Cowlitz River Project

FERC No. 2016

Fisheries and Hatchery Management Plan Update

Final

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Tacoma Power

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Acronyms/Abbreviations & Glossary

Acclimation pond	Concrete or earthen pond or a temporary structure used for rearing and imprinting juvenile fish in the water of a particular stream before their release into that stream.
Adipose fin	A small fleshy fin with no rays, located between the dorsal and caudal fins.
Anadromous (anadromy)	Fish which hatch and rear in fresh water, migrate to the ocean to grow and mature, and return to fresh water to spawn.
AHA	All "H" Analyzer
Artificial production	A fish that is produced in a controlled environment, such as a hatchery. *(contrast natural production)*
BMPs	Best Management Practices
Broodstock	Adult fish used by hatcheries to propagate the next generation of fish.
Capacity	A parameter in the spawner recruit function for naturally spawning populations. It is a measure of the quantity and quality of space and food available to the population.
Ceratomyxa shasta	*C. shasta*. A parasite that infects salmonids on the Pacific coast.
Coded Wire-Tag	A magnetically detectable wire etched with a distinctive binary code implanted in the nose of a young fish, which, when retrieved, allows for the identification of the origin of the fish bearing the tag.
Delisting Criteria (recovery criteria)	Criteria incorporated into ESA recovery plans describing conditions, in terms of both biological status and threats, that when met, would result in a determination that a species was no longer threatened or endangered and could be proposed for removal from the federal list of threatened and endangered species.
DPS	Distinct Population Segment. A group of steelhead trout that is (1) substantially reproductively isolated from other conspecific units and (2) represents an important component of the evolutionary legacy of the species.
EDT	Ecosystem Diagnosis and Treatment. A science-based approach to formalizing and analyzing actions to improve the sustainability and production of migratory

	salmon. The approach integrates the quality and quantity of habitat across the salmon life cycle. It estimates the ability of the environment to support a population in terms of abundance, productivity, and life history diversity.
ESA	Endangered Species Act. A 1973 act of Congress mandating that endangered and threatened species of fish, wildlife, and plants be protected and restored.
ESA recovery plan	A plan to recover a species listed as threatened or endangered under the ESA. Plans must, at a minimum, contain (1) site-specific management actions necessary to achieve the plan's goal; (2) objective, measurable criteria which, when met, would result in a determination that the species should be removed from the list; and (3) estimates of the time required and cost to carry out the actions needed to achieve the plan's goal.
Escapement	The portion of a run that is not harvested and escapes to natural or artificial spawning areas.
ESU	Evolutionarily Significant Unit. A group of Pacific salmon that is (1) substantially reproductively isolated from other conspecific units and (2) represents an important component of the evolutionary legacy of the species.
Exploitation Rate	The proportion of the total run that is caught in a given fishery. In contrast, harvest rate refers to the proportion of the run that is available to the fishery that is caught.
Eyed egg	A fish egg containing an embryo that has developed to the point where the eyes are visible through the egg membrane.
Fingerlings	A young fish in its first or second year of life.
Fish collection/handling facility	Holding area where juvenile salmon and steelhead are separated from adult fish and debris by a separator and then passed to holding ponds or raceways until they are loaded onto juvenile fish transportation barges or trucks.
Fitness (Individual)	The mean number of adult, or sexually mature offspring, produced by an individual organism. Individual fitness is the multiplicative product of two probabilistic components: (1) viability fitness, which measures the probability that an individual will survive to sexual maturity from egg formation, and (2) reproductive fitness, the expected number of sexually mature offspring that the individual will produce after attaining sexual maturity. Individual fitness is a function of the individual's genotype (genetic makeup at egg formation)

	and the environments to which that organism is exposed throughout its lifetime.
Fitness (Population)	The mean fitness of all individual within a population that interbreed when mature within a common environment.
Fry	A stage of development in young salmon or trout. During this stage the fish is usually less than one year old, has absorbed its yolk sac, is rearing in the stream, and is between the alevin and parr stage of development.
FBD	Future brood document. WDFW hatchery planning document.
Genetic legacy populations	A population that has had minimal influence from non-indigenous fish due to artificial propagation activities, or may exhibit important life history characteristics that are no longer found throughout the ESU.
Harvest rate	The proportion of the run that is available to a given fishery that is caught by the fishery. In contrast, exploitation rate refers to the proportion of the total run that is caught in the fishery.
HGMP	Hatchery and Genetic Management Plan
HOB	The number of hatchery-origin fish used as hatchery broodstock.
HORs	Hatchery-origin recruits. The number of HORs equals the sum of HOS + HOB + hatchery-origin fish intercepted in fisheries.
HOS	The number of hatchery-origin fish spawning naturally.
Homing	The ability of a salmon or steelhead to correctly identify and return to their natal stream, following maturation at sea.
Imprinting	The physiological and behavioral process by which migratory fish assimilate environmental cues to aid their return to their stream of origin as adults.
Indigenous	Native to the watershed
Integrated hatchery program	A hatchery program with the intent 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.
Jack	A precocious or early maturing salmonid fish; most are males.

Kelt	A spent or spawned out steelhead.
Local adaptation	The evolutionary product of natural selection for a population that inhabits and reproduces within a specific environment for many generations until a genetic-environmental equilibrium is established where the phenotypic means of the population equal, or approximately equal stochastically, the phenotypic optima that confer maximum fitness for the species in the specified environment.
Managers	WDFW and NOAA
MPG	Major Population Grouping. An aggregate of independent populations within an ESU or DPS that share similar genetic, ecological, and spatial characteristics.
Natal stream	Stream of origin.
NOAA	National Oceanic and Atmospheric Administration
NOB	The number of natural-origin fish used as hatchery broodstock.
NORs	Natural-origin recruits. The number of NORs equals the sum of NOB + NOS + natural-origin fish intercepted in fisheries.
NOS	The number of natural-origin fish spawning naturally.
Natural production	A fish that is produced by parents spawning in a stream or lakebed, as opposed to a controlled environment such as a hatchery. *(contrast artificial production)*
Natural Recruitment	The stage at which a juvenile has survived long enough to become part of (i.e., recruited into) a population or an exploitable segment of a population.
Outmigration	The downstream migration of fish toward the ocean.
Parr	The developmental life stage of salmon and trout between alevin and smolt when the young have developed parr marks and are actively feeding in fresh water.
pHOS	Proportion of natural spawners composed of HORs. Equals HOS/ (NOS + HOS).
PIT-Tag	Passive Integrated Transponder tags are used to identify individual salmon for monitoring and research purposes. This miniaturized tag consists of an integrated microchip that is programmed to include specific fish information.

	The tag is inserted into the body cavity of the fish and decoded at selected monitoring sites.
PNI	Proportionate natural influence on a composite hatchery-/natural-origin population. Can also be thought of as the percentage of time the genes of a composite population spend in the natural environment. Equals pNOB/(pNOB + pHOS).
pNOB	Proportion of hatchery broodstock composed of NORs. Equals NOB/(HOB + NOB).
Recruitment	The number of fish that enter the exploitable stock and become susceptible to fishing due to growth and/or migration.
Recruits	The total number of fish of a specific stock available at a particular stage of their life history.
Recruits per spawner	The number of adult fish returning to an area per the number of fish that spawned the year before.
Redd	A salmon or steelhead spawning nest in gravel in which eggs are deposited.
SA	Settlement Agreement
SAR	Smolt to adult return rate. Average rate of survival of outmigrant smolts to adults returning to the Cowlitz subbasin.
Segregated hatchery program	A hatchery program with the intent for the hatchery population to represent a distinct population that is reproductively isolated from naturally-spawning populations.
Smolt	The salmonid or trout developmental life stage between parr and adult, which the juvenile is at least one calendar year old and has adapted to the marine environment.
Stray	A natural phenomena of some adult spawners not returning to their natal stream, but entering and spawning in some other stream.
Stray Rate	The proportion of a hatchery run that escapes harvest but does not return to the hatchery of origin.
Terminal Fishery	The fishery that takes place in the last portion of the migration route of fish returning to fresh water to spawn.
WDFW	Washington Department of Fish and Wildlife
Wild fish	Any fish not produced by a fish hatchery.

1 INTRODUCTION

Section 8.2.2 of the Cowlitz River Hydroelectric Project Settlement Agreement (SA) directs Tacoma Power to develop a Fisheries and Hatchery Management Plan (FHMP). The initial FHMP was submitted in 2004 and approved by the Federal Energy Regulatory Commission (FERC) in 2006 (Appendix B). License Article 6 of the SA (Appendix A) stipulates that Tacoma Power, as the Licensee, in collaboration with the Cowlitz Fisheries Technical Committee (FTC), will update the FHMP every six years. This report is prepared in fulfillment of this requirement.

The conclusions and recommendations in this updated FHMP are consistent with the SA and represent adjustments and clarifications of the prior FHMP. It is intended to improve implementation of the adaptive management process and incorporate the most recent science to effectively meet resource priorities identified in the SA. It takes into account results of studies conducted as a part of the fulfillment of the SA and knowledge evolving from the broader scientific community. Feedback from affected agencies and Tribes and the public have also provided guidance in the preparation of this document.

The scientific foundation for the FHMP rests, to a significant degree, upon the work of the Independent Scientific Advisory Board (ISAB) as presented in NPCC (2000), and of the Hatchery Scientific Review Group (HSRG) (HSRG. 2009). HSRG was specifically tasked by the US Congress to develop principles and recommendations for the management and operation of hatcheries consistent with conservation and harvest goals. Their recommendations (Appendix E) were consulted in the preparation of this FHMP Update.

Other factors/changes that must be taken into consideration, include: legal requirements under the ESA (Appendix C), new knowledge and information from sources outside the Cowlitz program, changes in fisheries and hatchery operations outside the project area that affect the fish population in the project area, lessons learned from the experience of the FTC during its tenure, advice and recommendations from interested parties, and the public, record of implementation of actions called for in the 2006 FHMP.

1.1 PURPOSE AND CONTENT OF THE FHMP

Article 6 of the license for the Cowlitz River Project, FERC No. 2016, effective July 18, 2003 required the FHMP to identify:

- The quantity and size of the fish to be produced at the Cowlitz Hatchery Complex (addressed in Section 2.5, Decision Rules, and Section 3, Action Plan);
- Rearing and release strategies for each stock, including upward and downward production adjustments to accommodate recovery of indigenous stocks (addressed in Section 2.2.1, Natural Production Goals and Constraints; Section 2.5, Decision Rules; and Section 3, Action Plan);

- Credit mechanisms for production of high quality natural stocks (addressed in Section 2.5.2, Rules for Adjusting Hatchery Production to Conform with the SA);

- Plans for Licensee-funded on-going monitoring and evaluation (addressed in Section 4, Monitoring and Evaluation Action Plan); 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 (addressed in Section 3, Action Plan).

This report is an update of the FHMP modified and approved by FERC in 2006. The recommendations brought forward address the points identified in Article 6. They are further guided by the emphasis on conservation required by the SA, the ESA and state mandates and policies (Appendix D) to restore and protect naturally spawning salmon and steelhead populations. The SA also recognizes that harvest benefits are important.

Section 2.1 is an overview of the process whereby an annual action plan is developed and implemented. The purpose of the action plan is to assure the goals in Section 2.2 are met over time.

Section 2.2 of this report defines the goals for recovery and restoration of indigenous salmonid populations affected by the SA. It also identifies the managers' harvest goals, which are based on the principle of optimum sustainable harvest, where harvest benefits are maximized subject to the constraints imposed by recovery objectives.

Section 2.3 identifies and documents the key assumptions upon which the action plan, and biological and management targets are based. The key assumptions form the scientific foundation for the action plan.

Section 2.4 presents recent status and trend information for natural and hatchery production and for harvest in terms of metrics that measure progress toward goals. This information provides feedback to the annual action plan.

Section 2.5 decision rules to be applied each year. It defines how management is to respond to the anticipated resource conditions as they vary from year to year. This includes, for example, the number of fish to be released. In addition to the biological constraints inherent in the decision rules, this section also includes the rules for adjusting hatchery production to conform to the SA (i.e., production limitations and crediting for natural production increases).

Section 3 is the action plan. Here the actions/decisions regarding hatchery programs, habitat, passage, harvest, and monitoring priorities are identified for each affected population.

Section 4 is the monitoring and evaluation plan (M&E). The monitoring priorities for each population are integrated into a comprehensive M&E plan.

Other special topics are covered as follows: credit mechanism (Section 2.5.3), acclimation ponds (Sections 3.7.1 and 5.2), resident fish (Section 5.6), productivity

testing (Section 5.4), smolt-to-adult survival (Section 2.3.2), nutrient enhancement (Sections 3.15 and 5.1), off-station programs (Section 5.3) and selected hatchery operational changes (Section 5.5).

Ten appendices are included that supplement information provided in this FHMP Update.

Appendix A provides an electronic link to the Cowlitz River Hydroelectric Project FERC SA and license articles.

Appendix B provides electronic links to the first version of this FHMP produced in 2006 and to FERC's Order approving the 2006 FHMP.

Appendix C is an electronic link to relevant Endangered Species Act documents.

Appendix D is an electronic link to the Washington Department of Fish and Wildlife's website that provides information about state hatchery policies and programs.

Appendix E is an electronic link to the website of the Hatchery Scientific Review Group. Relevant information may be found by following the link to the Columbia River Systemwide Report, where recommendations are presented by species or by population.

Appendix F documents public comments received on the draft of this FHMP Update and responses developed by Tacoma Power.

Appendix G provides an electronic link to Tacoma Power's website for the Cowlitz Fisheries Technical Committee (FTC). From here, the Credit Mechanism files can be accessed that address annual crediting calculations for each population considered in this FHMP Update.

Appendix H presents detailed tables, organized by population, that identify parameters that are uncertain and that affect program decisions. Monitoring priorities are listed.

Appendix I provides an electronic link to Tacoma Power's Cowlitz FTC website from where population specific assumptions and data can be obtained.

Appendix J is a detailed monitoring and evaluation program for the hatchery populations described in this FHMP Update.

2 ADAPTIVE MANAGEMENT AND SCIENCE FRAMEWORK

Section 2.1 describes the process whereby an annual, scientifically defensible work plan is established that is consistent with the SA and that meets resource goals (Section 2.2). The science framework consists of a set of key assumptions that defines the working hypothesis (Section 2.3), status and trend information that shows progress toward goals (Section 2.4), and a set of decision rules that prescribes the appropriate action, given the goals, the key assumptions, and the forecast for the coming season (Section 2.5).

2.1 ANNUAL DECISION MAKING PROCESS (ADAPTIVE MANAGEMENT)

The purpose of the annual decision process described in this document is to produce an annual action plan that assures progress toward the long-term goals for harvest and recovery of indigenous populations (Section 2.1). The action plan incorporates monitoring and evaluation (M&E) components, which are then fed back into the decision process to complete the adaptive management loop, assuring that the most recent information is used to guide decisions. The annual decision process also provides an important opportunity to inform and engage the public.

The process has four steps: 1) establish and document a scientifically defensible working hypothesis (key assumptions); 2) report and review most recent empirical data on key population metrics (status and trends); 3) establish biological targets and management triggers to assure appropriate response to annual variation in population abundance (Decision Rules); and 4) update the natural escapement, hatchery broodstock, and terminal harvest targets and M&E priorities for the coming season (Action Plan). This process is illustrated in Figure 2-1.

The opportunities to make progress will vary from year to year depending on status and trends in population abundance and productivity and forecasts for the coming season. Other unforeseen events and circumstances may also warrant in-season management responses.

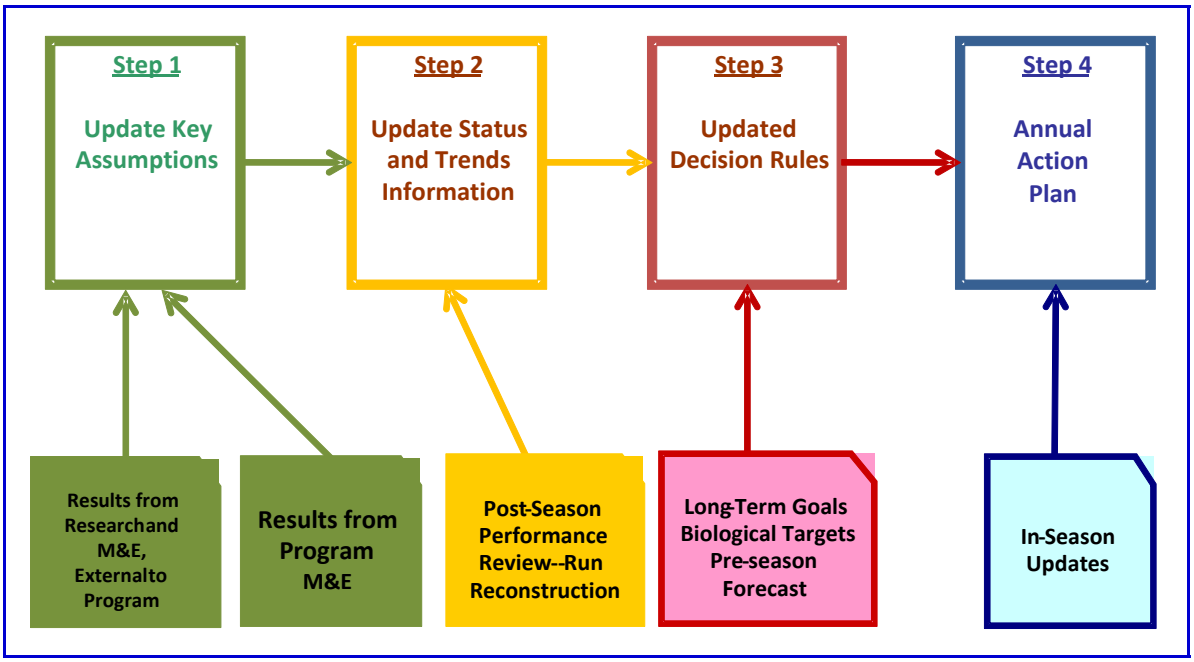


Figure 2-1. Components of the annual decision/adaptive management process.

2.1.1 Process

The annual decision making process centers around a pre-season workshop, held under the FTC auspices, where status and trends, key assumptions, and previously agreed upon decision rules are reviewed and translated into an Annual Action Plan (Section 3). Prior to this workshop, Washington Department of Fish and Wildlife (WDFW) and Tacoma Power will update key assumptions and status and trends based on monitoring results from the most recent season. That information is captured in the In-Season Implementation Tool (ISIT), a database and calculator described in Appendix I. Decision rules will be reviewed each year, but are expected to change less frequently. Barring extraordinary circumstances, the decision rules should only be updated every six years, as the FHMP is updated. In other words, decisions will change each year due to new information, but the rules for making those decisions should remain the same. The decision rules are described below for each Cowlitz population in Section 3.

The agenda for the pre-season workshop is driven by the outline of the Status and Trends and Key Assumptions sections, where the new information brought in through the M&E program will be highlighted. The Status and Trends portion of the agenda will cover natural production (e.g., most recent spawning escapement abundance and composition), harvest, and hatchery production by species and hatchery program. The Key Assumptions part of the agenda will include, for each population: habitat and natural production parameters, smolt to adult survival parameters (e.g., most recent estimates of average fish passage survival at Cowlitz Falls, harvest parameters (e.g., pre-terminal exploitation rates), and hatchery production parameters (e.g., updated in-hatchery survival projections).

2.1.2 Roles and Responsibilities

The process described here is not intended to in any way alter the legal and policy mandates and responsibilities of the management entities involved in the fishery management process in the Cowlitz Basin. Instead it is meant to provide a structure within which those responsibilities can be carried out in a manner that is consistent with the SA. The role of the FTC will be to review information brought forward at the annual workshop, apply decision rules and approve the action plan for the coming year. The FTC may also convene to review progress during the year at selected milestones identified in the annual work plan. In agreeing to this FHMP Update, Tacoma Power and the managers (WDFW and NOAA) commit to provide the data and information required to complete the action plan at the end of the workshop.

The FTC will conduct an annual meeting/workshop to inform the public about this process, results to date and identify the most effective way for the public to stay informed.

2.1.3 Annual Work Products

End products of the workshop, which will be held in March of each year, will be an updated version of the status and trends, key assumptions, and previously agreed upon decision rules. This will be followed by a meeting in April to allow the FTC to finalize the recommended Action Plan in Section 3, and status reports on the five FHMP topics identified in Section 6 of the SA (quantity and size of the fish to be produced, rearing and release strategies for each stock, credit mechanisms, and monitoring and evaluation and a fisheries management strategy). The Annual Action Plan is the blueprint for actions related to the FHMP Update for the coming year. All work products produced as part of the annual review process, including the Action Plan, will be included in a comprehensive annual report.

2.2 CONSERVATION AND HARVEST GOALS

This section identifies goals for recovery and rebuilding of indigenous salmonid populations and for fisheries in the Cowlitz Basin. These goals may in some cases go beyond the obligations of the license. However, actions taken under the terms of the SA should be consistent with and significantly contribute to these goals. These goals are expected to change infrequently and should apply beyond the six year duration of this FHMP Update.

2.2.1 Natural Production Goals and Constraints

The SA places a high priority on rebuilding indigenous salmon and steelhead populations, including contributing to the recovery of ESA-listed species. Section 6.1.1 of the SA, titled Guidance for Future Interpretation and Decision Making, states for example, that:

> *"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".*

The Lower Columbia River Salmon Recovery Plan (LCRSRP) establishes quantified recovery goals in terms of viability and abundance targets for all indigenous salmon and steelhead populations identified in the Cowlitz Basin (LCRFRB 2010). The plan also notes that improvements are needed in all management areas (i.e., habitat, harvest, hydro system passage, and hatchery production) to meet recovery goals. The LCRSRP recognizes that different populations may have different recovery priorities. Populations with the highest priority are designated as Primary, followed by Contributing and Stabilizing (Table 2-1). It is noteworthy that all populations, regardless of their designation, contribute to the recovery of their respective ESUs as their viability increases.

Table 2-1. Recovery goals for Cowlitz salmon and steelhead populations.

Species	Population	Recovery Priority	Viability Status Objective[a]		Improve-ment	Abundance		Target
						Historical	Current	
Fall Chinook	L. Cowlitz	Contributing	VL	M+	50%	24,000	500	3,000
Chum (Fall)	L. Cowlitz	Contributing	VL	M	>500%	195,000	<300	900
Chum (Summer)	L. Cowlitz	Contributing	VL	M	>500%	n/a	n/a	900
Winter Steelhead	L. Cowlitz	Contributing	L	M	5%	1,400	350	400
Coho	L. Cowlitz	Primary	VL	H	100%	18,000	500	3,700
Fall Chinook	U. Cowlitz	Stabilizing	VL	VL	0%	28,000	0	--
Spring Chinook	U. Cowlitz	Primary	VL	H+	>500%	22,000	300	1,800
Winter Steelhead	U. Cowlitz	Primary	VL	H	>500%	1,400	<50	500
Coho	U. Cowlitz	Primary	VL	H	>500%	18,000	<50	2,000
Spring Chinook	Cispus	Primary	VL	H+	>500%	7,800	150	1,800
Winter Steelhead	Cispus	Primary	VL	H	>500%	1,500	<50	500
Coho	Cispus	Primary	VL	H	>500%	8,000	<50	2,000
Spring Chinook	Tilton	Stabilizing	VL	VL	0%	5,400	100	--
Winter Steelhead	Tilton	Contributing	VL	L	>500%	1,700	<50	200
Coho	Tilton	Stabilizing	VL	VL	0%	5,600	<50	--

[a] VL= Very Low, L = Low, M = Medium, H = High. The left-hand column describes the current viability status and the right-hand column describes the desired status as presented in the LCRSRP.
Source: LCRFRB 2010.
Note: Other fish species not listed in table may be present in the Cowlitz River. Management impacts on these species may be discussed by the FTC as issues arise.

