FINAL

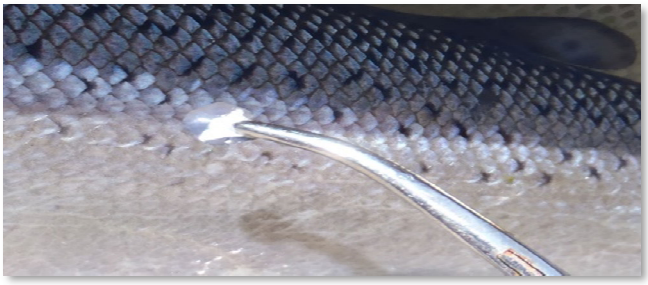
Lewis River Hatchery and Supplementation Plan (FERC Project Nos. 935, 2071, 2111, 2213)

December 2020

Prepared by:

PACIFICORP AND COWLITZ COUNTY PUD

Version 3



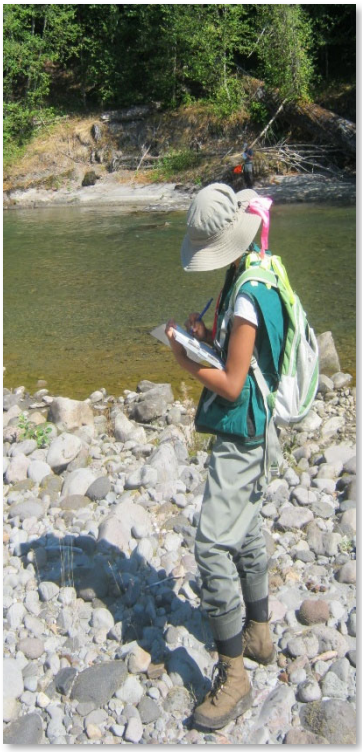


Table of Contents

List of Tables

List of Figures

List of Appendices

Definition of Terms and Acronyms Used in This Plan

Alternative Dispute Resolution: A process of mediation described in the Agreement.

Annual Operating Plan (AOP): An annual planning document that describes the methods and protocols needed to implement the Hatchery and Supplementation Plan and program.

Annual Operating Report (AOR): An annual report that compiles all information gathered from implementation of the H&S Plan.

Aquatic Coordination Committee (ACC): Committee formed of signatories to the Lewis River Settlement Agreement acting as the governing body for implementation of the aquatic provisions in the Settlement Agreement.

Aquatic Monitoring and Evaluation Plan (AMEP): A planning document required by Section 9 of the Agreement focused on monitoring and evaluation activities upstream of Merwin Dam, including fish passage, surveys for salmon, steelhead and bull trout and estimates of ocean recruits.

Aquatic Technical Subgroup (ATS): A group formed under the ACC to provide technical expertise to the ACC and to develop and review planning documents related to implementation of the Settlement Agreement. Formerly referred to as the Hatchery and Supplementation Subgroup (HSS).

Artificial Production Review and Evaluation (APRE): The programmatic review of hatchery facilities and practices conducted by the Northwest Power and Conservation Council. Recommendations from the Artificial Production Review and Evaluation should be incorporated into the H&S Plan.

Biological Opinion: A document that states the opinion of either the U.S. Fish and Wildlife Service or the National Marine Fisheries Service as to whether an action is likely to jeopardize the continued existence of listed species or result in the loss or adverse modification of critical habitat.

Blank Wire Tag (BWT): A small, uncoded wire tag inserted in the snout of fish and detectible through hand-held or fixed detectors.

Coded-wire Tag (CWT): A 0.5 to 1.1 mm length of magnetized stainless steel wire 0.25 mm in diameter with each tag containing a row of numbers. Tags are inserted into fish (typically the snout) to identify individual or groups of fish.

Distinct Population Segment (DPS): Pacific salmon that represents an evolutionarily significant unit (ESU) for the purposes of listing, delisting, and reclassifying.

Double Index Tag (DIT) group: Paired release groups, each tagged with a unique CWT code, where both groups are presumed identical except that one group is externally marked with

an adipose fin clip (AD+CWT) and the other is not (CWT only). DIT groups are used to determine differential exploitation rates on marked and unmarked fish subjected to mark-selective fisheries.

Ecosystem Diagnosis and Treatment (EDT) model: An analytical habitat-based model that organizes empirical environmental data and professional opinion of habitat conditions at a stream-reach scale.

Effective Population Size: The average size of a population representing the number of individuals that can contribute genes equally to the next generation.

Endangerd Species Act (ESA): Federal law passed in 1973 providing a framework to conserve and protect endangered and threatened species and their habitats. https://www.fisheries.noaa.gov/national/endangered-species-conservation/endangered-species-act

Evolutionarily Significant Unit (ESU): A Pacific salmonid population that is substantially reproductively isolated from other conspecific population units and represents an important component in the evolutionary legacy of the species.

FERC: Federal Energy Regulatory Commission

Floating Surface Collector (FSC): a floating barge located in the forebay of Swift Dam designed to provide attraction flow at the surface of the reservoir in order to capture out-migrating juvenile salmonids and adult steelhead (kelt) for transport downstream of Merwin Dam.

Floy tag™: External tags providing a visible means of identifying individual fish through different color and alphanumeric coding combinations.

Generalized Random Tessellation Stratified (GRTS): A spatially balanced sampling scheme for large-scale environmental surveys.

Hatchery and Genetic Management Plan (HGMP): Plans that describe, in a format prescribed by NOAA Fisheries, the operation of each hatchery program and their potential effects and risks on listed species.

Hatchery and Supplementation Plan (H&S Plan): A planning document required by Section 8 of the Agreement developed by the ATS providing the strategic direction for implementing the Hatchery and Supplementation Program.

Hatchery-origin (HOR): Fish spawned in a hatchery or reared in a controlled environment prior to release into the natural environment.

Hatchery and Supplementation Program (H&S Program): Program including all components of Section 8 of the Settlement Agreement as provided in the H&S Plan.

Hatchery Scientific Review Group (HSRG): An independent scientific review group established by the U.S. Congress to initiate hatchery reform balancing both conservation and harvest goals.

Juvenile: For purposes of this plan, juvenile refers to actively swimming young fish (e.g., fry, parr and smolts) that have not yet reached sexual maturation.

Kelt: A post-spawn iteroparous fish such as a steelhead or cutthroat.

Licensees (or Utilities): PacifiCorp and Cowlitz PUD, collectively the owner and operators of the Lewis River Hydroelectric Projects.

Major Population Group (MPG): A major population group (MPG) is comprised of salmon populations that are geographically and genetically cohesive. The MPG is a level of organization between demographically independent populations and the ESU or DPS.

Merwin Collection Facility (MCF): An adult trapping, collection and sorting facility located at the base of Merwin Dam.

M&E: monitoring and evaluation.

Natural-origin (NOR): Progeny of fish that spawn naturally, including progeny of hatchery-origin fish or strays that spawn naturally. For fish management purposes, any fish possessing an adipose fin (and no tags) are considered of natural origin.

NMFS (or NOAA Fisheries): National Marine Fisheries Service, informally referred to as NOAA Fisheries.

NOAA: National Oceanic and Atmospheric Administration is part of the Department of Commerce and oversees the NMFS.

Ocean Recruits: Total escapement of hatchery and natural origin fish accounting for harvest from ocean, Columbia River and terminal fisheries.

Overall Downstream Survival (ODS): the percentage of juvenile salmonids that enter the project from natal streams and survive to enter the Lewis River below Merwin Dam by collection, transport and release via the juvenile fish passage system, passage via turbines, or some combination thereof.

Population Level Monitoring: monitoring and evaluation at a level that includes the spatial or geographical extent of a listed population to inform on the recovery status of a listed population.

Proportion of Hatchery Origin Spawners (pHOS): Proportion of natural spawners in a watershed or stream composed of hatchery-origin adults.

Proportion of Natural Origin Broodstock (pNOB): Proportion of a hatchery broodstock composed of natural-origin adults.

Proportionate Natural Influence (PNI): An estimate of the proportion of natural influence on a population composed of hatchery and natural origin fish. Calculated as pNOB/(pNOB+pHOS).

PIT tag: Passive Integrated Transponder (PIT) tags are electronic tags each having a unique code allowing identification of individual tagged fish throughout their life with specialized readers that activate the tags indefinitely.

Radio tag: Tag that transmits a unique code at a specified frequency allowing individual detection of nearby fish with specialized fixed or mobile receivers.

Smolt to adult return (SAR): Survival rate is measured from the point from which a juvenile fish is released or naturally migrates to its return as an adult.

Services: Includes the U.S. Fish and Wildlife Service and the National Marine Fisheries Service

Self-Sustaining Population: A population that can perpetuate itself and persist at a viable salmonid population (VSP) level for a specified period of time in the absence of (or despite) external intervention.

Settlement Agreement (Agreement): A binding agreement between the Utilities, federal and state regulatory agencies, tribal entities and non-governmental organizations specifying the Utilities' obligations to mitigate effects of hydropower operation on fisheries, wildlife, recreation, cultural, and aesthetic resources.

Single Nucleotide Polymorphism (SNP): A DNA sequence variation that occurs when a single nucleotide (adenine, thymine, cytosine, or guanine) in the genome sequence is altered; usually present in at least 1 percent of the population.

Stubby dorsal fin: A dorsal fin in which the rays have become crooked or compressed along the leading edge as compared to naturally produced fish. Stubby dorsal fins are indicative of fish reared in a hatchery environment.

Utilities: PacifiCorp and Cowlitz PUD, collectively the owner and operators of the Lewis River Hydroelectric Projects.

VSP: A Viable Salmonid Population (VSP) is defined as an independent population of any Pacific salmonid that has a negligible (<5%) risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100-year time frame.

WDFW: Washington Department of Fish and Wildlife

EXECUTIVE SUMMARY

This Hatchery and Supplementation Plan (H&S Plan) provides the framework for implementing activities associated with Section 8 (Hatchery and Supplementation Program) of the Lewis River Settlement Agreement (Agreement) dated November 30, 2004. Section 8.25 of the Agreement directs PacifiCorp and Cowlitz PUD (Licensees or Utilities) to update the H&S Plan every five years, or earlier if required by approved Hatchery and Genetic Management Plans (HGMPs). Any modifications to the H&S Plan must be finalized through consultation with the Aquatic Coordination Committee (ACC) and subject to approval of the National Marine Fisheries Service (NMFS or NOAA Fisheries) and the U.S. Fish and Wildlife Service, collectively known as the Services.

The original H&S Plan was filed in December 2009 and updated in December 2014. This version (2020) represents the third version (second update) to the H&S Plan, and includes several key updates from previous versions:

1. The monitoring and evaluation section has been updated to incorporate and be consistent with monitoring and recovery guidance provided by NMFS (Crawford and Rumsey 2011).

2. The adaptive management sections have been updated to provide improved guidance and flexibility to effectively implement the Hatchery and Supplementation Program (H&S Program).

3. Increased focus and guidance on developing and transitioning from segregated to integrated hatchery programs that are consistent with recommendations by the Hatchery and Scientific Review Group (HSRG).

4. Additional figures and tables have been added to assist reviewers in understanding the relationships and differences between the H&S Plan, Aquatic Monitoring and Evaluation Plan (AMEP) and Annual Operating Plan (AOP).

5. Incorporates recommendations from the Comprehensive Periodic Review (Section 8.2.6 of the Agreement) completed in July 2020.

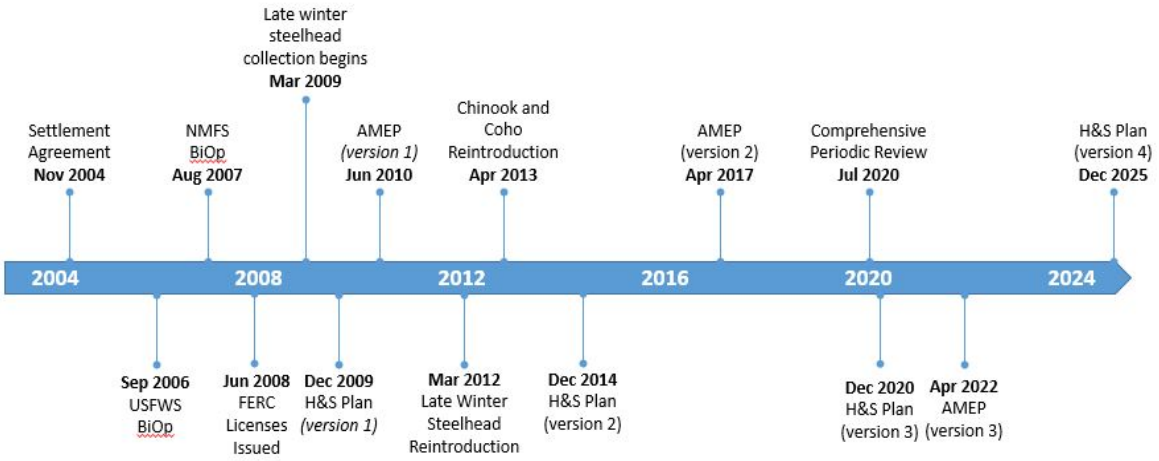


Figure E-1 Timeline of milestones related to the Hatchery and Supplementation Program and associated activities.

