size of 8 fpp				
On station release at Cowlitz Salmon Hatchery				
COHO, COWLITZ RIVER (26.0002)				
EGG TAKE GOAL	2,843,952			
PLANTING GOAL	2,310,000	1-Apr	15	154,000
Release size of 15 fpp				
On station release at Cowlitz Salmon Hatchery				
			TOTAL	345,021

COWLITZ TROUT HATCHERY

		DATE	SIZE	POUNDS
LATE WINTER STEELHEAD, COWLITZ RIVER (26.0002)				
EGG TAKE GOAL	589,865			
Broodstock collected at Cowlitz Salmon Hatchery separator				
PLANTING GOAL	450,000	1-Apr	5	90,000
Release size of 5 fpp				
On station release at Cowlitz Trout Hatchery				
SEARUN CUTTHROAT, COWLITZ RIVER (26.0002)				
EGG TAKE GOAL	83,378			
Integrated broodstock, 30% minimum wild upper basin adults				
PLANTING GOAL	50,000	1-Apr	8	6,250
Release size of 8 fpp				
On station release at Cowlitz Trout Hatchery				

Table 5-1 continued. Cowlitz Complex Production Table.

EARLY WINTER STEELHEAD, COWLITZ RIVER (26.0002)				
EGG TAKE GOAL	283,487			
Broodstock collected at Cowlitz Salmon Hatchery separator				
PLANTING GOAL	200,000	1-Apr	5	40,000
Release size of 5 fpp				
On station release at Cowlitz Trout Hatchery				
SUMMER STEELHEAD, COWLITZ RIVER (26.0002)				
EGG TAKE GOAL	750,406			
Broodstock collected at Cowlitz Salmon Hatchery separator				
PLANTING GOAL	450,000	1-Apr	5	90,000
Release size of 5 fpp				
On station release at Cowlitz Trout Hatchery				
			TOTAL	226,250
			COWLITZ COMPLEX TOTAL	**571,271**

Appendix 6. Juvenile Marking Protocols

Table 6-1. Cowlitz River Basin Juvenile Salmonid Marking Program - 2003

Cowlitz Project (FERC No. 2016) Fisheries and Hatchery Management Plan

Release Location	Spring Chinook	Fall Chinook	Coho	Steelhead[38]	Cutthroat	Chum	Sockeye	Pink	NOTES
Cowlitz Trout Hatchery	NA	NA	NA	100% adipose clip	100% adipose clip	NA	NA	NA	
Lower river net pen releases	NA	NA	NA	100% adipose clip	NA	NA	NA	NA	
Cowlitz Salmon Hatchery	100% adipose clip + coded wire tag (cwt)	96% unmarked, 4% ad+cwt	100% ad clipped, 3% ad+cwt	NA	NA	NA	NA	NA	
Mayfield Dam Collector	Blank wire tag - snout	Blank wire tag - snout	Blank wire tag - snout	Blank wire tag - snout	Blank wire tag - snout	NA	NA	NA	
Tilton River	NA	NA	NA	Not marked	Not marked	NA	NA	NA	Fry plants
Cowlitz Falls Fish Collection Facility	Un-marked, small percent elastomer marked	NA	Un-marked	Unmarked, small percent elastomer marked	100% elastomer marked and numeric tag	NA	NA	NA	Only smolts marked
Upper Cowlitz River basin	Not marked	NA	NA	Fry: not marked, smolts: adipose and RV clip	NA	NA	NA	NA	Fry and smolt plants

[38] All stocks – late winter-run, early winter-run, summer-run

Appendix 7. Cowlitz FTC Reviewer Comments and Responses

TACOMA'S RESPONSES TO COMMENTS RECEIVED ON FINAL DRAFT – FISHERIES AND HATCHERY MANAGEMENT PLAN, JULY 2, 2004

Comments from NOAA Fisheries, July 20, 2004:

Comment 1:

Page 9. The list of reasonable and prudent measures (RPM) that follows does not include the specific terms and conditions that are associated with the RPMs. For example, #19 (page 11) is just the RPM, and does not include the terms and conditions that would allow a resident trout stocking program. Either delete these, add the terms and conditions, or explicitly state in the sentence on page 9 that these are only RPMs.

Response to Comment 1:

Tacoma Power has changed the text to indicate these are reasonable and prudent measures.

Comment 2:

Page 13. Section 3.5, Viable, Self-Sustaining, and Recovered Populations. This whole section, including the title and table, should be modified. Changes throughout the document reflecting these abundance values also should be made. The abundance values called for in license article 3 are not equivalent to Aviable, self-sustaining, and recovered populations.@ We believe the abundance values stated below are Aself-sustaining@ as required by license article 3. Following are the abundance values and an explanation of how NOAA Fisheries, along with the U.S. Fish and Wildlife Service, arrived at them.

The target abundance value for coastal cutthroat trout, salmon, and steelhead in the Cowlitz River is not a population recovery goal, but rather one of many criteria used in determining whether or not a fish ladder will be built. Nevertheless, for the likely continued persistence of the population in the short term, the abundance target should be greater than or equal to the minimum population size that prevents an unacceptable rate of inbreeding and risk of extinction in the near term. The absolute number of individuals in a population is one indicator of whether the population can sustain itself into the future in the face of environmental fluctuations and small-population stochasticity. This aspect of evaluating extinction risk is related to the concept of minimum viable populations (McElhany et al. 2000).

Conservation biologists have argued that endangerment of a population (likelihood of extinction) should be defined as the probability of persistence over a period of time. A minimum viable population size might then be defined as the population size N at which the probability of persistence over the next x years is y%. Quantitative approaches to population viability analysis are categorized into three groups: 1) Arules of thumb,@ 2)

analytical approaches, and 3) simulation approaches (Thompson 1991). Abundance estimates, population growth rate, population spatial structure, and diversity parameters are necessary in evaluating population viability (McElhany et al. 2000). Limited information on these parameters for Cowlitz River coastal cutthroat trout, salmon, and steelhead precludes the use of analytical or simulation approaches for assessing population viability and determining a minimum viable population size. Until we have information on these parameters, we propose to use a Arule of thumb@ approach in determining the minimum population size that prevents an unacceptable rate of inbreeding and risk of extinction.

The A50/500" rule of thumb prescribes a short-term effective population size (N_e) of 50 to prevent an unacceptable rate of inbreeding, and a long-term population size of 500 (N_e) to maintain overall genetic variability and to ensure that critically low numbers do not result from normal variation associated with environmental variation (Soule 1980; Thompson 1991). The effective population size is the ideal number of breeding individuals produced each generation by random union of an equal number of male and females randomly drawn from the previous generation. The effective population is a smaller number of individuals than the minimum viable census population (N), which is the total number of mature fish in the population, including fish that do not successfully spawn in any given year. We propose to use the minimum viable census population size as the abundance value for cutthroat trout, salmon, and steelhead in the Cowlitz River Basin to be used in evaluating the merit of building a fish ladder.

Preliminary abundance targets are provided below for both the Tilton River and upper Cowlitz River Basin. A single abundance target combining these two areas is not proposed due to NOAA Fisheries= definition of a population to use when assessing population viability. NOAA Fisheries defines an independent population as Aa group of fish of the same species that spawns in a particular lake or stream (or portion thereof) at a particular season and which, to a substantial degree, does not interbreed with fish from any other group spawning in a different place or in the same place at a different season@ (McElhany et al. 2000).

When using the 50/500 rule of thumb for the minimum viable effective population, the minimum viable census population (N) can be determined using either: 1) a second Arule of thumb,@ or 2) an analytical formula (Thompson 1991). In order to use the analytical formula, data available on sex ratio, progeny produced, and change in population size is needed to translate the minimum viable effective population size (N_e) to the minimum viable census population (N). Lack of information on these data for cutthroat trout, salmon, and steelhead in the Cowlitz River at this time forces us to devise a second rule of thumb when determining abundance targets. An average value for the N_e/N ratio of 10%-50% is often proposed as a rule of thumb, resulting in the minimum viable census population falling within one order of magnitude of the minimum effective population size (Thompson 1991). The tables below contain a range of potential abundance targets (minimum viable census population size (N)) over a range of spawning rates using 50 and 100 as the minimum effective population size (N_e). Spawning rate is defined as the

number of successful spawners of the total mature fish in the population. We assume a spawner sex ratio of 1 male:1 female.

Table 1. Relationship between an effective population size, N_e, of 50 and census population size, N, given various levels of adult contribution to the next generation (spawner rate) and assuming equal numbers of males and females and equal contribution to the next generation by each adult.

	Spawner Rate (% of total mature fish)					
	10%	*20%*	*30%*	*40%*	*50%*	*60%*
N Abundance Target	*500*	*250*	*167*	*125*	*100*	*83*
N_e Effective Population	*50*	*50*	*50*	*50*	*50*	*50*

Table 2. Relationship between an effective population size, N_e, of 100 and census population size, N, assuming a 20% spawner rate success (Waples 1990) and assuming equal numbers of males and females and equal contribution to the next generation by each adult.

N Abundance Target	*1000*	*500*	*333*	*250*	*200*	*167*
N_e Effective Population	*100*	*100*	*100*	*100*	*100*	*100*

Setting a single target abundance level is challenging due to the variety of migratory and life-history patterns observed in coastal cutthroat trout. Anadromous coastal cutthroat trout spawn first at 2-4 years of age and may return 2-5 times to overwinter and spawn (Moyle 2002). Furthermore, both adults and juveniles can migrate extensively within a system throughout a year and coastal cutthroat trout can spawn multiple times, making it difficult to determine how many of the downstream and upstream migrants passing a particular location should be attributed to the spawning population of interest in any given year. Some have even returned from coastal waters to their natal rivers as non-spawning fish. This complicated life history confounds abundance estimates and increases the uncertainty in determining population viability.

Due to the difficulty in accurately attributing coastal cutthroat trout captured at the collection facilities within the Cowlitz system to the spawning population for that year, we recommend using the conservative target abundance level of 500 fish each for the Tilton River and upper Cowlitz River populations.