The ESA requires that hatchery programs be operated consistent with the recovery of listed populations. NOAA requires that a Hatchery and Genetic Management Plan be submitted and approved that demonstrates this consistency. Hatcheries can affect natural populations through genetic, ecological, and harvest management mechanisms. In 2000, Congress established the Hatchery Scientific Review Group (HSRG) and gave it the

assignment to determine how hatcheries should be operated to enhance harvest and at the same time be consistent with goals for long-term recovery and sustainability of naturally spawning populations.

The HSRG, and others, have concluded that there are two ways to reduce the potential adverse effects of hatchery fish on natural populations: a) reduce the number of hatchery fish that are allowed to compete or interbreed with wild fish, and/or b) make sure that the hatchery fish that do interbreed are similar (genetically) to their wild counterpart (HSRG 2009). Consequently, two hatchery broodstock strategies have been identified segregated (or isolated) and integrated. The HSRG standards and guidelines will be used in this plan until the FTC determines that new information warrants a change.

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 fitness and survival (HSRG 2004).

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 (HSRG). 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 naturally spawning population.

The purpose of hatchery programs, in general, is to increase abundance of fish primarily for harvest and, in some cases, to reduce demographic extinction risk to wild populations. Properly sized and managed, hatcheries represent a balance of demographic benefits (e.g., increased harvest) versus genetic risk (reduced fitness of wild fish) (HSRG 2009). The HSRG developed a set of standards for acceptable hatchery influence based on expected fitness loss and the recovery priority of the affected natural population (Table 2-2).

Table 2-2. HSRG standards for hatchery influence on naturally spawning populations.

Population Designation	HSRG Standards		
	Segregated Hatchery	Integrated Hatchery	
Primary	pHOS < 5%	PNI > 0.67	pHOS less than the smaller of pNOB/2 and 30%
Contributing	pHOS < 10%	PNI >0.5	pHOS less than the smaller of pNOB and 30%
Stabilizing	pHOS no higher than current levels		

Source: HSRG 2009
pHOS = proportion Hatchery Origin Spawners
pNOB = proportion Natural Origin hatchery Brood
PNI = pNOB/(pNOB+pHOS)

Thus the range of options for sizing and operating hatchery programs are constrained by the ESA through the HGMP requirements, the LCRSRP goals for recovery of natural populations, and state policies that adopt the HSRG standards for hatchery influence (Table 2-3). The programs must also operate within the parameters defined by the SA.

Table 2-3. Summary of minimum goals for indigenous stocks in the Cowlitz Basin.

Population	Designation	Spawner Abundance	pHOS	pNOB	PNI
L. Cow. Fall Chin.	Contributing	3,000	<30%	>30%	> 0.50
L. Cow. Win. Sthd	Contributing	400	<30%	>30%	> 0.50
L. Cow. Coho	Primary	3,700	<10%	>20%	> 0.67
L. Cow. Cutthroat (includes Tilton)	Not designated	Unknown	Unknown	0	Unknown
Up. Cow. Fall Chin.	Stabilizing	NS	--		--
Up. Cow. Sp. Chin.	Primary	1,800	<30%	>60%	>0.67
Up. Cow. Win. Sthd	Primary	500	<30%	>60%	>0.67
Up. Cow. Coho	Primary	2,000	<30%	>60%	>0.67
Cispus Sp. Chin.	Primary	1,800	<30%	>60%	>0.67
Cispus Win. Sthd	Primary	500	<10%	>20%	>0.67
Cispus Coho	Primary	2,000	<30%	>60%	>0.67
Tilton Sp. Chin.	Stabilizing	NS	--		--
Tilton Win. Sthd	Contributing	200	<30%	<30%	>0.50
Tilton Coho	Stabilizing	50	--		--

The indigenous salmonid populations of interest, in the Lower Cowlitz subbasin are fall Chinook, winter steelhead, chum and coho. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of their historical levels. Extinction risks are significant for all focal species. Coho are designated as Primary for ESU recovery; all other populations are designated as Contributing. Lower Cowlitz

chum are a component of a larger population which includes the Coweeman and Toutle rivers.

Fall Chinook, winter steelhead and coho populations have been heavily influenced by hatchery programs. Chum probably has not. The HSRG standards for hatchery influence will affect the size and operation of the hatchery programs as well as harvest management.

Indigenous salmonid species of interest in the Upper Cowlitz subbasin include fall Chinook, spring Chinook, winter steelhead, and coho. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels. Winter steelhead, coho, and spring Chinook are designated as Primary for ESU recovery. Spring Chinook, coho, and winter steelhead have been reintroduced into the upper Cowlitz in recent years in an effort to re-establish natural production. Returns of spring Chinook, winter steelhead, and coho include both natural and hatchery produced fish (LCRFRB 2010).

The Upper Cowlitz River is composed of two major tributaries, the Upper Cowlitz River and the Cispus River. Currently, these two population components are managed as one. After significant recovery, each river may be managed independently.

Indigenous salmonid species of interest in the Tilton subbasin include spring Chinook, winter steelhead, and coho. Salmon and steelhead numbers have declined to only a fraction of historical levels. Winter steelhead are designated as Contributing while coho and spring Chinook are designated as Stabilizing for ESU recovery. Fall Chinook are considered a component of the lower Cowlitz River population.

2.2.2 Harvest Goals and Constraints

The SA recognizes the importance of harvest, stating in section 6.1.2 that

> *"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".*

And in Section 6.1.6, it states:

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

Furthermore, the Fishery Management Evaluation Plan (FMEP) approved by NOAA Fisheries in December of 2003 provides for harvest opportunity of Lower Columbia salmon and steelhead populations, consistent with state mandates to restore and recover 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, including this SA.

Hatchery and natural production of salmon and steelhead contribute to fisheries both within the Cowlitz Basin (terminal fisheries) and outside the Basin (pre-terminal fisheries). The contributions to terminal and pre-terminal fisheries vary by species; fall Chinook are primarily harvested in pre-terminal fisheries, whereas steelhead are harvested in terminal fisheries, and spring Chinook and coho are important to both.

The long-term goals for harvest in terms of catch numbers, harvest rates, and seasons by fishery are shown in Table 2-4. Note that these are not necessarily the goals associated with the SA, but rather long term goals that may require implementation of measures beyond the scope of the SA.

Table 2-4. WDFW long-term harvest goals for Cowlitz salmon and steelhead.[1]

Fishery	Metric	Fall Chinook	Spring Chinook	Coho	Steelhead	Searun Cutthroat
Pre-terminal	Expl. Rate	≤ 37%	< 10%	≤ 24%	< 1%	<1%
Lower Cowlitz	In river Catch	5,000-7,000	10,000-20,000	20,000-30,000	Winter Stlhd- 10,000-20,000 Summer Stlhd- 10,000-20,000	4,500
	Season	Aug.-Oct.	Apr.-June	Aug.-Nov	Winter Stlhd- Nov.-April Summer Stlhd- May-Aug.	June-Nov.
Upper Cowlitz	In river Catch	Consistent with return of 7,000 adults	Consistent with return of 8,000 adults	Consistent with return of 20,000-35,000 adults	Consistent with return of 12,000 adults	N/A
	Season	Aug.-Nov.	Apr.-July	Aug.-Jan.	Nov.-May	N/A
Tilton	In river Catch	Consistent with return of 6,000 adults	Consistent with return of 1,000-3,000 adults	Consistent with return of 6,000-8,000 adults	Consistent with return of 4,000-6,000 adults	N/A
	Season	Aug.-Nov.	Apr.-June	Aug.-Jan.	Nov.-May	N/A

[1] Harvest goals were provided by WDFW.

Most of the harvest of all species currently comes from hatchery production. Harvest in all fisheries is, to some extent, constrained by the need to protect and rebuild natural production as cited above. In the long-term, the expectation is that these constraints will ease as natural populations recover and become more productive.

Selective harvest of marked hatchery fish can improve the ability to fully harvest hatchery fish without overharvesting less productive wild populations. The goals shown in Table 2-4 are expected to be met more frequently over time as natural stocks recover.

2.3 KEY ASSUMPTIONS

The purpose of this section is to define the scientific foundation of the FHMP Update. This foundation is described in terms of standard models in population dynamics and a set of parameters. Together this is often referred to as a working hypothesis; here we use the collective term "key assumptions" in reference to the range of assumptions that make up the working hypothesis. The key assumptions capture our understanding of how the system work and how management actions affect outcomes. The identification and documentation of the key assumptions are necessary to apply the scientific method and to assure accountability. **The key assumptions predict how the system will respond on average.** Models built around the key assumptions help develop long-term strategies to meet harvest and conservation goals over time. Population abundances will vary from year to year around the averages predicted by the models. Management responses to annual run-forecasts are addressed in the section titled Decision Rules.

In the following sections, key assumptions are presented for: (1) habitat and natural production, (2) smolt to adult survival, (3) harvest, and (4) hatchery production.

2.3.1 Habitat and Natural Production

The natural production potential for each of the Cowlitz salmon and steelhead populations has a habitat component and a genetic component. The habitat potential is defined by the two parameter Beverton-Holt production function. The productivity parameter is a measure of the rate of reproduction of the population, when competition is not a factor in survival (i.e., at very low abundance levels). Productivity is expressed as smolts per spawner and is primarily a measure of habitat quality. The other habitat parameter is abundance. Abundance represents the number of smolts that the habitat can sustain over time and is a measure of both habitat quality and quantity and takes into account competition for food and space.

The genetic component of natural production potential is expressed as relative fitness. Left to its own devices over time, a naturally spawning population will adapt and take full advantage of the habitat potential and become locally adapted. The presence of hatchery fish in the naturally spawning population will reduce the productivity of the population as a whole. This reduced productivity is expressed as relative fitness, defined as the productivity of the hatchery influenced population divided by the productivity of the locally adapted natural population. Relative fitness is expected to increase for some populations (Table 2-5) due to the reduced hatchery influence, when the HSRG standards are met (see Tables 2-2 and 2-3).

Table 2-5. Estimated current and expected future natural production potential (based on updated HSRG analysis using AHA).

Population	Designation	Productivity [1]		Abundance[2]		Relative Fitness[3]	
		Current	Expected[4]	Current	Expected	Current	Expected
L. Cow. Fall Chin.	Contributing	316	400	667,095	850,000	0.5	0.65
L. Cow. Win. Sthd	Contributing	12	20	3,660	6,000	0.5	0.9
L. Cow. Coho	Primary	21	25	30,654	35,000	0.58	0.9
Up. Cow. Fall Chin.	Stabilizing	164	same	522,294	same	0.5	0.5
Up. Cow. Sp. Chin.	Primary	37	67	99,345	180,000	0.5	0.9
Up. Cow. Win. Sthd	Primary	19	35	12,791	23,000	0.5	0.9
Up. Cow. Coho[5]	Primary	18	65	147,688	525,000	0.5	0.9
Tilton Sp. Chin.	Stabilizing	22	same	19,418	same	0.5	0.5
Tilton Win. Sthd	Contributing	10	12	1,661	2,100	0.5	0.65
Tilton Coho	Stabilizing	27	same	32,400	same	0.5	0.5
L. Cow. Cutthroat (includes Tilton)	Not designated	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown

[1] Habitat based potential for EDT analysis times relative fitness, expressed as smolts per spawner.
[2] Habitat based potential from EDT analysis times relative fitness, expressed as number of smolts.
[3] Population fitness relative to a locally adapted natural population, based on AHA analysis of hatchery effects on productivity.
[4] Expectation within the six year period of this FHMP Update.
[5] Upper Cowlitz and Cispus populations are combined.

2.3.2 Smolt to Adult Survival

The overall spawner to spawner production of the indigenous populations (NORs) also depends on survival conditions during the juvenile and adult migrations from the spawning grounds to the ocean and back. Table 2-6 shows the assumed downstream (juvenile passage) and upstream (adult passage) survivals within the Cowlitz Basin, as well as the overall survival from smolt to returning adult (SAR), including passage survivals.

Table 2-6. Estimated smolt to adult survivals in absence of harvest.

Population	Designation	Current Juvenile Passage[1]	Current Adult Passage[2]	Current SAR[3]
L. Cow. Fall Chin,	Contributing	100%	100%	0.93%
L. Cow. Win. Sthd	Contributing	100%	100%	11.8%
L. Cow. Coho	Primary	100%	100%	13.7%
Up. Cow. Fall Chin.	Stabilizing	20%	100%	0.93%
Up. Cow. Sp. Chin.	Primary	20%	100%	5.5%
Up. Cow. Win. Sthd	Primary	40%	100%	11.8%
Upper Cow. Coho[4]	Primary	40%	100%	2.4%

Population	Designation	Current Juvenile Passage[1]	Current Adult Passage[2]	Current SAR[3]
Tilton Spring Chin.	Stabilizing	97%	100%	5.5%
Tilton Winter Sthd	Contributing	97%	100%	11.8%
Tilton Coho	Stabilizing	96%	100%	4.0%
Lower Cow Cutthroat (includes Tilton)	Not designated	97%	100%	5.7%

[1] In-subbasin (Cowlitz) downstream survival of juvenile outmigrants.
[2] In-subbasin (Cowlitz) downstream survival of returning adults.
[3] Out-of-subbasin (Cowlitz) survival from smolt to adult.
[4] Upper Cowlitz and Cispus populations are combined.

Articles 1 and 2 of the SA call for improvements in downstream survival to support self-sustaining populations, as determined by NOAA and the USFWS in consultation with the FTC and agencies. The expected survivals shown in Table 2-6 represent expectations within the six-year period of this FHMP Update but not necessarily the requirement under Articles 1 and 2.

2.3.3 Harvest

The SARs shown in Table 2-6 reflect mortalities other than those associated with fisheries. Tables 2-7 and 2-8 show the current and assumed future (within six years) harvest rates for pre-terminal (Ocean and Columbia River) and terminal fisheries[1]. Harvest rates may vary to some degree from year to year. The values shown in Tables 2-7 and 2-8 represent the average values used for planning purposes.

Table 2-7. Estimated current harvest rates on indigenous populations by fishery in fishery years through 2004.

Population	Designation	Ocean Fisheries		Columbia River Fisheries		Terminal (Sport) Fisheries	
		NORs	HORs	NORs	HORs	NORs	HORs
L. Cow. Fall Chin.	Contributing	42%	42%	12%	12%	2%	25%
L. Cow. Win. Sthd	Contributing	0.5%	0.5%	4%	4%	2%	60%
L. Cow. Coho	Primary	5%	33%	23%	29%	2%	15%
Up. Cow. Fall Chin.	Stabilizing	42%	42%	12%	12%	2%	10%
Up. Cow. Sp. Chin.	Primary	34%	34%	2%	5%	1%	3%
Up. Cow. Win. Sthd	Primary	0.5%	0.5%	4%	4%	3%	80%
Up. Cow. Coho	Primary	5%	5%	23%	29%	5%	25%

[1] Note that the FTC has no influence on current or future harvest in pre-terminal fisheries. In-river fishery goals are set by the managers, in this case primarily WDFW, consistent with state policies and federal ESA requirements.

Population	Designation	Ocean Fisheries		Columbia River Fisheries		Terminal (Sport) Fisheries	
		NORs	HORs	NORs	HORs	NORs	HORs
Tilton Sp. Chin.	Stabilizing	34%	34%	2%	5%	1%	3%
Tilton Win. Sthd	Contributing	0.5%	0.5%	4%	4%	3%	80%
Tilton Coho	Stabilizing	5%	5%	23%	29%	5%	25%
L. Cow. Cutthroat (includes Tilton)	Not designated	0%	0%	0%	0%	5%	34%

Note: CWT tag data from Cowlitz Hatchery was used to calculate harvest of HORs (Brood Years 1997-2001). CWT tag data from Lewis River Type N coho Double Index Tag Groups (DITs) were used as a surrogate to calculate harvest of lower Columbia coho NORs in ocean and Columbia River fisheries (Brood Years 1999-2003).

Table 2-8. Expected harvest rates by fishery within the six year period of this FHMP Update.

Population	Designation	Ocean Fisheries		Columbia River Fisheries		Terminal (Sport) Fisheries	
		NORs	HORs	NORs	HORs	NORs	HORs
L. Cow. Fall Chin.	Contributing	33%	44%	10%	12%	2%	25%
L. Cow. Win. Sthd	Contributing	0.5%	0.5%	4%	4%	2%	60%
L. Cow. Coho	Primary	5%	33%	23%	29%	2%	15%
Up. Cow. Fall Chin.	Stabilizing	33%	44%	10%	12%	2%	10%
Up. Cow. Sp. Chin.	Primary	34%	34%	2%	5%	1%	6%
Up. Cow. Win. Sthd	Primary	0.5%	0.5%	4%	4%	3%	80%
Up. Cow. Coho	Primary	5%	5%	23%	29%	4%	25%
Tilton Sp. Chin.	Stabilizing	34%	34%	2%	5%	1%	6%
Tilton Win. Sthd	Contributing	0.5%	0.5%	4%	4%	3%	80%
Tilton Coho	Stabilizing	5%	5%	23%	29%	4%	25%
L. Cow. Cutthroat (includes Tilton)	Not designated	0%	0%	0%	0%	5%	34%

2.3.4 Hatchery Production Parameters

In-hatchery survival and post release performance of hatchery fish are shown in Table 2-9. The SAR values are survival from release to harvest. The stray rate is the percent of the returning adults that escape fisheries, but do not return to the hatchery. Relative reproductive success is a measure of the natural productivity of hatchery fish in the wild, relative to their naturally produced counterparts. Unlike the relative fitness parameter in Table 2-5, which reflects the genetic make-up of the entire spawning population, the relative reproductive success factor represents the performance of first generation hatchery fish.

Table 2-9. Survival of hatchery-origin fish by life stage.

Population	In-Hatchery Survival				SAR[2]	Stray Rate	Rel. Reprod. Success[1]
	Eggs per Female	Percent Females	Pre-Spawning Survival	Egg to Smolt Survival			
L. Cow. Fall Chin.	5,300	50%	95%	87%	0.34%	25%	0.8
L. Cow. Sp. Chin.	3,800	50%	87%	84%	0.86%	13%	NA
L. Cow. L. Win. Sthd	5,085	50%	90%	87%	1%	10%	0.8
L. Cow. E. Win. Sthd	4,339	50%	90%	89%	1.1%	25%	0.11
L. Cow. Sum. Sthd	3,693	50%	90%	88%	4%	5%	0.18
L. Cow. Coho	3,500	50%	90%	76%	2.7%	0.27%	0.8
Cutthroat (includes Tilton)	1,000	50%	97%	55%	3.0%	unknown	0.8
Up. Cow. Fall Chin.	5,300	50%	95%	87%	0.34%	100%	0.8
Up. Cow. Sp. Chin.	3,800	50%	87%	84%	0.86%	100%	0.8
Up. Cow. Win. Sthd	5,085	50%	90%	87%	1%	100%	0.8
Up. Cow. Coho	3,500	50%	90%	76%	2.6%	100%	0.8
Tilton Sp. Chin.	3,800	50%	87%	84%	0.86%	100%	0.8
Tilton Win. Sthd	5,085	50%	90%	87%	1%	100%	0.8
Tilton Coho	3,500	50%	90%	76%	2.6%	100%	0.8

[1] Reproductive success of hatchery-origin fish spawning naturally relative to natural-origin fish.
2 SAR date calculated from CWT tagging groups (1997-2001 Brood Years). www.rmpc.org
Source: In-hatchery data from Cowlitz Hatchery Annual reports,

The production of hatchery fish (i.e., the number of smolts released), is a management variable, which is discussed in the Decision Rules section and in the Action Plan section. A key assumption, however, is that hatchery production is limited subject to conditions in Article 5 of the SA. Hatchery production will be constrained by goals for recovery of listed populations set forth in the LCRSRP and the HSRG standards for hatchery influence on indigenous populations. Status of naturally produced populations will also affect hatchery production levels.

2.3.5 Stock Identification (Marking) Strategy

In order to implement the hatchery operational changes, management strategies and monitoring requirements outline in this FHMP Update, the ability to visually identify a fish as to origin in real time is required. Table 2-10 describes the marking strategy (by stock) to be used for the duration of this FHMP Update. All marking/tagging of hatchery fish will be done at either Cowlitz Salmon or Cowlitz Trout hatcheries under currently existing agreements between Tacoma Power and WDFW.

Table 2-10. Stock identification marks of salmonid population groups found in the Cowlitz River.

Species	Population Group	CWT	Ad Clip	Agency Only Wire Tag
Fall Chinook	Lower Cowlitz HOR	Portion	All	
	Lower Cowlitz NOR			
	Upper Cowlitz HOR (if initiated)		All	All
	Upper Cowlitz NOR			All
	Tilton NOR			
Spring Chinook	Lower Cowlitz HOR	Portion	All	
	Upper Cowlitz NOR			
	Upper Cowlitz HOR			All
Coho[1]	Lower Cowlitz HOR		All	
	Lower Cowlitz NOR			
	Upper Cowlitz HOR	All	All	
	Upper Cowlitz NOR			All
	Tilton NOR			
Summer Steelhead	Lower Cowlitz HOR		All	
Late Winter Steelhead	Lower Cowlitz HOR		All	
	Lower Cowlitz NOR			
	Upper Cowlitz HOR		All	
	Upper Cowlitz NOR			All
	Tilton HOR (if initiated)		All	
	Tilton NOR			
Cutthroat	Lower Cowlitz HOR		All	
	Tilton NOR			
	Upper Cowlitz NOR			All

[1] Identified marking strategy to begin in 2012.

2.4 STATUS AND TRENDS

If the key assumptions and the decision rules are sound, we would expect that natural escapement abundance and composition would meet or exceed the goals identified in Table 2-3, while at the same time harvest goals in Table 2-4 are also met. Status and trend monitoring estimate annual status of natural production and harvest in metrics that relate directly to the goals. The results of the status and trend monitoring provide feedback to the annual review process. Time series of observed values for natural escapement, pHOS, PNI and harvest will over time demonstrate progress toward goals, provided key assumptions are reasonable accurate.

This section summarizes status of natural populations and harvest of natural and hatchery populations. Tables 2-11 and 2-12 compare recent 5-year averages with the goals identified in the goals section. Further information about recent trends for populations and fisheries are available in the ISIT spreadsheets (Appendix I). Table 2-13 shows recent hatchery production and broodstock take.