H&S Plan Contents

Section 8.2.2 of the Agreement states:

"The H&S Plan shall address the means by which the Licensees shall use the Hatchery Facilities to accomplish the goals and requirements of the Hatchery and Supplementation Program, including, without limitation, the Hatchery Targets. It shall also be consistent with the objective of restoring and recovering wild stocks in the basin to healthy and harvestable levels".

Section 8.2.2 of the Agreement identifies several topics the H&S Plan shall address. Table E-1 summarizes these topics and identifies where they are addressed in the Plan or other supporting documents. In an effort to reduce redundancy and improve clarity, some Plan components have been moved to the AMEP or the AOP.

Table E-1 Summary of H&S Plan topics required by Section 8.2.2 of the Settlement Agreement, including the location where each topic is addressed in the H&S Plan or other supporting documents.

	TOPIC	LOCATION
1	A description of the Hatchery Facilities, including upgrades identified in Schedule 8.7	Section 2.1 in this Plan; 2014 H&S Plan, Section 8.1.
2	Identification of species and broodstock sources to be used for the Hatchery and Supplementation Program	2.0 Hatchery Production and 2020 AOP
3	The quantity and size of fish to be produced	2.0 Hatchery Production and 2020 AOP
4	The allocation of smolts and adults between the hatchery and supplementation programs and a description of how the two programs are to be implemented at the same facility without causing unacceptable adverse impacts on each other	2020 AOP
5	Rearing and release strategies for each stock including, but not limited to, timing, planned distribution, locations for release, procedures to transport smolts to acclimation sites for supplementation purposes, and upward and downward production adjustments to accommodate natural returns	2020 AOP (note that in-season adjustments are described in the AOP; longer term adjustments are determined by the ACC's Decision Rules)
6	The Ocean Recruits Methodology	2017 AMEP
7	Plans and protocol for supplementation stocks	2020 AOP
8	Broodstock collection and breeding protocols	2020 AOP
9	Policies in effect regarding in-basin and out-of-basin stock transfers	2020 AOP and WDFW 2006
10	Measures to minimize potential negative impacts of the Hatchery and Supplementation Program on ESA-listed species	Section 2.0 Hatchery Production
11	Measures to protect production processes from predators, e.g., netting, consideration of evolving hatchery practices to condition fish to avoid predators	2014 H&S Plan
12	A description of how the Hatchery and Supplementation Program monitoring and evaluation requirements will be implemented, including, but not limited to, marking strategies	Section 5.0 and the 2020 AOP
13	A description of the methods to prevent unacceptable adverse impacts, if any, of (1) the hatchery program on the reintroduction program, and (2) the supplementation program on native resident species	Section 2.0 Hatchery Production
14	Fish health protocols	2020 AOP attachment

Deviations from Settlement Agreement

The H&S Plan is structured to be consistent with Section 8 of the Agreement. However, in an effort to reduce redundancy between the AMEP and H&S Plan, some H&S Plan components are addressed in the AMEP, as noted in Table E-1. Other deviations from the Agreement are described below.

- Fall Chinook and Chum Monitoring and Evaluation (Section 9.3): Monitoring of wild fall Chinook and chum populations, including juvenile tagging, is included in the H&S Plan monitoring and evaluation (M&E) objectives. These activities are aligned with monitoring objectives for steelhead and Coho in the North Fork Lewis River downstream of Merwin Dam.
- Juvenile Supplementation (Section 8.5): The Agreement states that juvenile supplementation shall occur for all three transport species (spring Chinook, Coho, and late winter steelhead). The intent of this program was to acclimate and release juvenile hatchery fish upstream of Swift Dam. However, juvenile supplementation was discontinued due to low floating surface collector (FSC) efficiency. Currently, the H&S Plan relies exclusively on transport of adults upstream of Swift Dam. Adults used for the supplementation programs are sourced from adult traps at Merwin Dam and the Lewis River Hatchery.

- The Agreement states that recommendations from the Northwest Power and Conservation Council's Artificial Production Review and Evaluation (NPCC 2005) should be incorporated into the H&S Plan. The HSRG has adopted the Northwest Power and Conservation Council's recommendations and provides the metrics used to evaluate whether programs meet the recommendations. Since the development of the Agreement, the HSRG has developed updated recommendations pertaining to the design and operation of hatcheries (HSRG 2014). Unless the Northwest Power and Conservation Council's process is updated, the H&S Plan will refer to HSRG recommendations as a basis for evaluating the Lewis Basin hatchery programs.

- The Agreement uses the term '*supplementation'* to describe transport of juveniles upstream of Swift Dam. The H&S Plan uses adults to meet the supplementation goals of the Agreement. The use of adults is often referred to as 'reintroduction' which can cause confusion. However, to remain consistent with the Agreement, this plan continues to use the term supplementation to refer to both juvenile and adult transport activities and considers the term *reintroduction* to be synonymous with *supplementation*.

Review and Comment Periods

Comprehensive Periodic Review 8.2.6

Section 8.2.6 of the Agreement requires that the draft H&S Plan undergo periodic reviews. An independent review was completed in June 2020 with the following goals: 1) ensure the program is meeting the intent of the Agreement, 2) ensure the program is consistent with

current hatchery and supplementation strategies, 3) determine whether the program (as planned) is capable of meeting the outcome goals described in the Agreement, and 4) provide recommendations to improve the success of the program. Edits and recommendations from this review are incorporated into this final H&S Plan and are summarized in Appendix C. Additionally, comments from the independent review with respect to the program key questions are also summarized in Appendix C.

ACC Review and Comment Period

Section 8.3.2 of the Agreement requires that the Utilities prepare this plan in Consultation with the ACC. No ACC comments were received from the required 60-day review period provided by the Utilities.

Potential Amendments to the Plan

1. *Consistency with Hatchery and Genetic Management Plans and Biological Opinions*

At the time of this H&S Plan revision, final HGMPs for each hatchery program operating on the North Fork Lewis River have not been submitted to NOAA Fisheries. This plan is intended to be consistent with the HGMPs. However, if discrepancies are identified, this plan shall be amended (as necessary) to maintain consistency with the HGMPs and as required by the Agreement.

2. *In-Lieu Decision*

Section 7.6 of the Agreement directs PacifiCorp to establish an In-Lieu fund if the Services determine that fish passage into Yale or Merwin lakes is not required. The In-Lieu Decision, as it pertains to anadromous fish reintroduction into Merwin and Yale, is currently subject to Alternative Dispute Resolution (ADR) procedures as provided in the Agreement.

Presently, this plan only describes reintroduction efforts upstream of Swift Dam based on the preliminary decision of the Services. Once the ADR process is complete and an In-Lieu decision is finalized, updates to the H&S Plan may be required to be consistent with this decision.

3. *Population Level Monitoring*

This term refers to monitoring and evaluation at a level that includes the spatial or geographical extent of a listed population, and thereby, informing on the recovery status of a listed population (e.g., lower Columbia River Coho salmon). Goals and objectives of the H&S Program are provided in the Agreement (Appendix A). These goals and objectives focus on achieving the Outcome Goals of the Agreement and evaluating the effects of implementing the H&S program on the Outcome Goal. Thus, the scope of the H&S Plan is limited with respect to recovery planning and population level monitoring. However, data collected and analyzed as part of implementing both the H&S Plan and AMEP should be incorporated as part of larger resource agency efforts to determine the recovery status of listed populations occurring in the lower Columbia River ESU. The role or obligations of the

H&S Program may require further clarification by the FERC if inconsistencies between the HGMP's, Agreement or FERC licenses should occur.

4. Definition of Self-sustaining as it pertains to the reintroduction outcome goal

The H&S Plan is designed to achieve the reintroduction outcome goals of the Agreement. As part of the stated goals, the term self-sustaining is not defined as to when a reintroduced population is determined to be self-sustaining. The Utilities believe that at some point hatchery supplementation must end to determine (or prove) whether a 'naturally producing' population is self-sustaining. This determination is based on whether a natural population is able to achieve adult to adult abundance (i.e., ≥ 1.0) and juvenile productivity targets in the long term and in the absence of hatchery supplementation.

1.0 INTRODUCTION

The Lewis River Settlement Agreement (Agreement) for the Lewis River Hydroelectric Projects dated November 30, 2004 includes a comprehensive suite of salmon and steelhead protection, mitigation, and enhancement measures that will be implemented over the terms of the new project licenses (PacifiCorp and Cowlitz PUD 2004). As described in Section 8 (Hatchery and Supplementation Program), a key feature of the Agreement is the reintroduction of spring Chinook, Coho and late winter steelhead into their historical range above Merwin Dam using hatchery supplementation and newly constructed fish passage facilities. The Hatchery and Supplementation (H&S) Plan provides guidance for implementing activities associated with Section 8 of the Agreement. Development of the H&S Plan is a requirement of both the Agreement and the Federal Energy Regulatory Commission (FERC) Hydroelectric Project Licenses (Figure 1-1).

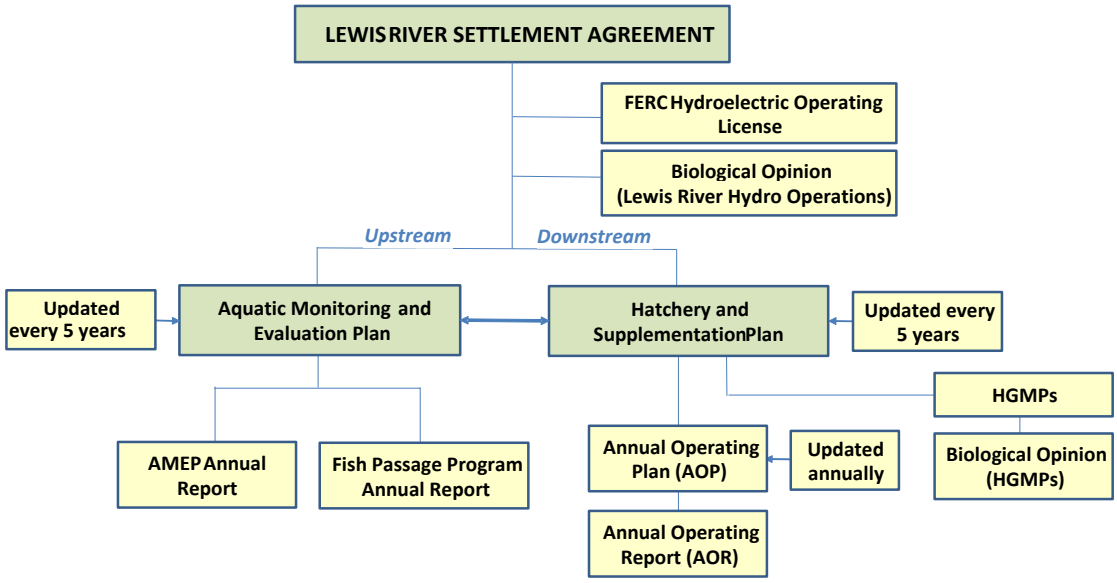


Figure 1-1 Structure and relationship between the Lewis River Settlement Agreement and required plans and reports for upstream and downstream fish passage and fish production programs.

H&S Program Goals

Section 8.1 of the Agreement states that the goals of the Hatchery and Supplementation Program (H&S Program) are to:

1. *Support self-sustaining, naturally producing, harvestable native anadromous salmonid species throughout their historical range in the North Fork Lewis River Basin, and*

2. *Provide for the continued harvest of resident and native anadromous fish species.*

The H&S Plan shall be designed to adaptively manage the H&S Program and be consistent with the reintroduction outcome goal of the Agreement:

> "*to achieve genetically viable, self-sustaining, naturally reproducing, harvestable populations above Merwin Dam greater than minimum viable populations.*"

The H&S Program shall also be consistent with the Endangered Species Act (ESA), applicable state and federal fisheries policies, regional recovery plans, and recommendations of the Hatchery Science Review Group (HSRG) to the extent practicable. The supplementation portion of the program shall be a part of the reintroduction program (in addition to fish passage) and be limited to spring Chinook, winter steelhead and Coho.

The Aquatic Monitoring and Evaluation Plan (AMEP) is designed to meet the monitoring and evaluation (M&E) requirements outlined in Section 9 of the Agreement. The primary focus of the AMEP is the evaluation of the reintroduction program for spring Chinook, Coho and winter steelhead upstream of Swift Dam, including the upstream adult fish collection facility at Merwin Dam (MCF) and the downstream juvenile floating surface collector (FSC) located in the forebay of Swift Dam (Figure 1-3). The AMEP has a separate suite of monitoring objectives; however, results from both the H&S Plan and AMEP monitoring objectives are summarized together in an inclusive matrix which is presented at the beginning of the AMEP report each year (see AMEP objective 23).

The Annual Operating Plan (AOP) is designed to describe the methods used to implement the H&S Plan and provides information on hatchery production plans, release protocols, broodstock collection, spawning protocols, hatchery facility upgrades, and M&E activities downstream of Merwin Dam. The AOP is updated annually and is developed collaboratively within the Aquatic Technical Subgroup (ATS) of the Lewis River Aquatic Coordination Committee (ACC).

1.1 ADAPTIVE MANAGEMENT

Adaptive management of the program is critical to ensuring the program's goals and objectives remain relevant and allows managers to modify objectives as the program matures. Several requirements of the Agreement provide managers the opportunity to review and modify the program, including requirements to (1) review and develop an AOP every year, (2) rewrite or update the H&S Plan every five years and (3) solicit periodic comprehensive reviews of the program by an independent contractor.