For the short time period and specific circumstances that this target abundance number is to be used, we recommend an N_e of 100 as a threshold for salmon. Additionally, for this indicator of sustainability to be valid, it must take into account the presence of hatchery-origin fish among the spawners. It should be underscored that this is not the level that we believe constitutes recovery, but rather it is a realistic number for the question at hand - a threshold that is indicative of a potentially sustainable population. Since the average ratio of potential spawners to actual spawners for salmon and steelhead is thought to be approximately 20% (Waples 1990), we recommend using the abundance level of 500 fish each for the Tilton River and the upper Cowlitz River groups

of Chinook salmon, coho salmon, and steelhead. We propose that all fish returning to the Tilton and all fish returning to above Cowlitz Falls would be each counted as one population for each species in each location since they are all originating from the same hatchery stocks and have not had long enough to evolve into distinct populations. In other words, the abundance value would be 500 for each Chinook salmon and steelhead group (one group each) above Cowlitz Falls and 500 for each Chinook salmon, coho salmon, and steelhead group (one group each) in the Tilton River.

It should be emphasized that these proposed abundance targets are based on our interpretation of currently available data and literature and should be modified as more rigorous analysis of new data is completed. These are interim abundance targets and ongoing and future planning processes, such as recovery planning, may change the targets and our approach to setting these targets.

Response to Comment 2:

Tacoma has adjusted Table 3-1. – *Adult abundance targets by basin and species*, to reflect the abundance values proposed herein and included the entire text of Comment 2 into the Final FHMP (See Section 3).

Comment 3:

Page 17. There will be a delay in hatchery production up to two years before releases reflect changes due to credit. For example, if in the spring/summer of 2004 the five-year moving averaged total spring juvenile production was 300,000, then spawning in the fall of 2004 could be reduced to reflect the credit. However, these fish would not be released until the spring of 2006. Would the credit mechanism require that the Washington Department of Fish and Wildlife (WDFW) destroy eggs that have already been collected? If, for example, in 2004 the credit was 100,000 smolts, then would WDFW destroy juveniles on hand from the 2004 brood, or would the credit apply to the 2005 brood, which would not be released until 2006? This should be described clearly so that all the parties know the delay involved and the consequences of destroying fish on hand.

Response to Comment 3:

Tacoma has changed the text to clarify when the credit will begin and when and how the Cowlitz Complex hatchery production will change. No fish already present at the Cowlitz Complex will be destroyed. For example, the Final FHMP notes that when the credit is calculated in 2004, no affect upon the hatchery operations will occur until 2005 and after.

Comment 4:

Page 18. The title of Table 3-4 needs to be corrected. Footnote 2 needs clarification; all juveniles going upstream now will be marked, so these should not be counted as natural production. Does Tacoma Power propose to count those hatchery fish released upstream

of the dams as natural production? Our understanding is that much of the production out of the upper basin in the past was from the juvenile releases. You may want to compare survival, from release to collection, of marked fish released to estimate the proportion of hatchery fish in past collections.

Response to Comment 4:

Tacoma has corrected the title of the Table *Juvenile Counts at Mayfield and Cowlitz Falls Dam (1997-2003)*. Tacoma does not support the continued release of juveniles in the upper Cowlitz River basin. The Final FHMP calls for the ending of all juvenile releases in the upper Cowlitz River basins. If upper basin juvenile releases from the Cowlitz Complex were to continue (life stages prior to smolt), and if the resulting migrant fish could be identified as to origin, Tacoma proposes to take credit for the production due to the competition affects upon naturally produced out migrants that reduce natural fish abundance.

Comment 5:

Page 19. The comparison for steelhead used in Table 3.5 is not an appropriate example for comparison of hatchery and natural steelhead. These are summer steelhead, for one, and second, the hatchery steelhead are Skamania Stock derivatives and have a long history of domestication.

Response to Comment 5:

The data presented on hatchery fish versus wild fish survival is meant to illustrate that the 2:1 credit is conservative based on research conducted in other basins. As the summer steelhead value is not used to calculate the credit, the inclusion of this data point is reasonable. The Cowlitz late winter steelhead stock also has a long history of domestication as this stock has been reared at the hatchery for over 35 years.

Comment 6:

Page 22. The fry planting analysis does not look right. The assumption that fry plants will reduce the number of naturally produced smolts due to density dependence includes the assumption that adding fry will cause the carrying capacity to be exceeded. If the 50,000 smolt capacity is used, and the fry to smolt productivity estimate is used, then the fry capacity should be at least 1,666,666 fry (50,000 smolts/3% fry to smolt survival). The production of naturally produced smolts should not be affected until the number of fry exceeds this level. The main reason that fry releases are not used is that the survival benefit of rearing the fish in the hatchery is lost (> 80% egg to smolt survival).

Response to Comment 6:

The assumption that the number of naturally produced smolts should not be affected until the fry capacity value is achieved is not correct. Competition effects, which reduce fish

survival, occur at all seeding levels. As the number of fry increase in a stream, competition effects become greater until the point that adding more fry results in no increase in production (i.e. the stream reaches carrying capacity). However, it should be noted that when applying the Beverton-Holt production function, adding more fish does increase (very slightly) the number of fry produced even after capacity of the stream is reached.

The data in Table 3-8 of the Final Draft FHMP does show that total smolt numbers increase as more and more hatchery fry are added. The effect being demonstrated is that as more hatchery fry are added to the stream, the production of natural smolts decreases due to competition effects (i.e. fish competing for food and space).

Comment 7:

Page 25. There might be some benefit in acclimating some production in the upper basin to address the issues raised by the Yakama Nation. If adults are not naturally distributing themselves to all the "good" habitat, then a short-term acclimation program may be used to fill this habitat. This would not have to be a large program and all fish released could be uniquely marked so as not to disrupt the productivity study.

Response to Comment 7:

Acclimation facilities for juvenile production in the upper Cowlitz River basins could be considered in the next iteration of the FHMP (after Year 6). Text has been added in various sections of the Final FHMP to emphasize this point (See Executive Summary). Also, see response to Comment 1 from the Yakama Nation. Marking of juvenile releases would be a prudent measure to evaluate the program.

Comment 8:

Page 37-38. Are the Artificial Production Review and Evaluation comments going to addressed in this FHMP? This should be stated in the document after the list on page 38.

Response to Comment 8:

The applicability of the Artificial Production and Review Evaluation findings to the Cowlitz Complex will be addressed in more detail in the Hatchery Complex Remodel and Phase-In Plan, Settlement Agreement, License Article 7. Tacoma Power has added text to this section of the Final FHMP to describe how these comments are addressed.

Comment 9:

Page 38. This section needs to be updated to reflect changes in harvest impacts since the 1996 brood year. The Lower Columbia Fish Recovery Board (LCFRB) has produced a harvest white paper that shows that harvest impacts have been reduced from levels that

are described in this section. All of the tables in section 4.7 should remain, but they should be labeled Abefore,@ with new tables showing the current exploitation rates. Fall Chinook salmon is now managed not to exceed 49% and has averaged in recent years less than 45%. Naturally produced coho salmon are now protected by selective fisheries for marked hatchery coho salmon in ocean and in river sport fisheries.

It also needs to be identified that NOAA Fisheries has signed a Fisheries Management and Evaluation Plan (FMEP) for the Cowlitz Basin and lower river sport fisheries authorizing fisheries managed by WDFW in the Cowlitz River. These fisheries for spring Chinook salmon are selective for marked hatchery Chinook salmon only and have reduced the exploitation rate on naturally produced spring Chinook salmon to less than 10% (see the Washington Lower Columbia River FMEP which NOAA Fisheries concurred with by letter on December 29, 2003). It is interesting that selective fisheries are mentioned in the fall Chinook salmon section but not in the spring Chinook salmon section.

Response to Comment 9:

Tacoma Power has revised the text of the Final FHMP to include the overall harvest exploitation rates received from NOAA Fisheries.

Comment 10:

Page 42. It should be noted that cutthroat trout retention is not permitted in the Cowlitz River Basin above Mayfield, thus protecting naturally produced cutthroat trout in these areas.

Response to Comment 10:

Comment noted. Harvest impacts to naturally-produced (unmarked) sea-run cutthroat occur in lower Cowlitz River consumptive fisheries from incidental take and hook-and-release fishing.

Comment 11:

Page 46. Under Artificial Propagation Programs, the last sentence could include language that states that in addition to being similar to the naturally produced population, the programs must also be operated to achieve program goals, i.e., to meet broodstock and harvest goals.

Response to Comment 11:

Comment noted. Tacoma has changed the text of the Final FHMP.

Comment 12:

Page 48. Table 5-2. The table harvest rate numbers need to be updated; current estimates are 22% for wild (unmarked) spring Chinook salmon and 53% for hatchery spring Chinook salmon (this is based on the 2001-2003 fisheries management, from the LCFRB recovery plan). Impacts to naturally produced spring Chinook salmon were broken out into 18% ocean, 1% mainstem commercial, 1% mainstem sport, and 2% tributary sport. In addition, it should be noted that harvest directed at naturally produced (wild) spring Chinook salmon will need approval from NOAA Fisheries because directed fisheries were not proposed under the current FMEP.

Response to Comment 12:

Tacoma has revised the text of the Final FHMP to include the overall harvest exploitation rates received from NOAA Fisheries.

Comment 13:

Page 48-49. Currently there are no proposals to increase harvest of wild spring Chinook salmon in the lower Columbia River. Harvest will continue to target marked hatchery fish only and is not expected to target wild fish until natural production levels are at or near recovery levels.

Response to Comment 13:

Comment noted.

Comment 14:

Page 50. Table 5-3. The table needs to be updated to reflect changes in fisheries management; the differences between hatchery and wild spring Chinook salmon harvest rates could be included. For estimates, see #12 above for comments on Table 5-2, including the comment regarding a fishery directed at naturally produced adults.

Response to Comment 14:

Tacoma has revised the text of the Final FHMP to include the overall harvest exploitation rates received from NOAA Fisheries.

Comment 15:

Page 51. Fourth bullet. The drop rate needs to be defined, as does who would be funding the monitoring and evaluation activities needed to estimate this rate.