2.4.1 Natural Production Status

Table 2-11. Recent 5-year average spawning escapement and composition.

Population	Designation	NOR Escapement[2]		pHOS[3]		PNI	
		Status	Goal	Status	Goal	Status	Goal
Lower Cow. Fall Chin.	Contributing	472	3,000	76%	<30%	0.03	> 0.50
Lower Cow. Win. Sthd	Contributing	unk	400	unk	<30%	0	> 0.50
Lower Cow. Coho	Primary	unk	3,700	unk	<10%	0	> 0.67
Upper Cow. Fall Chin.	Stabilizing	0	--	--	--	--	--
Upper Cow. Sp. Chin.	Primary	86	3,600	44%	<30%	0	>0.67
Upper Cow. Win. Sthd	Primary	490	1,000	53%	<10%	0	>0.67
Upper Cow. Coho	Primary	4,893	4,000	72%	<30%	0	>0.67
Tilton Sp. Chin.	Stabilizing	0	--	--	--	--	--
Tilton Win. Sthd	Contributing	88	200	65%	<30%	0	0.5
Tilton Coho	Stabilizing	802	--	73%	--	0	--
Lower Cow. Cutthroat (includes Tilton)	Not designated	Unk	Unk	Unk	Unk	0	Unk

Note: Upper Cowlitz number includes Cispus.

2.4.2 Recent Harvest by Fishery and Population

Table 2-12. Recent 5-year average catch estimates by fishery and stock.

Population	Ocean Fisheries[1,2]		Columbia River[1,2]		Terminal (Sport)[3]	
	Status	Goal	Status	Goal	Status	Goal
Lower Cow. Fall Chinook	8,237	NS	1,491	NS	2,400	5,000-7,000
Lower Cow. Spring Chinook	10,700	NS	1,040	NS	1,406	10,000-20,000
Lower Cow. Late Winter Sthd	12		100		1,746	5,000-10,000

[2] Escapement goals are from LCRSRB 2010.

[3] pHOS and PNI goals are based on HSRG standards (HSRG 2009).

Population	Ocean Fisheries[1,2]		Columbia River[1,2]		Terminal (Sport)[3]	
	Status	Goal	Status	Goal	Status	Goal
Lower Cow. Early Winter Sthd	2		196		2,427	5,000-10,000
Lower Cow. Summer Sthd	14		1,081		11,064	10,000-20,000
Lower Cow. Coho[4]	46,331		27,279		7,214	20,000-30,000
Cutthroat	Unknown		Unknown		Unknown	4,500
Upper Cow. Fall Chin.[5]	--	--	--	--	0	Consistent with return of 7,000 adults
Upper Cow. Spring Chin. [5]	unk		165		95	Consistent with return of 8,000 adults
Upper Cow. Winter Sthd[5]	0		1		17	Consistent with return of 12,000 adults
Upper Cow. Coho[5]	1,799		749		1,124	Consistent with return of 20,000-35,000 adults
Tilton Spring Chin.	--		--		--	Consistent with return of 1,000-3,000 adults
Tilton Fall Chinook						Consistent with return of 6,000 adults
Tilton Winter Sthd	0		1		9	Consistent with return of 4,000-6,000 adults
Tilton Coho	636		265		662	Consistent with return of 6,000-8,000 adults

NS=Not specified
[1] See Table 2.4 for assumed exploitation rates.
[2] Source: RMIS CWT database, 1997-2001 brood years.
[3] Source: Draft WDFW Sport Catch Record Card Database, 2003-2008 catch years.
[4]Based on average exploitation rates and run sizes
[5] Upper Cowlitz harvest rate assumed to be 15%.

2.4.3 Recent Hatchery Production

Table 2-13. Recent 5-year average hatchery releases, broodstock take and total adult return.

Hatchery Program	Broodstock Strategy[1]	Number of Broodstock	pNOB	Number of Fish Released	Size at Release (fish/lb)	Total Hatchery Return of Hatchery Origin Adults[2]
L. Cow. Fall Chin.	Integrated	2,407	3%	5,088,129	63.76	7,171
L. Cow. Sp. Chin.	Segregated	912	-	893,848	6.73	3,947
L. Cow. L. Win. Sthd	Segregated	206	0	402,940	9.98	3,685
L. Cow. E. Win. Sthd	Segregated	116	-	268,366	6.82	2,114
L. Cow. Sum. Sthd	Segregated	277	-	396,993	5.99	5,531
L. Cow. Coho	Segregated	2130	0	3,269,213	14.96	64,666
Cutthroat	Segregated	387	0	152,402	5.19	4,721
Up. Cow. Fall Chin.	Segregated	Lower river HORs planted			Adult	
Up. Cow. Sp. Chin.	Integrated	Uses lower river program as brood, also some adults planted	0	286,273	90.26	
Up. Cow. Win. Sthd	Integrated	Used lower river program as brood		140,448	43.94	
Up. Cow. Coho	Integrated		100%			
Tilton Sp. Chin.	Integrated	0		0	n/a	
Tilton Winter Sthd	Integrated	0			n/a	
Tilton Coho	Segregated	Lower river HORs planted		0	Adult	

[1] Broodstock strategy listed is the intended strategy to be used by the hatchery.
[2] Disposition of fish by species: Average values for return years 2006-2010 (data provided by WDFW):
Fall Chinook: Spawned 33%, Passed upstream 63%, Released Downstream 0%, Lake Plant 0%, Donated 2%, N.E. 0%, Mortality 3%, Culled 0%, Sold 0%.
Spring Chinook: Spawned 23%, Passed upstream 58%, Released Downstream 0%, Lake Plant 0%, Donated 13%, N.E. 0%, Mortality 4%, Culled 2%, Sold 0%.
Late winter steelhead: Spawned 10%, Passed upstream 34%, Released Downstream 5% (practice stopped in 2009), Lake Plant 0%, Donated 48%, N.E. 0%, Mortality 3%, Culled 1%, Sold 0%.

Early Winter Steelhead: Spawned 5%, Passed upstream 0%, Released Downstream 47% (practice stopped in 2009), Lake Plant 22%, Donated 24%, N.E. 0%, Mortality 1%, Culled 0%, Sold 0%.
Summer Steelhead: Spawned 6%, Passed upstream 0%, Released Downstream 46% (practice stopped in 2009), Lake Plant 2%, Donated 43%, N.E. 0%, Mortality 2%, Culled 0%, Sold 0%
Coho: Spawned 2% , Passed upstream 36% , Released Downstream 1%, Lake Plant 0%, Donated 57%, N.E. 3%, Mortality 0%, Culled 0%, Sold 1%.
Cutthroat: Spawned 9%, Passed upstream 0%, Released Downstream 42%, Lake Plant 43%, Donated 1%, N.E. 0%, Mortality 1%, Culled 5%, Sold 0%.

2.5 DECISION RULES

2.5.1 Conservation and Harvest-driven Rules

Natural escapement, hatchery broodstock collection and terminal fisheries will be operated in accordance with a set of pre-determined and agreed upon decision rules. The decision rules are based on the key assumptions identified above. The decision rules are designed to move each indigenous population toward its rebuilding goal and each fishery toward its harvest goal. Rebuilding of indigenous populations is the first priority. The SA states that:

> *"Particular emphasis is placed on ecosystem integrity and the restoration and recovery of wild, indigenous salmonid runs to harvestable levels, while also providing significant improvements to area recreational facilities. "*

The calculations that link the key assumptions to the goals are captured in the ISIT tool, which is both a database and a calculator. The Decision Rules are based on these calculations. For any given run size, the Decision Rule calculates the management targets in terms of natural escapement abundance and composition (pHOS), harvest, and hatchery broodstock. These management targets constitute the action plan for the coming season. The Decision Rules are designed to generate management targets that drive the system towards the biological targets, which in turn are the metrics that define the resource goals.

The Decision Rules provide the flexibility to adjust management targets from year to year in response to changing run sizes, allowing the manger to use all the in-season tools at her/his disposal to optimize progress toward sustainable harvest and conservation goals.

Hatcheries will serve different roles for different populations and at different times. Often hatchery programs serve the purpose of augmenting harvest. For some populations, however they also serve as gene banks, as tools for re-colonization, or as demographic safety nets for indigenous populations. These varying roles are captured in the Decision Rules, which are not expected to change each year. The reason for devising them is in fact to assure that a consistent strategy is applied over time that will assure progress toward goals in the long term even as annual population abundance varies. The Decision Rules will be re-evaluated every six years as the FHMP is updated.

The Decision Rules for each population and each hatchery program are described in Section 3.

2.5.2 Rules for Adjusting Overall Hatchery Production to Conform with the 650,000 Pound Standard

Once the decision rules have been applied for each population, the overall program must be tested for compliance with the conditions of the SA regarding total production from the Cowlitz Hatcheries and crediting for natural production. The agreed upon method for making these adjustments are defined next.

Article 5 states that:

> *"Total hatchery production for all stock 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."*

2.5.3 The Crediting Rule

The SA requires that the FHMP identify credit mechanisms for the production of high quality natural stocks (Article 6 of the SA). 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 SA that states hatchery production numbers are expected to be adjusted downward as wild stocks recover. When originally conceived, the crediting mechanism assumed single populations (stocks) of all species in the Cowlitz Basin (five species total, excluding chum). With the completion of the Lower Columbia River Salmon Recovery Plan, the species complex within the Cowlitz River has been delineated to a much finer scale. There are now twelve separate populations among the original five species (excluding chum) in the Cowlitz Basin, and adjustments to the original crediting mechanism are warranted. Crediting for the production of natural smolts is possible when they can be captured and transported, which may show a benefit to that specific population, but populations in the lower river are not available for capture, and therefore cannot receive a benefit.

The number of juveniles produced from the Upper Cowlitz River will be calculated at the Barrier Dam. This way, the juvenile estimate includes any losses due to transportation or passage through the dams. The number of NOR juveniles from Mayfield would be calculated in the river below the Mayfield powerhouse.

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.

1) Crediting for naturally produced smolts is viewed as an incentive to increase the Fish Passage Survival (FPS) at both Cowlitz Falls and Mayfield dams.

2) Credits shall be applied (reduction of hatchery program) on a species-specific and population-specific basis (as defined in the LCRSRP). Tilton River populations are an exception (see item 4 below).

3) In the event that no hatchery population exists, credits accumulated for that population will remain unused, with the exception of spring Chinook where naturally produced spring Chinook above Cowlitz Falls Dam will be credited against the lower river spring Chinook hatchery program. Until such time that a method is approved and implemented to differentiate zero-age out-migrating spring Chinook from fall Chinook in the Upper Cowlitz, the number of out-migrating Chinook juveniles collected will be proportioned to race based on the number of adult fall Chinook and spring Chinook females placed in the Upper River the year prior. The proportion estimated to be spring Chinook will be available for crediting. The number estimated to be fall Chinook will not be available for crediting until and unless a hatchery program is established for that population. All yearling out-migrating Chinook collected from the Upper Cowlitz will be assumed to be spring Chinook and credited as such.

4) The Upper Cowlitz (including tributary populations above Cowlitz Falls Dam) shall be considered as "Upper River population" and can affect only those hatchery programs developed for those populations. The Upper Cowlitz coho out-migrants and Tilton River fall Chinook, coho, steelhead and cutthroat out-migrants will be credited against the lower river hatchery programs (species-specific) to reduce the impacts on hatchery programs for upper river populations.

5) In the event that the application of credits (and commensurate reduction in hatchery programs) impacts the ability to achieve major objectives of the FHMP (conservation and sustainable fisheries), adjustments in the application of credits maybe altered by the FTC (i.e., forego credit, apply credits across populations).

6) A minimum (floor) of hatchery production may be established by the FTC on a population-by-population basis. Note that the floor applies only to crediting. Hatchery production may be reduced below this floor to meet conservation and or the 650,000 poundage standard.

7) Because the number of natural-origin out-migrants is converted to pounds of production for crediting, base production from which credits are subtracted (by species) is established as numbers of smolts of a specified "base size" at release. If the size at release changes or varies, the base production remains the poundage associated with base production numbers at "base size". For example, spring Chinook historically have been reared to 5 fish per pound (fpp) (base size) and 967,000 smolts have been released. Total poundage then is 194,400 pounds (base production). Many more spring Chinook could be

released if the fish per pound at release was reduced, but the base production would remain at 194,400 and credits would be subtracted from the poundage number, rather than the number of smolts.)

Table 2-14 identifies how natural production credits will be assigned to each hatchery program. The credit mechanism will be calculated as follows:

1) For every yearling wild/natural juvenile produced from the upper Cowlitz and Tilton rivers, 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 rivers, 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 2:1 or 0.5:1 credit ratio began in year 1 of the FHMP and is applied to a reduction in the Cowlitz Hatchery Complex production obligation beginning with the next brood year for each species. For example, if the most recent five-year rolling average for coho natural-origin juveniles was 200,000 (data available in the late spring), the credit would be assigned to the following brood year egg collection. 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
- SAR is defined as Smolt-to-Adult survival rate, including all fisheries-induced mortality
- SAR = Number of adults accounted for from any identifiable group of fish/Number of juveniles released from that same group

Current 5-year average SAR data are available for NOR coho, NOR cutthroat and NOR steelhead from the Tilton River (Henning 2010).

- Coho = Wild SAR/Hatchery SAR = 4.04/2.7 = 1.49
- Cutthroat = Wild SAR/Hatchery SAR = 5.67/3.0 = 1.89
- Steelhead = Wild SAR/Hatchery SAR = 0.99/1.0 = 0.99

Therefore, credits will be applied at the ratio of 1.49 HOR coho/NOR coho, 1.89 HOR cutthroat/NOR cutthroat, and 0.99 HOR steelhead/ NOR steelhead rather than the original 2.0/1.0 as described above.

Table 2-14. Assignment of natural production credits to hatchery programs.

Populations to be Credited for NOR Production	Hatchery Programs Paying for Credits						
	Lower Cowlitz Spring Chinook	Lower Cowlitz Fall Chinook	Lower Cowlitz Late Winter Steelhead	Lower Cowlitz Coho	Upper Cowlitz Coho	Lower Cowlitz Cutthroat	Upper Cowlitz Late Winter Steelhead
Upper Cowlitz Spring Chinook	X						
Upper Cowlitz Late Winter Steelhead							X
Upper Cowlitz Coho				X			
Tilton Fall Chinook		X					
Tilton Late Winter Steelhead			X				
Tilton Coho				X			
Tilton Cutthroat						X	
Upper Cowlitz Cutthroat						X	

2.6 METHODS AND TOOLS

The decision support tools and analytical methods used in the Annual Decision Making Process were developed for the implementation of hatchery reform projects in the Columbia Basin and Puget Sound. These tools have been adapted to each of the populations in the Cowlitz Basin, but may need to be reviewed and updated, or replaced, periodically or as new and better tools are developed. The In-Season Implementation Tool (ISIT), which was used to capture and summarize status and trends information as well as Decision Rules, is described in Appendix I, where links to each of the ISIT spreadsheets are provided for each population.

The All H Analyzer (AHA) tool developed by the HSRG process has been incorporated in the ISIT spreadsheet. This is where the key assumptions are captured and the expected long term outcomes of the decision rules are calculated. Documentation for the AHA can be found at the following website: http://hatcheryreform.us. The AHA tool incorporates data from many sources. Data for in-hatchery survival by life stage, adult returns, number of adults spawned, and juveniles released were taken from Cowlitz Salmon Hatchery annual reports (Johnson and Newhouse 2005a, 2006a, 2007a, 2008a, 2009a), Cowlitz Trout Hatchery annual reports (Johnson and Fitch 2005b, 2006b, 2007b, 2008b, 2009b) and Hatchery Genetic Management Plans (HGMPs) for Cowlitz fall Chinook, summer steelhead, winter steelhead, coho, and spring Chinook (WDFW 2005a, 2005b, 2005c, 2005d, 2005e). Data for survival to adult (SAR) from juvenile releases, exploitation rates for fisheries and escapement were taken from the Regional Mark Processing Center (Regional Mark Processing Center 2010). Data on smolt passage through Mayfield Dam (Tilton River), juvenile outmigration, adult returns and adults planted in the Tilton were taken from Cowlitz River Evaluation Program Annual Reports

(Henning 2006, 2007, 2007, 2008, 2009, 2010). Data on smolt passage through Cowlitz Falls Dam (Upper Cowlitz), juvenile outmigration, adult returns and adults planted in the Upper Cowlitz were taken from draft data summaries for the Cowlitz Falls Anadromous Fish Reintroduction Project (Serl and Morrill 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010). Data for natural population structure in the Cowlitz Basin, Recovery Goals, population designations, and current abundance of natural populations were taken from the Lower Columbia River Fish Recovery Board Draft Recovery Plan (LCRFRB 2010).

3 2012 ACTION PLAN

This section describes agreed upon actions for the upcoming year. The actions are based on the goals and assumptions above and the application of the decision rules to the upcoming season (2012).

The Decision Rules do not automatically incorporate the constraints imposed by the SA in terms of maximum overall hatchery production. This is accomplished according to Sections 2.5.2 and 2.5.3.

Actions are presented by population and hatchery program. Each population section is outlined as follows:

1. **Management Targets.** These sections show the current status of the population and the expected condition, in the long term, when the goals for the population are met.

2. **Decision Rules**. These sections define the agreed upon strategies, or rules, whereby hatchery programs will be managed in response to the annual abundance in order to meet population goals over time.

3. **2012 Action Plan**. These sections summarize the specific management actions that will be taken in 2012, according to the Decision Rules.

4. **Monitoring Priorities**. These sections identify the critical assumptions upon which the management strategy is based, and also the variables that need to be monitored to measure success over time.

In this chapter, Upper Cowlitz and Cispus populations are combined under the Upper Cowlitz heading. Segregated hatchery programs are addressed under the heading of the natural population with which they are most closely associated. Thus the summer and early winter steelhead programs are covered in the section titled Lower Cowlitz Steelhead. An exception to this is Lower Cowlitz spring Chinook, which has its own section. The Tilton fall Chinook program is presented as a part of the Lower Cowlitz fall Chinook program, since there is no natural population of fall Chinook identified in the Tilton.

3.1 LOWER COWLITZ FALL CHINOOK

Lower Cowlitz fall Chinook is designated as a Contributing population with a minimum abundance target of 3,000 natural origin spawners (Figure 3-1). Lower Cowlitz fall Chinook stocks are important contributors to ocean and in-river fisheries.

3.1.1 Management Targets

Pre-terminal exploitation rates and the proportion of hatchery fish in the natural spawning population prevent this population from meeting conservation goals. Unknown factors

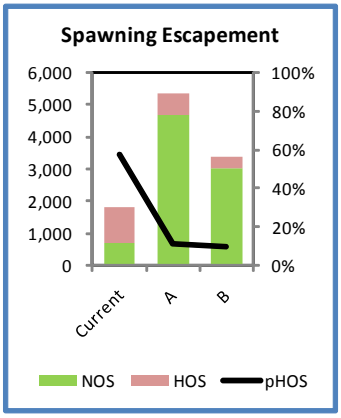
(perhaps cutthroat predation, *Ceratomyxa shasta*, etc.) affecting NOR survival reduce the natural productivity by about 30% from the EDT estimate.

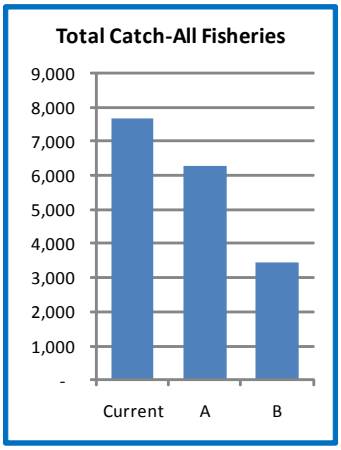
In order to retain harvest benefits and meet conservation goals, the hatchery program will be integrated with a pNOB of 30%. Biological targets cannot be met unless pHOS is reduced below 30%, which requires a reduction in the number of smolts released and/or reduced exploitation of NORs and/or increased harvest of HORs.

Figure 3-1 describes the current potential and two views of the long-term future for the population and the fisheries it supports (labeled "Recent Past" and Scenarios "A" and "B", respectively). This figure and similar ones in the following sections display the result of AHA analysis (Section 2.6 and Appendix I). This analysis provides scientific accountability by identifying the information and assumptions upon which the expected outcomes are based. Note also that the analytical results shown in Figure 3-1 represent the current and future potential of the system and may differ from what has been observed in any give period of time. Observed and the potential (modeled) results are subject to different sources of error. This is why the NOR abundance in Figure 3-1 is different from the number shown in Table 2-11 (702 versus 472). Figure 3-2 summarizes the conditions under which harvest and conservation goals are expected to be met in the future. The figure shows where we are now and where we expect to be in the future and the changes necessary to get there. The Decision Rules described in Section 3.1.2 demonstrate how we intend to get from the current condition to the long-term target (Scenario A in Figure 3-2 is the preferred option). For example, the Decision Rules look at the run size forecast and apply the HSRG standards to determine the size of the hatchery program for the coming season. Adjustments are also made annually to apply credit for natural production. Thus the numbers in Figure 3-1, and their equivalents in the subsequent sections, do not, for example, display the 2012 hatchery production numbers. Those numbers are shown in Section 3.1.4, following the application of the Decision Rules in Section 3.1.2.

The Decision Rules that are appropriate in the near term, given the current conditions and long-term goals, are shown in Figure 3-2. Note again that the outcome of applying these rules will change annually and translated into a new set of actions (e.g., hatchery release numbers). Application of the rules is a centerpiece of the annual review (Section 2.1).

Lower Cowlitz Fall Chinook	Recent Past	A Contributing Biological Targets	Options to meet Long-term Goals A	B (Seg)
Natural Production				
Productivity (Smolts/Spawner)	188		555	316
Capacity (Smolts)	396,608		1,171,605	667,095
SAR	0.93%		0.93%	0.93%
Fitness	0.50		0.88	0.50
PNI	0.05	> 0.5	0.72	0.00
Effective pHOS	58%	< 30%	12%	10%
Ocean Harvest Rate	42%		35%	35%
Columbia River Harvest Rate	12%		10%	10%
NOR Abundance potential	702	> 3,000	4,667	3,034
Hatchery Production				
Lower Cowlitz Program	5,244,456		2,400,000	1,200,000
SAR	0.25%		0.34%	0.34%
Stray Rate	20%		20%	20%
pNOB	3%		30%	0%
NOB	72		329	-
NOB as % of NOR escapement	10%		7%	0%
Ocean Harvest Rate	42%		42%	44%
Columbia River Harvest Rate	12%		15%	15%
Terminal Harvest Rate	26%		26%	26%
Expected Catch All Fisheries	7,682		6,267	3,442
Hatchery Surplus	2,035		1,882	729
Average Terminal HOR Run	7,530		4,722	2,276
Expected HOS	1,114		699	337





Source: See Section 2.6.