Figure 1-2 outlines the framework for adaptive management. The foundation of the adaptive management process is a set of key management questions that relate to program goals. Managers use M&E results to answer these questions and determine whether the program is meeting its goals. If the program is not meeting its goals, alternative approaches should be developed through modification of the AOP and H&S Plan.

The Lewis River ACC has primary responsibility for implementing the adaptive management framework in Figure 1-2. As part of monthly ACC meetings, the ACC is provided status

updates of the H&S Program. When necessary, the ACC shall make decisions regarding recommended changes to the program proposed by the ATS or Utilities. Decisions by the ACC follow Consensus based protocols provided in the ACC and TCC ground rules document, which requires the use of a Request for Decision Template and Record of Decision Template (PacifiCorp and Cowlitz PUD, 2000). Final decisions are documented in the ACC meeting notes and recorded in the Utilities annual operations report to the FERC. The Lewis River ATS provides technical expertise and recommendations to the ACC and helps develop and review planning documents related to implementation of the Agreement.

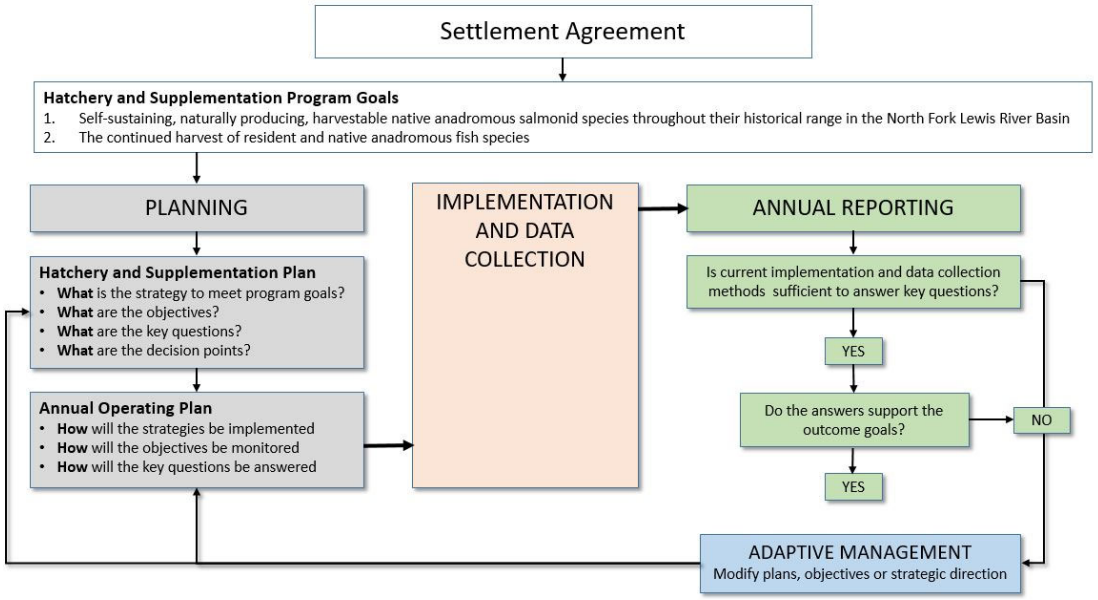


Figure 1-2 Framework for planning, data collection and annual reporting requirements of the Agreement, including how adaptive management is incorporated into the H&S Program.

Several decision rules have been developed as part of the adaptive management framework. The results of data collection and annual reporting are used to make changes to how the hatchery and supplementation program are managed (e.g., number of hatchery releases, broodstock management strategy, and supplementation strategy). These decision rules are summarized below (Table 1-1) and discussed in more detail in the relevant sections of the Plan.

Table 1-1 Decision Rules for the Lewis River Hatchery and Supplementation Program.

Section of the Plan	Decision Rule
Sections 2.4.2, 2.5.2, 2.6.2 Hatchery Adult Targets	As natural production of spring Chinook, Coho, and late winter steelhead upstream of Merwin Dam exceeds the respective threshold levels for each species, hatchery production levels would be reduced on a 1:1 basis. Hatchery production would not be decreased below the level needed to produce the 'floor' level of adult ocean recruits.
Section 3.0 Supplementation Component	Transport goals may be modified by the ACC at any time based on, but not limited to, changes to habitat conditions, model assumptions, forecasted fish returns and declining fecundity rates.
Section 3.1.4 Spring Chinook NOR Disposition	All NOR spring Chinook returning to adult traps are transported upstream as part of the supplementation strategy.
Section 3.2.4 Coho NOR Disposition	All NOR Coho returning to adult traps above broodstock needs (e.g., 30% pNOB for early run) are transported upstream as part of the adult supplementation strategy.
Section 3.3.4 Late Winter Steelhead NOR Disposition	Broodstock consist only of NOR returns (100% pNOB). Currently, the only NOR late winter steelhead transported upstream are those containing a PIT tag identifying them as upriver production (above Swift Dam). During the implementation of this H&S Plan, the AOP will be updated to describe the disposition of NOR steelhead (without PIT tags) arriving at the MCF or Lewis River ladder that exceed broodstock needs to determine what portion, if any, of these NOR returns should be transported upstream.

1.2 PLAN FORMAT

This Plan consists of seven sections (including Section 1, Introduction) designed to address requirements outlined in Section 8.2.2 of the Agreement.

1.2.1 *Hatchery Production Component*

Section 2 describes the North Fork Lewis River hatchery programs, including hatchery program types and release goals. The goal of these programs is to maintain harvest opportunities downstream of Merwin Dam (anadromous species) and in project reservoirs (resident species) and provide anadromous fish for supplementation efforts in the basin.

1.2.2 *Supplementation Component*

Section 3 describes current strategies to reintroduce spring Chinook, late winter steelhead and Coho upstream of Swift Dam. This section also identifies numeric targets for reintroduction based on Ecosystem Diagnosis and Treatment (EDT) analysis.

1.2.3 *Monitoring and Evaluation Objectives*

Section 4 describes the M&E program, which includes both hatchery and supplementation program components. The H&S Plan identifies several monitoring objectives intended to be consistent with regional salmon and steelhead recovery goals and in compliance with the Agreement, the ESA, HSRG recommendations, final Hatchery and Genetic Management Plans (HGMPs) and the Biological Opinion.

NOAA Fisheries has provided guidance and recommendations for monitoring the recovery of ESA listed salmon and steelhead populations using viable salmonid population (VSP) parameters (Crawford and Rumsey 2011). The H&S Program will strive to be consistent with this guidance to the extent practical. Detailed study designs and protocols to meet objectives of the H&S Program will be provided each year in the AOP.

Most M&E objectives are associated with a series of key questions designed to support and guide the development of specific monitoring efforts as part of the AOP. The AOP provides the methods required to address key questions including the appropriate metrics, precision targets, and deliverables and, when appropriate, decision rules. Decision rules are based primarily on population monitoring outcomes and specify levels (e.g., minimum abundance) when adaptive management should be implemented. For example, a program may move from the re-colonization to local adaptation phase when the 5-year average natural origin fish (NOR) abundance reaches a specific numeric target.

1.2.4 *Fish Marking Strategies*

Section 5 proposes strategies for marking and tagging both hatchery and supplementation component fish. Tags include Passive Integrated Transponder (PIT) tags, Coded Wire Tags (CWT) and Blank Wire Tags (BWT). Marking strategies predominantly include removal of the adipose fin but can also include other fin clips or dyes for purposes of short-term marking strategies to evaluate juvenile trapping efficiency.

1.2.5 *Expected Outcomes*

Section 6 presents recent empirical data on the supplementation programs, including the number of adults trapped and transported, number of smolts collected at the Swift FSC, and data on FSC efficiency. These data provide a comparison of the current status of the program to program goals.

1.2.6 *Annual Operating Plan and Annual Operating Report*

Section 7 describes the contents of the AOP and Annual Operating Report (AOR), which are required by the Agreement (Sections 8.2.3 and 8.2.4). The AOP provides the primary means to adaptively manage the program within the guidance of the H&S Plan as it is updated annually and can incorporate new technology or methods to achieve the goals and objectives of the program. The AOR includes all information gathered pursuant to implementation of the H&S Plan. This includes information on M&E activities downstream of Merwin Dam, hatchery operations, and fish transport and production, which will be used to determine if program targets are met.

Section 7 also describes how M&E results are reported, including integrating results from AMEP activities using a master table. The master table is intended to provide a summary of results from all M&E activities and provide the location where detailed reporting of each objective may be found.

1.3 SITE AREA

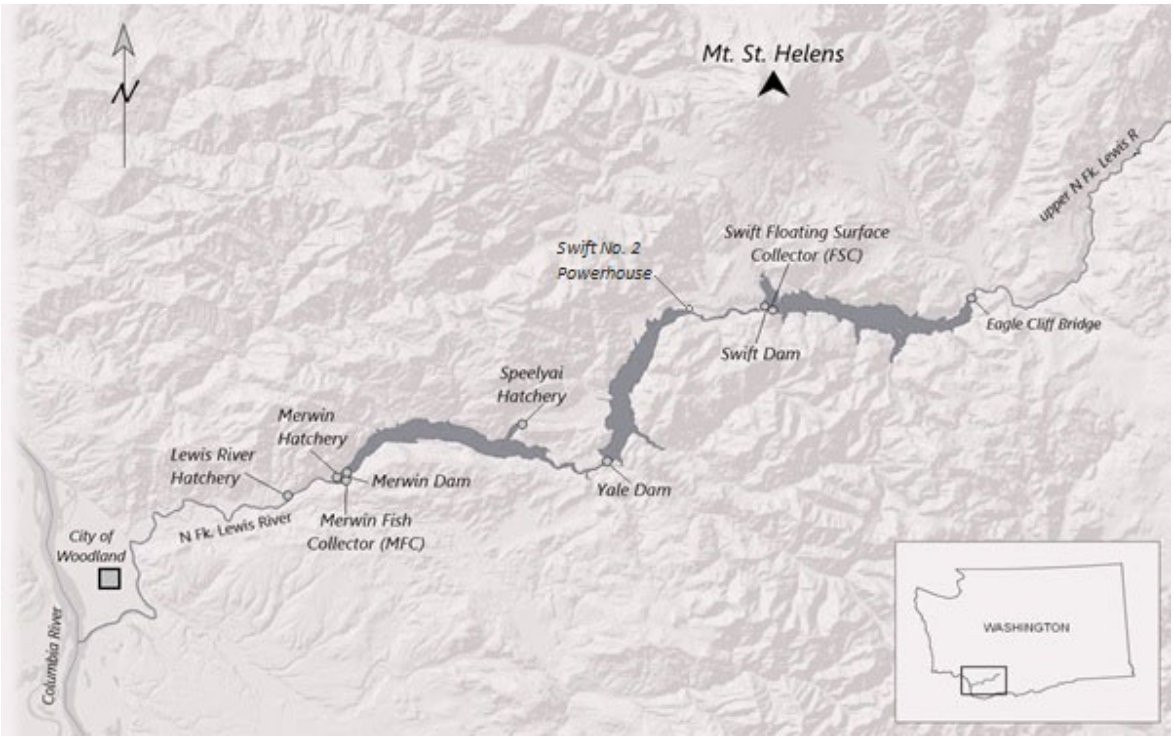


Figure 1-3 Area map showing locations of Lewis River fish hatcheries, collection facilities, hydroelectric projects and reservoirs.

2.0 HATCHERY PRODUCTION COMPONENT

The H&S Program produces juvenile fish to serve two primary purposes: 1) contribute to harvest, and 2) meet adult supplementation targets upstream of Swift Dam. Additionally, hatchery plants of rainbow trout and kokanee provide recreational fishing opportunities in Swift and Merwin reservoirs.

Spring Chinook, Coho and steelhead juveniles are released in the mainstem North Fork Lewis River downstream of Merwin Dam, and kokanee and rainbow trout are released in reservoirs upstream of Merwin Dam (Table 2-1).

Table 2-1 Total juvenile hatchery production of the North Fork Lewis River hatchery complex and designated release locations.

Species	Number of fish (pounds)	Release Location
Spring Chinook	1,350,000	North Fork Lewis River
Early Winter Steelhead	100,000	North Fork Lewis River
Late Winter Steelhead*	50,000	North Fork Lewis River
Summer Steelhead	175,000	North Fork Lewis River
Coho Salmon	2,000,000	North Fork Lewis River
Kokanee	93,000 (12,500)	Merwin Reservoir
Rainbow trout	50,000 (20,000)	Swift Reservoir
TOTAL	**3,818,000**	

*juvenile releases of late winter steelhead are exclusively for supplementation purposes (see Section 3.0)

2.1 HATCHERY FACILITY UPGRADES

Hatchery facilities have been modified through hatchery upgrades defined in Section 8.7 of the Agreement. Upgrades were designed to improve operational flexibility and rearing conditions by reduced loading densities and increased flow indexes. Fish handling upgrades consisted of a new sorting facility at Lewis River Hatchery and spawning area upgrades at Speelyai Hatchery. An annual list of hatchery upgrades will be included in annual reporting of the H&S Program (AOR).

2.2 RESERVOIR FISH PLANTS

As part of the H&S Plan, both hatchery rainbow trout and kokanee production will continue as described below. The purpose of both programs is to provide recreational fisheries in Merwin and Swift reservoirs.