Response to Comment 15:

Tacoma Power currently funds, and will continue funding, all juvenile coded wire tag programs at the Cowlitz Complex. The “drop rate”, or percent of hatchery juveniles that

do not have a missing adipose fin, is currently calculated for all lots of coded wire tagged fish released from the Cowlitz Complex.

Comment 16:

Page 52. Reintroduction strategy. The FHMP did not consider in Appendix 3 the strategy that was supported by the Yakama Nation and could be supported by NOAA Fisheries. This is the current strategy of releasing marked smolts that are acclimated in the upper basin. By marking the smolts, they can be distinguished from naturally produced juveniles and can be selected for release into the upper basin when they return as adults. By releasing smolts and not fry, the hatchery survival benefit can be fully utilized. The FHMP should consider this approach, but it should not be fully implemented until fish collection efficiency improves.

Response to Comment 16:

Acclimation facilities for juvenile production in the upper Cowlitz River basins could be considered in the next iteration of the FHMP (after Year 6). Also, see response to Comment 1 from the Yakama Nation. Marking of juvenile releases would be a prudent measure to evaluate the program. In addition, the text in Appendix 3 has been changed to describe the pros and cons of this type of program

Comment 17:

Page 53. Pre-Trigger 1 or 2. In "Prior to initiating Phase 1", the term "Phase 1" does not seem appropriate, since activities from Phase 1 are already ongoing before reaching Trigger 1. The term should be "Trigger 1" or something similar.

Response to Comment 17:

Tacoma Power has changed the text of the Final FHMP to reflect this comment.

Comment 18:

Page 57. 5.1.3.6. First bullet. It is probably unrealistic to expect WDFW to change Pacific Salmon Commission and Pacific Fisheries Management Council Chinook salmon harvest management to support selective fisheries. These ocean fisheries target healthy naturally produced stocks (e.g., Hanford Reach upriver bright fall Chinook salmon) as well as unmarked hatchery fall Chinook salmon stocks, and going to a selective fishery would cause them to forego harvest on these healthy stocks.

Response to Comment 18:

Tacoma Power received this text from the WDFW and included the text unedited in the Final FHMP.

Comment 19:

Page 59. Currently, the fisheries cannot be managed for marked hatchery fall Chinook salmon since only a small percentage of the hatchery fall Chinook salmon are adipose fin clipped. If Tacoma Power is willing to support the marking of all fall Chinook salmon production, then selective fisheries could be implemented in the Cowlitz River; however, mainstem and ocean fisheries would not be selective for Chinook salmon (see the previous comment).

Response to Comment 19:

Comment noted. In the Final FHMP Tacoma Power proposes to fund the beginning of mass marking all Cowlitz Complex fall Chinook released in 2006, the first brood year following the approval for implementation of the FHMP.

Comment 20:

Page 62. As noted above, the mainstem sport fisheries for fall Chinook salmon will not be selective for hatchery fall Chinook salmon. Under current fisheries management, tule fall Chinook salmon fisheries are managed not to exceed the Rebuilding Exploitation Rate (RER). The RER is annually reviewed by NOAA Fisheries as part of the Pacific Fisheries Management Council salmon fisheries management process. The RER is based on the naturally produced population in the Coweeman River, and is updated based on new return data. The current RER is 49%. Under the FMEP, WDFW will manage Cowlitz River fisheries not to exceed this rate. In addition, WDFW also manages Cowlitz River fisheries to meet hatchery broodstock needs and natural escapement.

Response to Comment 20:

Comment noted. Tacoma has revised the text of the Final FHMP to include the overall harvest exploitation rates received from NOAA Fisheries.

Comment 21:

Page 63. Table 5-5. The table needs to be corrected to reflect that there are not selective fisheries for fall Chinook salmon, and probably never will be, except possibly in the Cowlitz River.

Response to Comment 21:

The table has been changed to reflect that the fishery may be non-selective. However, it should be noted that in the future Washington State is moving toward the mass-marking of fall Chinook from lower Columbia River hatcheries to allow selective fisheries**.**

Comment 22:

Page 65. Second full bullet. It will be very difficult to develop an integrated program for fall Chinook salmon if hatchery fall Chinook salmon are not marked.

Response to Comment 22:

Comment noted. Also, see response to Comment 19.

Comment 23:

Page 65. Fifth full bullet. This bullet is correct regarding mass marking only affecting fisheries in the Cowlitz River. The FHMP states that mass marking of fall Chinook salmon will be implemented. Is Tacoma Power funding this?

Response to Comment 23:

Comment noted. In the Final FHMP Tacoma Power proposes to fund the beginning of mass marking all Cowlitz Complex fall Chinook released in 2006, the first brood year following implementation approval of the FHMP.

Comment 24:

Page 66. Other actions need to be included, such as increasing flows to move hatchery fish downstream and out of the basin, and altering release locations for a portion of the production to areas below primary fall Chinook salmon habitat.

Response to Comment 24:

Other plans for the implementation of the Settlement Agreement (SA) and the license for the Cowlitz Project filed with FERC include actions for assisting in the recovery of the listed population of fall Chinook in the lower Cowlitz River. Examples include weekly transport flows (SA License Article 13) and volitional release of juveniles from the Cowlitz Complex (SA License Article 7).

Comment 25:

Page 68. Should trigger 1 be subyearling to spawner and not smolt to spawner since fall Chinook salmon out migrate as subyearlings? How will the year 7 trigger be addressed if the spring Chinook salmon subyearlings are still being collected at Mayfield?

Response to Comment 25:

Comment noted. The Final FHMP text changed to refer to subyearlings.

Comment 26:

Page 71. First bullet. The ocean fisheries will not move to selective fisheries for Chinook salmon for the reasons described in #18 above. This bullet should be deleted.

Response to Comment 26:

Comment noted. Tacoma Power received this text from the WDFW and included the text unedited in the Final FHMP. The text says that WDFW will work to promote selective fisheries where appropriate; ocean selective fisheries may not be appropriate.

Comment 27:

If managed correctly, the resident trout fishery could probably continue.

Response to Comment 27:

Comment noted. See response to USFWS Comment 12.

Comment 28:

Page 74. Table 5-6. The harvest of naturally produced late-run winter steelhead is currently not contemplated in the FMEP and will require that the population be at or near recovery levels. An amended FMEP will need to be submitted. Future management will continue to target only hatchery steelhead. The table should be revised to reflect this.

Response to Comment 28:

Comment noted. The current 8% harvest rate included in Table 5-6 *Summary of biological significance, habitat quality, fishery exploitation rates, and Phase I strategy for late winter steelhead* is an incidental harvest rate from consumptive fisheries and hook-and-release fishing.

Comment 29:

Page 79. The FHMP did not consider the strategy that was supported by the Yakama Nation and could be supported by NOAA Fisheries. This is the current strategy of releasing marked smolts that are acclimated in the upper basin. By marking the smolts, they can be distinguished from naturally produced juveniles, and can be selected for release into the upper basin when they return as adults. By releasing smolts and not fry, the hatchery survival benefit can be fully utilized.

Response to Comment 29:

Comment noted. An upper Cowlitz River basin juvenile (fry) release strategy was considered in the development of the FHMP (see Appendix 3 *Reintroduction Strategies*). Acclimation facilities for juvenile production in the upper Cowlitz River basins will be considered in the next iteration of the FHMP (after Year 6). Text has been added throughout the Final FHMP to reflect this comment (See Executive Summary).

Comment 30:

Page 84. Delete first bullet under harvest. Ocean fisheries do not harvest steelhead.

Response to Comment 30:

Comment noted. This bullet has been deleted.

Comment 31:

Page 92. Delete first bullet under harvest. Ocean fisheries do not harvest steelhead.

Response to Comment 31:

Comment noted. Tacoma Power received this text from the WDFW and included the text unedited in the Final FHMP.

Comment 32:

Page 99. Delete first bullet under harvest. Ocean fisheries do not harvest steelhead.

Response to Comment 32:

Comment noted. This bullet has been deleted.

Comment 33:

Page 103. Table 5-14. The table and section discussion regarding harvest rate numbers need to be updated; current estimates are 18% for wild (unmarked) coho salmon and 51% for hatchery coho salmon (this is based on the 2001-2003 fisheries management, from the LCFRB recovery plan). Impacts to naturally produced coho were broken out into 10% ocean, 6% mainstem commercial, 2% mainstem sport, and 1% tributary sport. In addition, it should be noted that harvest directed at naturally produced (wild) coho salmon will need approval from NOAA Fisheries (if coho salmon become listed), because directed fisheries were not proposed under the current FMEP. Table 5-15, page 104, also needs to be updated.

Response to Comment 33:

Comment noted. Tacoma Power has changed the text to indicate the listed status of coho salmon in the lower Columbia River system. Tacoma has revised the text of the Final FHMP to include the harvest exploitation rates received from NOAA Fisheries.

Comment 34:

Page 107. The 30% of successful spawners criteria needs further explanation: Does the total number of successful spawners include spring Chinook salmon, steelhead, and coho salmon? Does it include wild and hatchery fish or just wild adults? Is the 30% rate supposed to represent what the levels will be in the future?

Response to Comment 34:

Comment noted. Tacoma Power proposed the 30% criteria as a reasonable and prudent "rule of thumb" for minimizing the impacts to listed, naturally-produced coho salmon. The HSRG notes that for local adaptation to drive fish genetics, the proportion of hatchery fish on the spawning grounds must be less than 50%. The 30% value was set to allow for harvest, while at the same time reducing hatchery fish impacts.

Comment 35:

Page 110. It may be preferable to investigate going to an integrated program sooner than after 15 years. This idea should be evaluated as part of the 10-year comprehensive hatchery review. If natural production is high enough, at the proposed hatchery production level, 350 naturally produced coho would be needed to make up 20% of the broodstock. The ability to do this may occur sooner than 15 years.

Response to Comment 35:

Comment noted. Tacoma Power will evaluate the concept of an integrated hatchery program at the Cowlitz Complex in the next iteration of the FHMP (after Year 6).