Figure 3-1. Biological targets, key assumptions and expected outcomes under recent conditions and under future options to meet long-term harvest and conservation goals for Lower Cowlitz fall Chinook.

There is uncertainty about whether the effects of *C. shasta* disease are fully accounted for in the productivity parameter for the current condition. Fall Chinook will not be used for nutrient enhancement in the lower river because of disease concerns.

3.1.2 Decision Rules

In order to meet the HSRG standards for hatchery influence on a Contributing population, the size of the hatchery program will range from 1.5 to 2.4 million as the NOR run ranges from 720 to 1,150 adults. This is premised on the feasibility to operate an integrated program where 30% of the broodstock is made up of natural-origin adults[4] (Figure 3-2). Tools to calculate the annual program size are provided in Appendix G. An expected NOR run size to the Cowlitz of about 700 adults is consistent with available observations and best professional judgment. A value of 638 is entered into the Decision Rule in

[4] The methodology for capturing NOR broodstock is being developed as part of the M&E program (see Appendix J for details).

Figure 3-2, based on an average NOR escapement estimate of 472 and an in-river harvest rate of 26%.

A. Key assumptions

Hatchery SAR	0.25%	Natural SAR	0.93%	
Pre terminal HOR Exploitation Rate	42%	Pre terminal NOR Exploitation Rate	**49%**	
Terminal Harvest HOR Rate	26%	Terminal Harvest NOR Rate	26%	
Stray Rate of HORs	**20%**	Habitat Productivity	188	smolts/Spawner
Expected Ave. HOR Return	5,555	Habitat Capacity	397	Thousand Smolts
Hatchery Smolts per Spawner	2185	Relative Fitness	0.50	
Max % of NORs Accessible for Brood	**30%**	Ave. NOR at 49% ER;	**702**	
		Ave. NOR at 40% ER;	**3,683**	

B. Biological Targets

pNOB	pHOS	PNI	NOR Spawners (NOS)
30%	**30%**	**0.5**	**3,000**

C. Decision Rules

For NOR less than	732	Release	1,500,000	Smolts		**BS**	686
					Predicted NOR 638	**NOB**	142
↓		↓				**HOB**	545
For NOR greater than	1,172	Release	2,400,000	Smolts		**Release**	1,500,000

Source: See Section 2.6.
Note: An electronic version of this tool is available in Appendix I.

Figure 3-2. Snapshot of the control page for the Decision Rule calculator for Lower Cowlitz fall Chinook.

Each year, 1,600 of the adult returns from this program will be transported above Mayfield to provide harvest and assist in achieving nutrient enhancement targets in the Tilton. There is no distinct fall Chinook population identified in the recovery plan for the Tilton. Fall Chinook transferred to the Tilton are considered part of the Lower Cowlitz fall Chinook population.

3.1.3 Monitoring Priorities

Priorities for monitoring and evaluation are driven by the adaptive management decision making requirements. Monitoring will focus on collecting the data needed to estimate the indicators that a) affect management decisions, b) are uncertain, and c) are feasible to observe and estimate. These indicators fall into three broad categories: key assumptions about how the "system" works; status and trends of the resource; and management precision. See Chapter 4 and Appendices H and J for more details.

Key Assumptions—parameters estimated from the accumulation of data over time. Accuracy and precision will improve from year to year.

The most critical assumptions for Lower Cowlitz fall Chinook are stray rates from the existing hatchery program. In addition, the ability to collect NORs for incorporation in the hatchery brood (pNOB) is uncertain. Harvest rates of NORs and HORs (both in pre-terminal and terminal fisheries) affect natural origin escapement and pHOS, which determine hatchery program levels and are also critical to the decision rules. The five-year average of pHOS and pNOB will be complied and reported each year and will serve as the trigger for altering program size. Stock identification marks for this population can be found in Table 2-10.

Annual Status and Trends—tracks annual outcomes in terms of variable annual biological targets. These targets are revised each year according to decision rules and take run forecasts into account. Viewed over time (the trends part), this information will track progress towards conservation and harvest goals.

For Lower Cowlitz Fall Chinook, annual estimates of spawner abundance (NOS) and composition (pHOS) as well as NOR and HOR catch in all fisheries are important to track progress toward goals over time. Five-year running averages of NOS and catch should be reported every year.

Management Precision—performance evaluation to improve run forecasting and harvest over time to more effectively implement the decision rules. In other words, this monitors the effectiveness of the application of the Decision Rules.

A methodology for estimating HOR and NOR returns and harvest of Lower Cowlitz fall Chinook adults in all fisheries should be developed to allow more accurate estimates of these values.

Appendix G contains tables identifying the critical parameters, that is, those that are uncertain, affect decisions and should be monitored.

Chapter 4 identifies the variables, parameters estimated, frequency of sampling and data collected that will be used to effectively address the needs for all populations in a comprehensive monitoring plan.

3.1.4 Actions for 2012

Assuming an NOR run of less than 732 adults in 2012 and applying the Decision Rules for conservation (Figure 3-2) results in a fall Chinook program of 1,500,000 smolts (Table 3-1).

Table 3-1. 2012 Lower Cowlitz fall Chinook hatchery program.

2013 Smolt Release Number[1] Prior to Credit Adjustment	1,500,000
Release Size (fish/lb)	80
Credit Adjustment (number)	29,292
Credit Adjustment (lbs)	366
Adjustment for Pound Limit, if any	879,505
Net Smolt Release Target for 2013 (number)	1,500,000
Net Smolt Release Target for 2013 (lbs)	18,750
Adults Transported Above Mayfield for Harvest	1,600

[1] Target smolt number to be released from to 2012 brood, i.e. smolts will be released in 2013.

3.2 LOWER COWLITZ SPRING CHINOOK

There are no natural production goals for Lower Cowlitz spring Chinook. This is a segregated harvest program. The original broodstock source was the native spring Chinook from the Upper Cowlitz basin. The program therefore also serves as a temporary gene bank for the planned reintroduction of spring Chinook into the Upper Cowlitz/Cispus and Tilton basins.

3.2.1 Management Targets

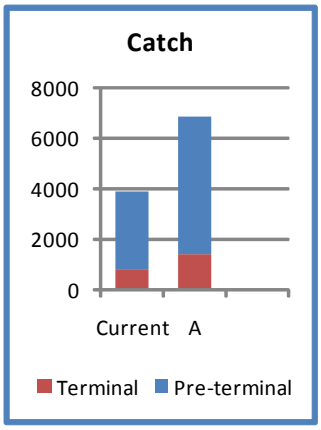
No changes to the assumptions or management targets are expected over the period covered by this FHMP Update. The goals are to maintain population viability and to maximize harvest within the Cowlitz River, subject to the limitations associated with the operational constraints and priorities of the Cowlitz Salmon Hatchery.

The genetic identity and diversity of the population will continued to be maintained by employing Best Management Practices (BMPs) in the hatchery (collecting eggs over the entire return timing, 1:1 mating schemes, etc.) in order for the population to be an effective source for re-colonization of the upper watershed. Otherwise, no significant conservation constraints have been identified.

Lower Cowlitz Spring Chinook

	Recent Past (2009)	A Segregated Hatchery Population Biological Targets	Options to meet Long-term Goals A
Natural Production			
ductivity (Smolts/Spawner)	0		0
Capacity (Smolts)	0		0
SAR	5.50%		5.50%
Fitness	0.50		0.50
PNI	-	-	-
Effective pHOS	100%	-	100%
ɔloitation Rate-All Fisheries	47%		47%
NOR Abundance potential	0	-	0
Hatchery Production			
Lower Cowlitz Program	971,964		1,801,949
Upper Cowlitz Program	-		-
SAR	0.9%		0.8%
Stray Rate	13.00%		13.00%
pNOB	0%		0%
ɨ-terminal Exploitation Rate	37%		37%
Terminal Harvest Rate	15%		15%
Expected Catch	3,133		5,492
Terminal Catch	790		1,385
Hatchery Surplus*	3,646		6,333

* includes fish from Upper Cowlitz Program transported to Upper Cowlitz



Source: See Section 2.6.

Figure 3-3. Biological targets, key assumptions and expected outcomes under recent conditions and under future options to meet long-term harvest and conservation goals for Lower Cowlitz spring Chinook.

3.2.2 Decision Rules

Hatchery production is constrained by the priorities and production limits of the hatchery. Recent production targets of about 194,000 pounds of yearling smolts are expected to increase to 231,250 (prior to credits) for the duration of this FHMP Update. The size of the smolts will range from 16 to 5 fish per pound.

3.2.3 Monitoring Priorities

Key Assumptions—parameters estimated from the accumulation of data over time. Accuracy and precision will improve from year to year.

The critical assumptions for Lower Cowlitz spring Chinook are that: 1) hatchery-origin spring Chinook do not prey on NOR fall Chinook, and 2) hatchery-origin spring Chinook contribute to harvest. No further monitoring is identified.

Stock identification marks for this population can be found in Table 2-10.

Annual Status and Trends—tracks annual outcomes in terms of variable annual biological targets. These targets are revised each year according to decision rules and by taking run forecasts into account. Viewed over time (the trends part), this information will track progress towards conservation and harvest goals.

For Lower Cowlitz spring Chinook, annual estimates of pre-terminal and terminal harvest rates are critical to assessing achievement of harvest goals. Monitoring of Upper Cowlitz spring Chinook and Lower Cowlitz fall Chinook will include values for this program. No further monitoring is identified.

Management Precision—performance evaluation to improve run forecasting and harvest over time to more effectively implement the Decision Rules. In other words, this monitors the effectiveness of the application of the Decision Rules.

A methodology for estimating HOR contribution to all fisheries should be developed. This methodology should include a strategy to identify specific contribution by Lower River spring Chinook. These values will be collected during monitoring for Upper River spring Chinook. No further monitoring is identified.

3.2.4 Actions for 2012

Table 3-2. 2012 Lower Cowlitz Spring Chinook Hatchery Program.

Pounds of Smolts to be Released[1] Prior to Credit Adjustment	231,250 lbs
Release Size (fish/lb)	5, 8, and 16
Credit Adjustment (lbs)	1,126 lbs
Adjustment for Pounds Limit, if any	0 lbs
Net Smolt Release Target for 2013/2014 (lbs)	231,250 lbs
Net Smolt Release Target for 2014—number @ 5/lb	497,849
Net Smolt Release Target for 2014—number @ 8/lb	800,000
Net Smolt Release Target for 2013—number @ 16/lb (fall release)	500,000

[1] Target smolt number to be released from the 2012 brood, i.e. smolts will be released in 2014.

3.3 LOWER COWLITZ COHO

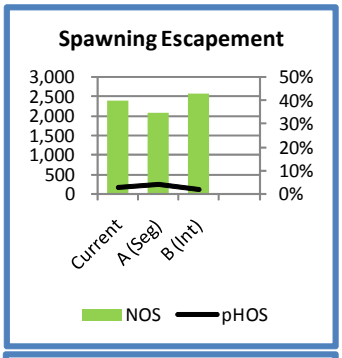
The Lower Cowlitz coho is designated as a Primary population. It is likely meeting the HSRG standards for hatchery influence in most years. Better information about spawner abundance and composition is required to confirm this. The hatchery program is managed as segregated harvest program. Abundance of natural origin spawners is most likely less than the recovery target of 3,700 fish.

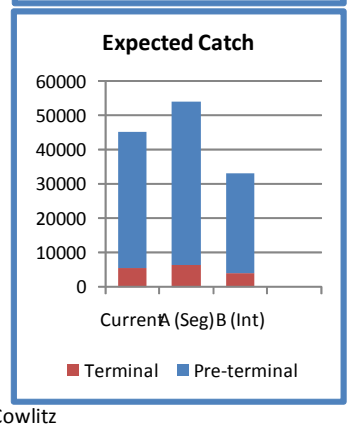
3.3.1 Management Targets

Figure 3-4 describes two views of the future for the population and the fisheries it supports (Options A and B). It identifies the conditions under which harvest and conservation goals will be reached in the future. The figure also captures the current conditions; in other words, it shows where we are now and where we expect to be in the

future. Section 3.3.2, Decision Rules, describes how we intend to get from the current condition to the long-term target (Options A or B). In the future, consideration could be given to converting to an integrated hatchery program to further improve fitness of the natural population (Figure 3-4). It is unlikely that the recovery goals for this population will be reached without measures that are beyond the scope of this SA, such as either habitat improvement or significant reduction in NOR harvest rates in pre-terminal fisheries. In recent years, the highest harvest rates on NORs have occurred in mainstem Columbia fisheries.

Lower Cowlitz Coho (Type N)	Recent Past	A Primary Management Targets	Options to meet Long-term Goals	
			A (Seg)	B (Int)
Natural Production				
roductivity (Smolts/Spawner)	21		16	28
Capacity (Smolts)	30,655		24,027	41,427
SAR	13.73%		13.73%	13.73%
Fitness	0.72		0.56	0.97
PNI	-	> **0.67**	-	0.91
Effective pHOS	3%	< **5%**	4%	2%
Exploitation Rate-All Fisheries	28%		28%	28%
NOR Abundance potential	2,393	> **3,700**	2,087	2,566
Hatchery Production				
Lower Cowlitz Program	2,841,363		2,400,000	1,100,000
Upper Cowlitz Program	-		978,000	978,000
SAR	2.7%		2.7%	2.7%
Stray Rate	0.27%		0.27%	0.27%
pNOB	0%			20%
NOB	-		-	184
NOB as % of NOR escapement	0%		0%	7%
Pre-terminal Exploitation Rate	52%		52%	52%
Terminal Harvest Rate	15%		15%	15%
Expected Catch	39,931		47,472	29,203
Terminal Catch	5,434		6,461	3,974
Hatchery Surplus*	31,890		38,732	24,321





* includes fish from Upper Cowlitz Program transported to Upper Cowlitz

Note that integrated programs are significantly less sensitive to pHOS. Even when pHOS is small, i.e. less than 5%, there is a fitness benefit to integration.

Source: See Section 2.6.

Figure 3-4. Biological targets, key assumptions and expected outcomes under recent conditions and under future options to meet long-term harvest and conservation goals for Lower Cowlitz coho.

3.3.2 Decision Rules

The proportion of hatchery fish on the spawning ground (pHOS) for the Lower Cowlitz coho population is affected by all hatchery programs in the project area. Thus the decision rules for the Lower Cowlitz hatchery program are affected by the size of the Upper Cowlitz integrated program. These rules call for the program size to be

determined by the expected size of the Lower Cowlitz natural return and the 5% pHOS limit. For example, if the Upper Cowlitz hatchery program is scheduled to release 978,000 smolts, then the size of the Lower Cowlitz program will range from 1,200,000 to 2,400,000 smolts as the NOR run ranges from 990 to 1,535 (Figure 3-5). Tools to calculate the annual program size are provided in Appendix I.

These rules define the conservation constraints on the Lower Cowlitz hatchery program. The program size may further be constrained by the crediting rules (Sections 2.5.3 and 3.13.1) and by the "650" rule (Sections 2.5.2 and 3.13.2).

A. Key assumptions

Hatchery SAR	2.68%	Natural SAR	13.73%	
Pre terminal HOR Exploitation Rate	52%	re-term. NOR Exploit. Rate	**28%**	←
Terminal Harvest HOR Rate	15%	erminal Harvest NOR Rate	2%	
Stray Rate of HORs	**0.27%**	Habitat Productivity	21	smolts/Spawner
Expected Ave. HOR Return	34,362	Habitat Capacity	30,655	Smolts
Hatchery Smolts per Spawner	1194	Relative Fitness	0.72	
Max % of NORs Accessible for Brood	**20%**			

B. Biological Targets

pNOB>	pHOS<	PNI>	NOR Spawners (NOS)>	Upper River Program size
0%	**5%**	**0.67**	**3,700**	**978,000**

C. Decision Rules

For NOR less than	990	release	1,203,231	smolts
For NOR greater than	1,535	release	2,404,009	smolts

For intermediate NOR returns

NOR	BS	NOB	HOB	pNOB	Release
1200	1,395	235	1,160	17%	1,665,916

Source: See Section 2.6.
Note: This figure is a "screenshot" from the ISIT calculator in Appendix I.

Figure 3-5. Illustration of conservation Decision Rule for the Lower Cowlitz coho program.

3.3.3 Monitoring Priorities

Key Assumptions—parameters estimated from the accumulation of data over time. Accuracy and precision will improve from year to year.

The most critical assumption for Lower Cowlitz coho is stray rates from the existing segregated program. The stray rate of hatchery-origin fish is assumed to be very low. This is based on recent field surveys that should be monitored annually. In addition, harvest rates on NORs and HORs (both in pre-terminal and terminal fisheries) affect natural-origin escapement and pHOS which determine hatchery program levels (see

Appendix G and Chapter 4 for more details). Stock identification marks for this population can be found in Table 2-10. The five-year average pHOS will be complied and reported each year and will serve as the trigger for altering program size.

Annual Status and Trends—tracks annual outcomes in terms of variable annual biological targets. These targets are revised each year according to decision rules and by taking run forecasts into account. Viewed over time (the trends part), this information will track progress towards conservation and harvest goals.

For Lower Cowlitz coho, annual estimates of spawner abundance and composition (pHOS) and NOR and HOR catch in all fisheries are most important to track progress toward goals over time. Five-year running averages of pHOS, NOS and catch should be reported every year.

Management Precision—performance evaluation to improve run forecasting and harvest over time to more effectively implement the Decision Rules. In other words, this monitors the effectiveness of the application of the Decision Rules.

A methodology for estimating HOR and NOR returns and harvest of Lower Cowlitz coho adults in all fisheries should be developed to allow more accurate estimates of these values.

Appendix G contains tables identifying the critical parameters, i.e., those that are uncertain and affect decisions and should be monitored.

Chapter 4 identifies the variables, parameters estimated, frequency of sampling and data collected that will be used to effectively address the needs for all populations in a comprehensive monitoring plan.

3.3.4 Actions for 2012

By assuming an NOR return in excess of 1,578 and applying the Decision Rules, the resulting coho release number is 2,400,000 fish.

Table 3-3. 2012 Lower Cowlitz coho hatchery program.

2014 Smolt Release Number[1] Prior to Credit Adjustment	2,400,000
Release Size (fish/lb)	15
Credit Adjustment (number)	271,602
Adjustment for Pound Limit, if any	1,008,323
Net Smolt Release Target for 2014 (number)	1,200,000
Net Smolt Release Target for 2014 (lbs)	80,000

[1] Target smolt numbers to be released from the 2012 brood, i.e. smolts will be released in 2014.

3.4 LOWER COWLITZ STEELHEAD

The Lower Cowlitz indigenous late winter steelhead population is designated as Contributing. The HSRG standards for hatchery influence have not been met in recent years. The proportion of hatchery fish effectively spawning with the indigenous late winter steelhead population exceeds the 10% limit. In addition, the census number of strays from the segregated summer steelhead program exceeds the 30% limit associated with ecological risk. Even though the abundance of natural-origin spawners exceeds the 400 fish recovery target, a large proportion of these fish are likely offspring of hatchery fish spawning in the wild with low fitness.

Hatchery steelhead production is a high priority for harvest in the Cowlitz basin. Both the summer (Skamania-origin) and late winter (Cowlitz-origin) hatchery steelhead are selectively harvested at high rates in the recreational fisheries.

3.4.1 Management Targets

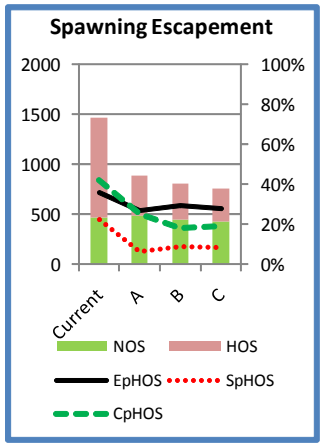
Natural-origin steelhead were sampled in tributaries of the lower Cowlitz basin and compared genetically to Cowlitz Hatchery steelhead broodstocks (summer, early-winter, and late-winter) to examine hatchery introgression into natural populations in 2008-2009. Cowlitz tributary natural-origin adults were also compared to natural-origin steelhead collected in other nearby tributaries in the lower Columbia drainage to characterize existing genetic diversity. Lower Cowlitz tributary natural-origin steelhead had the highest ancestry in a native gene pool and were genetically distinct from the three Cowlitz Hatchery stocks. However, ancestry or introgression was estimated from all three hatchery stocks in the natural-origin steelhead. The Cowlitz Hatchery early winter-run stock (non-native, Puget Sound-origin) showed the highest introgression level among the three stocks. The eight marked, hatchery-origin adults collected during sampling appeared to originate from all three hatchery stocks, with the early-winter stock being the major contributor. Lower Cowlitz tributary natural-origin steelhead were genetically most similar to natural-origin steelhead in the Coweeman and Elochoman rivers, and were distinct from steelhead in the nearby Toutle River subbasin. Introgression from hatchery stocks is a significant concern in recovery planning for the ESA-listed Lower Cowlitz population. For this reason, the early winter-run program will be terminated.

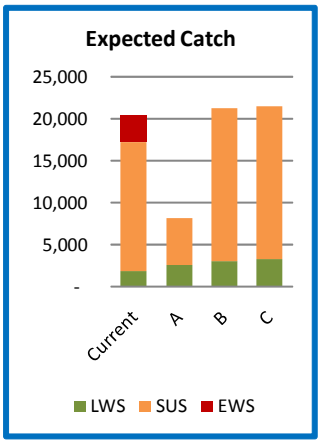
Figure 3-6 describes three views of the future for the population and the fisheries it supports (Scenarios A, B and C). It identifies the conditions under which harvest and conservation goals will be reached in the future. The figure also captures the current conditions, in other words, it shows where we are now and where we expect to be in the future. Section 3.4.2, Decision Rules, describe how we intend to get from the current condition to the long-term target (Scenarios A, B or C). In order to meet conservation standards, the Lower Cowlitz steelhead programs must either be substantially reduced or excess hatchery fish removed by operating weirs in spawning tributaries in the Lower Cowlitz River, as illustrated by Options A, B and C in Figure 3-6. Weir efficiency is the main difference among Options A, B and C.

Weirs will be installed and operated to remove summer steelhead (Option B). In addition, they will be used to collect NOR brood to convert the late winter steelhead

program to an integrated program. The efficiency of the weirs in capturing summer steelhead (80%) and late winter steelhead (20%) are key assumptions addressed in the M&E plan.