It is important to note that neither of these programs shall interfere with anadromous reintroduction efforts and shall be managed separately. Thus, if these programs adversely affect the program's ability to create self-sustaining anadromous populations, the ACC and regulatory agencies will modify or possibly eliminate these programs.

2.2.1 *Kokanee*

The Agreement calls for the annual release of 12,500 pounds of kokanee into Merwin Reservoir for the purpose of sport harvest. Release size shall be between 7 and 8 fish per pound resulting in total annual releases of about 93,000 kokanee. If necessary, and with approval of the ACC, average release size may be adjusted at any time. However, at no time shall total release poundage exceed 12,500 pounds.

No changes are proposed for the existing kokanee program as the continued release of this species poses little risk to the success of the reintroduction effort upstream of Swift Dam and continues to provide a popular Merwin Reservoir fishery.

2.2.2 *Rainbow Trout*

The Agreement calls for the annual release of 20,000 pounds of rainbow trout into Swift Reservoir. Release size is approximately 2.5 fish per pound resulting in total annual releases of about 50,000 catchable rainbow trout. If necessary, and with approval of the ACC, average release size may be adjusted at any time. However, at no time shall total release poundage exceed 20,000 pounds.

The H&S Plan proposes that the rainbow trout program continue so long as plants do not adversely affect the ability to create self-sustaining anadromous populations, and the number of these fish entering juvenile collection facilities can be sorted accurately without anesthetization and returned to Swift Reservoir (i.e., not transported downstream of Merwin Dam). Modification to the rainbow trout program provided under Section 8.6.3 of the Agreement. Decisions to modify this program are subject to approval of the Services and WDFW, and will be initiated through the ACC using a new decision making process developed by the ACC in 2020.

2.3 INTEGRATED AND SEGREGATED HATCHERY MANAGEMENT

Hatchery stocks may be managed as integrated or segregated programs. These two types of programs have different management strategies. Therefore, the HSRG has different management guidelines for integrated and segregated programs.

2.3.1 *Integrated Programs*

Integrated programs use both natural-origin (NOR) and hatchery-origin (HOR) fish as broodstock. The proportion of natural-origin broodstock in the hatchery (pNOB) and the proportion of hatchery-origin fish on the spawning grounds (pHOS) determine the influence the natural and hatchery environments have on the composite population. Integrated programs are designed to minimize the genetic divergence of HORs from the naturally spawning population. Integrated programs may have both conservation (i.e., reintroduction or supplementation) and harvest goals.

Two Lewis River hatchery programs are currently being managed as integrated programs: late winter steelhead (100 percent pNOB) and Type N Coho (30 percent pNOB).

2.3.2 *Segregated Programs*

Segregated programs use only HORs as broodstock. Therefore, there is no gene flow from the natural origin population to the segregated population. The goal of segregated programs is to prevent hatchery-origin adults from spawning naturally to minimize gene flow from the hatchery population to the natural origin population. In general, the primary intent of a segregated program is to create a hatchery-adapted population that can be used to meet harvest goals.

The Lewis River spring Chinook and Type S Coho programs are currently being managed as segregated programs (HOR broodstock only) during the re-colonization phase. As the number of NORs increases, the intent is to transition to integrated programs by gradually incorporating NORs into the broodstock. This transition will begin to occur once sufficient NORs are available to meet the supplementation program adult transport goals; excess NORs may be used as broodstock. In preparation for changes in hatchery management objectives, the ATS will develop transition plans detailing protocols for transitioning from segregated to integrated hatchery programs, where appropriate.

2.3.3 *HSRG Guidelines for Integrated and Segregated Hatchery Programs*

Hatchery production and facilities, to the extent possible, will be operated consistent with HSRG guidelines for segregated and integrated programs (Table 2-2). Transitioning any program from segregated to integrated may take several generations, and not all guidelines may be met during the transition period.

The North Fork Lewis River hatchery programs will strive to produce smolts that migrate rapidly from the basin that achieve smolt to adult survival rates that meet hatchery broodstock and reintroduction targets. This will be achieved by implementing best management practices and HSRG recommendations (e.g., volitional release strategies) to the extent possible given the limitations of hatchery facilities, and releasing fish at sizes that result in high survival or reduced effects on native salmonids.

The AOP describes specific hatchery production protocols (e.g., spawning, rearing, release sizes, release strategies, etc.) for each program.

Table 2-2 HSRG (2014) guidelines for segregated and integrated hatchery programs.

Segregated (Harvest)	Integrated (Conservation and Harvest)
Maintain an effective population N_e of at least 500 fish.	Use mating protocols that maximize the effective population size (N_e) in the hatchery, including factorial mating, maintenance of the individual pedigrees, and cryopreserved gametes when necessary.
Avoid the use of broodstock from natural populations or other hatchery populations	Collect and spawn adults randomly with respect to time of return, time of spawning, size and other characteristics related to fitness.
Mark or tag all hatchery released fish, so that the proportions of natural and hatchery-origin fish among natural spawners and in the broodstock can be monitored and controlled.	Rear in a hatchery environment and with operational protocols that ensure all portions of the population are treated equally and have the same opportunity to contribute to the release population.
Produce fish that have the physiological fitness to migrate rapidly to saltwater and to survive in that environment through growth regimes that promote smoltification.	Mark or tag all hatchery-released fish to ensure correct identification for use in future broodstocks or in other monitoring programs.
Produce fish that have the morphological characteristics to meet harvest goals.	Use a hatchery environment that allows synchronization of adult maturation, incubation, and emergence, and out-migration with natural populations.
Produce fish that have behavioral characteristics, such as adult run-timing to meet harvest goals.	Rear fish at reduced densities in enriched environments to improve cryptic coloration, territorial fidelity, and social behavior.
Avoid crowding and build-up of wastes and dead fish in fish holding units.	Release fish volitionally during the out-migration timing of the natural stock
Monitor fish health regularly and implement needed treatment immediately	Use a hatchery environment and operational protocols that maximize the survival of each individual including captive rearing.
Use prophylaxis by vaccination where feasible.	Use prophylaxis by vaccination where feasible, monitor the health of stocks regularly, and implement needed treatment immediately.
Use adequate diets that have been stored for only short periods.	Use adequate diets that have been stored for only short periods.
Use locally adapted stocks that are likely to develop reasonable resistance to pathogens likely to be present in the water supply.	Use locally adapted stocks that are likely to develop reasonable resistance to pathogens likely to be present in the water supply.
Avoid practices and situations likely to result in chronic stress (e.g. frequent fish handling etc.)	Avoid practices and situations likely to result in chronic stress (e.g. frequent fish handling etc.)

The effects of hatcheries on natural populations vary depending on their biological significance to the recovery and sustainability of the Evolutionarily Significant Unit (ESU). Different definitions of biological significance are used by managers throughout the Pacific Northwest. In an effort to provide some consistency, the HSRG uses the population designations (Primary, Contributing, and Stabilizing) defined by the Lower Columbia River Fish Recovery Board for salmon and steelhead populations (LCFRB 2004). Viability requirements for recovery are highest for Primary and lowest for Stabilizing populations.

The HSRG provides pHOS and proportionate natural influence (PNI) guidelines for integrated programs to minimize the genetic divergence of HORs from the naturally spawning population (HSRG 2014). Guidelines differ depending on the biological significance of the population. The guidelines for primary populations (North Fork Lewis River spring Chinook) and contributing populations (North Fork Lewis River Coho and spring Chinook) are shown below. Note that these guidelines only apply to the local adaptation and full recovery phases (See Section 3.0, Table 3-1 for details on recovery phases). Currently, the North Fork Lewis River supplementation program populations are all in the re-colonization phase, which does not have specific pHOS and PNI guidelines.

Primary populations—

- Integrated hatchery programs--PNI $\geq$ 0.67; pHOS $\leq$30 percent

Contributing populations—

- Integrated hatchery programs--PNI > 0.50; pHOS $\leq$30 percent

The guidelines do not specify minimum pNOB levels. In order to achieve the minimum guidelines for a primary population (PNI $\geq$ 0.67 and pHOS $\leq$30 percent), the hatchery broodstock needs to incorporate ~60% NORs[1]. To achieve the minimum guidelines for a contributing population (PNI $\geq$ 0.50 and pHOS $\leq$30 percent), the hatchery broodstock needs to incorporate ~30 percent NORs[2]. However, if pHOS levels are lower than the minimum guidelines, pNOB levels may also be lower and the population would still achieve the target PNI level.

2.4 SPRING CHINOOK

2.4.1 *Hatchery Strategy*

The spring Chinook hatchery program is designed to contribute to harvest and provide adults for the reintroduction program upstream of Swift Dam (Table 2-3). In the short term, it will continue to be managed as a segregated program, and no natural origin fish will be used as hatchery broodstock. In the long-term, the goal is to integrate this program. As the reintroduced population becomes established upstream of Swift Dam and begins contributing NOR returns in excess of supplementation needs, the HSRG suggests the spring Chinook program begin integrating NORs into the broodstock. This is a long-term goal, and the HSRG recommends that managers allow a minimum of three to four generations to establish a locally adapted population before integrating the hatchery program (see Section 6.5, Program Key Question No. 8)

Washington Department of Fish and Wildlife (WDFW) sets the spring Chinook broodstock collection target required to achieve the smolt release target stipulated in the Agreement. The broodstock target is updated annually in the AOP along with broodstock collection

[1] PNI = pNOB/(pNOB+pHOS). If pNOB is 60% and pHOS is 30%, 60%/(60%+30%) ~0.67 PNI
[2] PNI = pNOB/(pNOB+pHOS). If pNOB is 30% and pHOS is 30%, 30%/(30%+30%) ~0.50 PNI

protocols. To help reach this target, WDFW manages harvest in the North Fork Lewis River to allow sufficient adult spring Chinook returns to adult collection facilities.

Table 2-3 North Fork Lewis River Spring Chinook hatchery program.

	Spring Chinook
Population Designation	Primary
ESA Status	Threatened
Program Objective	Harvest/Reintroduction Upstream of Swift Dam
Program Type - Short Term	Segregated
Program Type - Long Term	Integrated
Hatchery Releases	1,350,000
Broodstock Target	1,250
pNOB Target	0% (current program)

2.4.2 *Adult Production Targets*

The hatchery and supplementation actions proposed in the H&S Plan are designed to achieve the hatchery and natural production adult targets shown in Table 2-4. The values in the table are referred to as adult ocean recruits, which include escapement plus the number of fish caught or available in ocean and freshwater fisheries. The estimate of ocean recruits will be provided in the AMEP annual report. This calculation is not always possible, and ocean recruits analysis may use hatchery releases (Double Index Tag (DIT) groups) as a surrogate for estimates until an adequate number of NOR smolts are captured, PIT tagged and released from the Swift FSC.

Modifications to hatchery production may be made as natural production from reintroduction efforts increases (described in Section 8.3 of the Agreement). As natural production of spring Chinook upstream of Merwin Dam exceeds its threshold level, hatchery production levels for that species would be reduced on a 1:1 basis. For example, when natural spring Chinook adult ocean recruits equal 3,977 fish (1,000 fish over the threshold value of 2,977), the hatchery production target for this species would be reduced by 1,000 adults to 11,800 (12,800-1,000 = 11,800). This would be accomplished by reducing the number of juveniles released from the hatchery each year based on natural production estimates using the Ocean Recruits methodology described in the AMEP over a 5-year period (rolling average).[3]

[3] The 5-year period was selected as it is consistent with the independent review process established in the Agreement. The ACC will have the opportunity to evaluate hatchery production every year as part of their review of the Annual Aquatic Monitoring and Evaluation Report

The number of NOR adult returns to the Lewis River have been insufficient to perform a meaningful estimate of Ocean Recruits (AMEP REFERENCE) and therefore no adjustments to hatchery production targets have occurred.[4]

Reductions in hatchery production targets may return to initial levels if natural production decreases below the threshold level. It is important to note that reductions in hatchery production based on increases in natural production are consistent with HSRG recommendations.

As called for in the Agreement (Section 8.3), spring Chinook hatchery production targets would not be reduced below the numbers needed to achieve the "Hatchery Target Floor" level shown in Table 2-4. Regardless of the number of Chinook naturally produced upstream of Merwin Dam, the Lewis River hatcheries would continue to release juveniles to achieve the hatchery target floor[5].

Table 2-4 Hatchery and natural production adult threshold levels (ocean recruits) and floor level (HORs) for spring Chinook (Pacificorp and Cowlitz PUD 2017).

Return Type (Ocean Recruits)	Number
Hatchery Target	12,800
Natural Production Threshold	2,977
Grand Total	15,777
Hatchery Target Floor	2,679

2.5 COHO SALMON

2.5.1 *Hatchery Strategy*

The Coho program is designed to contribute to harvest and provide adults for the reintroduction program upstream of Swift Dam. The Type-N program is currently operated as an integrated program with a pNOB target of 30 percent (Table 2-5). In the short term, the Type-S program will continue to be managed as a segregated program, and no natural origin fish will be used as hatchery broodstock. In the long-term, the H&S program goal is to integrate the Type-S Coho program as Type-S (early) NOR returns exceed supplementation needs. It is important to note that NOR Coho salmon are treated as one population in the Recovery Plan and no differentiation between early and late Coho is provided (LCFRB 2010). In preparation for changes in hatchery management objectives, the ATS will develop transition plans detailing protocols for transitioning from segregated to integrated hatchery programs, where appropriate.