Comment 36:

Page 112. Under harvest, it should be noted that selective recreational fisheries have already been established in the ocean and mainstem management areas. The lower Cowlitz River coho salmon fisheries are also selective and should protect naturally produced coho salmon, and should not inhibit that productivity test in the Tilton. As described earlier under recent fisheries management regimes, the overall harvest impact on naturally produced coho salmon is down to around 18% for all fisheries, almost half of that identified in Table 5-15.

Response to Comment 36:

Comment noted. Tacoma has revised the text of the Final FHMP to include the harvest exploitation rates received from NOAA Fisheries.

Comment 37:

Page 113-124. In the FHMP, has Tacoma Power identified a specific study plan on how it will determine the structure, distribution, and productivity of chum, sockeye, and pink salmon populations in the Cowlitz River?

Response to Comment 37:

Comment noted. The FHMP does not include any specific study plans, rather it gives direction to the Cowlitz Fisheries Technical Committee (FTC) through the hypotheses in Section 6 and by the objectives and tasks proposed in Section 7 to develop and implement study plans. The plans will be developed with insight and input from NOAA Fisheries, USFWS and WDFW.

Comment 38:

Page 127. With the cutthroat trout broodstock program, why must it be 30%, when under the Hatchery Scientific Review Group, proportion of natural fish in the broodstock can be 10%-20% (see page 110 for coho salmon)?

Response to Comment 38:

The 30% value was a compromise developed by the FTC. Tacoma Power had proposed 100% integration, while WDFW proposed a 10-20% rate. The HSRG notes that the percentage should be higher than 10-20% if the population has a long history of domestication with little input of wild fish genetics. The Cowlitz sea-run cutthroat trout program has just such a history.

Comment 39:

Page 129. Section 5.10.3.5 Does WDFW agree with the description that the current hatchery program is made up of native and Beaver Creek hatchery cutthroat trout?

Response to Comment 39:

WDFW distributed a document titled *Cowlitz Integrated Cutthroat Program* to the Cowlitz FTC on June 25, 2004. In that document they referenced a Washington Department of Game report (Crawford 1979) that describes the beginning of the Cowlitz Hatchery cutthroat program as consisting of broodstock from Beaver Creek and native Cowlitz River stock.

Comment 40:

Page 129. Section 5.10.3.5. The citation Tipping and Springer 1980 is not in the reference list, and, according to WDFW, the program has changed dramatically since the 1980s.

Response to Comment 40:

Comment noted. Tacoma Power has included the citation in the reference list**.**

Comment 41:

What happens to the smolts that are not collected at Cowlitz Falls Dam? Are these the ones that are recovered at Mayfield, or are they lost in Riffe Lake? If some survive past Riffe Lake and are recovered at Mayfield Dam, then they are marked and returned to the Tilton River and not the Upper Cowlitz. If some rear in Riffe Lake, they cannot get back above Cowlitz Falls Dam.

Response to Comment 41:

Comment noted. Many of these questions were addressed in the Biological Opinion issued by NOAA Fisheries (March 23, 2004) for the Cowlitz Hydroelectric Project. Downstream migrants not collected at Cowlitz Falls Dam end up in Riffe Lake. Downstream migrants collected at Mayfield Dam consist of Chinook migrants from the upper Cowlitz River basin, and coho, cutthroat and steelhead migrants from the Tilton River system. All migrants collected at Mayfield Dam are uniquely marked to distinguish them as adults. Spring Chinook adults marked as juveniles at Mayfield are transported to the upper Cowlitz River basin (see Appendix 4 *Adult Handling Protocols).* As noted, fish entering Riffe Lake as juveniles cannot access natal streams due to a lack of adult passage facilities at Cowlitz Falls Dam. It is assumed that NOAA Fisheries will address this issue as part of the Biological Opinion being developed for the Cowlitz Falls Dam project.

Comment 42:

Page 130. Naturally produced cutthroat trout in the lower river do not support a consumptive fishery. Under current regulations, all wild (unmarked) cutthroat trout must be released.

Response to Comment 42:

Comment noted. Harvest impacts to naturally-produced (unmarked) sea-run cutthroat occur in lower Cowlitz River consumptive fisheries from incidental take and hook-and-release fishing.

Comment 43:

Is there more than one population of cutthroat trout in the Cowlitz River Basin? If there is, then the population that will be integrated with the hatchery program will need to be identified. If there is only one population, then broodstock could be collected from naturally produced cutthroat trout in the lower river, which will allow the hatchery program to be integrated and meet production goals (i.e., the WDFW goal of 100,000 smolts).

Response to Comment 43:

Comment noted. The USFWS has not provided data on cutthroat population status in the Cowlitz River. The current cutthroat trout hatchery program rears the sea-run form of the species. Thus, broodstock collection will be focused on known migrants arriving at adult collection facilities. Due to the difficulty in finding, collecting, and determining the life history form of any cutthroat captured in tributaries downstream of Mayfield Dam, action to collect these data are not proposed in the FHMP.

Comment 44:

Page 131. The RPM from the March 29, 1999, Biological Opinion on Artificial Propagation in the Columbia River Basin also had specific terms and conditions that accompanied these, and for the resident trout RPM, the following term and condition was identified:

> *5a. The action agencies shall discontinue resident trout stocking into primary spawning and nursery areas of listed salmon and steelhead, unless the action agency can demonstrate that stocking resident trout will not jeopardize the survival or recovery of listed salmon or steelhead. As a condition of stocking resident trout, the action agency shall implement a monitoring and evaluation program to evaluate the potential impacts. The results of the monitoring and evaluation program shall be included in the annual report required in 3 above. (Page 150 of the biological opinion).*

If managed correctly, the resident trout fishery could probably continue.

Response to Comment 44:

Comment noted. However, the term and condition described above notes that a resident fish stocking program may continue if such a program will not jeopardize the survival of listed salmon. As noted in the FHMP, resident fish and fisheries reduce listed steelhead survival through competition and loss due to incidental harvest. The Fisheries Management Plan developed by WDFW (WDFW 2003), indicates that "based on professional judgment, they estimate a maximum of 15% of the age 1 or older steelhead parr would be intercepted in trout fisheries." The WDFW notes that wild fish losses in bait fisheries may be 16% or higher. Based on this information and the data presented in the FHMP on resident fishery impacts on wild trout (see section 5.11.2), Tacoma Power believes that the survival of listed steelhead are jeopardized by such programs. Tacoma Power recognizes all technical parties views and believes the best choice for salmonid

stock recovery is ending support for the resident fish program for all the reasons included in the Final Draft FHMP and in the technical document *Impacts of Resident Trout Fisheries on Anadromous Fish Populations, June 25, 2004* prepared for the Cowlitz FTC. This decision is supported by comments received from the USFWS on the Final Draft FHMP (See July 2, 2004 comment letter).

Comment 45:

Page 134. 6.0 Adaptive Management Plan. NOAA Fisheries looks forward to working cooperatively Tacoma Power on the adaptive management plan for the FHMP. It is our expectation that there will either be 1) a whole separate adaptive management plan developed as described in the March 23, 2004, Biological Opinion on the Cowlitz River Hydroelectric Project, or 2) the adaptive management plan described in the FHMP document will be part of the overarching adaptive management plan, including that described in the Biological Opinion.

Response to Comment 45:

Comment noted.

Comment 46:

Page 134. These FHMP goals should be worded verbatim as in the Settlement Agreement.
If managed correctly, the resident trout fishery could probably continue.

Response to Comment 46:

Comment noted.

Comment 47:

Page 136. The mention of Population Change Criteria here is not appropriate.

Response to Comment 47:

Comment noted. Tacoma Power has changed the text in the Final FHMP.

Comment 48:

Page 140. Section 6.3.3.1-4. Evaluation should start after the remodel of hatchery facilities.

Response to Comment 48:

Comment noted.

Comment 49:

Page 141. Section 6.3.4.1. Harvest rate for fall Chinook salmon will be higher since there will not be a selective fishery on fall Chinook salmon until all production is marked. Will Tacoma Power be willing to fund marking?

Response to Comment 49:

Comment noted. In the Final FHMP Tacoma Power proposes to fund the beginning of mass marking all Cowlitz Complex fall Chinook released in 2006 the first brood year following the approval for implementation of the FHMP.

Comment 50:

Page 144. Section 7.1.9. This objective will have to wait until the remodel is completed and should be part of a comprehensive evaluation of the hatchery facilities after it has been remodeled.

Response to Comment 50:

Comment noted.

Comments from Washington Department of Fish and Wildlife, July 21, 2004:

Comment 1:

WDFW staff has worked collaboratively with Tacoma Power (TP) staff for the past three years to complete a FHMP that meets our collective interests and is consistent with the Settlement Agreement for the Cowlitz River Hydroelectric Projects. We appreciate the attempt to resolve outstanding issues through a facilitated process with the Cowlitz FTC during May-June 2004, however, the July 2, 2004 draft FHMP fails to adequately address WDFW comments and concerns raised during the development of the FHMP.

Response to Comment 1:

Comment noted. The following responses will address all issues the WDFW considers are inconsistent with the Settlement Agreement (SA). Although agreement was not reached with WDFW on some of the issues, agreement was reached with other members of the Cowlitz FTC on the majority of the issues. Tacoma Power has made an effort to find the best solution from widely differing FTC recommendations.

Comment 2:

Section 1.0, Introduction, articulates the requirement of the FHMP in part to identify a fisheries management strategy consistent with the priority objective of maximizing the natural production of wild indigenous fish stocks and species in the basin. Further at the bottom of page 2, the FHMP states "...recommendations for harvest actions are concentrated within the Cowlitz River, including the upper watershed". The Department supports these statements, however, throughout the document statements made regarding harvest actions imply that this plan will direct harvest management and usurp the Department's authority. WDFW requires that language be added to acknowledge the Department's jurisdiction and authority to regulate fisheries in the Cowlitz River.