Lower Cowlitz Steelhead	Recent Past	A Contributing Population Biological Targets	Future Options: no weir A	Weirs B	Weirs C
Natural Production					
Productivity (Smolts/Spawner)	12		16	15	15
Capacity (Smolts)	3660		4925	4687	4760
SAR	11.8%		11.8%	11.8%	11.8%
Fitness	0.5		0.67	0.64	0.65
PNI	-	> 0.5	0.53	0.51	0.52
Total Effective pHOS (EpHOS)	36%	< 30%	27%	29%	28%
Seg Effective pHOS (SpHOS)	22%	< 10%	6%	9%	8%
Seg Census pHOS (CpHOS)	42%	< 30%	25%	18%	19%
NOR Abundance potential	468	> 400	486	450	433
Hatchery Production					
Late Winter Sthd					
Release LC program	284,681		400,000	481,389	525,000
Release UC program	-		-	118,000	118,000
Stray Rate	10%		10%	10%	10%
Rel. Reprod. Success	80%		80%	80%	80%
Weir Efficiency	0%		0%	20%	35%
Harvest Rate	62%	60%	62%	62%	62%
SAR	1%		1%	1%	1%
Summer Sthd					
Release	550,000		200,000	650,000	650,000
Stray Rate	10%		10%	10%	10%
Rel. Reprod. Success	18%		18%	18%	18%
Weir Efficiency	0%		0%	80%	80%
Harvest Rate	70%	70%	70%	70%	70%
SAR	4%		4%	4%	4%
Early Winter Sthd					
Release	300,000		0	0	-
Stray Rate	10%		10%	10%	10%
Rel. Reprod. Success	20%		20%	20%	20%
Weir Efficiency	0%		0%	20%	20%
Harvest Rate	55%	55%	55%	55%	55%
SAR	2%		2%	2%	2%
Expected Catch	20,467		8,083	21,921	22,192





Source: See Section 2.6.

Figure 3-6. Biological targets, key assumptions and expected outcomes under recent conditions and under future options to meet long-term harvest and conservation goals for Lower Cowlitz steelhead.

3.4.2 Decision Rules

As soon as feasible[5], the late winter steelhead program will become integrated. The size of this program and the segregated summer steelhead program will be shaped by the size of the natural population, the 10% limit on effective hatchery spawners, and the 30% maximum proportion of hatchery fish from segregated programs. This is illustrated in Figure 3-7 below. The ISIT calculator for this population (Appendix I) will be used as an aid to determine program size each year. Hatchery fish from future Upper Cowlitz programs will stray into the Lower Cowlitz natural population; therefore, the size of this release (as discounted by FPS) must be accommodated within the limits imposed by these conservation rules.

A. Key Assumptions CURRENT CONDITIONS

	SAR	HR	Stray Rate	Rel. Rep Success	Relative Fitness	Weir Effective-ness
Nat LWS	12%	2%			50%	
LWS	1%	62%	10%	80%		20%
SuS	4%	70%	10%	18%		80%
EWS	2%	55%	10%	20%		20%
Tilton LWS	1%	62%	5%	80%		20%

B. Biological Targets

Census pHOS	Effective pHOS	Segreg. pHOS	pNOB	PNI
30%	30%	10%	30%	0.5

C. Decision Rules

	Release #	Adult Return	Harvest	BS	Census Spawners	Effective Spawners	(Seg. HORs)
NOR Run Forecast:		**506**	10	73	423	**423**	
LC-LWS	481,389	4,836	2,988		148	118	
UC-LWS	118,000	1,185	733		36	29	29
SuS	650,000	26,000	18,200		156	28	28
Tilton LWS	48,500	487	301		7	6	6
					163	181	63
				Stray "Budgets":	245	181	63

Source: See Section 2.6.
Note: This is a screenshot from the ISIT calculator (Appendix I).

Figure 3-7. Illustration of conservation decision rules for the Lower Cowlitz steelhead programs.

[5] Feasibility will depend on weir efficiency and spawner abundance

These rules define the conservation constraints on the Lower Cowlitz hatchery program. The program size may further be constrained by the crediting rules (Sections 2.5.3 and 3.13.1) and by the "650" rule (Sections 2.5.2 and 3.13.2).

3.4.3 Monitoring Priorities

Key Assumptions—parameters estimated from the accumulation of data over time. Accuracy and precision will improve from year to year.

The most critical assumption for Lower Cowlitz winter steelhead is stray rates from the existing segregated summer steelhead and the planned integrated late winter steelhead programs. The stray rate of hatchery-origin fish is not well documented with field data and should be monitored annually. In addition, harvest rates on NORs and HORs in terminal fisheries affect natural-origin escapement and pHOS, which determine hatchery program levels. See Appendix G and Chapter 4 for more details. Stock identification marks for this population can be found in Table 2-10. The five-year average pHOS will be complied and reported each year and will serve as the trigger for altering program size.

Annual Status and Trends—tracks annual outcomes in terms of variable annual biological targets. These targets are revised each year according to decision rules and by taking run forecasts into account. Viewed over time (the trends part) this information will track progress towards conservation and harvest goals.

For Lower Cowlitz steelhead, annual estimates of spawner abundance and composition (pHOS) and NOR and HOR catch in terminal fisheries are important for tracking progress toward goals over time. Five-year running averages of pHOS, NOS and catch should be reported every year.

Management Precision—performance evaluation to improve run forecasting and harvest over time to more effectively implement the Decision Rules. In other words, this monitors the effectiveness of the application of the Decision Rules.

A methodology for estimating HOR and NOR returns and harvest of Lower Cowlitz steelhead adults should be developed to allow more accurate estimates of these values.

Appendix G contains tables identifying the critical parameters, i.e., those that are uncertain, affect decisions and should be monitored.

Chapter 4 identifies the variables, parameters estimated, frequency of sampling and data collection that will be used to effectively address the needs for all populations in a comprehensive monitoring plan.

To determine the fate of recycled summer steelhead, a study will be implemented to evaluate the assumed harvest, stray rates, and weir removal rates used in the FHMP modeling. For summer steelhead, there are some data on steelhead recycling from past studies in the lower Cowlitz River (trucking returning adults downstream to provide additional harvest opportunity); however, these studies left some important questions unanswered. Specifically, what are the stray and harvest rates of recycled summer steelhead? The study will use a combination of radio tags, Floy tags and other

identification methods as needed to determine the fate of recycled summer steelhead. WDFW proposes that the study be conducted by USGS. While previous studies have determined how many recycled fish returned to the separator at the Cowlitz Salmon Hatchery, these studies have not accurately determined the fate of fish that did not arrive at the separator. This study will ensure that data on the fate of recycled summer steelhead are collected and will be used to guide future management decisions about recycling summer steelhead in the Cowlitz basin.

The study proposes to recycle up to 500 summer-run steelhead one time, using a combination of radio tags, Floy tags and opercula punches to allow for evaluation. Returns to hatchery facilities, lower river weirs and harvest rates will be enumerated. The study will begin when WDFW secures funding. The impact of recycling (presumed to be increased pHOS) will require reducing the currently proposed program from 650,000 to 625,892 summer steelhead.

3.4.4 Actions for 2012

Assuming an NOR return of 506 late winter steelhead, the Decision Rules indicate a release of 482,389 late winter steelhead smolts along with 650,000 summer steelhead smolts. The Upper Cowlitz and Tilton programs are assumed to be no greater than 118,000 and 48,500 late winter steelhead, respectively (see Figure 3-7).

Table 3-4. 2012 Lower Cowlitz late winter steelhead hatchery program.

2013 Smolt Release Number[1] Prior to Credit Adjustment	482,389
Release Size (fish/lb)	5.5
Credit Adjustment (number)	8,092
Credit Adjustment (lbs)	1,471 lbs
Adjustment for Pound Limit, if any	0
Net Smolt Release Target for 2013 (number)	473,297
Net Smolt Release Target for 2013 (lbs)	86,054 lbs

[1] Target smolt number to be released from the 2012 brood, i.e., smolts will be released in 2013.

Table 3-5. 2012 Lower Cowlitz summer steelhead hatchery program.

2013 Smolt Release Number[1] Prior to credit adjustment	650,000
Release Size (fish/lb)	5.5
Adjustment for Pound Limit, if any	0
Net Smolt Release Target for 2013 (number)	650,000
Net Smolt Release Target for 2013 (lbs)	118,182

[1] Target smolt number to be released from the 2012 brood, i.e., smolts will be released in 2013.

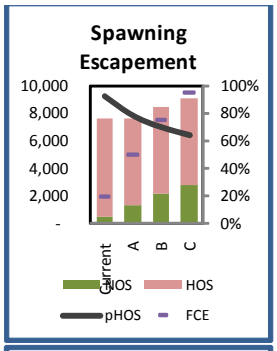
3.5 UPPER COWLITZ FALL CHINOOK

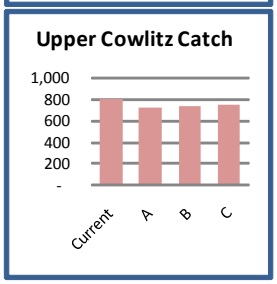
The upper Cowlitz fall Chinook population is designated as a Stabilizing population. Recovery goals for this population have not been quantified.

3.5.1 Management Targets

Figure 3-8 describes three views of the future for the population and the fisheries it supports (Scenarios A, B, and C). It identifies the conditions under which harvest and conservation goals will be reached in the future. The figure also captures the current conditions. In other words, it shows where we are now and where we expect to be in the future. Section 3.5.2 (Decision Rules) describes how we intend to get from the current condition to the long-term target (Scenarios A, B, or C). Substantial improvements in fish passage survival (FPS) are required before a naturally spawning population can be sustained in the Upper Cowlitz/Cispus watersheds (Figure 3.8).

Upper Cowlitz Fall Chinook	Recent Past	A Stabilizing Population Biological Targets	Options to meet Long-term Goals A	B	C
Natural Production					
Productivity (Smolts/Spawner)	164		164	164	164
Capacity (Smolts)	522,294		522,294	522,294	522,294
SAR	0.19%		0.47%	0.70%	0.88%
FPS	20%		50%	75%	95%
Fitness	0.5		0.50	0.50	0.50
PNI	-	-	-	-	-
Effective pHOS	93%	-	79%	70%	64%
Terminal Harvest Rate	2%		2%	2%	2%
NOR Abundance potential	462	-	1,378	2,146	2,793
Hatchery Production					
Release (from Hatchery)	-		-	-	-
pNOB	0%		0%	0%	0%
Adults Transported above CF	8,000		7,000	7,000	7,000
Harvest Rate	10%		10%	10%	10%
Expected Catch	809		728	743	756





Source: See Section 2.6.

Figure 3-8. Biological targets, key assumptions and expected outcomes under recent conditions and under future options to meet long-term harvest and conservation goals for Upper Cowlitz fall Chinook.

3.5.2 Decision Rules

There are no plans to release juvenile fall Chinook in the Upper Cowlitz/Cispus Rivers. Depending on availability, up to 7,000 adult fall Chinook from the Lower Cowlitz hatchery program will be transported and released above Cowlitz Falls for harvest and nutrient enhancement purposes. The number (7,000) is based on watershed carrying capacity, consistent with the nutrient enhancement rules (Section 5.1). Under current

downstream passage conditions, natural production cannot be self-sustaining in the Upper Cowlitz. Efforts to re-colonize cannot be successful until substantial improvement in juvenile downstream passage has been achieved.

A. Key Assumptions CURRENT CONDITIONS

	NOR	HOR
SAR	0.2%	0.5%
Preterm Harv. Rate	49%	51%
Low Cow. Harv Rate	2%	2%
Up Cow. Mortality	0%	10%

FPS	0.20
Relative Fitness NORs	50%
Rel. Rep Success HORs	80%

100% of HORs smolts released below Mayfield

B. Biological Targets **No Biological Targets Specified for this Stabilizing Population**

C. Decision Rules

- 7000 marked fall Chinook from the Lower Cowlitz hatchery program will be transported above Cowlitz Falls for harvest, habitat preparation and nutrient enhancement.

Source: See Section 2.6.
Note: This is a screenshot from the ISIT calculator (Appendix I).

Figure 3-9. Illustration of conservation Decision Rule for the Upper Cowlitz/Cispus fall Chinook program.

3.5.3 Monitoring Priorities

Key Assumptions—parameters estimated from the accumulation of data over time. Accuracy and precision will improve from year to year.

The most critical assumptions for Upper Cowlitz fall Chinook are fish passage survival and assumptions about the productivity and capacity of the habitat. The current actions that place adult fall Chinook into the area are aimed at providing harvest, habitat preparation and nutrient enhancement. Monitoring of Upper Cowlitz spring Chinook and coho will include values for this program. No further monitoring is identified.

Stock identification marks for this population can be found in Table 2-10.

Annual Status and Trends—tracks annual outcomes in terms of variable annual biological targets. These targets are revised each year according to decision rules and by taking run forecasts into account. Viewed over time (the trends part), this information will track progress towards conservation and harvest goals.

For Upper Cowlitz fall Chinook, annual estimates of NOR returns (counted at the Cowlitz Salmon Hatchery), pre-spawning mortality of HORs and NORs (including fishery induced mortality), and enumeration of smolt out-migrants from the Upper Cowlitz are important for tracking progress toward goals over time. Monitoring Upper Cowlitz spring Chinook and Lower Cowlitz fall Chinook will include values for this program. No further monitoring is identified.

Management Precision—performance evaluation to improve run forecasting and harvest over time to more effectively implement the Decision Rules. In other words, this monitors the effectiveness of the application of the Decision Rules.

A methodology to estimate NOR returns of Upper Cowlitz fall Chinook adults in-season should be developed. This methodology should include a strategy to identify and transport all NORs and the appropriate number of HORs to selected locations in the upper river for harvest and natural spawning. These values will be collected during monitoring for Lower Cowlitz fall Chinook, Upper River spring Chinook and Upper River coho. No further monitoring is identified.

3.5.4 Actions for 2012

Table 3-6. 2012 Upper Cowlitz Fall Chinook program.

2014 Smolt Release Number[1] Prior to Credit Adjustment	0
Number of Adults Transported and Released above Cowlitz Falls	≤ 7,000

[1] Target smolt number to be released from the 2012 brood, i.e., smolts will be released in 2014.

3.6 UPPER COWLITZ SPRING CHINOOK

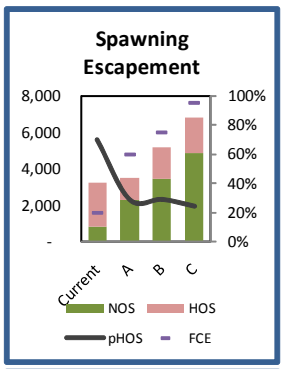
The Upper Cowlitz spring Chinook population is designated as Primary. There are currently few natural spawners in the Upper Cowlitz/Cispus Rivers. The Lower Cowlitz hatchery population is derived from the native spring Chinook from this area and will be used to reintroduce natural production.

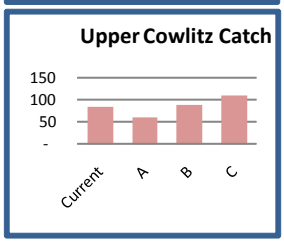
3.6.1 Management Targets

Figure 3-10 describes three views of the future for the population and the fisheries it supports (Scenarios A, B, and C). It identifies the conditions under which harvest and conservation goals will be reached in the future. The figure also captures the current conditions, showing where we are now and where we expect to be in the future. Section 3.6.2, Decision Rules, describes how we intend to get from the current condition to the long-term target (Scenarios A, B, or C). Until substantial improvements in FPS have been made, this analysis suggests that it is unlikely that natural production can be sustained above Cowlitz Falls (Figure 3-10).

Upper Cowlitz Spring Chinook

Natural Production	Recent Past (Current)	A Primary Population Biological Targets	Options to meet Long-term Goals A	B	C
Productivity (Smolts/Spawner)	37		67	67	69
Capacity (Smolts)	99,345		178,877	179,427	183,865
SAR	1.10%		3.30%	4.13%	5.23%
FPS	20%		60%	75%	95%
Fitness	0.5		0.90	0.90	0.93
PNI	-	> 0.67	0.78	0.78	0.80
Effective pHOS	70%	< 30%	29%	29%	24%
Seg. pHOS	70%	< 5%			
Terminal Harvest Rate	1%		1%	1%	1%
NOR Abundance potential	833	> 3,600	2,308	3,433	4,850
Hatchery Production					
Release (from Hatchery)	-		69,287	69,287	69,287
pNOB	0%		100%	100%	100%
Adults Transported above CF	2,500		1,200	1,800	2,000
Harvest Rate	3%		3%	3%	3%
Expected Catch in Upper Cowlitz	83		59	88	109





Source: See Section 2.6.

Figure 3-10. Biological targets, key assumptions and expected outcomes under recent conditions and under future options to meet long-term harvest and conservation goals for Upper Cowlitz spring Chinook.

3.6.2 Decision Rules

Due to the poor fish passage survival at Cowlitz Falls, for the duration of this FHMP Update, the Upper Cowlitz spring Chinook program is expected to be in a colonization phase. Adult hatchery fish from the Lower Cowlitz segregated spring Chinook program will be transported upstream along with any returning natural-origin fish from the Upper Cowlitz for this purpose. During this colonization phase, at least 8,000 fish (NORs and HORs), pending availability, will be transported, including all NORs returning to Barrier Dam. This number (8,000) is based on the carrying capacity of the upper watershed. During the colonization phase, there will be no differentiation between Lower Cowlitz and Upper Cowlitz spring Chinook. According to the AHA analysis, local adaptation in the upper river, resulting in differentiation between the two populations, cannot occur until fish passage survival at Cowlitz Falls is substantially improved. Delaying the onset of local adaptation will delay recovery of the Upper Cowlitz population, but it will not significantly reduce the fitness of the existing population.

Once the five year running average FPS exceeds 60%, the program will move into a local adaptation phase. The Upper Cowlitz/Cispus spring Chinook program will then convert into an integrated hatchery program by using NORs as broodstock. Once the 60% FPS trigger has occurred, hatchery fish from the Lower Cowlitz segregated program will no longer be transported above Cowlitz Falls. Instead, returning adults from the future

integrated program will be transported above Cowlitz Falls. A period of transition will be necessary to fully convert from the current segregated program to a fully integrated program. This transition period could include starting the integrated program a couple of years sooner than the trigger is achieved, or passing a limited number of HORs from the segregated program upstream after the integrated program is started.

Hatchery juveniles from the future integrated program would be released into the lower Cowlitz River.

3.6.3 Monitoring Priorities

Key Assumptions—parameters estimated from the accumulation of data over time. Accuracy and precision will improve from year to year.

The most critical assumptions for Upper Cowlitz spring Chinook are fish passage survival and assumptions about the productivity and capacity of the habitat. The current actions that place adult spring Chinook into the area are aimed at colonizing available habitat. See Appendix G and Chapter 4 for more details. Stock identification marks for this population are shown in Table 2-10. The five-year average fish passage survival will be updated and reported each year and will serve as the trigger for implementing any additional actions.

Annual Status and Trends—tracks annual outcomes in terms of variable annual biological targets. These targets are revised each year according to Decision Rules and take run forecasts into account. Viewed over time (the trends part), this information will track progress towards conservation and harvest goals.

For the Upper Cowlitz, annual estimates of NOR returns (counted at the Cowlitz Salmon Hatchery), pre-spawning mortality of HORs and NORs (including fishery induced mortality), and enumeration of smolt out-migrants from the Upper Cowlitz are important for tracking progress toward goals over time. A five-year running averages of these values should be complied and reported every year.

Management Precision—performance evaluation to improve, for example, run forecasting over time to more effectively implement the Decision Rules. In other words, this monitors the effectiveness of the application of the Decision Rules.

A methodology for estimating NOR returns of Upper Cowlitz spring Chinook adults in-season should be developed. This methodology should include a strategy to identify and transport all NORs and the appropriate number of HORs to selected locations in the upper river for harvest and natural spawning.

Appendix G contains tables identifying the critical parameters, i.e., those that are uncertain and affect decisions and should be monitored.

Chapter 4 identifies the variables, parameters estimated, frequency of sampling and data collected that will be used to effectively address the needs for all populations in a comprehensive monitoring plan.

3.6.4 Actions for 2012

Table 3-7. 2012 Upper Cowlitz spring Chinook hatchery program.

2014 Smolt Release Number[1] Prior to Credit Adjustment	0
Number of Adults Transported and Released Above Cowlitz Falls	8,000

[1] Target smolt number to be released from the 2012 brood, i.e., smolts will be released in 2014.

3.7 UPPER COWLITZ COHO

Coho have been reintroduced into the upper Cowlitz from the lower Cowlitz hatchery program. This evolving Upper Cowlitz population has been designated as Primary in the LCSRP, with a minimum abundance target of 4,000 natural-origin spawners (Figure 3-11). This population has the potential to play a key role in the recovery of the Lower Columbia coho ESU. Upper Cowlitz coho contribute to pre-terminal fisheries as well as fisheries in the lower and upper Cowlitz basins.

3.7.1 Management Targets

The factors that inhibit progress toward conservation goals for this population are fish passage survival at Cowlitz Falls and strays from adult HORs transported upstream for harvest purposes. Only HORs that are positively identified as Upper Cowlitz coho (i.e., hatchery fish with 100% NOR parents), will be transported to the Upper Cowlitz. No Lower Cowlitz coho will be transported above Cowlitz Falls.

The current hatchery program is integrated with a pNOB of 100%. These fish are reared and released from the Cowlitz Salmon Hatchery to avoid the loss due to low fish passage survival at Cowlitz Falls Dam. The challenge for this population is to provide fishing opportunity in the upper Cowlitz without exceeding a pHOS of 30% effective HOR spawners. The pHOS target can be met by a combination of increased FPS, increased harvest rate on HORs, and/or by limiting the number of adult HORs that are transported to the upper Cowlitz.

Another potential means to improve homing and harvest rates for HORs that are transported above Cowlitz Falls would be to acclimate and release smolts from satellite ponds in the Upper Cowlitz. These acclimation ponds would be located where harvest opportunities would be greater and/or the likelihood would be significantly reduced that unharvested HORs end up mingling with NOR spawners. Unless transported below the Barrier Dam, a consequence of releasing hatchery fish in the upper basin would be reduced smolt to adult survival due to the limited fish passage survival. Smolts released from the acclimation ponds would have to be uniquely identified in order to be distinguished from those released directly from the hatchery.

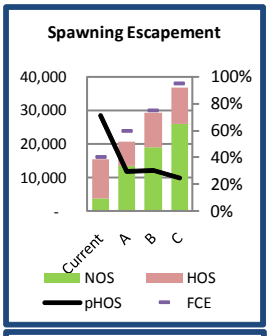
The credit mechanism (Section 2.5.3) for Upper Cowlitz coho would reduce this hatchery program by two smolts for every natural-origin smolt captured at Cowlitz Falls and released in the lower river. The hatchery program, however, would not be reduced due to crediting below a minimum level defined by the maximum number of adult HORs that could be transported in a high survival year for NORs. For this population, this number

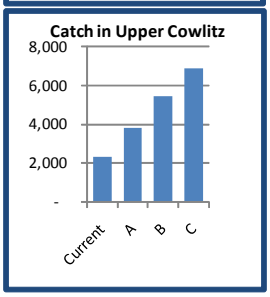
is estimated at 10,603 adults, which would require a smolt release of about 552,884 fish. This would be the minimum credit "floor".

Figure 3-11 describes three views of the future for the population and the fisheries it supports (Scenarios A, B, and C). It identifies the conditions under which harvest and conservation goals will be reached in the future. The figure also captures the current conditions, showing where we are now and where we expect to be in the future. Section 3.7.2, Decision Rules, describes how we intend to get from the current condition to the long-term target (Scenarios A, B, or C).