[4] Adjustments to hatchery production are not possible until after the results of the Ocean Recruit analysis are completed. Thus, the current hatchery production plan will continue unchanged unless superseded by the HGMP or Biological Opinion.

[5] Hatchery target floor numbers may be modified after the final HGMP Biological Opinion is issued

WDFW sets the Coho broodstock collection targets to achieve the smolt release target stipulated in the Agreement. There are separate broodstock targets for the Type-N and Type-S programs, but a single smolt release target. The broodstock targets are updated annually in the AOP along with broodstock collection protocols. To help reach these targets, WDFW manages harvest in the North Fork Lewis River to allow sufficient adult Coho returns to adult collection facilities.

Table 2-5 North Fork Lewis River Coho hatchery program.

	Type N Coho	Type S Coho
Population Designation	Contributing	Contributing
ESA Status	Threatened	Threatened
Program Objective	Harvest/Reintroduction Upstream of Swift Dam	Harvest/Reintroduction Upstream of Swift Dam
Program Type - Short Term	Integrated	Segregated
Program Type - Long Term	Integrated	Integrated
Hatchery Releases	2,000,000 (Type N and Type S runs combined)	
Broodstock	850	1,300
pNOB Target	30%	0% (current program)

2.5.2 *Adult Production Targets*

The hatchery and supplementation actions proposed in the H&S Plan are designed to achieve the hatchery and natural production adult targets shown in Table 2-6. As with spring Chinook, the values in the table are adult ocean recruits, which include escapement plus the number of fish caught or available in ocean and freshwater fisheries. The estimate of ocean recruits will be provided as part of the AMEP annual report.

Hatchery production will be reduced on a 1:1 basis as the NOR production threshold is exceeded by reducing the number of juvenile hatchery releases. The ACC will consider adjusting hatchery production after the initial five years of the program based on the results of the Ocean Recruits analysis. However, as called for in the Agreement (Section 8.3), hatchery production targets would not be reduced below the numbers needed to produce the “Hatchery Target Floor” level shown in Table 2-6.

Note that this program may be adjusted after the final Biological Opinion for the Coho HGMP is issued.

Table 2-6 Hatchery and natural production adult threshold levels (ocean recruits) and floor level (HORs) for Coho (PacifiCorp and Cowlitz PUD 2017).

Return Type (Ocean Recruits)	Number of Ocean Recruits
Hatchery Target	60,000
Natural Production Threshold	13,953
Grand Total	73,953
Hatchery Target Floor	12,558

2.6 STEELHEAD

2.6.1 *Hatchery Strategy*

There are three steelhead hatchery programs in the North Fork Lewis River (Table 2-7). The summer and early winter steelhead programs are designed to contribute to harvest and are managed as segregated programs. The late winter steelhead program is designed to provide adults for the reintroduction program upstream of Swift Dam and is managed as a fully integrated program (i.e., pNOB = 100 percent).

WDFW sets the steelhead broodstock collection targets to achieve the smolt release targets stipulated in the Agreement (Table 2-7). These targets are updated annually in the AOP along with broodstock collection protocols. To help reach these targets, WDFW manages harvest in the North Fork Lewis River to allow sufficient adult steelhead returns to adult collection facilities. Late winter steelhead are not adipose clipped and may not be retained in the terminal fishery.

Table 2-7 North Fork Lewis River Summer, Early Winter and Late Winter Steelhead hatchery programs.

	Summer Steelhead	Early Winter Steelhead	Late Winter Steelhead
Population Designation	Stabilizing	Contributing	Contributing
ESA Status	None	None	Threatened
Program Objective	Harvest	Harvest	Reintroduction Upstream of Swift Dam
Program Type - Short Term	Segregated	Segregated	Integrated
Program Type - Long Term	Segregated	Segregated	Integrated
Hatchery Releases	175,000	100,000	50,000
Broodstock	180	90	75
pNOB Target	0%	0%	100%

2.6.2 *Adult Production Targets*

The combined actions proposed in the H&S Plan are designed to achieve the hatchery and natural production adult ocean recruit targets shown in Table 2-8. Adult recruits include escapement plus the number of fish caught or available in ocean and freshwater fisheries.

Hatchery production will be reduced on a 1:1 basis if the NOR production target is exceeded by reducing the number of juvenile hatchery releases. The ACC will consider adjusting hatchery production after the initial five years of the program based on the results of the Ocean Recruits analysis.[6] Hatchery production targets would not be reduced below the numbers needed to produce the "Hatchery Target Floor" level shown in Table 2-8. Note that this program may be adjusted after the final Biological Opinion for the late winter steelhead HGMP is issued.

Table 2-8 Hatchery and natural production adult threshold levels (ocean recruits) and floor level (HORs) for steelhead (Pacificorp and Cowlitz PUD 2017).

Return Type (Ocean Recruits)	Number
Hatchery Target	13,200
Natural Production Threshold	3,070
Grand Total	16,270
Hatchery Target Floor	2,763

2.7 ADVERSE IMPACTS OF HATCHERY PRODUCTION

Section 8.2.2 of the Agreement requires the H&S Plan to provide:

> *"A description of the methods to prevent unacceptable adverse impacts, if any, of (1) the hatchery program on the reintroduction program, and (2) the supplementation program on native resident species"*

The term "unacceptable" is subjective and, for ESA-listed anadromous species, will ultimately be determined by the Biological Opinion issued in response to submitted HGMPs for each hatchery production program. Therefore, modifications of hatchery operations needed for consistency with the future Biological Opinion will be achieved through modification of the AOP.

The Agreement specifies that the H&S Program should follow HSRG recommendations and guidelines (HSRG 2009, 2014). Therefore, hatchery programs should, to the extent possible,

[6] The 5-year period was selected as it is consistent with the independent review process established in the Agreement. The ACC will have the opportunity to evaluate hatchery production every year as part of their review of the Annual Hatchery operations plan.

follow recommendations provided in Table 2-2 to reduce any adverse impacts of any hatchery program on ESA listed species.

3.0 SUPPLEMENTATION COMPONENT

According to Section 8 of the Agreement, the goals of the H&S Program are "to support (i) self-sustaining, naturally producing, harvestable native anadromous salmonid species throughout their historical range in the North Fork Lewis River Basin, and (ii) the continued harvest of resident and native anadromous fish species… The supplementation portion of the program shall be a part of the reintroduction program (in addition to fish passage) and shall be limited to spring Chinook, steelhead and Coho."

The Regional Assessment of Supplementation Project (RASP 1992) defined supplementation as:

> *"the use of artificial propagation in an attempt to maintain or increase natural production, while maintaining the long-term fitness of the target population and keeping the ecological and genetic impacts on non-target populations within specified biological constraints."*

According to RASP (1992), the main elements of a supplementation program are:

- Use of artificial spawning and/or rearing conditions to bypass "survival bottlenecks" and increase survival above expected natural rates
- Increasing natural production or maintaining production in the face of anticipated declines
- Long-term preservation of the fitness and fundamental genetic integrity of target populations
- Limitation of ecological and genetic impacts on both target and non-target populations

It is worth highlighting that the four elements listed above are not unique to supplementation programs. For example, these same goals can be utilized by hatchery programs focused on harvest augmentation as well as habitat restoration projects. However, RASP (1992) notes that the "unique feature of supplementation is the assumption that artificial propagation can be used to improve the production of naturally-spawning populations without adverse genetic or ecological effects".

Supplementation programs can be implemented using many different strategies. To be successful, supplementation strategies should consider the ecosystem context and habitat conditions in which they operate. The HSRG has developed a framework to help guide the goals and objectives of supplementation programs (HSRG 2014). The HSRG framework recognizes four biological phases of restoring natural populations: preservation, re-colonization, local adaptation, and full restoration (Table 3-1). During each of these phases, the HSRG framework describes the ecological conditions of the population and habitat, the objectives for the population that should drive the supplementation program strategies, and guidance for identifying "triggers" for moving between biological phases.

Based on the HSRG framework outlined in Table 3-1, spring Chinook, late winter steelhead, and Coho in the North Fork Lewis Basin are all currently in the re-colonization phase of restoration. All anadromous fish were extirpated from areas upstream of Merwin Dam, and the primary goal of the supplementation program is to re-introduce these populations to the North Fork Lewis River Basin upstream of Merwin Dam to support recovery of self-sustaining populations.

Table 3-1 Biological phases of restoration and objectives for different ecosystem conditions (from HSRG 2014).

Biological Phases	Ecosystem Conditions	Objectives
Preservation	Low population abundance; habitat unable to support self-sustaining population; ecosystem changes pose immediate threat of extinction	Prevent extinction; regain genetic diversity and identity of existing population
Re-colonization	Underutilized habitat available through restoration and improved access	Re-populate suitable habitat from pre-spawning to smolt outmigration (all life stages)
Local Adaptation	Habitat capable of supporting abundances that minimize risk of extinction as well as tribal harvest needs; prevent loss of genetic diversity; and promote life history diversity	Meet and exceed minimal viable spawner abundance for natural-origin spawners; increase fitness, reproductive success and life history diversity through local adaptation
Full Restoration	Habitat restored and protected to allow full expression of abundance, productivity, life history diversity, and spatial distribution	Maintain viable population based on all viable salmonid population (VSP) attributes using long term adaptive management

During the re-colonization phase, the primary purpose of each supplementation program is to increase natural production by artificially spawning fish in a hatchery and allowing their progeny to reproduce naturally in underutilized habitat above Merwin Dam. Transport for re-introduction purposes is currently focused on habitat upstream of Swift Dam. Future passage into habitat above Merwin and Yale dams is currently under review by the National Marine Fisheries Service (NMFS or NOAA Fisheries) and the U.S. Fish and Wildlife Service, collectively known as the Services, pursuant to Section 4.1.9 of the Agreement. Currently, the primary strategy of all North Fork Lewis River supplementation programs is to release hatchery-origin juveniles in the lower river (i.e., downstream of Merwin Dam) and transport (upstream of Swift Dam) returning HOR and, when available, NOR adult returns to distribute and spawn naturally. The expectation is that hatchery-origin adults released upstream of Swift Dam will spawn in the natural environment and produce offspring that return as adults, thus contributing to the re-establishment of self-sustaining, locally adapted natural origin populations.

This Plan establishes targets for the number of adults transported above Swift Dam. The transport goals for adult spring Chinook, late winter steelhead, and Coho are based on revised estimates of habitat capacity provided by EDT modeling following habitat

verification surveys upstream of Swift Dam conducted in 2017 and 2018 by the U.S. Geological Survey (Table 3-2).

Table 3-2 Adult transport goal by species for supplementation programs upstream of Swift Dam (Malone 2018).

	Spring Chinook	Late Winter Steelhead	Coho
Adult Transport Target	3,000	1,700	6,800

The current transport target can be comprised of both hatchery- and natural-origin adults. Weekly transport goals are established to help meet the season goals based on average return timing. In general, within a given week, preference is given to transport of natural origin fish and any remaining deficit is filled with available hatchery-origin adults. With the Services' approval, these transport goals may be modified by the ACC at any time based on, but not limited to, changes to habitat conditions, model assumptions, forecasted fish returns and declining fecundity rates. Additionally, transport targets are exclusive of any nutrient enhancement activities that may be recommended by the ACC. That is, the number of nutrient enhancement carcasses is not limited by the adult transport target.

The following sub-sections outline the current strategy for each supplementation group. As mentioned above, the spring Chinook, late winter steelhead, and Coho populations are all in the re-colonization phase. Although North Fork Lewis River hatcheries will continue to produce juveniles needed for the supplementation programs for the foreseeable future, there are many key questions that need to be addressed over the next five years to develop criteria for determining when these populations move from the re-colonization to the local adaptation phase, and how populations will be managed once they are in the local adaptation phase. These key questions are identified in the Monitoring and Evaluation section of this plan (Section 4.0).

3.1 SPRING CHINOOK

3.1.1 *Supplementation Strategy*

The spring Chinook juvenile and adult supplementation program was initiated in 2013 (Figure E-1). Initially, approximately 100,000 smolts were acclimated and released upstream of Swift Reservoir. The purpose of the acclimation program was to improve the distribution of returning adults to spawning habitat upstream of Swift Reservoir. In June 2019, the ACC decided to suspend the juvenile acclimation program upstream of Swift Reservoir and release these smolts downstream of Merwin Dam (ACC 2019). This decision was due in part to low collection efficiency of spring Chinook smolts at the Swift FSC. Smolts released downstream of Merwin Dam are assumed to have higher survival rates than smolts released above Swift. A decision to restart the acclimation program will be reviewed annually by the ACC and should consider collection efficiency improvements at the Swift FSC, continued evaluation of spawner distribution upstream of Swift Dam and adult return rates to the lower river traps.

Currently, the reintroduction strategy for spring Chinook relies solely on transport of adults from returns to the Merwin and North Fork Lewis River hatchery traps. The timing and number of adults released upstream mimics timing of the North Fork Lewis run downstream of Merwin Dam. Timing curves are updated as part of the AOP each year.

The reintroduction strategy was designed to be a 15-year[7] program. This strategy is expected to continue throughout this H&S Plan performance period regardless of the number of actual adult returns[8].

The re-introduction program will continue to prioritize natural origin returns for transport upstream of Swift Dam. However, because NORs are uncommon (Table 6-1), the program will continue to rely and transport mostly HORs.