Response to Comment 2:

Comment noted. Tacoma Power has changed the text to indicate that Tacoma Power fully acknowledges the WDFW, as representatives of the state of Washington, are the owners of the fish resources in the Cowlitz River. All decisions on the management and fate of the resource are the purview and responsibility of the WDFW. Nothing in the Final FHMP is meant or intended to usurp or preclude the WDFW from their mandated resource management responsibilities and roles in the Cowlitz River basin. The Final FHMP makes recommendations for harvest actions, which support the SA principles. Tacoma Power anticipates the WDFW, as signatory, will use their authority to implement these actions.

Comment 3:

Section 3.7 proposes a Credit Mechanism for Natural Fish Production that would start in year one of the FHMP. The WDFW cannot support reducing hatchery production via a credit mechanism prior to demonstrated success of the reintroduction program for anadromous salmonids above Mayfield Dam. In addition there is sufficient uncertainty in the credit mechanism proposed that WDFW has previously commented and continues to request monitoring and evaluation, similar to that proposed in section 7.1.3, be completed in order to develop the credit mechanism for review by the FTC.

Response to Comment 3:

The credit is tied to the number of naturally produced juveniles collected and released alive below the Barrier Dam. The credit rises and falls as natural production increases and decreases, thus overall fish production never decreases. The credit mechanism is called for in the SA, and is consistent with the principles outlined therein, one of which states:

> "ESA constraints will be a factor in determining the upper bound of production at the remodeled hatchery complex. Hatchery production numbers are expected to be adjusted downward as wild stocks recover."

Tacoma Power does not believe that further confirmation of the success of the upper Cowlitz River basin anadromous fish reintroduction program is needed. Natural production from the upper river basins, measured as juvenile salmonid outmigrants, has been documented at Cowlitz Falls Dam since 1996 thus demonstrating reliable success.

If natural production were to drop, the credit mechanism allows for hatchery production to increase. The credit mechanism simply replaces hatchery production with natural production, as envisioned in the SA. Tacoma Power has proposed a more conservative credit mechanism in the Final FHMP than proposed by American Rivers/Trout Unlimited in their comments on the Final Draft. The data presented in section 3.7 of the Final FHMP clearly shows that the credit mechanism could be substantially larger. The credit value proposed was set at a lower level as a compromise to address WDFW's concerns regarding this issue. Comments on the Final Draft FHMP received from other FTC members were highly supportive of the credit mechanism as proposed (See USFWS Comment 3)

Comment 4:

Sections 5.1.3 (spring Chinook), 5.3.3 (late winter steelhead), 5.4.3 (early winter steelhead), and 5.6.3 (coho) contain language under Production Adjustment and Credit Mechanisms that propose reducing hatchery production by a commensurate amount if changes in rearing practices increase hatchery survival. The Department does not support this recommendation and does not see this as consistent with the Settlement Agreement.

Response to Comment 4:

The SA does not specify the amount of hatchery production required in any brood year. Instead, it simply sets a "not to exceed" value of 650,000 lbs. Therefore Tacoma Power does not believe that a reduction in hatchery production violates the SA.

As hatchery fish can impact natural populations through mechanisms such as competition for food and space, reducing hatchery releases is expected to benefit natural fish populations inhabiting stream reaches in the lower Cowlitz River and Columbia River by reducing these impacts. The Final FHMP proposes to change hatchery operations to emphasize quality over quantity in regards to hatchery production. If successful, this will result in higher adult survivals allowing a decrease in hatchery production without a reduction in adult numbers. This process will benefit natural fish without impacting competing goals such as harvest.

Comment 5:

In Section 5, Objectives and Strategies, stock harvest profile tables are presented that describe historical harvest rates and examples of harvest rates that could occur in the future (Phase 1 and 2) based on a set of assumptions. The body of the text incorrectly portrays the values for Phase 1 and 2 as constraints that will not be exceeded. This portrayal is not consistent with the recognition that through time information will be gained that may alter these values through adaptive management. The WDFW will make adjustments to the harvest rates annually based on the best available science and cannot support a plan that could be perceived to constrain the Department's jurisdiction regarding harvest management.

Response to Comment 5:

Comment noted. See response to WDFW Comment 2. Tacoma Power received this text from the WDFW and included the text unedited in the Final FHMP. Tacoma Power notes, however, that the data presented in some of these tables are harvest goals put forward by the WDFW (See Table 5-2). It is recognized that as goals, they may change based on new information.

Comment 6:

*Section 5.0, Objectives and Strategies describes the production values in Table 5.1 as being designed to meet the adult benchmark targets outlined in the Settlement Agreement. The Department does not support this concept as it incorrectly implies that the purpose of the "Contribution Benchmarks" is to establish mitigation levels. The contribution benchmarks are discussed in Article 3 (Upstream Fish Passage: Barrier, Mayfield and Mossyrock) along with other types of information that the parties may find useful in evaluating the implementation of the Settlement Agreement. For example, then next bullet in Article 3 (b) requests "tables estimating the annual number of adult recruits origination **[sic]** from the Cowlitz River basin upstream of the Toutle River ..."*

Response to Comment 6:

The level of hatchery production proposed in the FHMP (7.7 million juveniles) is designed to meet the adult benchmark targets outlined in the SA. These benchmarks are not meant to be mitigation goals, but rather as indicators of hatchery performance. They are also used to establish justification for the species mix and numbers of juveniles released from the hatchery. Tacoma Power believes this approach corrects a criticism pointed out in the APRE process, i.e. a lack of clearly defined hatchery performance goals. Text has been added throughout the Final FHMP to more clearly state the purpose of the benchmark values.

Comment 7:

In the January 6, 2004, Public Review Draft FHMP, Section 5.0 contained Table 5-1 Cowlitz Hatchery Complex: artificial production levels for the current 2003 Brood Document, proposed interim 2004-2007, and after rebuild (2008). The final draft FHMP omits the proposed interim 2004~2007 production column in the table. The Department asks that a table be included in the final draft FHMP that includes this column and the values for fish production as provided to Tacoma Power by WDFW at the June 25, 2004 Cowlitz FTC meeting. The fish production proposed by WDFW includes a mix of production that reduces the total poundage from the current program to 650,000 pounds of anadromous fish (as required by the Settlement Agreement and License) and 50,000 pounds of resident trout. Proposed production levels in the final draft FHMP reduce the production further without adequate justification. The production as proposed by WDFW meets the guiding language in Section 6 of the Settlement Agreement and best meets the interest of the varying constituents of the Department. Specifically the production proposed by WDFW provides spring and fall Chinook, coho, late winter steelhead and sea-run cutthroat trout for reintroduction, recovery and harvest opportunities, and provides early winter steelhead and resident trout for harvest opportunities.

Response to Comment 7:

Tacoma Power has agreed to make best efforts to maintain the 2004 brood document levels of production currently occurring at the Cowlitz Complex during the rebuild period (2005-2007). The table presented by WDFW at the June 25, 2004 FTC meeting proposed to increase hatchery production from current levels during the remodel. The level of hatchery production proposed in the FHMP (7.7 million juveniles) is designed to meet the adult benchmark targets outlined in the SA. These benchmarks are not meant to be mitigation goals, but rather as indicators of hatchery performance. They are also used to establish justification for the species mix and numbers of juveniles released from the hatchery. Furthermore, the production numbers proposed in the Final Draft FHMP are a compromise that was agreed to by WDFW and other FTC members at the mediated meeting.

The resident fish program was thoroughly evaluated and discussed by the FTC during the FHMP draft plan review process. Tacoma Power recognizes all technical parties views and believes the best choice for salmonid stock recovery is ending support for the resident fish program for all the reasons included in the Final Draft FHMP and in the technical document *Impacts of Resident Trout Fisheries on Anadromous Fish Populations, June 25, 2004* prepared for the Cowlitz FTC. This decision is supported by comments received from the USFWS on the Final Draft FHMP (See Comment 12).

Comment 8:

Section 5.0, Objectives and Strategies, reference is made to implementing integrated hatchery programs. The Department supports consideration of integrated programs, however, would like to see language that directs the details of specific programs be developed within the Adaptive Management and Monitoring and Evaluation process. It is inappropriate to include statements in the FHMP regarding implementation without including the fully developed programs.

Response to Comment 8:

Comment noted. As noted in the FHMP, it will not be possible to implement an Integrated Type hatchery program until self-sustaining natural populations are established in the basin. As the success of the reintroduction effort will not be known for some years, Tacoma Power is unable at this point to determine the degree to which each program could be integrated. It is anticipated that the actual integration process will be filled out in more detail in the second iteration of the FHMP in year 6.

Comment 9:

In Section 5.4.2 (early winter steelhead) and 5.5.3 (summer steelhead) the FHMP proposes to eliminate recycling of steelhead below Mayfield Dam. The Department requests language be added that would allow recycling to provide additional harvest opportunity in years of low returns.

Response to Comment 9:

Tacoma has revised the text of the Final FHMP to consider reinstituting recycling through the Adaptive Management Process. The current plan calls for using the results of the lower Cowlitz River steelhead genetics study that was proposed by WDFW to quantify the risks of the non-native steelhead programs on native late winter steelhead. This change was made at the suggestion of the USFWS. If study results indicate no impact or a low level of risk to late winter steelhead, the recycling program may, at the direction of the FTC, be reinitiated in years of low returns.

Comment 10:

In several instances the FHMP proposes to direct actions of the WDFW that are outside the Cowlitz Hydroelectric License. For example Section 5.11.2.2. Resident Non-salmonids states "Under the FHMP non-salmonids will not be stocked upstream of Mayfield Dam". The Department provided comment on this issue in the letter to Mr. LaRiviere dated February 11, 2004. The FHMP needs to be revised to focus on those actions that directly relate to Appendix A, Article 6 of the License.

Response to Comment 10:

Comment noted. This statement is a recommendation from Tacoma Power and a notice that funding will be directed at salmonid recovery actions. Nothing in the Final FHMP is meant or intended to usurp or preclude the WDFW from their mandated resource management responsibilities and roles in the Cowlitz River basin.

Comment 11:

While progress has been made to resolve outstanding issues, language remains in the FHMP that WDFW cannot support. Without the resolution of these issues the Department must require that Washington Department of Fish and Wildlife" be removed from the cover of the document as a coauthor.