Upper Cowlitz Coho A Primary Population

	Recent Past	A Primary Population Biological Targets	Future Scenarios (when Long-term Goals are met) A	B	C
Natural Production					
Productivity (Smolts/Spawner)	24		85	85	87
Capacity (Smolts)	196,917		707,695	707,765	728,030
SAR	2.40%		3.60%	4.50%	5.70%
FPS	40%		60%	75%	95%
Fitness	0.50		0.90	0.90	0.92
PNI	0.58	> 0.67	0.77	0.77	0.80
Effective pHOS	71%	< 30%	30%	30%	25%
Harvest Rate (in Upper Cowlitz)	2%		15%	15%	15%
NOR Abundance potential	3,832	> 4,000	13,513	18,960	25,957
Hatchery Production					
Release (from Hatchery)	1,002,716		978,000	978,000	978,000
pNOB	100%		100%	100%	100%
Adults (HOR) Transported above CF	15,000		9,000	13,000	15,000
Harvest Rate (in Upper Cowlitz)	15%	> 20%	20%	20%	20%
Total Abundance in Upper Cowlitz	17,647		24,887	35,290	43,954
Expected Catch	2,307		3,827	5,444	6,894





Source: See Section 2.6.

Figure 3-11. Biological targets, key assumptions and expected outcomes under recent conditions and under future options to meet long-term harvest and conservation goals for Upper Cowlitz coho.

Options for meeting long-term goals shown in Figure 3-11 represent different levels of fish passage survival. Under each of these options, the natural population will have recovered to the point where it can sustain a terminal fishery. In other words, selective harvest will no longer be necessary in the extreme terminal area. The Decision Rules (Section 3.7.2) are appropriate steps in the transition from the current condition to any of the three future options shown in Figure 3-11.

3.7.2 Decision Rules

Full implementation of the hatchery reform standards requires a fish passage survival of 60% (see Scenario A above). The current 5-year running average fish passage survival is about 40%. Sixty percent is a milestone towards even higher survival rates (e.g.,

Scenarios B and C). The 60% 5-year running average for fish passage survival is also the trigger for implementing the 30% pHOS standard for hatchery influence (see Scenario A). It is expected that the 60% milestone/trigger will be approached in about five years as downstream passage improvements are completed. According to the AHA analysis, as fish passage survival increases from current levels toward the 95% goal, natural-origin abundance of Upper Cowlitz coho will increase from less than 5,000 toward 30,000 fish. This increase would be due to both passage survival improvement and fitness gain.

During the transition period, between now and the first time the 5-year running average fish passage survival exceeds 60%, all NORs, returning to the Barrier Dam collection facility will be transported upstream along with a maximum of 25,000 HORs from the Upper Cowlitz integrated hatchery program. Unless NOR returns are also higher and harvest rates greater, in years when the maximum number of HORs are transported, it is likely that pHOS standards may not be met. To some degree, occasional high pHOS years will be offset by years of lower pHOS.

Once the 60% trigger is reached, the number of hatchery fish transported upstream for harvest will be limited to assure that an effective pHOS of 30% or less is achieved. All returning NORs will be transported. As a result of the increased fish passage survival, the abundance of returning NORs is expected to increase significantly. The reduced HOR influence will further increase the productivity and abundance of the natural population to the point where it can support a terminal fishery in most years.

Note also that the conservation constraints (maximum proportion of HORs allowed to spawn) for the Lower Cowlitz coho population potentially affect the Upper Cowlitz hatchery program as well (see Section 3.3). Fish from this program, which are released in the Lower River, may stray to spawning grounds in the Lower River. The Decision Rules for the Lower and Upper coho programs take this into account.

3.7.3 Monitoring Priorities

Key Assumptions—parameters estimated from the accumulation of data over time. Accuracy and precision will improve from year to year.

The most critical assumptions for Upper Cowlitz coho are fish passage survival and the harvest rate on HORs in the Upper Cowlitz. See Appendices H and J and Chapter 4 for more details. Stock identification marks for this population can be found in Table 2-10. The five-year average fish passage survival will be reported each year and will serve as the trigger for implementing the 30% pHOS rule.

Annual Status and Trends—tracks annual outcomes in terms of variable annual biological targets. These targets are revised each year according to Decision Rules and by taking run forecasts into account. Viewed over time (the trends part), this information will track progress towards conservation and harvest goals.

For the Upper Cowlitz, annual estimates of spawner abundance and composition (pHOS), enumeration of smolt out-migrants, and catch in the Upper Cowlitz are most important to track progress toward goals over time. Five-year running averages of pHOS, NOS and catch should be reported every year.

Management Precision—performance evaluation to improve, for example, run forecasting over time to more effectively implement the decision rules. In other words, this monitors the effectiveness of applying the Decision Rules.

A methodology for estimating NOR return of Upper Cowlitz coho adults in-season must be developed before the fish passage survival trigger is met. This methodology should include a strategy to identify and transport the appropriate number of HORs to selected locations in the upper river for harvest while assuring that a 30% pHOS is met, once the trigger is met.

Appendix G contains tables identifying the critical parameters that are uncertain, affect decisions and should be monitored.

Chapter 4 identifies the variables, parameters estimated, frequency of sampling and data collected that will be used to effectively address the needs for all populations in a comprehensive monitoring plan.

3.7.4 Actions for 2012

Table 3-8 summarizes the planned actions for 2012, consistent with the Decision Rules for Upper Cowlitz/Cispus coho. Note that broodstock collected in 2012 will produce smolts to be released in 2014.

Table 3-8. 2012 Upper Cowlitz/Cispus coho program.

2014 Smolt Release Number[1] Prior to Credit Adjustment	978,000
Release Size (fish/lb)	15
Credit Adjustment (number)—See Section 3.13.1	0
Credit Adjustment (lbs)	0
Adjustment for Pound Limit, if any	0
Net Smolt Release Target for 2014 (number)	978,000
Net Smolt Release Target for 2014 (lbs)	65,200
All NOR returns not needed for brood will be transported above Cowlitz Falls.	
Number of HOR Adults from Upper Cowlitz Integrated Program Transported above Cowlitz Falls	≤25,000

[1] Target smolt number to be released from the 2012 brood, i.e., smolts will be released in 2014.

3.8 UPPER COWLITZ STEELHEAD

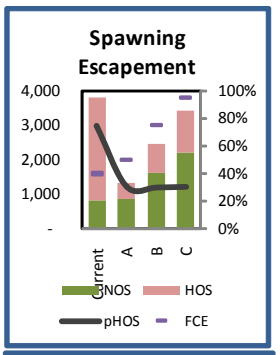
The Upper Cowlitz/Cispus late winter steelhead population is designated as Primary with an abundance goal of 1,000 natural origin spawners (NORs). Less than 700 NORs are returned to the Upper Cowlitz/Cispus each year. They are heavily influenced by hatchery origin spawners that were also transported up-river each year until 2010.

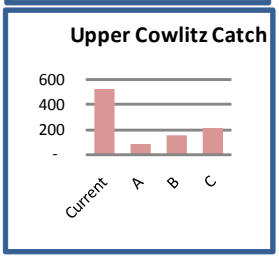
3.8.1 Management Targets

Figure 3-12 describes three views of the future for the population and the fisheries it supports (Scenarios A, B, and C). It identifies the conditions under which harvest and conservation goals will be reached in the future. The figure also captures the current conditions, showing where we are now and where we expect to be in the future. Section 3.8.2, Decision Rules, describes how we intend to get from the current condition to the long-term target (Scenarios A, B, or C). The existing natural population does not meet the HSRG standards for maximum hatchery influence on a Primary population. Recovery of these populations is inhibited by low fish passage survival and a high proportion of hatchery fish (pHOS) on the spawning grounds (Figure 3-12).

Upper Cowlitz Steelhead

	Recent Past (2009)	A Primary Population Biological Targets	Options to meet Long-term Goals A	B	C
Natural Production					
Productivity (Smolts/Spawner)	19		34	34	34
Capacity (Smolts)	12,791		22,880	23,097	23,091
SAR	4.72%		5.90%	8.85%	11.21%
FPS	40%		50%	75%	95%
Fitness	0.5		0.89	0.90	0.90
PNI	0.57	> 0.67	0.77	0.77	0.77
Effective pHOS	74%	< 30%	30%	30%	30%
Terminal Harvest Rate	3%		3%	3%	3%
NOR Abundance potential	818	> 1,000	861	1,617	2,216
Hatchery Production					
Release (from Hatchery)	99,340		118,053	118,053	118,053
pNOB	100%		100%	100%	100%
Adults Transported above CF	3,500		550	1,000	1,400
Harvest Rate in Upper Cowlitz	15%		15%	15%	15%
Expected Catch in Upper Cowlitz	525		83	150	210





Source: See Section 2.6.

Figure 3-12. Biological targets, key assumptions and expected outcomes under recent conditions and under future options to meet long-term harvest and conservation goals for Upper Cowlitz steelhead.

3.8.2 Decision Rules

Once the five year rolling average fish passage survival is greater than 50% (see Scenario A in Figure 3-12), the local adaptation phase may begin and the Decision Rules illustrated in Figure 3-13 will be implemented. In preparation for this step, an integrated program will be initiated using 30% NORs from the Upper River population and transitioning to 100% pNOB. The smolts produced would be released from the hatchery in the Lower River and returning adults passed to the upper watershed. The Lower Cowlitz steelhead analysis allowed for a release of up to 165,000 Upper Cowlitz steelhead (see Figure 3-6, Scenario B), while still meeting the conservation goals (stray rates) for Lower Cowlitz steelhead (see Section 3.4.2; Decision Rules for Lower Cowlitz Steelhead).

A. Key Assumptions

	NOR	HOR			
SAR	5.9%	0.9%		FPS	50%
Preterm Harv. Rate	4%	4%		Relative Fitness NORs	89%
Low Cow. Harv Rate	2%	60%		Rel. Rep Success HORs	80%
Up Cow. Mortality	1%			BS	59
			100%	of HORs smolts released below Mayfield	

B. Biological Targets

Effective pHOS	pNOB	PNI	NOR Spawners (NOS)	HOR harvest rate above CF
30%	100%	0.8	1,000	50%

C. Decision Rules

This population will remain in the colonization phase until FPS exceeds 50%, then the decision rules will be defined by the biological targest per calculator below. The 50% FPS is the trigger point for the local adaptation phase.

	Return to Barrier Dam	Broodstock	Adults Transported Above CF	Upper Cowlitz Harvest	Census Escapement	Effective Spawners
NORs	**1,000**	59	941	9	931	931
		Int HORs	**1,012**	506	506	405
					pHOS	30%

Source: See Section 2.6.
Note: This is a screenshot from the ISIT calculator (Appendix I).

Figure 3-13. Illustration of conservation decision rule for the Upper Cowlitz/Cispus steelhead program.

3.8.3 Monitoring Priorities

Key Assumptions—parameters estimated from the accumulation of data over time. Accuracy and precision will improve from year to year.

The most critical assumption for Upper Cowlitz steelhead is fish passage survival. See Appendix H and J and Chapter 4 for more details on overall monitoring. Stock identification marks for this population can be found in Table 2-10.

Annual Status and Trends—tracks annual outcomes in terms of variable annual biological targets. These targets are revised each year according to Decision Rules and by taking run forecasts into account. Viewed over time (the trends part), this information will track progress towards conservation and harvest goals.

Management Precision—performance evaluation to improve, for example, run forecasting over time to more effectively implement the Decision Rules. In other words, this monitors the effectiveness of the application of the Decision Rules.

Appendix H contains tables identifying the critical parameters that are uncertain and affect decisions and should be monitored.

Chapter 4 identifies the variables, parameters estimated, frequency of sampling and data collected that will be used to effectively address the needs for all populations in a comprehensive monitoring plan.

3.8.4 Actions for 2012

Table 3-9. 2012 Upper Cowlitz steelhead hatchery program.

2013 Smolt Release Number[1]	118,000

[1] Target smolt number to be released from the 2012 brood, i.e., smolts will be released in 2013. All smolts will be released from the hatchery below Mayfield.

Kelt Reconditioning Study – A study will be implemented using a limited number of winter steelhead kelts to determine if kelt reconditioning can benefit recovery of listed winter steelhead in the upper Cowlitz River. The study duration will not exceed four years and the total number of kelts reconditioned will not exceed 20 fish annually. Selected NOR kelts will be collected at Cowlitz Falls Dam and transported to the Cowlitz Trout Hatchery for inclusion in the study. Females will be rated as good or fair condition (see below) and only those males that are rated as good condition will be used in this study, consistent with the following priority: 1) good females, 2) fair females, and 3) good males. Because of the small number of fish included in this study, it is likely that only "good" females will be used. At the end of the study data will be summarized and analyzed, and presented to the FTC to determine if kelt reconditioning should occur in future years, and if so, at what level.

Wild late winter-run steelhead kelts will be collected at the Cowlitz Falls Fish Facility between April and July where abundance historically has averaged about 200 wild (unmarked) kelts per year (range 86 to 373). Tacoma Power will transport the kelts to the

Cowlitz Trout Hatchery (CTH) where adults will be held in the adult holding ponds. Kelts will be sequestered by arrival week and reconditioning will be modeled after the Yakama Nation kelt "short-term" reconditioning program at Prosser.

Specific details need to be developed, but generally reconditioning involves a one-time injection with antibiotics (Oxytetracycline), regular treatment with formalin to prevent fungal infection and introduction of feed using freeze-dried krill. Steelhead kelts will be held 3 to 5 weeks depending on the re-initiation of feeding. They will then be transported to a pre-determined release location (e.g., Castle Rock, below much of the in-river sport fishery, or some other location acceptable to the FTC). The release could be conducted by hatchery staff.

While at CTH, the steelhead will be held under conditions that are more conservative than normal adult brood holding (i.e., given 2 to 3 times more water and space). Shade cloth covers will be installed to reduce stress during holding. The water supply will be re-used from the juvenile ponds but there is a long history of successful long-term adult broodstock holding at CTH during summer months under higher loading conditions.

It is recommended that the screening criteria used by the Yakama Nation be adopted for this study. This involves selecting kelts in "good" or "fair" condition that are most likely to survive the reconditioning process. These fish are identified by the following criteria:

- Good: Lack of any wounds or descaling
- Fair: Lack of any major wounds and/or descaling

In addition, marking and evaluation will be undertaken. Cost effective evaluation method(s) will be explored (e.g., PIT tags, radio, acoustic, CWT, or elastomer).

Biological parameters to be included in the study include, but are not limited to the following:

- Measurements of weight gain and other phenotypic traits of reconditioned kelts deemed appropriate during the study compared to non-reconditioned kelts
- Speed of post-release downstream migration of reconditioned vs. non-reconditioned kelts
- Amounts of feed used during reconditioning
- Survival rate of kelts during reconditioning
- Return rate of reconditioned kelts compared to non-reconditioned kelts

Study results will be provided via Cowlitz Trout Hatchery Annual reports.

3.9 TILTON SPRING CHINOOK

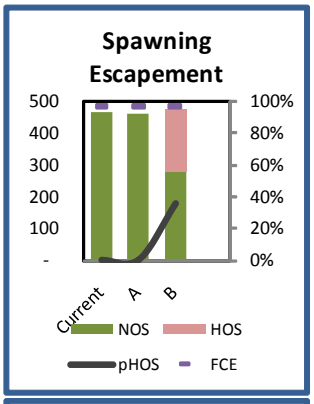
This is a Stabilizing population with little current natural production and no hatchery program.

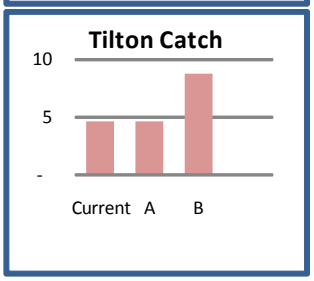
3.9.1 Management Targets

Figure 3-14 captures the current conditions of the population, showing where we are now and where we expect to be in the future.

Tilton Spring Chinook

	Recent Past (2009)	A Stabilizing Population Biological Targets	Options to meet Long-term Goals A	B
Natural Production				
Productivity (Smolts/Spawner)	22		44	22
Capacity (Smolts)	19,418		38,836	19,418
SAR	5.34%		5.34%	5.34%
FPS	97%		97%	97%
Fitness	0.5		1.00	0.50
PNI	1.00	-	1.00	-
Effective pHOS	0%	-	0%	36%
Terminal Harvest Rate	1%		1%	1%
NOR Abundance potential	468	-	459	281
Hatchery Production				
Release (from Hatchery)	-		-	-
pNOB	0%		0%	0%
Adults Transported above CF	-		-	200
Harvest Rate	3%		3%	3%
Expected Catch	5		5	9





Source: See Section 2.6.

Figure 3-14. Biological targets, key assumptions and expected outcomes under recent conditions and under future options to meet long-term and conservation goals for Tilton spring Chinook.

3.9.2 Decision Rules

There are no near-term plans to use hatchery production to rebuild this population.

3.9.3 Monitoring Priorities

Key Assumptions—parameters estimated from the accumulation of data over time. Accuracy and precision will improve from year to year.

There is currently no population of Tilton spring Chinook; therefore, no monitoring is identified.

Annual Status and Trends—tracks annual outcomes in terms of variables annual biological targets. These targets are revised each year according to Decision Rules and taking run forecasts into account. Viewed over time (the trends part), this information will track progress towards conservation and harvest goals.

Because there currently is no population of Tilton Spring Chinook, no monitoring is identified.

Management Precision—performance evaluation to improve run forecasting and harvest over time to more effectively implement the Decision Rules. In other words, this monitors the effectiveness of the application of the Decision Rules.

There is currently no population of Tilton Spring Chinook; therefore, no monitoring is identified.

3.9.4 Actions for 2012

None.

3.10 TILTON COHO

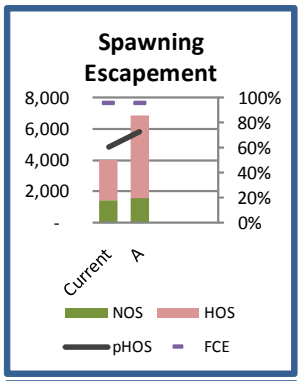
This is a Stabilizing population with some natural production and high degree of hatchery influence (high pHOS) (Figure 3-10).

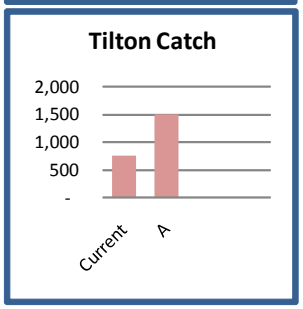
3.10.1 Management Targets

Figure 3-15 captures the current conditions of the population, showing where we are now and where we expect to be in the future. Section 3.10.2, Decision Rules, describes how we intend to get from the current condition to the long-term target. No quantitative conservation targets have been identified for this population. It is expected to provide harvest benefits and nutrient enhancement.

Tilton Coho

Natural Production	Recent Past (2009)	A Stabilizing Population Biological Targets	Options to meet Long-term Goals A
'roductivity (Smolts/Spawner)	27		27
Capacity (Smolts)	32,400		32,400
SAR	5.76%		5.76%
FPS	96%		96%
Fitness	0.5		0.50
PNI	-	-	-
Effective pHOS	60%	-	73%
rminal Harvest Mortality Rate	5%		5%
NOR Abundance potential	1,396	**50**	1,597
Hatchery Production			
Release (from Hatchery)	-		-
pNOB	0%		0%
; Transported above Mayfield	3,000		6,000
Harvest Rate	25%		25%
Total Abundance in Tilton	4,470		7,681
Expected Catch	750		1,500





Source: See Section 2.6.

Figure 3-15. Biological targets, key assumptions and expected outcomes under recent conditions and under future options to meet long-term harvest and conservation goals for Tilton coho.

3.10.2 Decision Rules

A total of 6,000 adult coho will be transported to the Tilton River. These fish will be HORs originating from Lower Cowlitz segregated hatchery returns and all NORs originating from the Tilton. The purpose is to utilize habitat, provide harvest, and enhance nutrients.

3.10.3 Monitoring Priorities

Key Assumptions—parameters estimated from the accumulation of data over time. Accuracy and precision will improve from year to year.

The most critical assumptions for Tilton coho are fish passage survival and productivity and capacity of the habitat. Current actions that place adult coho into the area are aimed at colonizing available habitat and providing harvest. Monitoring of Lower Cowlitz coho, Upper Cowlitz coho and Tilton steelhead will include values for this program. No further monitoring is identified.

Stock identification marks for this population can be found in Table 2-10.

Annual Status and Trends—tracks annual outcomes in terms of variable annual biological targets. These targets are revised each year according to Decision Rules and

will take into account the run forecasts. Viewed over time (the trends part), this information will track progress towards conservation and harvest goals.

For Tilton coho, annual estimates of NOR returns (counted at the Cowlitz Salmon Hatchery), pre-spawning mortality of HORs and NORs (including fishery induced mortality), and enumeration of smolt out-migrants from the Tilton River are most important to track progress toward goals over time. Monitoring of Lower Cowlitz coho, Upper Cowlitz coho and Tilton steelhead will include values for this program. No further monitoring is identified.

Management Precision—performance evaluation to improve run forecasting and harvest over time to more effectively implement the decision rules. In other words, this monitors the effectiveness of the application of the Decision Rules.

The strategy of identifying and transporting all NORs and the appropriate number of HORs to selected locations in the upper river for harvest and natural spawning should be retained. These values will be collected during monitoring for Lower Cowlitz coho and Upper Cowlitz coho. No further monitoring is identified.

3.10.4 Actions for 2012

Table 3-10. Tilton coho program 2012 actions.

Hatchery Adults Transferred to the Tilton	6,000

3.11 TILTON STEELHEAD

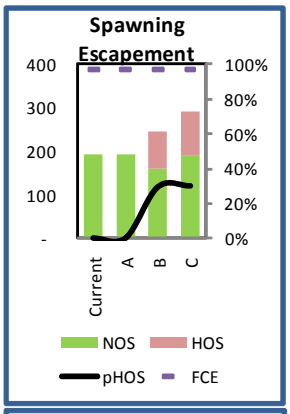
The Tilton steelhead population has been designated as Contributing in the recovery plan.

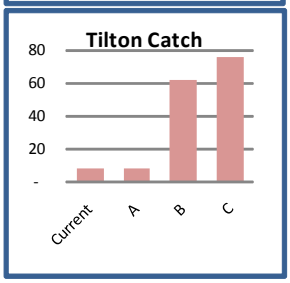
3.11.1 Management Targets

Figure 3-16 describes three views of the future for the population and the fisheries it supports (Scenarios A, B, and C). It identifies the conditions under which harvest and conservation goals will be reached in the future. The figure also captures current conditions, showing where we are now and where we expect to be in the future. Section 3.11.2, Decision Rules, describes how we intend to get from the current condition to the long-term target (Scenarios A, B, or C). The population does not currently meet HSRG standards and it is unlikely that the recovery goal for abundance can be met without habitat improvement (Figure 3-16). In the long term, an integrated conservation program may be used to meet HSRG standards and thereby increase natural productivity.