Currently, the transport target may be comprised of both hatchery- and natural-origin adults. HORs are spring Chinook identified by a missing adipose fin or presence of a CWT in the snout, while NORs have an intact adipose fin and no snout CWT; a portion of NORs may also have a PIT tag (applied at the Swift FSC during sub-sampling of juvenile outmigrants). Weekly transport goals based on average return timing are established to help meet season-long transport goals. In general, within a given week, preference is given to transporting NORs, and any remaining deficit is filled with HORs. The ATS shall develop, as part of the AOP, handling protocols that shall define the distribution of trapped adults based on broodstock needs, number of returns (run size and timing), obligations stated within Section 8 of the Agreement, FERC licenses and associated recovery documents (e.g., HGMPs and Biological Opinions).

During the 5-year duration of this plan, the supplementation strategy described above is not anticipated to change. However, during this period, the ATS should develop a strategy for transitioning the current segregated program to an integrated program. In determining a transition approach and timeline, the plan should consider recent HOR and NOR abundance, program objectives (i.e., reintroduction vs. harvest), hatchery capacity and program performance.

3.1.2 *Supplementation Stock Origin*

Adults for the reintroduction efforts come from returns to the North Fork Lewis River traps. This stock was chosen because the original native stock was extirpated, and adult returns from the existing hatchery population, although originating from multiple out-of-basin stocks, have generally been able to support broodstock needs (Table 6-1). This hatchery population therefore represents the stock most likely to adapt to environmental conditions in the North Fork Lewis River. The hatchery-origin stock will be used in the first generation of supplementation efforts. As NOR spring Chinook begin returning to the lower traps from

[7] The Agreement (Section 8.5) calls for Chinook and steelhead supplementation to continue for 15 years; Coho 9 years.
[8]The ACC may stop, or extend the program based on collected data.

upstream reintroduction efforts, the supplementation program will preferentially use these returns for transport upstream of Swift Dam[9].

Since 2012, spring Chinook escapement to the hatcheries has averaged about 1,595 fish (Table 6-1) - less than the 4,400 adults needed for the broodstock (1,400 adults) and supplementation (3,000 adults) programs. Since inception (2013), the adult supplementation program has not met annual spring Chinook transport targets. The lack of consistent adults available for supplementation creates generational gaps and inconsistent cohorts. Thus, the adult supplementation program must extend past the 15-year minimum duration after supplementation begins (2028) as proposed in the initial H&S Plan (2009).

If North Fork Lewis River spring Chinook returns fail to meet the transport target of 3,000 adults, Cowlitz or Kalama River returns may be used for the reintroduction program with approval from the ACC and Services. If neither of these sources provide sufficient adults, the ATS will recommend potential actions to the ACC including suspension of the spring Chinook reintroduction program.

3.1.3 *Supplementation Release Numbers*

Modeled EDT capacity upstream of Swift Dam for existing habitat conditions is 2,980 adults (Malone 2018). The program goal is to transport and release 3,000 adults upstream of Swift Reservoir. As described in sections 3.1.1 and 3.2.1, this can be a combination of HORs and NORs. The sex ratio of transported fish should consist of a relatively equal proportion of males and females to ensure spawning success is not limited by this metric. NOR returns in excess of broodstock or upstream transport needs shall continue to be transported upstream subject to approval by the ACC.

3.1.4 *Use of Natural Origin Returns*

Spring Chinook NORs are not currently being incorporated into the hatchery program broodstock. All NORs returning to adult traps are transported upstream as part of the supplementation strategy.

3.1.5 *Supplementation Release Locations*

Transported adults shall be released at Eagle Cliff using the release pipe installed at the day use parking area. If this is not possible due to damage of the release tube, adults may be released at the Swift Reservoir boat ramp.

In 2017, transported adult spring Chinook were released at additional locations upstream of the current release site immediately upstream of Eagle Cliff Bridge. The goal of releasing adult salmon at different locations was to enhance their distribution into spawning areas. Additional release sites included the Muddy River Bridge, Clear Creek Bridge and the bridge just downstream of Lower Falls on the mainstem. An approximately equal portion of the transported spring Chinook were released at each additional site with remaining fish being released at the Eagle Cliff Bridge release site. In 2018 and 2019, all spring Chinook were

[9] Preference will apply to all NOR returns, including strays that did not originate upstream of Swift Dam.

released at the Eagle Cliff site due to poor numbers available for the reintroduction effort. The decision to continue seed planting in the future will depend on the availability of spring Chinook available for reintroduction and shall be described each year in the AOP.

3.2 COHO SALMON

3.2.1 *Supplementation Strategy*

The Coho supplementation program (exclusive of the hatchery preparation plan) was initiated in 2013 (Table 6-3). The H&S Plan and Agreement identify only early Coho (type S) as the reintroduction species (as opposed to late Coho, type N). However, as recommended by the ATS, the ACC agreed that early and late Coho be managed as one group for reintroduction purposes (ACC 2015). Early and late Coho differ in their return and subsequent spawn timing. Peak spawning for early Coho is September while late Coho peak in November. The inclusion of both early and late Coho aligns the Coho supplementation program with regional recovery planning efforts that do not differentiate between an early and late Coho population in the North Fork Lewis River (LCFRB 2010). By incorporating late Coho into the supplementation program, the transport period expands from two months (September to October) to four months (September to December). Natural factors such as water temperature, water flow, and turbidity influence natural spawning success, and therefore will influence future run timing for natural origin Coho. Other benefits of incorporating both early and late Coho into the reintroduction program include: 1) a more flexible transportation schedule that can be adapted to actual run sizes and timing; and 2) more potential for Coho to distribute into the upper basin due to the extended transportation window and variable flow conditions in the fall.

The reintroduction strategy for Coho currently relies entirely on transport of adults into areas upstream of Swift Dam. This strategy is based on the availability of both early and late Coho from returns to the MCF and Lewis River Hatchery, which have averaged over 30,000 adults (and jacks) between 2010 and 2018 (H&S Subgroup 2019). Adult reintroduction alone should provide both the abundant founding population and the mechanism to increase population fitness as described in the Lewis River Fish Planning Document (Cramer and Associates 2004), therefore use of juvenile acclimation in areas upstream of Swift Dam has not been considered for this species. Currently, the transport target can be comprised of both hatchery and natural-origin adults. HORs are Coho identified by a missing adipose fin, or presence of a CWT, while NORs are those fish with an intact adipose fin and no CWT; a portion of NORs may also have a PIT tag (applied at the Swift FSC during sub-sampling of juvenile outmigrants).

NOR returns in excess of broodstock or upstream transport needs shall either be transported upstream or released downstream of Merwin Dam (i.e., never surplused). The ACC will decide whether to transport in excess of the 6,800 Coho goal upstream of Merwin Dam. Weekly transportation goals based on average return timing are established to help meet annual goals. In general, within a given week, preference is given to transporting NORs and any remaining deficit is filled with available HORs. The ATS shall develop, as part of the AOP, handling protocols that shall define the distribution of trapped adults based on

broodstock needs, number of returns (run size and timing), obligations stated within Section 8 of the Agreement, FERC licenses and associated recovery documents (e.g., HGMPs and Biological Opinions).

During the 5-year duration of this plan, the supplementation strategy is not anticipated to change. However, during this period, the ATS should develop a plan that describes the future of the early Coho segregated and late Coho integrated hatchery programs. In determining options for the plan, the ATS will first determine an appropriate way to evaluate whether program goals are achieved. Next, the ATS will suggest program changes to broodstock use, composition of broodstock, and continuation or suspension of the supplementation program based on program performance (whether goals have been achieved). Information to inform these determinations includes survival rates and productivity upstream of Swift Dam as well as demographic and genetic risks to the supplemented population.

3.2.2 *Supplementation Stock Origin*

Broodstock for the reintroduction efforts come from returns of Coho to the North Fork Lewis River hatchery complex. Initially, early Coho were used for re-introduction since the native North Fork Lewis River Coho provided the initial broodstock for the hatchery program and because historical information suggested that early Coho were predominantly upper North Fork Lewis River spawners (PacifiCorp and Cowlitz County PUD 2014). As described above, the current strategy for reintroduction has been modified to use both early and late hatchery Coho stocks. The late Coho hatchery program is currently an integrated program using a portion of returning NORs for broodstock. A combination of both early and late Coho hatchery programs is currently thought to best represent the stock most likely to adapt to environmental conditions in the North Fork Lewis River. Adult returns from the supplementation program (NORs) will continue be transported upstream once integrated program broodstock needs are met.

3.2.3 *Supplementation Release Numbers*

Modeled EDT Coho capacity upstream of Swift Dam for current habitat conditions is 6,800 adults. The program goal is to transport and release 6,800 adults upstream of Swift Reservoir to spawn naturally in the mainstem and tributaries upstream of Swift Dam. As described in Section 3.2.1, this can be a combination of HORs and NORs. The sex ratio of transported fish should consist of a relatively equal proportion of males and females to ensure spawning success is not limited by this metric. NOR returns in excess of broodstock or upstream transport needs shall continue to be transported upstream subject to approval by the ACC.

3.2.4 *Use of Natural Origin Returns*

Natural origin adult returns are not currently being incorporated into the early Coho segregated program broodstock, while up to 30 percent of the late Coho integrated hatchery program broodstock may be comprised of NORs returning to MCF or Lewis River

Hatchery. All NOR Coho returning to adult traps above broodstock needs are transported upstream as part of the adult supplementation strategy.

3.2.5 *Supplementation Release Locations*

The current release location for transported Coho is Eagle Cliff Bridge. Spawner surveys for adult Coho released at Eagle Cliff between 2013 and 2018 indicate that, in general, hatchery-origin adult Coho distribute throughout the watershed upstream of Swift Reservoir (PacifiCorp and Cowlitz PUD 2019). However, in years of below average streamflow, Coho distribution is predominantly limited to the North Fork Lewis River mainstem downstream of the Muddy River confluence and in reservoir tributaries. Alternative release sites upstream of the Eagle Cliff Area should be considered during development of the AOP as a contingency for drought years. These sites may include Muddy and Clear Creek bridges, and Curly Creek Bridge and Forest Road 90 Bridge (near lower falls) on the mainstem North Fork Lewis River.

3.3 LATE WINTER STEELHEAD

3.3.1 *Supplementation Strategy*

The late winter steelhead supplementation program was initiated in 2012 (Table 6-6). The reintroduction strategy relies on the transport of adult late winter steelhead into areas upstream of Swift Dam. The existing population of natural origin late winter steelhead[10] (downstream of Merwin Dam) is relatively small with escapement (excluding returns to the traps and HORs) averaging approximately 350 NORs since 2013 (PacifiCorp and Cowlitz PUD 2019). The integrated hatchery program uses 100 percent natural origin broodstock comprised of fish collected at existing lower river adult traps. Adults returning from the hatchery program will only be used for reintroduction upstream of Swift Dam. Broodstock for the program will continue to be derived each year from natural origin returns (as indicated by an intact adipose fin and no BWT).

All smolts produced by the hatchery program are tagged with a BWT in their snout prior to release; the adipose fin is left intact. This tag identifies these fish as late winter HOR steelhead when they are subsequently recaptured (either as adults for upstream supplementation or juveniles during outmigration studies). This program differs from the spring Chinook and Coho hatchery programs in that it is solely focused on providing adult returns for reintroduction and there is no harvest objective (thus, the intact adipose fin).

Currently, transported adults are composed of both hatchery and natural-origin adults. HORs have an intact adipose fin and a BWT. NORs have an intact adipose fin and a PIT tag (applied at the Swift FSC during sub-sampling of juvenile outmigrants) indicating they originated upstream of Swift Dam. Presently, all BWT (HOR) and PIT tagged (NOR) adults are transported upstream of Swift Dam.

[10] Late winter hatchery steelhead are referred to as “late” because their run timing is distinct from the non-endemic, early winter steelhead stock (i.e., Chambers Creek stock).

The current supplementation strategy shall be conducted for at least 15 years (until 2024), unless otherwise determined by the ACC through the adaptive management process. Throughout this period there are no proposed trigger points that would discontinue the program prior to its completion. The 15-year period is required in the Agreement (Section 8.5.1) with a provision for continuing supplementation. As the program is in its 11th year, a plan for evaluating the success of this strategy in achieving recovery goal objectives will be developed by the ATS through development of the AOPs during the duration of this H&S Plan to inform decisions about potential continuation.

3.3.2 *Supplementation Stock Origin*

The Lower Columbia Fish Recovery Board's Lower Columbia Salmon Recovery & Fish and Wildlife Subbasin Plan identifies the lower North Fork Lewis River late winter steelhead population (including Cedar Creek) as a unique population for recovery (rated as "contributing") and recommends its use for reintroduction into the North Fork Lewis River Basin upstream for adult supplementation (LCFRB 2010).

Only broodstock that meet genetic assignment criteria as outlined in the AOP are retained for potential spawning. To ensure that broodstock for the supplementation program originate from the North Fork Lewis River Basin, all potential broodstock are genetically screened prior to spawning. The AOP provides selection protocols based on this probability analysis to ensure that hatchery-origin, summer steelhead, or strays outside the Distinct Population Segment (DPS) are not incorporated into the broodstock.

As natural production increases upstream of Swift Dam through supplementation, the number of adult returns originating upstream of Swift Dam should also increase making them available for broodstock or, when appropriate[11], upstream transport; thereby reducing the need to mine lower river NOR broodstock. During early stages of program implementation, a proposed approach to meet this objective is described in Table 3-3.