Response to Comment 11:

Comment noted. Tacoma Power has changed the text of the Final FHMP. Tacoma Power would like to acknowledge the significant contributions of WDFW to the Final FHMP. Members of the Department authored many sections.

Comments from Yakama Nation, July 23, 2004:

Comment 1:

There is not any reference to the comments agreed to at the June 25 2004 meeting that the YN had agreed to the use of the adult productivity study for five years. If it was not working then juveniles would be used to begin the reintroduction of the upper basin. Those comments need to be incorporated into the document.

Response to Comment 1:

Comment noted. The results of discussions on this issue are incorporated into the Final FHMP in multiple locations. See section 3.9.3 for more information.

Comment 2:

R/S) needed to implement adult fish passage, and to provide sport fishing opportunity once the stock recovers. This must include subsistence fishery

Response to Comment 2:

Comment noted. Tacoma Power could support this proposal, however, nothing in the Final FHMP is meant or intended to usurp or preclude the Washington Department of Fish and Wildlife and the Yakama Nation from their mandated resource co-management responsibilities and roles in the Cowlitz River basin.

Comment 3:

P 46 Fishery Management. Investigate new sport fishing opportunities for surplus hatchery spring Chinook in the river reach extending from Riffe Lake to Cowlitz Falls Dam, once the productivity experiment study is implemented. When was this discussed or agreed to by the FTC? The YN approached the WDFW to get some of the "surplus" fish, but was denied due to the fish being put into the upper basin.

Response to Comment 3:

Comment noted. This recommendation was proposed by Tacoma Power in the Final Draft FHMP as a way to provide harvest opportunity without impacting wild fish recovery activities. Nothing in the Final FHMP is meant or intended to usurp or preclude the Washington Department of Fish and Wildlife from their mandated resource co-management responsibilities and roles in the Cowlitz River basin. Tacoma Power could support the decision to provide surplus fish to the Yakama Tribe if such a proposal was put forth by the co-managers.

Comment 4:

p. 48 Table 5-2. Summary of biological significance, habitat quality, fishery exploitation rates, and Phase 1 strategy for each population of spring Chinook. This chart seems to infer that these stocks are extinct, when they are not! All fish were moved to the hatchery.

Response to Comment 4:

Comment noted. Tacoma Power received this text and table from the WDFW and included the text unedited in the Final FHMP.

Comments from Trout Unlimited and American Rivers, July 23, 2004:

Comment 1: Segregated v. Integrated and Upstream passage/productivity testing

While we agree with the concepts of segregated and integrated hatchery programs, we have many concerns about the actual use of these programs within the FHMP. Along the lines of our first set of comments, we would like to see further explanation in the FHMP as to how WDFW and TP will incorporate both types of programs at a single facility simultaneously.

As we explained in our initial comments, we remain concern that a segregated program is being used for reintroduction and recovery of anadromous fish, namely Chinook and coho, in the Upper Cowlitz and Tilton Rivers, a program goal that requires an integrated facility. We are also concerned that initially the program will put an unlimited number of these non-locally adapted hatchery Chinook and coho, originally reared to be segregated, on top of the limited number of native, locally adapted Chinook and coho that are also passed into the upper watershed (notably, some of the unmarked Chinook may be of hatchery origin or are the offspring of hatchery origin fish because full marking has not been implemented at the facility). This situation undermines the entire concept of segregated and integrated programs and exacerbates the problems identified by the APRE (FHMP, 37) such as decreased fitness of the natural populations, increasing competition to the detriment of the natural origin stocks, and overwhelming the carrying capacity, which is extremely limited in the upper watershed. While we recognize that supplementation requires the use of marked hatchery fish and unmarked natural fish, the marked hatchery fish should originate from an integrated hatchery program to minimize the problems identified above. That is not being proposed in the FHMP.

Response to Comment 1:

Comment noted. As noted in the Final FHMP, it will not be possible to implement an Integrated Type hatchery program until self-sustaining natural populations are established in the basin. As the success of the reintroduction effort will not be known for some years, Tacoma Power is unable at this point to determine the degree to which each program could be integrated. It is anticipated that the actual integration process will be filled out in more detail in the second iteration of the FHMP due in year 7. Out of necessity all production will be started (or continued) with segregated hatchery stocks. These stocks were deemed suitable to use due to their Cowlitz River basin origins and history.

See section 3.3 of the Final FHMP or further information on the segregated and integrated programs at the Cowlitz Complex. Tacoma does not support the continued release of juveniles in the upper Cowlitz River basin. The Final FHMP calls for the ending of all juvenile releases in the upper Cowlitz River basins.

Comment 2:

The problems caused in the pre-trigger stage described above could have a profound detrimental impact on both the fish and the results of the productivity testing. Using hatchery fish reared in a segregated program for an integrated-type purpose would confound the testing protocol. Once productivity testing begins, the FHMP is unclear how many more of the segregated-type hatchery fish will be released in the upper basin. For example, on pg. 46 in the discussion of spring Chinook, the FHMP discusses the reintroduction of all natural origin fish and 2000 hatchery fish above Cowlitz Falls Dam. Yet on pg. 53, the discussion of Trigger 1 explains that the hatchery fish will be released into the upper basin only if the natural origin adults are less than 2000. The FHMP needs to be very clear that only natural origin adults will be placed in the upper watershed and will only be supplemented with hatchery fish if natural origin unmarked fish fall below 2000 or 1000, depending on the species.

Response to Comment 2:

Comment noted. Tacoma Power has changed the text in the Final FHMP to clarify the schedule of adult releases of all origins into the upper Cowlitz River basin.

Comment 3:

The primary goal of the Settlement Agreement, identified in Settlement Principle 6.1.1 is the re-establishment of self-sustaining naturally spawning salmonids in the upper watershed. While we understand that this requires the use of hatchery fish, we believe that the particular hatchery fish being proposed from the segregated program at Cowlitz Hatchery will cause potential harm to the restoration efforts. At the very least the FHMP should explain how using Chinook and coho from a segregated hatchery program will serve the restoration efforts in spite of the criticisms raised by the HSRG and APRE regarding the use of segregated hatchery fish for integrated program activities. At best, all attempts should be made to transition the hatchery from a segregated program to an integrated program before hatchery fish are used in the upper watershed. The FHMP calls for this transition to an integrated program to occur over an extended period of time. To the extent that it cannot be done before the pre-trigger and trigger 1 stages, then we recommend Tacoma Power significantly revise the number of segregated-type hatchery fish being passed above Cowlitz Falls Dam.

In the meantime, in order to satisfy the nutrient needs of the watershed, excess hatchery fish should be used for carcass enrichment and all natural origin fish should be passed upstream.

Response to Comment 3:

Comments noted. See section 3 of the Final FHMP for further information on the segregated and integrated programs at the Cowlitz Complex. The hatcheries cannot be integrated until natural populations are established in the upper basin. The Final FHMP proposes to use hatchery adults to expedite the local adaptation process, and then reduce the number of hatchery adults released each subsequent year as natural abundance

increases. Tacoma Power has changed the coho section so that fewer hatchery fish are released in the upper basin as natural coho abundance increases.

Comment 4: Establishment of abundance criteria v. VSP criteria

The targets discussed above are provided by NOAA Fisheries and USFWS on pg. 13. These abundance targets follow a discussion of the criteria necessary to establish viable, self-sustaining populations, which includes distribution, diversity and productivity in addition to abundance. The FHMP should include a discussion as to how the plan will address all four VSP criteria, not just abundance.

Response to Comment 4:

The Final FHMP is not trying to achieve self-sustaining salmonid population levels based upon the Viable Salmonid Population (VSP) criteria established for lower Columbia River tributary populations. Rather the alternative criteria for defining self-sustaining runs were established in the SA. The results of juvenile and adult monitoring programs will be used to address changes in distribution, productivity and abundance.

Comment 5: Crediting mechanisms

The proposal for a 2:1 ratio is a better start than the 1:1 previously proposed. We would like to see this ratio subject to ongoing monitoring, evaluation and adjustment. As noted in the FHMP, the data from other watersheds suggest a much higher ratio making the 2:1 ratio very conservative. Tacoma Power and WDFW should make all efforts to determine the appropriate ratio for the Cowlitz and incorporate it as soon as possible. This would change the table on pg. 17.

We appreciate the efforts in the FHMP to explain the relationship between the smolts produced, adult benchmark and pounds of fish relative to the settlement agreement. This is best displayed in Table 5-1. We would only request that the FHMP clarify that these numbers are subject to the crediting mechanism. So for example, if the crediting mechanism is applied frequently, the numbers in Table 5-1 would change after rebuild (>2008). Throughout the text of the document, the FHMP sometimes identifies the numbers as hard numbers and other times it subjects the numbers to the crediting mechanism.

Response to Comment 5:

Comment noted. A footnote has been added to the referenced table to address this comment. Juvenile and adult monitoring objectives and tasks are provided in section 7 of the FHMP.

Comment 6: Tables

The Tables (5-2 through 5-24) describe expected fishing rates without any connection of the harvest levels to conservation objectives. It is incumbent upon WDFW and TP to regulate and influence the harvest levels to ensure self-sustaining populations in the Cowlitz. For example, the expected harvest rate on natural origin fall Chinook through all fisheries is 65% after 15 years (long-term target). This is a significant harvest level on wild fish and needs supporting discussion to justify it in light of the conservation and restoration objectives in the watershed. It may very well be the case that the harvest will be supported by the natural populations, however that needs to be explained and described in the FHMP.

Response to Comment 6:

Comment noted. All decisions on the management and fate of the resource are the purview and responsibility of the WDFW. Nothing in the Final FHMP is meant or intended to usurp or preclude the WDFW from their mandated resource management responsibilities and roles in the Cowlitz River basin. The effect the 65% harvest rate may have on fall Chinook would be examined in a future iteration of the FHMP once more is known about population size and productivity.