Tilton Steelhead

	Recent Past (2009)	A Contributing Population Biological Targets	Options to meet Long-term Goals A	B	C
Natural Production					
Productivity (Smolts/Spawner)	10		19	12	17
Capacity (Smolts)	1,661		3,322	2,080	2,959
SAR	11.45%		11.45%	11.45%	11.45%
FPS	97%		97%	97%	97%
Fitness	0.5		1.00	0.63	0.89
PNI	1.00	> 0.5	1.00	0.50	0.77
Effective pHOS	0%	< 30%	0%	30%	30%
Seg pHOS	0%	> 10%	0%	30%	30%
Terminal Harvest Rate	4%		4%	4%	4%
NOR Abundance potential	194	> 200	194	160	190
Hatchery Production					
Release (from Hatchery)	-		-	39,816	51,561
pNOB	0%		0%	30%	100%
Adults Transported above Mayfield			0	140	170
Harvest Rate	40%		40%	40%	40%
Expected Catch	8		8	62	76





Source: See Section 2.6.

Figure 3-16. Biological targets, key assumptions and expected outcomes under recent conditions and under future options to meet long-term harvest and conservation goals for Tilton steelhead.

3.11.2 Decision Rules

The management of this population will transition from the colonization phase over time. In the short term, 51,000 juveniles from the Lower Cowlitz late winter steelhead program will be transferred at 20 fish/lb to acclimation ponds in the Tilton. They will then be released from the ponds at 5.5 fish/lb. The purpose of this program is re-colonization and harvest. Once sufficient numbers of NORs return, this program may be converted to an integrated harvest/conservation program following the decision rules in Figure 3-17.

A. Key Assumptions CURRENT CONDITIONS

	NOR	HOR			
				FPS	0.97
SAR	11.4%	1.0%		Relative Fitness NORs	100%
Preterm Harv. Rate	4%	4%		Rel. Rep Success HORs	80%
Low Cow. Harv Rate	2%	60%		Broodstoc	26
Tilton Harv Rate	2%	40%	100%	of HORs smolts released below Mayfield	

B. Biological Targets

Effective pHOS		pNOB	PNI	NOR Spawners (NOS)
30%	10%	100%	0.5	200

C. Decision Rules

This population will remain in the colonization phase for the duration of this FHMP In the future, a transition to an integrated program should be considered as the colonization phase transitions to the local adapation phase. At this stage the biological targets will define the decision rules and the calculator below will apply.

	Return to Barrier Dam	Broodstock	Adults Transported Above Mayfield	Tilton Harvest	Census Escapement	Effective Spawners
NORs	200	26	174	3	171	171
		Int HORs	152	61	91	73
					pHOS	30%

Source: See Section 2.6.
Note: This is a screenshot from the ISIT calculator (Appendix I).

Figure 3-17. Illustration of conservation Decision Rule for the Tilton steelhead program.

3.11.3 Monitoring Priorities

Key Assumptions—parameters estimated from the accumulation of data over time. Accuracy and precision will improve from year to year.

The most critical assumption for Tilton steelhead is juvenile fish passage at Mayfield Dam. See Appendix H and J and Chapter 4 for more details on overall monitoring. Stock identification marks for this population can be found in Table 2-10.

Annual Status and Trends—tracks annual outcomes in terms of variable annual biological targets. These targets are revised each year according to the Decision Rules and by taking into account the run forecasts. Viewed over time (the trends part), this information will track progress towards conservation and harvest goals.

Management Precision—performance evaluation to improve, for example, run forecasting over time to more effectively implement the Decision Rules. In other words, this monitors the effectiveness of the application of the Decision Rules.

Appendix H contains tables identifying the critical parameters that are uncertain, affect decisions and should be monitored.

Chapter 4 identifies the variables, parameters estimated, frequency of sampling and data collected that will be used to effectively address the needs for all populations in a comprehensive monitoring plan.

3.11.4 Actions for 2012

Table 3-11. Tilton steelhead program 2012 actions.

Steelhead Reared to 20 fish/lb at Cowlitz Hatchery and transferred to the Tilton River Basin	51,000
Released from Acclimation Ponds at 5.5 fish/lb 2013.	50,000

3.12 LOWER COWLITZ CUTTHROAT

Hatchery production of cutthroat is based on harvest goals and constrained by total Cowlitz Hatchery Complex production limits (Section 2.5.2) and by potential for adverse ecological interactions with, indigenous salmon and steelhead populations. The number of fish released should be smallest number possible to meet harvest objectives.

3.12.1 Management Targets

The harvest benefits in terms of numbers of fish caught are largely unknown. The potential ecological interaction risks associated with the program are also unknown. Harvest rates in the past have ranged from 26 - 46% (average 34%) (Tipping and Blankenship 1993).

3.12.2 Decision Rules

Conservation adjustments to the size of the cutthroat program will be based on an assessment of harvest benefits versus ecological risks. The program will be sized to assure that harvest benefits outweigh conservation concerns associated with ecological interactions with indigenous salmonids.

3.12.3 Monitoring Priorities

Key Assumptions—parameters estimated from the accumulation of data over time. Accuracy and precision will improve from year to year.

The most critical assumptions for Lower Cowlitz cutthroat are predation rates on NOR juveniles of other species (see Lower Cowlitz fall Chinook) and contribution to harvest.

Annual Status and Trends—tracks annual outcomes in terms of variable annual biological targets. These targets are revised each year according to Decision Rules and take into account the run forecasts. Viewed over time (the trends part), this information will track progress towards conservation and harvest goals.

For Lower Cowlitz cutthroat, annual estimates of terminal harvest rates are critical to assessing achievement of harvest goals. Monitoring of Lower Cowlitz fall Chinook, coho and steelhead will include values for this program.

Management Precision—performance evaluation to improve run forecasting and harvest over time to more effectively implement the Decision Rules. In other words, this monitors the effectiveness of the application of the Decision Rules.

A goal for harvest and a methodology for estimating HOR contribution to terminal fisheries should be developed. This methodology should include a strategy to identify the specific contribution by Lower River cutthroat to harvest and angler days. Values for harvest could be collected during monitoring for Lower River fall Chinook, coho and steelhead, but developing harvest goals for this species will require a separate effort.

3.12.4 Actions for 2012

The production target for brood year 2012 is 101,247 smolts at 4 fish per pound, including off-station releases.

An action plan for altering the release (later) and/or location (transporting downstream) of searun cutthroat should be developed and implemented to address predation if juvenile monitoring shows predation by this species is a concern.

3.13 SUMMARY OF HATCHERY PRODUCTION, ESCAPEMENT AND HARVEST TARGETS FOR 2011/2012

This section brings together the conservation rules from Sections 3.1 through 3.12 with the crediting rules and the hatchery poundage limits to arrive at a production plan for 2011/2012. More of the data and calculations used to develop the final hatchery production numbers and other management targets for 2011/2012 are available in Appendix I. The rules for crediting and poundage limits were presented in Section 2.5.

3.13.1 Updated Credit Calculations for 2012

Table 3-12. 2012 credit calculations for coho.

Natural Coho Production Credit Calculations

Smolt Out-migration Year	Natural Smolt Production: Upper Cowlitz	5 year rolling average	Tilton	5 year rolling average	Natural Production Credit for Tilton	Natural Production Credit for UC	Credit Adjusted LC Hatchery Production (for Tilton and UC)	Credit Adjusted UC Hatchery Production	Brood Year Affected
					Credit Ratio 1.49	Credit Ratio 1.49	LC-Base Production 2,400,000	UC-Base Production 978,000	
							2,400,000	978,000	
2002	53,653		11,185		0	0	2,400,000	978,000	
2003	172,346		38,127		0	0	2,400,000	978,000	
2004	127,143		35,965		0	0	2,400,000	978,000	
2005	274,507	156,912	39,334	31,153	0	0	2,400,000	978,000	
2006	71,823	139,894	22,782	29,479	43,923	208,443	2,147,634	978,000	
2007	102,838	149,731	26,551	32,552	48,502	223,100	2,128,398	978,000	
2008	13,077	117,878	24,114	29,749	44,326	175,638	2,180,036	978,000	
2009	41,110	100,671	27,075	27,971	41,677	150,000	2,208,323	978,000	2011
2010	110,191	67,808	35,360	27,176	40,493	101,034	2,258,474	978,000	2012
2011	NA	66,804	NA	28,275	42,130	99,538	2,258,332	978,000	2013
2012	NA	54,793	NA	28,850	42,986	81,641	2,275,373		2014
2013	NA	75,651	NA	31,218	46,514	112,719	2,240,767		2015
2014									2016
Smolt Capacity:		750,000		32,400					
				Max Credit:	**48,276**	**1,117,500**			
				Production"Floor" (LC+UC Programs):			**2,212,224**		

Table 3-13. 2012 credit calculations for spring Chinook.

Natural Spring Chinook Production Credit Calculations

Smolt Out-migration Year	Age 0: Upper Cowlitz	5 year rolling average	Credit	Age 1: Upper Cowlitz	5 year rolling average	Credit	Total Credit (smolts @ 5/lb))	Total Credit (lbs)	Credit Adjusted Hatchery Production (lbs)	Brood Year Affected
			Credit Ratio 0.5			Credit Ratio 2			Base Production (lbs) 231,250	
								0	231,250	
2002	4,505	4,505		0				0	231,250	
2003	6,172	5,339		18				0	231,250	
2004	18,128	9,602		20				0	231,250	
2005	8,271	9,269		35				0	231,250	
2006	4,936	8,402	4,201	54	25	51	4,252	850	230,400	
2007	323	7,566	3,783	55	36	73	3,856	771	230,479	
2008	1,116	6,555	3,277	10	35	70	3,347	669	230,581	
2009	6,139	4,157	2,079	28	36	73	2,151	430	230,820	2011
2010	9,723	4,447	2,224	45	38	77	2,301	460	230,790	2012
2011	NA	4,325	2,163	NA	35	69	2,232	446	230,804	2013
2012	NA	5,659	2,830	NA	28	55	2,885	577	230,673	2014
2013	NA	7,931	3,966	NA	37	73	4,039	808	230,442	2015
2014										2016
				180,000						
						Max Credit:	**72,000** lbs			
						Production Floor:	**159250 lbs**			

Table 3-14. 2012 credit calculations for fall Chinook.

Natural Fall Chinook Production Credit Calculations

					Credit Ratio					Credit Ratio		Base Production	
					0.5					2		2,400,000	
Smolt Outmigration Year	**Age 0**					**Age 1**					**Total Credit**	**Credit Adjusted Hatchery Production**	**Brood Year Affected**
	Upper Cowlitz	**Tilton**	**Total**	**5 year rolling average**	**Credit**	**Upper Cowlitz**	**Tilton**	**Total**	**5 year rolling average**	**Credit**			
2001												2,400,000	
2002												2,400,000	
2003												2,400,000	
2004												2,400,000	
2005												2,400,000	
2006		26,830	26,830	26,830	13,415		25,824	25,824	25,824	51,649	65,063	2,348,351	
2007		1,673	1,673	14,251	7,126		3,361	3,361	14,593	29,185	36,311	2,370,815	
2008		40,217	40,217	22,907	11,453		9,754	9,754	12,980	25,959	37,413	2,374,041	
2009		1,652	1,652	17,593	8,797		2,052	2,052	10,248	20,495	29,292	2,379,505	2011
2010	NA	177,999	177,999	49,674	24,837	NA	3,671	3,671	8,932	17,865	42,702	2,382,135	2012
2011	NA	NA	0	44,308	22,154	NA	NA	0	3,768	7,535	29,689	2,392,465	2013
2012	NA	NA	0	43,974	21,987	NA	NA	0	3,095	6,191	28,177	2,393,809	2014
2013													2015
2014													

Production Floor (based on decision rules--Figure 3-1b): 1,500,000

Table 3-15. 2012 credit calculations for steelhead.

Natural Late Winter Steelhead Production Credit Calculations

					Credit Ratio	Base Production	Credit Ratio	Base Production	
					0.99	165,000	0.99	481,389	
Smolt Outmigration Year	**Natural Smolt Production**				**UC Natural Production Credit**	**Credit Adjusted UC Production**	**Tilton Natural Production Credit**	**Credit Adjusted LC Production**	Brood Year Affected
	Upper Cowlitz	**5 year rolling average**	**Tilton**	**5 year rolling average**					
2002	5,145								
2003	10,557								
2004	11,289								
2005	17,205		8,134			165,000		481,389	
2006	9,209	10,681	4,829	6,482	10,574	154,426	3,267	478,122	
2007	7,905	11,233	5,992	6,318	11,121	153,879	3,267	478,122	
2008	2,369	9,595	3,879	5,709	9,499	155,501	3,267	478,122	
2009	4,183	8,174	4,358	5,438	8,092	156,908	3,267	478,122	2011
2010	9,150	6,563	8,842	5,580	6,498	158,502	3,267	478,122	2012
2011	NA	5,902	NA	5,768	5,843	159,157	3,267	478,122	2013
2012	NA	5,234	NA	5,693	5,182	159,818	3,267	478,122	2014
2013	NA	6,667	NA	6,600	6,600	158,400	3,267	478,122	2015
2014									2016
Smolt Capacity:		**25,500**		**3,300**					
			Max Credit:		**25,245**		**3,267**		
				Production "Floor":		**139,755**		**478,122**	

Note: Conservation or poundage standards may reduce hatchery production below the production "floor".

Table 3-16. 2012 credit calculations for cutthroat.

Natural Cutthroat Production
Credit Calculations

Credit Ratio	Base Production
1.89	102,401

Smolt Out-migration Year	Natural Smolt Production				Credit	Hatchery Production	Brood Year Affected
	Upper Cowlitz	Tilton	Total	5 year rolling average			
2001	989	493	1,482				
2002	987	180	1,167				
2003	1,273	416	1,689				
2004	717	684	1,401			102,401	
2005	1,017	518	1,535	458	866	101,535	
2006	729	235	964	407	768	101,633	
2007	711	645	1,356	500	944	101,457	
2008	185	569	754	530	1,002	101,399	
2009	308	1,086	1,394	611	1,154	101,247	2011
2010	482	821	1,303	671	1,269	101,132	2012
2011	NA	NA	0	780	1,475	100,926	2013
2012	NA	NA	0	825	1,560	100,841	2014
2013	NA	NA	0	954	1,802	100,599	2015
2014	NA	NA					2016

3.13.2 Adjustments to Meet Total Production Limits (650,000 lb) in 2012.

Table 3-17. 2012 adjustments to hatchery production for total pounds of production following conservation and credit adjustments.

Program	Release Size (Fish/lb)	WDFW Target[1] Production (# of smolts)	Conservation Adjustment[1]	NOR Run Associated with Base Production[1]	Credit Adjustment	650,000 lb Adjustment	NOR Run Associated with Adjusted Production	Release Year
LC Fall Chinook	80	4,200,000	2,400,000	NOR > 1,172	2,393,809	1,500,000	NOR >732	2013
LC Spring Chinook	5	500,000	500,000		497,115	497,115		2014
LC Spring Chinook	8	800,000	800,000		800,000	800,000		2014
LC Spring Chinook	16	500,000	500,000		500,000	500,000		2014
UC Spring Chinook	--	0	0		0	0		2014
LC Coho	15	2,400,000	2,400,000	NOR > 1,577	2,275,373	1,200,000	NOR> 1,018	2014
UC Coho [2]	15	978,000	978,000		978,000	978,000		2014
LC LW Steelhead	5.5	599,224	481,389	NOR > 506	478,122	478,122	NOR > 498	2014
UC LW Steelhead[3]	5.5	175,000	118,000[4]		118,000	118,000		2014
LC Summer Steelhead	5.5	650,000	650,000		650,000	650,000		2014
Tilton LW Steelhead[5]	20	50,000	51,000		51,000	51,000		2014
LC Cutthroat[6]	4	160,000	102,401		101,841	101,841		2014
Total lbs of production		810,400	741,762		731,815	648,951		

[1] Base Production represents the conservation limit to hatchery production, when the affected natural run meets the condition indicated in the table.
[2] Credit for Upper Cowlitz natural production applied to Lower Cowlitz hatchery program.
[3] Conservation adjustment is applied to both Lower and Upper Cowlitz steelhead production.
[4] Upper Cowlitz steelhead production is limited to 118,000 due to the expected NOR run size for the Lower Cowlitz population (about 500); see Decision Rule in Figure 3-7.
[5] Tilton steelhead will be reared to 20 fish/lb at the hatchery and then transferred to the Tilton Basin.
[6] Cutthroat program adjusted to reduce ecological interaction risks to listed species.

3.13.3 Hatchery Production Targets for All Programs in 2012

Table 3-18. Summary of hatchery production by release year from 2011 through 2013 for all Cowlitz programs.

Program	Release Size (fish/lb)	Release Year 2011[1]			Release Year 2012 [2,3]			Release Year 2013 [4]		
		BY	Number	Lbs	BY	Number	Lbs	BY	Number	Lbs
LC-Fall Chin	80	2010	4,779,500	59,744	2011	1,500,000	18,750	2012	TBD	TBD
LC-Spring Chin	5	2009	905,226	181,045	2010	906,369	181,274	2011	497,115	99,423
LC-Spring Chin	8	2009			2010			2011	800,000	100,000
LC-Spring Chin	16	2009	55,000[8]	4,583	2010	55,000[5]	4,583	2011	500,000	31,250
LC-Coho	15	2009	1,804,746	120,316	2010	842,716	56,181	2011	1,200,000	80,000
UC-Coho	15	2009	1,000,000	66,667	2010	1,000,000	66,667	2011	978,000	65,200
LC-LW Sthd	5.5	2010	361,757	65,774	2011	362,855	65,974	2012	478,122	86,931
UC-LW Sthd	5.5	2010	0		2011	0	0	2012	118,000	21,455
LC-Sum Sthd	5.5	2010	450,000	81,818	2011	450,000	81,818	2012	650,000	118,182
LC-Sum Sthd	6	2010	100,000	16,667	2011	100,000	16,667			
LC-EW Sthd	5.5	2010	300,000	54,545	2011	300,000	54,545			
Tilton LW Stlhd[6]	20							2012	51,000	2,550
LC-Cutthroat	4	2010	147,596	36,899	2011	147,599	36,900	2012	100,841	25,210
LC-Cutthroat	5.5	2010	10,000[9]	1,818	2011	10,000	1,818			
	Total			689,876			585,177			630,201[7]

Note: Cells shaded yellow are the production plan for BYs 2011 and 2012 (i.e. the 2011 FBD) Cells shaded blue are the production plan for BY 2010 and 2011 (2010 FBD).
[1] This production is from brood year 2010 and earlier.
[2] Except for fall Chinook, this production is already in the hatchery.
[3] The BY 2010 production numbers do not include the off-station production which amounts to about 22,000 lbs of Cowlitz Hatchery production.
[4] The BY 2011 production number incorporate off-station programs. They must be accommodated within these limits (see Section 5.3).
[5] Released at 12 fish/lb.
[6] Tilton steelhead will be reared to 20 fish/lb at the hatchery and then transferred to the Tilton Basin and released at 5.5 fish/lb.
[7] This total does not include the fall Chinook program. Size of this program will be determined in 2012.
[8] Transferred at 12 fpp.
[9] Transferred to FOC at 5.5 fpp.

3.13.4 Harvest Management Targets for 2012 and Each Year for the Duration of this FHMP Update

Action Plan for 2012

Table 3-19. Harvest management 2012 action plan.

Develop Harvest Expectations by Fishery and Stock[1] prior to 2012 Annual Workshop

[1] This information will not be available until run forecasts for 2012 are in hand.

3.13.5 Natural Escapement Targets for 2012 and Each Year for the Duration of this FHMP Update

Action Plan for 2012

Table 3-20. Natural escapement targets 2012 action plan.

Develop Escapement Abundance and Composition Expectations [1] prior to the 2012 Annual Workshop

[1] This information will not be available until February of 2012, when run forecasts are made.

3.14 NUTRIENT ENHANCEMENT PLAN FOR 2012

The amount of nutrient enhancement required in 2012 will be determined by WDFW based on spawning escapement estimates and availability of surplus hatchery fish, consistent with Section 5.1 of this report.

4 2012 MONITORING AND EVALUATION PLAN

The M&E plan is designed to provide the information needed for the adaptive management decision making process described in Chapter 2 of this report.

For any given run size, the Decision Rules will calculate the management targets in terms of natural escapement abundance and composition (pHOS), harvest, and hatchery broodstock. These management targets will then determine the action plan for the coming season. These Decision Rules and management targets are designed to drive the system towards biological targets, which, in turn, are the basis for the metrics that define resource goals. Given this path, monitoring should be focused on critical uncertainties within the key assumptions and the triggers found in the Decision Rules. In addition, we must monitor the management and biological targets to determine if progress is being made (i.e., status and trends).

This process does not presume that science can explain with any certainty the effects of management actions. However, the actions proposed in this plan are based on a set of key assumptions that are consistent with current scientific knowledge and the available information. The sensitivity of the expected outcomes from actions and the uncertainty of these assumptions are the drivers for monitoring and evaluation priorities that most directly affect management decisions. The precision standards that these assumptions should be held to can be found in the document NOAA Guidance for Monitoring Recovery of Salmon and Steelhead(NOAA 2011). Once fish passage survival is close to the standard, the fish passage studies will be held to precision standards required at other fish collection facilities.

4.1 CRITERIA FOR MONITORING PRIORITIES

Three true/false questions were used to rate each parameter:

A. Parameter affects our decision

B. There is significant uncertainty about assumed value

C. Uncertainty can be measured and resolved in a reasonable time frame.

Parameters received a rating of 3 if A, B and C are true. Parameters received a ranking of 2 if only A and B are true, and a ranking of 1 if only A is true. Individual ratings of each parameter can be found in Appendix H. Parameters that received a rating of 3 have the highest priority for monitoring and they are the focus of this M&E plan. Natural populations designated as Primary or Contributing will be the major targets for monitoring; however, some data will be collected for Stabilizing populations in the course of implementing the prioritized monitoring plan. All hatchery populations will be monitored with respect to their effect on conservation and harvest as well as performance effectiveness.

A detailed list of all parameters and their ratings is available in Appendix H. Parameters are categorized as follows:

1) Key Assumptions (found in AHA data set; Appendix I)

    a. Primary and Contributing populations

    b. Hatchery populations/programs

        - In-hatchery parameters
        - Out-of-hatchery parameters (based on a five-year running average)
        - Effects on conservation and the environment (based on a five-year running average)

2) Annual Status and Trend Information by Population (Biological Targets);

    a. Natural populations

    b. Hatchery populations

3) Management Targets and Precision

    a. Run size forecast and updates

    b. Achievement of pre-season escapement and harvest management targets.

Table 4-1 below identifies variables (parameters) estimated and data collected that will be used to effectively address the needs for all populations in the comprehensive monitoring plan. Appendix H links the variables estimated to decisions in the annual adaptive management process and Appendix J details the methods of analysis and data collection required to estimate priority parameters consistent with NOAA guidelines for accuracy and precision.