[11] The decision to transport trapped NOR late winter steelhead upstream requires consensus by the ACC.

Table 3-3 Guidance for the late winter steelhead integrated hatchery program including broodstock source, transport goals and composition.

Generation	Broodstock Source, Transport Goal and Composition
1st Generation (2009 - 2013) (COMPLETE)	All NOR broodstock for integrated hatchery program; all adult returns from the integrated program (BWTs) transferred upstream of Swift Dam; 500 total adults is the target.
2nd Generation (2014 - 2017) (COMPLETE)	All broodstock for integrated hatchery program comprised of NOR adults originating from both upstream and downstream of Merwin Dam; all adult returns from the integrated hatchery program to be transported upstream; 500 minimum total adults is the escapement target.
3rd Generation (2018 – 2021) (CURRENT)	All broodstock for integrated hatchery program comprised of NOR adults originating from both upstream and downstream of Merwin Dam); Adult returns composed of returns from the integrated hatchery program and those possessing a PIT tag to be transported upstream. Trapped NOR steelhead without a PIT tag may also be transported upstream if approved by the ACC; 1,700 total adults is the escapement target
4th Generation (2022-2024) (UPCOMING)	Integrated hatchery program may be suspended after ACC review and decision; all adults with intact adipose fins and non-stubby dorsal fins arriving at MCF released upstream of Swift Dam

3.3.3 *Supplementation Release Numbers*

The program goal is to transport and release 1,700 adult late winter steelhead upstream of Swift Reservoir to spawn naturally in the mainstem and tributaries upstream of Swift Dam. As described in section 3.3.1, this can be a combination of HOR (BWT) and NOR (PIT tagged) fish. The sex ratio of transported fish should generally consist of an equal proportion of males and females to ensure spawning success is not limited by this metric. The number of supplementation adults is based on the habitat capacity estimated by on the ground habitat surveys and EDT analysis for the North Fork Lewis River above Swift Reservoir (Malone 2018). NOR returns in excess of broodstock or upstream transport needs shall continue to be transported upstream subject to approval by the ACC.

3.3.4 *Use of Natural Origin Returns*

Broodstock for the late winter steelhead integrated hatchery program are currently collected at the MCF. Broodstock consist only of NOR returns; any returns possessing a BWT shall be transported upstream and not used as broodstock.

Currently, the only NOR late winter steelhead transported upstream are those containing a PIT tag identifying them as upriver production (upstream of Swift Dam). As Table 3-3 indicates, this program is in the 3rd generation of supplementation. It is anticipated that

NOR returns from upstream production will continue to increase as more adults are transported and collection at the Swift FSC improves. As this occurs, only a fraction (about 10 percent) of the total steelhead migrants collected from the Swift FSC will receive PIT tags. During the implementation of this H&S Plan, the AOP will be updated to describe the disposition of NOR steelhead (without PIT tags) arriving at the MCF or Lewis River ladder that exceed broodstock needs to determine what portion, if any, of these NOR returns should be transported upstream.

3.3.5 *Supplementation Release Locations*

The current release location for transported late winter steelhead is the Eagle Cliff Bridge at the upstream end of Swift Reservoir. Alternate upstream locations to enhance spawning distribution may be used if agreed to by the ACC.

The approach described in Sections 3.3.1 to 3.3.5 should be used as a guide for adaptive management decisions by the ACC. The decisions for broodstock use, composition of broodstock, and continuation or suspension of the juvenile supplementation program should be based on monitoring of survival rates and productivity upstream of Swift Dam as well as demographic and genetic risks to the supplemented population.

4.0 MONITORING & EVALUATION OBJECTIVES

All M&E activities performed in the North Fork Lewis River Basin as they relate to the Agreement and FERC operating licenses are currently contained in two plans:

- Aquatic Monitoring and Evaluation Plan (AMEP) – April 2017
- Lewis River Hatchery and Supplementation Plan (H&S Plan; this document) – 2020

The AMEP describes M&E activities in the North Fork Lewis River upstream of Merwin Dam, including fish passage performance, estimates of ocean recruits (smolt to adult, adult to adult survival) and life history performance of reintroduced species. An additional requirement of the AMEP is to monitor the effectiveness of the H&S Plan in meeting its goals and objectives (Section 9.5 of the Agreement). Actions taken to implement the H&S Plan are collectively called the H&S Program, which includes Hatchery Production (Section 2) and Supplementation activities (Section 3) downstream of Merwin Dam. The following objectives are intended to direct the M&E performed in the H&S Program to support the program goals. Specific strategies and detailed study designs for each objective are described in the AOP. The AOP is a collaborative document developed by the ATS, and modifications are made annually to adaptively manage the H&S Program objectives and introduce emerging science or technology as they develop.

The M&E objectives of the H&S Plan are classified into four main categories:

- *Administrative:* Includes the reporting and planning documents required by the Agreement, HGMPs and Biological Opinion(s)
- *Hatchery Monitoring:* The purpose of hatchery evaluation objectives is to operate hatchery programs in a way that maximizes survival and health of program fish to meet production targets and reduces adverse effects on naturally produced ESA listed species.
- *Abundance Monitoring:* Includes objectives related to monitoring trends in juvenile and adult abundance to evaluate the status, trend, and viability of North Fork Lewis River populations of salmon and steelhead.
- *Risk Assessment:* These objectives are directed at monitoring potential risks of hatchery and supplementation programs to ESA listed species.

Each objective (excluding administrative) is presented in the following format to provide the background and specificity needed to develop detailed AOP methodologies and statistical designs:

Key Questions: A list of specific questions for each objective intended to ensure that specific metrics or benchmarks (e.g., abundance, productivity, diversity and spatial structure) are addressed in annual reporting. Key questions also provide a template for developing monitoring plans as part of the AOP to inform adaptive management decisions. The list of key questions provided is not intended to be annual list of obligations. Rather, the list defines relevant guidance and focus for each objective. The ATS, through annual

planning meetings, will determine which key questions will be included as part of the AOP for a given year.

Purpose*:* Specifies the rationale for the stated objective including how the objective relates to VSP monitoring guidance and recommendations, when appropriate.

Recovery Monitoring Recommendations: A list of specific VSP monitoring recommendations provided by NOAA Fisheries (Crawford and Rumsey 2011) that pertain to each monitoring objective. Recommendations are numbered according to Crawford and Rumsey (2011) for reference. HSRG recommendations may also be included when applicable.

Proposed Strategy: A general approach that may be used to quantify the monitoring indicators with an acceptable level of precision and accuracy to address the objective(s). Other strategies may be initiated at any time.

Monitoring Indicators: The desired numerical, informational or deliverable by which the objective is measured. The list of indicators provided under each objective is intended to be an example of potential indicators. The actual indicators used may be modified by the ATS for any given year.

Frequency: The intended frequency of performing the required monitoring for each objective and stated as either an annual (continuous) or periodic requirement.

Limitations or Concerns: General description noting specific challenges especially those related to field data collection and deployment.

A framework for H&S monitoring and evaluation objectives is shown in Figure 4-1. Objectives are designed to support program goals, and their development is determined through requirements of the Agreement, federal and state policy, and any permits. The objectives are intended to be broad and applicable to the five-year duration of this plan. The AOP shall identify what indicators should be measured to address each applicable key question, and what targets are set for each objective or key question.

Results are reported in the AOR. The ATS shall review the results from the AOR annually to determine whether key questions were answered, whether targets identified in the H&S Plan have been met and whether future monitoring designs require modification. Based on the review, the ATS shall determine, during annual planning review, whether objectives or key questions need revision to adaptively implement the program. Modifications to the objectives or key questions shall be reviewed and approved by the ACC on an annual basis.

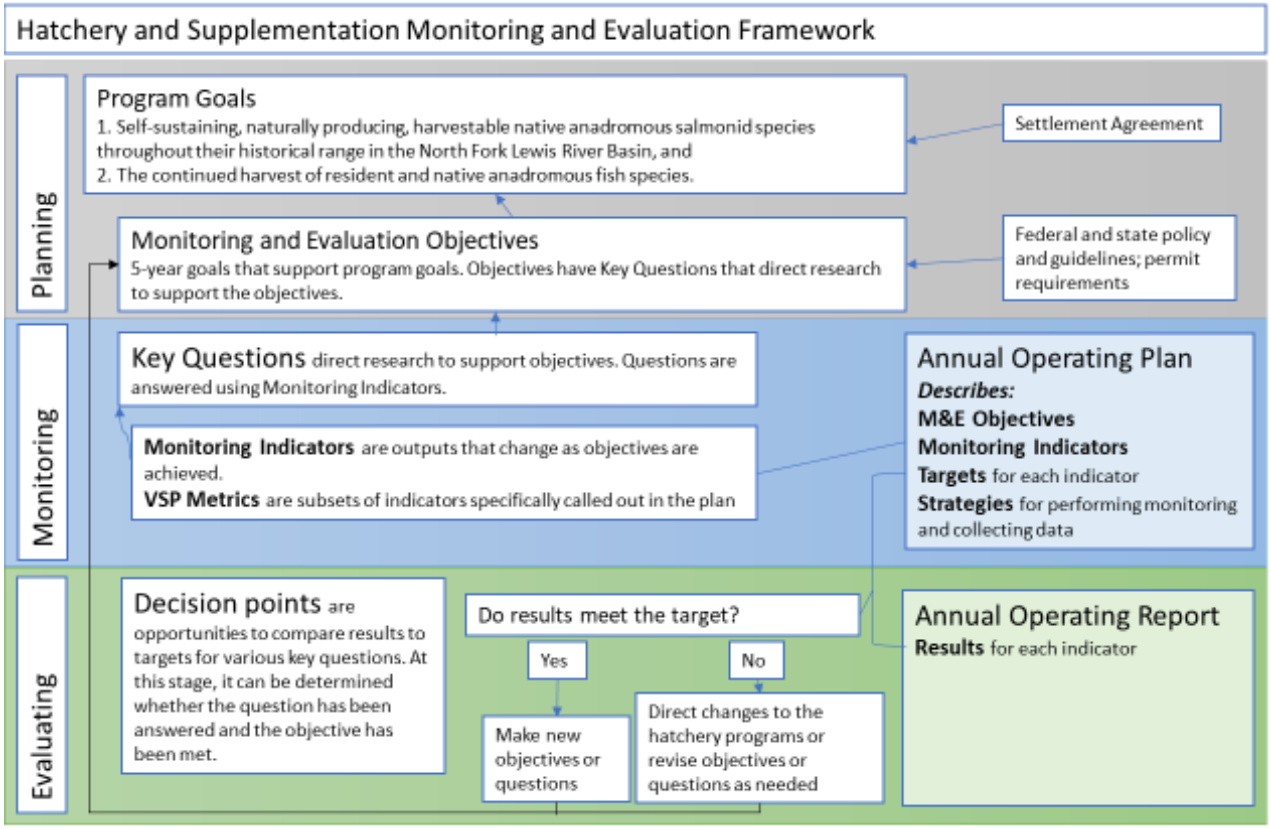


Figure 4-1 Hatchery and supplementation monitoring and evaluation framework.

4.1 ADMINISTRATIVE OBJECTIVES

4.1.1 *Objective 1.0*

NOAA acceptance of a Hatchery and Genetic Management Plan (HGMP) for each hatchery program on the North Fork Lewis River

4.1.2 *Objective 1.1*

Receive Biological Opinion for all submitted HGMPs

Key Questions

None

Purpose

The purpose of objectives 1.0 and 1.1 is to obtain ESA coverage for hatchery production and associated program activities. The HGMP represents the proposed operation of each hatchery program and is submitted to NOAA Fisheries for approval. Once approved, NOAA Fisheries will draft and finalize a Biological Opinion regarding the HGMP action and include specific terms and conditions, and reasonable and prudent measures to avoid jeopardizing ESA listed species from continued operation of the hatchery programs.

Continued operation of the hatcheries is critical as the supplementation program relies on hatchery returns for reintroduction efforts upstream of Swift Dam.

Recovery Monitoring Recommendations

An HGMP must be developed for each hatchery and submitted to NOAA Fisheries for approval (38)

4.1.3 *Objective 2.0*

Finalize a Hatchery and Supplementation Plan every 5 years

4.1.4 *Objective 2.1*

Finalize an annual operating plan (AOP)

4.1.5 *Objective 2.2*

Finalize an Annual Operations Report (AOR)

4.1.6 *Objective 2.3*

Finalize an annual hatchery operations report

Key Questions

None

Purpose

The purpose of objectives 2.0 through 2.3 is to ensure that reporting and planning requirements of the Agreement, HGMPs, and Biological Opinion (once issued) are met. The annual hatchery operations and H&S Program reports shall demonstrate whether the HGMP protocols are implemented as proposed. Reporting will include assessing the effectiveness of actions taken to limit the threat of hatchery operations to natural-origin fish as well as documenting whether each hatchery production program is meeting target production levels.

The AOP is the primary mechanism for adaptively managing the H&S Program. The AOP is developed collaboratively by the ATS on an annual basis and requires approval by the ACC and Services.

Recovery Monitoring Recommendations

- Documentation should be available that demonstrates that HGMPs have been implemented and to what extent (39).
- Every hatchery program should monitor and record the practices and protocols it follows through a standardized regional data dictionary and regional approach and be ready to report this information on an annual basis (40).