Comment 7: Sea-Run Cutthroat

We continue to be concerned about the sea-run cutthroat program as stated in our original comments. We may support a smaller, genetically appropriate and responsibly managed hatchery cutthroat program if TP and WDFW can produce a study or model showing that the hatchery impacts to listed Chinook and chum do not impeded their recovery. However, given that TP and WDFW have indicated they will not be able to provide such a study or model, a better strategy would be to end the program for all of the reasons cited in both the public draft and the final draft of the FHMP. Once the program is ended, TP should implement a monitoring and evaluation program to determine if passage of cutthroat trout is meeting expectations and projections for a self-sustaining population. After a period of 5 years has passed, if the population is not meeting the self-sustaining goals, then a smaller, more integrated program should be explored to support conservation and harvest goals. During the period that the hatchery program is terminated, harvest could occur on all remaining marked cutthroat at high levels, thus weeding the hatchery cutthroat out of the system. However, if TP and WDFW should insist on continued production, the program should move towards those same goals within an integrated program.

Response to Comment 7:

Comment noted. Tacoma Power has agreed to make best efforts to maintain the 2004 brood document levels of production at the Cowlitz Complex during the rebuild period (2005-2007) including the existing hatchery sea-run cutthroat trout program. The hatchery cutthroat program was thoroughly evaluated and discussed by the FTC during

the FHMP draft plan review process. Tacoma Power recognizes all technical parties views and continues to support a 30% integration rate for the hatchery cutthroat trout program, with a hatchery program termination point established upon reaching a self-sustaining population level of 500 naturally-produced adults.

Comment 8: Late winter steelhead

On page 72, the FHMP states that "any impact to the late winter steelhead from the non-indigenous hatchery program have been deemed acceptable by the FTC, and therefore no monitoring program is proposed to measure these impacts." In fact, the original TU/AR comments do not reflect this statement and the FHMP should be corrected accordingly. We remain very concerned about the impact to the late winter steelhead from the non-indigenous hatchery programs. Given that TP and WDFW are unwilling to explore the possibility of indigenous broodstock for the non-indigenous programs, the programs should at the very least apply hatchery reform methods to the segregated hatchery programs for steelhead to improve the system, including monitoring and evaluation. If the continuation of these segregated programs causes impacts to the native late winter steelhead to such an extent that the fishery is restricted or terminated, the FHMP should discuss the possibility of transitioning the program to an integrated late winter steelhead hatchery program to satisfy the fishery mitigation requirements.

Response to Comment 8:

Comment noted. The Final FHMP includes a recommendation for Tacoma to fund a steelhead genetic characterization study for the lower Cowlitz River and tributaries.

Comment 9: Coho

The coho section is generally not as well explained as the prior sections. The FHMP makes no mention of the fact that the Cowlitz coho are now proposed for listing as threatened and that harvest and hatchery impacts are the two main reasons for that proposed listing. We believe that proactive measures in the FHMP will contribute to a faster recovery of these species.

The coho experiment in Upper Cowlitz is very poorly explained. Because productivity testing will not occur for coho, the rationale for putting unlimited numbers of hatchery coho in the upper basin revolves around some experiment to verify the EDT models. This seems to be a very thin excuse to continue stocking the upper river to support a harvest program. This is further supported by the proposal to produce more smolts than are necessary to reach the adult benchmark. For all of the same reasons stated in point 1, we remain very concerned about stocking hatchery fish in the upper watershed, especially at unlimited numbers. We also remain very concerned about the predation on other listed fish by the overwhelming number of coho smolts, as explained on pg. 108. We would also like to see a much better explanation of the experimental regime and goals. While we understand that the stocking strategy will be reviewed in the future, we do not see any compelling evidence to proceed with such a precarious strategy now.

We do not believe that a 30% hatchery spawner limit is acceptable, especially given the segregated nature of the coho hatchery program. A more prudent ceiling is 10%.

Response to Comment 9:

Comment noted. The coho section of the Final FHMP has been changed to reflect these concerns. The number of hatchery coho released as certain triggers are achieved has been reduced. The capacity rationale has been eliminated, and text describing the status of coho has been included.

Comment 10: Support

We are very supportive of the management guidelines on pg. 10. We are also supportive of the use of adults during the productivity testing for the reasons outlined in the FHMP. We are not opposed to the juvenile acclimation as proposed by the Yakima Nation, but believe that the use of adults will serve the ultimate goals of the settlement agreement faster and better. If however, the use of juveniles is incorporated into the FHMP, we do not believe that those juveniles should be included in the credit mechanism as described in footnote 2 on page 18. The credit mechanism should apply only to juveniles produce from the gravel, thus the F2 generation from hatchery produced juveniles placed above the dams.
We are also supportive of the carcass enrichment program and support the full mass-marking of all fish produced at the Cowlitz hatchery.

Response to Comment 10:

Comment noted. See the Executive Summary for the proposal for juvenile supplementation in the upper Cowlitz River basins if productivity from adult releases is not successful.

The credit is tied to the number of naturally produced juveniles collected and released alive below the Barrier Dam. Natural production from the upper river basins, measured as juvenile salmonid outmigrants, has been documented at Cowlitz Falls Dam since 1996 thus demonstrating reliable success. If juvenile supplementation (parr releases) continues in the upper Cowlitz River basin Tacoma proposes that credit accrue from resultant production due to the competition upon naturally produced juveniles from hatchery fish releases. No credit will be taken for smolts released in the upper watershed.

Comments from U.S. Fish & Wildlife Service, July 23, 2004:

Comment 1:

In addition to the specific comments provided below on the FHMP, we believe the FTC needs to further discuss the proposed implementation, evaluation, and future modifications, through adaptive management, of some of the programs outlined in this final draft of the FHMP. We look forward to collaboratively working with you and other members of the FTC to address these issues.

Response to Comment 1:

Comment noted. The FHMP gives direction to the Cowlitz Fisheries Technical Committee (FTC) through the hypotheses in Section 6 and by the objectives and tasks proposed in Section 7 to develop and implement study plans by the Adaptive Management Process. Tacoma Power anticipates the program plans will be developed with particular insight and input from NOAA Fisheries, USFWS and WDFW.

Comment 2:

Section 3.5 Viable, Self-Sustaining, and Recovered Populations (page 13)
We recommend replacing the 3 paragraphs found in this section with the latest write-up NOAA Fisheries has provided to the FTC during recent discussions.

Response to Comment 2:

Comment noted. Tacoma Power has changed the text in the Final FHMP to incorporated the NOAA Fisheries write-up. See Section 3.5.1.

Comment 3:

Section 3.7 Credit mechanism (page 16)
We support the new recommendations for a credit mechanism whereby hatchery production would be reduced as wild fish returns increase. A reduction in hatchery production supports several criteria used to develop hatchery programs in this FHMP, including "When hatchery programs are located in an area where wild fish are listed, the hatchery program should be modified to adopt a conservation role along with an enhancement role." This credit mechanism not only promotes the recovery of wild fish through reduced competition for resources and reduced interbreeding, it implies a sunset clause for hatchery production in response to wild fish recovery.

Response to Comment 3:

Comment noted. Tacoma Power is in agreement with this approach.

Comment 4:

Section 3.8 Adult Supplementation (page 21)
Because all of the hatchery programs, except the sea-run cutthroat program, are currently proposed to be "segregated" programs, we recommend that the FHMP include a description of the potential of hatchery out plants (adult supplementation) to reduce the spawner success rate of natural fish due to competition and interbreeding. Limits on the percentage of adult hatchery fish to be released in the wild should be provided. Under a truly segregated program, attempts are made to prevent hatchery fish from spawning in the wild. Hatcheries produce domesticated salmon, which are selected on the basis of traits that are beneficial for survival in the hatchery itself. Such selection increases fitness in the hatchery, but often decreases fitness in the natural environment. (Campton, D. E. 1995. Genetic effects of hatchery fish on wild populations of Pacific salmon and steelhead: What do we really know? American Fisheries Society Symposium 15: 337-353, Bethesda, MD

We also recommend that the FTC discuss the future implementation of integrated hatchery programs for other stocks in addition to sea-run cutthroat.

Response to Comment 4:

Comment noted. As noted in the Final FHMP, it will not be possible to implement an Integrated Type hatchery program until self-sustaining natural populations are established in the basin. As the success of the reintroduction effort will not be known for some years, Tacoma Power is unable at this point to determine the degree to which each program could be integrated. It is anticipated that the actual integration process will be filled out in more detail in the second edition of the FHMP due in six years. See page 3.3 of the Final FHMP or further information on the segregated and integrated programs at the Cowlitz Complex. The Adaptive Management Process will be implemented specifically to develop the programs, or to the change the programs as new information is collected and analyzed.

Comment 5:

Section 5.0 Objectives and Strategies (page 43)
Third paragraph under "Artificial Production", the FHMP states that hatchery programs for native fish species will be operated based on the Hatchery Scientific Review Group protocols for integrated type programs. These integrated hatchery programs have not been fully developed and presented in the FHMP. As noted above, we recommend that the FTC further discuss the future implementation of integrated hatchery programs within the basin.

Response to Comment 5:

Comment noted. See Response to Comment 4.

Comment 6:

Sections 5.4 and 5.5 Early winter and summer steelhead (pages 85-96)
Recognizing the value of the early winter and summer steelhead fisheries, the Public Review Draft of the FHMP (January 6, 2004) calls for continued artificial production of these non-native stocks, although in reduced numbers, elimination of releases above Mayfield Dam, and a shift to late winter steelhead. The earlier version of the plan also included studies to better understand the genetic impact that the non-native steelhead production may be having on indigenous late winter steelhead; monitoring of impacts on other indigenous salmonids; and changes in management actions that might be triggered as the result of those studies. We support these measures and the wording in the original document because we feel that the earlier FHMP is more consistent with the Settlement Agreement than the final draft, particularly with respect to "the restoration and recovery of wild, indigenous salmonid runs including ESA-listed and unlisted stocks, to harvestable levels."

Our understanding is that TPU would not support an intensive monitoring of impacts from the non-native steelhead program unless criteria for judging impacts, and resulting management changes are developed and agreed upon. Because we do not have such criteria, or an agreement with the Washington State Department of Fish and Wildlife (WDFW) that management changes could be implemented, TPU has deleted the entire reference. We believe this is a mistake. The plan should include studies and adaptive management triggers so that if it is determined that non-native steelhead production is preventing or slowing recovery of wild fish stocks, changes can be made. We believe that additional work in developing criteria and a process by which changes in management actions should take place should be developed in coordination with FTC members.