Table 4-1. Variables estimated for each analytical method, monitoring activities needed, and populations affected.

Variables Estimated	Data/Observations Needed for the analysis	Application (Populations)
Spawner abundance and composition for Lower Cowlitz fall Chinook (NOS+HOS, pHOS)	Genotyped adult tissue samples, juvenile genotype samples, redd count, number of mass marked carcasses, and number of carcasses sampled	• Lower Cowlitz: FCH
Spawner abundance and composition for Lower Cowlitz coho and steelhead (NOS+HOS, pHOS)	Genotyped adult tissue samples, juvenile genotype samples, redd count, number of mass marked spawners, and number of spawners sampled	• Lower Cowlitz: COH, STHD
Spawner distribution	Redd counts by stream reach	• Lower Cowlitz: FCH, COH, and STHD

Variables Estimated	Data/Observations Needed for the analysis	Application (Populations)
Pre-terminal exploitation rates	CWT data	• Lower Cowlitz: FCH, COH, STHD • Upper Cowlitz: COH
Terminal catch of HORs	Catch, effort, and mark sampling data	• Lower Cowlitz: FCH, COH, STHD, SPC, CUT • Upper Cowlitz: FCH, COH, STHD, SPC • Tilton:COH, STHD
NOR mortality in terminal fisheries	Catch, effort, and mark sampling data	• Lower Cowlitz: FCH, COH, and STHD
HOB, NOB, pNOB	Counts of marked and unmarked returns to the hatchery, counts of HORs and NORs spawned	• Lower Cowlitz: FCH, COH, and STHD
Hatchery recruits per spawner ratio (and SAR)	Pre-spawn mortality, egg mortality, egg to smolt mortality, catch, and escapement	• Lower Cowlitz: FCH, COH, and STHD
PNI	pNOB (AM-6) and pHOS (AM-11 and 15) estimates	• Lower Cowlitz: FCH, and STHD • Upper Cowltiz: COH, SPC, STHD
Smolt abundance using stratified-Peterson (Darroch) mark-recapture method	Mark-recapture data	• Lower Cowlitz: FCH, COH, STHD
Smolt migration speed and timing	Mark-recapture data	• Lower Cowlitz: FCH, COH, STHD
Natural spawning escapement abundance (NOS) and pHOS at adult separator	Number of HORs, NORs by destination, mark sampling, catch sampling	• Upper Cowlitz: COH, SPC, STHD • Tilton:STHD
Smolt yield, timing and FPS at Cowlitz Falls	Smolt counts and mark-recapture for collection efficiency	• Upper Cowlitz: COH, SPC, STHD
Smolt yield, timing and FPS at Mayfield	Smolt counts and mark-recapture for collection efficiency	• Tilton: STHS, COH, SPC
Predation rate of cutthroat on salmonids	Stomach contents	• Lower Cowlitz: CUT

Notes: All variables are estimated annually.
Links between variables estimated and decisions are shown in Appendix H.

5 OTHER RELATED ISSUES

5.1 NUTRIENT ENHANCEMENT RULES

For a more complete discussion of Nutrient Enhancement in the Cowlitz Basin, see page 16 of the FHMP approved in 2006 (Appendix B).

5.1.1 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 construction of dams led to the dramatic reduction in the amount of MDN delivered to the Cowlitz River basin (Stockner and Ashley 2003). There is little doubt now that MDN are an important component of Pacific Northwest anadromous salmonid ecosystems (Stockner 2003). The productivity and capacity of watersheds within the Cowlitz River Basin are directly tied to the level (ultimately) of spawner-delivered MDN. This could 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 to determine 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, Bilby et al. 2001) to Wipfli's (2003) mesocosm experiments and the Slaney et al. (2003) whole stream fertilization experiments.

5.1.2 Biomass Needs

The wide range of potential nutrient loadings (Table 5-1) reflects 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 mesocosms (Wipfli et al. 2003). Although the direct applicability of these studies to the Cowlitz River is unclear, they provide indications of the potential importance of MDN in achieving the goals of the SA.

Table 5-1. Example of carcass-delivered nutrient needs, as coho units, for the watershed upstream of the Cowlitz River Barrier Dam.

Location	Bank Full Surface Area (m2)	Bilby et. al. (2001) (0.15kg/m2 or 0.033 coho/m2)	Wipfli et al. (2003) (1.9 kg/m2 or 0.422 coho/m2)
Tilton	1,595,726	53,000	674,000
Upper Cowlitz	4,637,435	154,000	1,957,000
Cispus	1,981,040	66,000	836,000
Total	8,214,201	273,500	3,467,000

While the values presented by Bilby and those of Wipfli (above) may have merit, the number of fish require to achieve some of those levels are not within the documented record on the Cowlitz River. To help establish a target level of nutrients, other comparisons can be made. One would be to estimate the level of nutrients available at the minimum viability abundance goals set forth in LCRSRP calculated from numbers of fish by species and average weight per fish (see Section 2.2.1). Another approach would be to determine the level of biomass that would be available when escapements are at what is believed to be current adult capacity for a given system, again using numbers of fish by species by average weight per fish (See Table 5-1). Currently, the number of fish carcasses exceeds the former level of nutrient enhancement (see Table 5-2). To achieve the latter level, additional resources and additional fish are needed. It is expected that as natural populations increase (recover) additional levels of nutrients will become available. It is also possible to estimate the level of nutrients available at historic levels of salmon escapement (those values estimated by EDT) (Table 5-2).

5.1.3 Proposed Actions

Distribution methods have yet to be determined; however, a combination of Regional Fishery Enhancement Groups (RFEGs), volunteers, Tacoma Power and WDFW staff is expected to be the best way to handle live fish and or carcass distribution. While live fish are the best way to achieve a more even distribution, at this time some of the required nutrients will need to be delivered via salmon carcasses. This is because existing limits on pHOS levels (proportion of fish spawning naturally that are of hatchery origin) for some species preclude accomplishing the maximum level using live fish at this time.

If analogs become available, they may be used as a substitute for salmon carcasses. The ease of storage, lack of disease concerns, ease of transportation and distribution of analogs offer the greatest ability to meet nutrient level goals where they are not being met by naturally spawning fish.

Additional nutrient enhancement for the lower river is not being considered until more precise estimates of the number of fish spawning naturally have been determined. Until that time, any additional nutrient enhancement should be focused on the Upper Cowlitz first, using live adult spring and fall Chinook (for better distribution and limited impact to conservation objectives), then, if necessary, by placing carcasses regardless of species (excluding steelhead). Currently, the WDFW policy concerning the distribution of excess carcasses and eggs from state hatcheries directs all food-quality fish carcasses in excess of broodstock needs to food banks (both state-wide and locally). This may limit the availability of carcasses available to nutrient enhancement projects within the basin. In addition, the reductions from historic production levels at Cowlitz Hatchery as well as WDFW's commercial selective fishing initiative (increasing the harvest of hatchery-origin fish) are expected to limit the number of surplus fish arriving at the facility and available for this purpose.

Table 5-2. Nutrient enhancement currently occurring in the Cowlitz Basin.

Population	Recovery Goal (LCRSRP)	Adult Capacity (from 2004 FHMP)	Assumed Historical Abundance (from LCRSRP)	lbs/ fish	Total Pounds at Recovery Goal	Total Pounds at Capacity	Total Pounds at Historical	Current Fish Spawning (lower river) or Transported Upstream (upper river)		Current Percent Recovery Goal	Current Percent of Capacity	Current Percent of Historical
								Number	Lbs.			
Lower Cowlitz Fall Chinook	3,000	10,508	24,000	15	45,000	157,620	360,000	2,362	35,430			
Lower Cowlitz Spring Chinook	NA	-						500	7,500			
Lower Cowlitz Coho	3,700	5,868	18,000	8	29,600	46,944	144,000	2,591	20,728			
Chum (Fall)[2]	900	unknown	195,000	10	9,000		1,950,000					
Chum (Summer)	900	unknown	unknown	10	9,000							
Total Pounds					83,600	204,564	2,454,000		63,658	76%	31.1%	2.59%
Upper Cowlitz Fall Chinook	NA	7,286	28,000	15		109,290	420,000	5,000	75,000			
Upper Cowlitz Spring Chinook (includes Cispus)	3,600	8,196	29,800	15	54,000	122,940	447,000	3,000	45,000			
Upper Cowlitz Coho (includes	4,000	35,445	26,000	8	32,000	283,560	208,000	20,000	160,000			

Population	Recovery Goal (LCRSRP)	Adult Capacity (from 2004 FHMP)	Assumed Historical Abundance (from LCRSRP)	lbs/ fish	Total Pounds at Recovery Goal	Total Pounds at Capacity	Total Pounds at Historical	Current Fish Spawning (lower river) or Transported Upstream (upper river)		Current Percent Recovery Goal	Current Percent of Capacity	Current Percent of Historical
								Number	Lbs.			
Cispus)												
Total Pounds					86,000	515,790	1,075,000		280,000	326%	54.3%	26.05%
Tilton Spring Chinook*	100	1,602	5,400	15	1,500	24,030	81,000	1,995	29,925			
Tilton Coho	50	2,916	5,600	8	400	23,328	44,800	3,000	24,000			
Total Pounds					1,900	47,358	125,800		53,925	2838%	113.9%	42.87%

*Fall Chinook are being used in the Tilton as a replacement for spring Chinook nutrients.

5.1.4 Nutrient Delivery

WDFW has developed a protocol for the design, implementation, monitoring, and reporting of the distribution of carcasses to restore nutrient levels in streams. Currently nutrients are being delivered by natural-origin fish, allowable levels of hatchery-origin fish on the spawning grounds, adults placed in upper watershed areas for re-colonization and hatchery fish placed in streams to achieve harvest goals. Direct placement of carcasses can be used to increase the nutrient level following established WDFW protocols.

5.2 DISCUSSION ON THE USE OF SATELLITE/ ACCLIMATION PONDS

The use of satellite ponds for acclimation and release of hatchery juveniles above Cowlitz Falls could serve to direct returning adults to the vicinity of their point of release. This could be used as a temporary tool for accelerating the colonization of unused habitat (i.e., a colonization strategy). In this case, the strategy would involve selecting tributaries with suitable habitat, acclimating and releasing juveniles in temporary facilities, allowing the returning adults to spawn, monitoring spawner abundance and distribution, and terminating the releases after a few years. The other application of this strategy would be to encourage the return of hatchery fish transported above Cowlitz Falls to locations where they would be available for harvest at a high rate (i.e., a selective harvest strategy). The selective harvest strategy would differ from the colonization strategy in that the objective would be to remove as many of the hatchery fish as possible through harvest. The acclimation ponds would be located where harvest opportunities would be greater and/or the likelihood that unharvested HORs would be unlikely to co- mingle with NOR spawners. The harvest strategy could be a more long-term one if it incorporates the ability to remove those hatchery fish that are not caught in the fishery.

A consequence of releasing hatchery fish in the upper basin, whether for harvest or colonization, would be a substantially reduced survival from smolt to adult, because of the limited fish passage survival. Depending on survival rates, the number of adult returns from releases upstream of Cowlitz Falls may be less than half of the adult returns resulting from juvenile releases directly from the hatchery. Smolts released from the acclimation ponds would have to be uniquely identifiable upon return in order to be distinguished from those released directly from the hatchery. If the fish reared in acclimation ponds in the upper river were transported and released below the barrier dam, fish passage loss and ecological interactions in the upper watershed could be avoided.

Currently the FTC has not made a formal recommendation on the use of acclimation ponds.

5.3 OFF-STATION PROGRAMS

WDFW has a long history of providing salmonid eggs and or juveniles to volunteer groups for Remote Site Incubators (RSI) and net pen programs throughout Washington, including the Cowlitz River basin (Table 5-3). While these programs have long been used to advance community interest in salmon/steelhead abundance, engage stakeholders

in propagation of natural resources and in some cases, increase harvest, they may pose a risk to recovery of listed species.

Three types of off-station programs are supported by the Cowlitz Salmon and Trout hatcheries:

- **In-basin**
  1) Remote site incubators (RSIs), and
  2) Net pens/smolt acclimation sites

- **Out-of-basin**
  3) Egg transfers (for Select Area Fishery Enhancement (S.A.F.E.) net pens)

The use of RSIs, in which eggs from hatchery adults are placed in stream-side incubators and allowed to hatch, immigrate and rear in the natural environment, can pose a risk to naturally producing populations (depending on size and location of program). Risks include directly competing with naturally produced fry for rearing space and food supply, particularly for those species that rear for extended periods in freshwater, and in cases where large numbers of fish are released.

RSIs have been shown to be a benefit to chum (a listed species in the Cowlitz River basin) and pink salmon populations, especially as a means of reintroduction. Chum and pink salmon do not rear in freshwater so competition between RSI juveniles and natural-origin fish is minimal.

The use of in-basin net pens, where hatchery-origin juveniles are reared (usually until smolted) and then released into the natural environment to continue their outmigration, produce returning adults that are imprinted to a location different than normal hatchery reared and released smolts. As such, these adults do not return to the hatchery with the same level of homing fidelity (they have a higher stray rate). These adults pose a genetic risk by breeding with naturally produced adults (domestication). Due to the higher stray rates of adults produced from net pen-reared juveniles, they generate more hatchery fish on the spawning grounds (pHOS) per fish released than direct hatchery plants, which needs to be accounted for in estimating total pHOS.

The HSRG made the following observations regarding the use of net pens and the practice of outplanting salmonid juveniles (HSRG 2004):

> "*Tagging and genetic studies have shown that outplanting and net pen programs promote stray rates that far exceed natural levels (Candy and Beacham 2000; Mackey et al. 2001).*"

The HSRG further noted that:

> "…*Outplanting and net pen releases from segregated hatchery programs* (summer steelhead in the Cowlitz is an example from Table 5.3) *are especially problematic because of the potentially high level of genetic divergence between the hatchery stock and natural populations where straying and natural spawning may occur. Although the natural spawning success of hatchery-origin fish may be*

> *less than that of natural-origin fish when they occur in the same stream, those same data indicate that significant numbers of hatchery-origin fish from nonnative or long-standing "domesticated" populations do indeed spawn successfully and can contribute significant numbers of progeny to naturally spawning populations (Chilcote et al. 1986;Campton et al. 1991; Mackey et al. 2001; Kostow et al. 2003; McLean et al. 2003)."*

The Cowlitz Salmon Hatchery also provides a egg source for out-of-basin net pens for fishery enhancement (S.A.F.E. program). This program poses very low risk to Cowlitz River basin populations and provides alternative commercial fishing locations that reduce the harvest rates on all natural populations in the lower Columbia River tributaries, including the Cowlitz River.

5.3.1 Actions

By the end of 2014, the existing in-basin RSI programs in the Cowlitz will be phased out or transitioned to programs that have a conservation benefit. Existing operations will need to be evaluated to determine their impact on naturally produced populations, their recovery benefit through reintroduction to vacant or underutilized habitat, and their potential benefits to other species (based on location), such as chum. Additionally, WDFW will need to coordinate this transition with stakeholders participating in the current program. Completing the transition by the end of 2014 will provide for smooth transition from the existing program to a new direction for the future. WDFW will attempt to implement changes prior to 2014 to the fullest extent possible. This time is needed by WDFW to follow established processes for working with constituents and finding suitable alternatives.

The existing in-basin smolt acclimation net-pen programs are not included in the proposed future hatchery program (Table 3-17). If smolt acclimation net-pen programs are proposed, then a reduction in the on-station program that accounts for increased stray rates will be required to maintain consistency with HSRG standards.

Out-of-basin egg transfers may continue in the future, subject to agreement between WDFW and Tacoma Power on the costs of these programs, provided the effects on conservation and production objectives are fully accounted for. In other words, they must be accounted for within the overall production limitations for (a) conservation (Sections 3.1 to 3.12), and (b) Cowlitz Hatchery production cap (Section 3.13). In the case of low adult abundance (fewer eggs/adults than needed to meet on-station, upper river, and off-station programs) for programs being managed to meet HSRG standards, reductions in the out-of-basin egg transfer program will be taken in either the on-station or off-station programs first before the upper river programs are reduced.

Table 5-3. Off-station programs: current (2010 FBD) production for off-station transfers.

Species	Number at Transfer	Size at Transfer (fish/lb)	Pounds at Transfer	Date of Transfer	Release Location	Group
Sp Chinook	55,000	12	4,583	Nov.	Net pens in lower river	Friends of Cowlitz
Sp. Chinook	125,000 125,000	Eyed eggs Green eggs	0	Nov	Grays R. Hatchery	WDFW
Coho	40,000	Eyed eggs	0	Jan	Various stream side incubators	Cowlitz Game and Anglers
Coho	230,000	Eyed eggs	0	Jan	Various stream side incubators	Friends of Cowlitz
Coho	2,200	Eyed eggs	0	Jan	Various projects	Region 5 Co-ops
Coho	1,000	100	10	June	Kraus Pond	Kraus Ryderwood Project
Summer Stlhd	100,000	6	16,667	Feb	Net pens in lower river	Friends of Cowlitz
Cutthroat	10,000	5.5	1,818	Feb	Net pens in lower river	Friends of Cowlitz

5.4 PRODUCTIVITY TESTING

As part of the development of this FHMP Update, the FTC has chosen to suspend productivity testing.

5.5 HATCHERY OPERATIONS

5.5.1 Cowlitz Salmon Hatchery Operations

An attraction water pump discharges treated hatchery effluent directly into the head of the ladder near the receiving pool 24 hours per day. When adult return numbers are low (usually steelhead and spring Chinook), this additional attraction water may entice the fish to move through the ladder at a faster rate, increasing the number of fish that reach the receiving pool and become available for broodstock purposes. When the return of adults is strong (usually in October and November during the coho return), the attraction flow water pump maybe turned off, eliminating the additional attraction.

***Proposed change**:* The attraction water pump (T-pump) will be operated only as needed to achieve adult collection numbers for each species.

5.5.2 Cowlitz Trout Hatchery

Prior to 2006, drain water from the Cowlitz Trout Hatchery was discharged into the lower portion of Blue Creek, upstream of the outlets to the five-acre steelhead and cutthroat trout rearing ponds. When the adults returned to the vicinity of the hatchery, a large portion of the fish held in the Cowlitz River downstream of the mouth of Blue Creek, leading to a concentrated fishery in a limited area of river.

Tacoma Power constructed a new outlet into the Cowlitz River downstream of the Blue Creek boat launch as part of the Cowlitz Hatchery Complex remodel project. The existing outfall into Blue Creek was maintained in an operational status. By routing the hatchery discharge directly into the Cowlitz River, this reduced the attraction of fish to Blue Creek and promoted their tendency to stray within the river system upstream to the Cowlitz Salmon Hatchery ladder and trap. This process was partially done to eliminate adult returns to the Cowlitz Trout Hatchery where they were not needed since all steelhead and cutthroat trout broodstock can be taken at the Cowlitz Salmon Hatchery separation facility. Another reason for the new hatchery outfall was to accommodate requests of the angling public and WDFW to spread out the fishery in the Cowlitz River upstream of the mouth of Blue Creek.

Since February 2007, WDFW has operated the outfall distribution of the Cowlitz Trout Hatchery water at an approximately 50:50 level except for the six week period in the spring when juvenile steelhead and cutthroat trout are being released from the five-acre ponds. During that time, 100% of the hatchery discharge is routed into Blue Creek.

***Proposed change**:* 100% of the water will be discharged down Blue Creek beginning February 15th and until August 10th. From August 11th to February 14th, water will be discharged approximately 50% to Blue Creek and 50% to the Cowlitz River outfall. In addition, WDFW proposes to investigate changes in the speed of upstream migration of adults for all species to determine the level of change and develop alternative methods of achieving the goal of returning to historical upstream migration speed if this proposed new strategy is not sufficient.

5.6 RESIDENT FISH

Article 5.b) of the SA states that:

> *"Through 2004, the Licensee will provide funding for 50,000 pounds of trout production. Subsequent to 2004, future trout production will be based upon a review by the FTC of the success or failure of the program and any impacts on listed stocks."*

Trout provided by Tacoma Power will be released into the Cowlitz basin, consistent with the tenets of the "Washington Department of Fish and Wildlife Statewide Steelhead Management Plan: Statewide Policies, Strategies, and Actions", completed by WDFW in February of 2008. This document states the following:

1) Protect wild steelhead stocks from potential interactions with hatchery-origin rainbow trout:

a) Hatchery-origin rainbow trout shall not be released in anadromous waters.

b) Hatchery-origin rainbow trout shall not be released in lakes if the release would result in significant negative impact to wild steelhead.

2) Protect wild steelhead stocks from importation, dissemination, and amplification of pathogens by adhering to the "Salmonid Disease Control Policy of the Co-managers of Washington State".

WDFW's Statewide Steelhead Management Plan limits releases of hatchery-origin rainbow trout into anadromous waters; therefore, WDFW will investigate and/or develop new release sites to benefit local communities in the Tilton and upper Cowlitz basins. Establishing new release sites will require time for WDFW to collaborate with the angling public, local communities, and other management entities to for the purpose of identifying and developing new locations. For the 2013 release year, WDFW will develop a new release strategy, including new release locations, that is consistent with the aforementioned key tenets of WDFW's Statewide Steelhead Management Plan.

5.6.1 Management Targets

Specific management targets will be included in the annual plan for 2013.

5.6.2 Decision Rules

Decision Rules for annual production targets will be included in the annual plan for 2012. WDFW will develop and present the annual stocking schedule for FTC review. All trout released will be marked to distinguish them from naturally produced steelhead. The entity providing the trout must adhere to all WDFW disease transfer protocols and provisions.

5.6.3 Monitoring Priorities

Key Assumptions—parameters estimated from the accumulation of data over time. Accuracy and precision will improve from year to year.

The most important key assumption for the Resident Fish Program is that unharvested fish will not interact (spawn) with NOR steelhead. Monitoring plans should be developed to assess the presence and estimate abundance of planted rainbow trout in locations used by and during the timing of NOR late winter steelhead spawning.

Annual Status and Trends—tracks annual outcomes in terms of variable annual biological targets. These targets are revised each year according to the Decision Rules and by taking into account run forecasts. Viewed over time (the trends part), this information will track progress towards conservation and harvest goals.

For the Resident Fish Program, annual estimates of terminal harvest rates are critical to assessing achievement of harvest goals. A specific monitoring plan (creel surveys) should be developed and the results of the survey reported on periodically.

Management Precision—performance evaluation to improve run forecasting and harvest over time to more effectively implement the decision rules. In other words, this monitors the effectiveness of the application of the decision rules.

No further monitoring is identified.

5.6.4 Actions for 2011

The existing program will be continued.

5.6.5 Actions for 2012

The production target for 2012 will be 50,000 pounds of rainbow trout. A monitoring plan will be developed (see Key Assumptions) to assess the presence and abundance of planted rainbow trout in known steelhead spawning locations. This plan will be developed by September 2012.

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