The development of criteria, monitoring programs, and management triggers for the hatchery programs follows the terms and conditions presented in the 1999 Artificial Propagation BiOp (NMFS 1999) which were to be used to guide the hatchery program development within the FHMP. These terms and conditions include: 1) "All agencies should consider monitoring and evaluating ecological interactions between listed salmon and steelhead and hatchery releases in nursery and rearing areas."; 2) "The WDFW should evaluate the potential for adverse effects on naturally-produced winter steelhead, by hatchery summer steelhead in spawning areas occupied by naturally-produced winter steelhead in the Cowlitz River Basin."; 3) "All action agencies shall monitor and evaluate their respective artificial propagation programs in the Columbia River Basin."; 4) "The WDFW shall conduct monitoring and evaluation activities for salmon and steelhead releases into the Cowlitz and Lewis River basins that include potential ecological interactions with listed Lower Columbia River steelhead."; and 5) "The WDFW shall attempt to conduct spawning ground surveys to estimate the number of hatchery steelhead that are spawning naturally in the habitat of listed Lower Columbia River steelhead."

Response to Comment 6:

Comments noted. Recognizing the diversity of opinions on this issue, and acknowledging that information and data may lead to management changes, the Final FHMP includes a recommendation for Tacoma Power to fund a steelhead genetic characterization study for the lower Cowlitz River and tributaries.

Comment 7:

Section 5.4 Early winter steelhead (Page 85)
Second paragraph, the last sentence found within the earlier FHMP was deleted. We believe that the following wording should be reinstated: "Studies of naturally reproducing early winter steelhead will be conducted in the Lower Cowlitz River downstream of the Barrier Dam to describe the population and to determine areas for action to reduce reproductive influence of early winter fish."

Response to Comment 7:

Comment noted. See response to Comment 6.

Comment 8:

Section 5.4.1. Synopsis of objectives and strategies (early winter steelhead) Page 86
Under Phase 1 Objectives, second paragraph, first bulleted paragraph, the words, "Conduct studies and" have been deleted from the first sentence. In the earlier draft, the sentence read, "Conduct studies and implement changes to the program that reduce straying and residualism, increase survival, increase harvest, and decrease conflicts caused by the presence of early winter steelhead in the watershed." We support inclusion of the original language. This information to be gathered is essential to determine what changes to the program are needed to support recovery of wild fish within the system.

Response to Comment 8:

Comment noted. See response to Comment 6.

Comment 9:

Section 5.5.1 Synopsis of Objectives and strategies (summer steelhead) (Page 93).
Under Phase 2 Objectives, second paragraph that starts "Proposed actions for summer steelhead. . ." a bulleted paragraph has been deleted from the earlier draft. We recommend that the following paragraph be reinstated: "Conduct studies and implement results to reduce straying, reduce residualism, increase survival, increase harvest, and decrease conflicts caused by the presence of summer steelhead in the watershed."

Response to Comment 9:

Comment noted. See response to Comment 6.

Comment 10:

Under 5.5.3 Strategies (summer steelhead) (page 97)
Under sub-section 5.5.3.1 Stock reintroduction and recovery, a whole section has been deleted from the earlier version of the FHMP:

"Genetic testing of natural steelhead spawners in the lower Cowlitz River. Although data indicate that early winter and summer steelhead may be spawning in the Lower Cowlitz River, their successes and resulting impacts to listed late winter steelhead is not known. To determine if introgression has occurred between these three stocks, genetic samples will be collected from unmarked steelhead spawning in the Lower Cowlitz River and compared to the late winter hatchery stock. The data collected from this study will be used to adjust both the early winter steelhead program as appropriate, based on consultation with NMFS staff and the FTC."

Response to Comment 10:

Comment noted. See response to Comment 6. The text has been replaced in the Final FHMP (See section 5.5).

Comment 11:

Section 5.10 Sea Run Cutthroat Program (page 124)
We supported Tacoma's proposed discontinuation of the hatchery sea-run cutthroat program as described in the FHMP Public Review Draft (January 6, 2004). Discontinuation of the program would reduce impacts to native sea-run cutthroat within the system. However, we feel the newly proposed integrated sea-run cutthroat program is a reasonable compromise between TPU and the WDFW proposals. We support the implementation of an integrated program, where natural selection in the wild drives the genetic fitness of the population. This program, as described, is likely to succeed in meeting the goal of increasing the number of naturally-produced fish in support of our primary goal of restoring natural spawning populations of salmon and steelhead within the basin.

We do need further discussion on the monitoring and analyses required to determine at what point the integrated program is to be modified or is no longer needed. Modifications would likely include a reduction (ultimately to zero) of the number of hatchery-origin spawners allowed to spawn in the wild as the abundance of naturally-produced fish increase to a certain level.

Response to Comment 11:

Tacoma Power's proposal is for a conservative hatchery integration program for recovering the sea-run cutthroat trout population in the Cowlitz River basin. Hatchery production will be eliminated once natural population adult abundance reaches the 500 adult criterion. The hatchery cutthroat program was thoroughly evaluated and discussed by the FTC during the FHMP draft plan review process. Tacoma Power recognizes all technical parties views and continues to support a 30% integration rate for the hatchery cutthroat trout program, with a hatchery program termination point established upon reaching a self-sustaining population level of 500 naturally produced adults.

Comment 12:

Section 5.11.2 Resident Fish Program (page 131)
We support the discontinuation of the resident fish stocking program in the Cowlitz River Basin as described in the Public Review Draft (January 6, 2004). The discontinuation of the program is a reasonable and prudent measure to reduce impacts to listed stocks in the basin. In contrast, we do not support the recently proposed changes to Section 5.11.2.1 where the current resident fish stocking program would be replaced by steelhead that do not leave the hatchery on their own volition. We feel that the potential negative impacts this program would have on naturally-produced resident and anadromous salmonids have not been adequately identified and quantified in this proposal. We are concerned not only with residualization of these planted steelhead and associated predation and competition with naturally-produced fish, but also with the impacts of harvest of these hatchery fish upon the naturally-produced fish.

This proposed program is in direct opposition to several criteria used to develop hatchery programs within the FHMP, including 1) "The action agencies should operate artificial propagation programs for fishery augmentation/mitigation in the Columbia River Basin in a manner that emphasizes the production and release of juveniles that are ready to migrate to the ocean and spend a minimum amount of time in the freshwater environment. This should minimize the interactions with, and thus impacts to listed salmon and steelhead, and unlisted natural fish in the migration corridor."; 2) "The action agencies should adopt measures to improve homing and reduce straying of all hatchery fish releases."; 3) "The action agencies should consider monitoring and evaluating predation by residual zed hatchery steelhead in the Columbia River Basin. Alternative methods/schemes to reduce steelhead residualism should be explored to minimize impacts to listed salmon and steelhead."; and 4) "The WDFW shall acclimate and release hatchery steelhead smolts in lower river reaches where possible, where few wild fish spawn and to which returning hatchery adults would be expected to home and have a tendency to hold prior to migrating upstream for spawning."

Response to Comment 12:

Comment noted. Tacoma Power recognizes the FTC divergent views and agrees with the USFWS that the best choice for salmonid stock recovery is ending support for the

resident fish program in the Cowlitz River basin for all the reasons included in the Final Draft FHMP and in the technical document *Impacts of Resident Trout Fisheries on Anadromous Fish Populations, June 25, 2004* prepared for the Cowlitz FTC.

Comment 13:

p. 21, section 3.8, 1st bullet – (and p. 25 under item #3)
Change to: "Out planting hatchery adults rather than juveniles ensures that the entire life-cycle of the resulting offspring is completed in nature.…."

Response to Comment 13:

Comment noted. Tacoma Power has changed the text of the Final FHMP.

Comment 14:

p. 25, paragraph under section #3 – remove the extra "current" or "currently"

Response to Comment 14:

Comment noted. Tacoma Power has changed the text of the Final FHMP.

Appendix 8. Comments on January 6, 2004 Public Review Draft

TACOMA'S RESPONSE TO COMMENTS RECEIVED FROM THE PUBLIC AND AGENCIES ON THE PUBLIC REVIEW DRAFT – FISHERIES AND HATCHERY MANAGEMENT PLAN, DATED JANUARY 6, 2004

From January 23, 2001 through January 6, 2004, a Technical Subcommittee consisting of Tacoma Power, consultant (Mobrand Biometrics Inc.) and Washington Department of Fish and Wildlife staff developed the outline and initial drafts of the Fisheries and Hatchery Management Plan (FHMP). Throughout this time period, regular reviews of the outline and FHMP were presented to the FTC as working drafts consistent with the plan review schedule established by the FTC in 2001 and modified in 2003.

On January 6, 2004, the draft FHMP was made available to the public for review and comment. Tacoma Power hosted a Public Briefing on February 5, 2004 to present the FHMP, hear comments, and answer questions. Tacoma Power held two workshops, March 2nd and March 4th, to give the public additional opportunity to learn about and discuss the plan. Due to the intense interest generated by the plan, and responding to multiple requests, Tacoma Power extended the public review and comment period to March 17, 2004, providing an additional month for review. The attachments are the complete record of comments and responses received by Tacoma Power from the public and resource agencies on the Public Review Draft, and from information assembled at the public forums. All comments were distributed to the FTC for their use in developing the Final Draft FHMP and for commenting upon the Final Draft.

Based on public and WDFW comments on the FHMP Public Review Draft, the Final Draft FHMP was revised to include continued sea-run cutthroat trout supplementation in the lower Cowlitz River basin. Those issues remaining unresolved were worked upon by the Technical Subcommittee and the FTC through participation in mediated FTC meetings for resolution. The Final Draft FHMP was distributed to the FTC on July 2, 2004 for review and comment. Tacoma Power received comments on the Final Draft FHMP from five of the six agencies or groups represented on the FTC. The responses to those comments are included in the Final FHMP as Appendix 7.

A full listing of the consultation record surrounding the development of the FHMP is appended to the FHMP submittal letter.