4.2 HATCHERY MONITORING OBJECTIVES

4.2.1 *Objective 3.0*

Determine whether hatchery production protocols incorporate best available management practices to support program targets and goals.

Key Questions

3A: Do hatchery broodstock collection protocols support program goals?
3B: Do spawning, rearing and release strategies support program goals?
3C: Are adult collection, handling and disposition (as defined in the AOP) protocols consistent with HSRG recommendations?
3D: What are the estimated smolt-to-adult returns (SAR's) for each hatchery stock or rearing treatment group?[12]
3E: Is the fish health monitoring and disease prevention strategy effective at reducing infections and limiting mortalities?
3F: Do hatcheries incorporate new scientific advances to improve fish culture effectiveness and efficiency?

Purpose

The purpose of objective 3.0 is to implement hatchery programs and practices that support the goals of the H&S program, are consistent with best management practices, and incorporate recommendations by the HSRG when possible. This objective also encourages hatchery programs to incorporate new scientific advances when available to continually improve overall hatchery performance in supporting the H&S program.

Recovery Monitoring Recommendations

- Monitor the performance and implementation of hatchery program operations, including in-hatchery survival, broodstock collection, and disease management.
- Assess effectiveness of hatchery operations by evaluating status and trends of key metrics including in-hatchery survival by life stage, size at release and other morphological indices.

Proposed Strategy

This objective monitors all life stages (adult collection, spawning, rearing and release) within the hatchery environment to produce high quality smolts with improved in-hatchery and post-release survival. Improved post-release survival (i.e., SAR's) supports the adult return targets of the H&S program for both broodstock and supplementation needs.

Strategies developed as part of this objective will include proactive disease control and monitoring to reduce mortalities from diseases. Fish health strategies will also monitor

[12] Estimates of SARs for smolts produced upstream of Swift is an objective of the AMEP (Objective 12, Ocean Recruit Analysis); therefore, the H&S Plan may report these estimates (when available) as part of annual reporting.

indirect sources of mortality and potential fish stressors such as, feeding protocols, fish condition upon release, precocity rate and environmental conditions (e.g., water quality, shading). Hatchery strategies shall incorporate new scientific tools and procedures whenever practical to improve overall fish health at all life stages. HSRG recommendations will be implemented when possible to mitigate effects of hatchery operations

Monitoring indicators

- smolt morphology (length, weight, smolt index)
- broodstock collection, retention and selection
- pNOB integration rates (integrated programs)
- spawning matrices
- phenotypic indicators (spawn timing, fecundity, size and age at maturity)
- feeding rations and protocols
- predation avoidance (avian)
- volitional release duration and timing
- Smolt to Adult Ratio (SAR)
- infection and mortality rates

Frequency

Annual and periodic

Limitations or Concerns

The HSRG has developed a comprehensive list of recommended hatchery practices and protocols intended to produce smolts that survive and emigrate quickly after release. The ability to implement global changes to hatchery operations may be limited by a number of factors that either make the proposed changes impractical, are inconsistent with current regulations or policies (e.g., HGMPs) or take substantial time to implement, especially if substantial construction or capital outlays are required. Furthermore, to determine whether recommendations have a significant effect, it may take several generations (of adult returns) to provide adequate data and analysis to support and justify implementation of specific recommendations. Lastly, without sufficient data to support and justify recommended changes, large capital outlays may be delayed.

4.2.2 *Objective 4.0*

Adopt strategies that limit potential post-release ecological interactions between hatchery and NOR listed species.

Key Questions

4A: Do current hatchery releases result in spatial and temporal overlap between HOR and NOR juveniles?

4B: Does the migration rate of HOR juveniles result in overlap with NOR juveniles or spawning adults?

4C: Are the number of hatchery released juveniles equal to or less than production targets?

4D: Are the sizes (length and weight) of released hatchery juveniles equal to or less than program targets?

4E: What is the precocity rate for hatchery juveniles by release group prior to scheduled releases?

Purpose

The purpose of this objective is to limit ecological interactions (predation, competition, residualism and pathogen transmission) between hatchery released juveniles on natural origin listed species.

Recovery Monitoring Recommendations:

- Every hatchery program should periodically monitor the residence time, spatial and temporal distribution of residual juvenile fish released from the program (41)
- Assess effectiveness of actions taken to address threats to natural origin fish due to hatchery operations (44)

Proposed Strategy

Interactions between hatchery released juveniles and ESA listed species cannot be observed directly. Therefore, this objective relies on "take surrogates" as described by NOAA Fisheries (NMFS 2017) to reduce the potential of adverse interactions between hatchery and natural-origin salmon and steelhead. Each key question provided under this objective relates directly to each take surrogate described by NOAA Fisheries. To reliably measure and quantify each take surrogate, specific monitoring indicators will be linked to each of the key questions. Monitoring indicators shall have measurable targets or limits designed to reduce spatial and temporal overlap between hatchery and NOR species, the number and size of hatchery smolts released and precocity rates of smolts prior to release.

Monitoring Indicators

- Smolt release timing
- Smolt release location
- Number of smolts released
- Timing of smolt releases
- Size of smolts released
- Precocity rate (visual, GSI, 11KT)
- Smolt migration rates

Frequency

Annual

Limitations or Concerns

The use of take surrogates is not a direct measure of take and therefore cannot quantify or estimate actual take related to large hatchery releases in the North Fork Lewis River. Also, post-release behavior (e.g., residualism) of hatchery smolts is not well understood and may lead to higher than expected take, especially if residualism rates are high among a particular release group or location.

4.3 ABUNDANCE MONITORING OBJECTIVES

4.3.1 *Objective 5.0*

Estimate spawner abundance of late winter steelhead, coho, chum and Chinook downstream of Merwin Dam

4.3.2 *Objective 5.1*

Determine the spatial and temporal distribution of spawning late winter steelhead, coho, chum and Chinook downstream of Merwin Dam

Key Questions

5A: Are estimates of spawner abundance unbiased and meeting precision targets?
5B: Are annual estimates of natural origin spawner abundance increasing, decreasing or stable?
5C: Are annual trends in spatial and temporal spawning distribution increasing, decreasing or stable?

Purpose

To collect unbiased, long-term, abundance, distribution and cohort trend data for natural origin adult spawners (Chinook, Coho, chum salmon and late winter steelhead) downstream of Merwin Dam. This includes recovery of CWT tags from salmon carcasses to inform harvest management, and collection of mark and tag status information (i.e., adipose clips and CWT presence) to inform calculation of pHOS and PNI.

A secondary purpose of this objective is to provide data for Objective 22 of the AMEP which describes combining estimates from downstream of Merwin Dam with transport and monitoring data for areas upstream of Swift Dam to evaluate spawning distribution and develop population-level estimates of spawner abundance and productivity for Chinook, Coho and late winter steelhead.

Recovery Monitoring Recommendations

- Incorporate a robust unbiased adult spawner abundance sampling design that has known precision and accuracy (6)
- Monitor ratio of marked hatchery-origin salmon and steelhead to unmarked natural origin fish in all adult spawner surveys (7)
- Strive to have adult spawner data with a coefficient of variation (CV) on average of 15 percent or less for all ESA populations (9)

- Conduct a power analysis for each natural population monitored within an ESU to determine the power of the data to detect a significant change in abundance and to provide that information to all interested parties (10)
- Utilize the protocols published in the American Fisheries Society Field Protocols Handbook whenever possible in order to standardize methodologies across the region in evaluating population abundance (11)
- Agencies and tribes should develop at least 12 brood years of accurate spawner information as derived from cohort analysis in order that NOAA Fisheries can use the geometric mean of recruits per spawner to develop strong productivity estimates. (12)
- Determine spatial distribution of listed Chinook, Coho, and steelhead with the ability to detect a change in distribution of ± 15 percent with 80 percent certainty. (14)

Proposed Strategy

Estimates of spawner abundance and spatial distribution will be generated annually for adult salmon and steelhead in the lower mainstem North Fork Lewis River through the collection and analysis of spawning ground data. Specifically, estimates of Chinook and Coho abundance will be generated by conducting mark-recapture surveys of salmon carcasses (Bentley et al. 2018) and redd surveys for late winter steelhead throughout their spawn time. Estimates of spawning distribution will be generated by documenting redd locations during peak spawning periods. Currently, chum salmon abundance in the lower North Fork Lewis River remains low. During Chinook surveys, live chum salmon and redds observed are enumerated and recorded to document presence. After the chum salmon population recovers and abundance begins to increase in the Lower North Fork Lewis River, additional methods for estimating spawner abundance will be employed.

The mainstem North Fork Lewis River survey area is generally bound by the lower end of Eagle Island upstream to Merwin Dam, which represents the majority of mainstem spawning habitat for salmon and steelhead. For Coho, tributaries of the North Fork Lewis River are included using a Generalized Random Tessellation Stratified (GRTS; Stevens and Olsen 2004) sampling design to supplement and support population level monitoring for the Lower Columbia River Coho ESU.

Monitoring Indicators

- Spawner abundance
- Spawner density by reach
- Spawn timing (phenotypic traits)

Frequency

Annual

Limitations and Concerns

Surveyor experience is especially important for accurate redd identification for all species and ideally should be performed by well-trained surveyors for each survey. The ability to

detect new redds is also complicated by redd superimposition that likely occurs for all species on the North Fork Lewis River. For salmon, there is spawning overlap between Coho and Chinook and the accuracy of redd assignment to each species has not been evaluated.

Using redd surveys to estimate steelhead abundance uses a standard WDFW methodology incorporating female per redd data obtained from Snow Creek in northwest Washington State. Based on these data, WDFW uses a standard assumption of 0.81 females per redd. This assumption may not be applicable to the North Fork Lewis River and site specific data may be needed to calibrate future abundance estimates.

4.3.3 *Objective 6.0*

Estimate juvenile outmigrant abundance for late winter steelhead, coho, and Chinook downstream of Merwin Dam.

Key Questions

6A: Are estimates of NOR juvenile outmigrant abundance unbiased and meeting precision targets?
6B: Is the abundance of NOR juvenile outmigrants by species and outmigration year increasing, decreasing, or stable?
6C: What are the morphological characteristics of outmigrating NOR juveniles relative to their conspecific HOR juveniles?

Purpose

To estimate the abundance of juvenile outmigrants by species and origin for the North Fork Lewis River downstream of Merwin Dam. Capture and sample juvenile fish to note morphological differences between HOR and NOR smolts, as well as other juvenile non-migrants (i.e., fry and parr).

Recovery Monitoring Recommendations

- Agencies and tribes should obtain simultaneous estimates of both juvenile migrants and adults for at least one population for each Major Population Group (MPG) within an ESU or DPS (13).
- The goal for all populations monitored for juvenile salmon migrants is to have data with a CV on average of 15 percent or less and steelhead migrant data with a CV on average of 30 percent or less
- A power analysis for each juvenile migrant population being monitored within an ESU should be conducted to determine the power of the data to detect a significant change in abundance and to provide that information to all interested parties, including for example, needed sample sizes.

Proposed Strategy

Outmigration abundance is often estimated through the use of rotary screw traps. These traps capture a portion of the total number of juveniles passing the trap location. By estimating the capture efficiency of the trap, an estimate of abundance can be derived for

juveniles passing the trap. The current strategy being implemented to evaluate this objective is the operation of rotary screw traps in the lower North Fork Lewis River. Morphological information is collected from captured fish. Trap operation and analysis protocols are described in the AOP.

Estimates of abundance are useful, if they are unbiased (i.e., accurate) and relatively precise Therefore, the assumptions of the estimator must be met and variance must be estimated in an unbiased manner. Because it is not possible to estimate the level of bias, study designs should strive to meet all the assumptions of the estimator(s) to the extent practical.

Monitoring Indicators

- abundance of juvenile migrants
- Morphology (length, smolt index, life stage) of migrants

Frequency

Juvenile outmigrant abundance and morphological sampling (Annual).

Limitations or Concerns

Juvenile outmigrant trapping can be complicated and requires development of clear study designs or protocols, project review and adaptive management to be successful. Estimates of abundance can be biased if the assumptions of the mark-recapture estimator are not met (e.g., equal survival and capture probability among marked and unmarked groups). Testing assumptions and describing how mark-recapture assumptions are being met is critical for developing unbiased estimates. The ability to specifically test all assumptions for the North Fork Lewis River smolt trapping project may be limited and should utilize results and recommendations from other juvenile migrant studies when applicable (e.g., tag retention studies). In addition, NOAA Fisheries recommends that trapping duration should encompass at least 90 percent of the outmigration period for each species (Crawford and Rumsey 2011), which means traps may be operated during high streamflow conditions in late winter and spring as well as lower flow periods in the summer. This is a potential limitation of operating traps in the North Fork Lewis River. Lastly, the number of smolts available for marking are often less than recommended to achieve sufficient statistical power. Thus, additional hatchery marked groups are sometimes used as a surrogate to increase the number of marks. These surrogate groups may not behave or have equal capture probabilities of other marked groups. Adaptive management to identify options for increasing trap efficiency or finding alternatives that allow marking of more fish are critical to the success of this monitoring strategy.

Chum are not currently included in the list of species to be monitored for this objective due to very low spawner abundance. As chum spawner abundance in the North Fork Lewis increases, inclusion of chum salmon juvenile abundance monitoring should be considered for addition to this objective.

4.4 RISK ASSESSMENT OBJECTIVES

4.4.1 *Objective 7.0*

Monitor the extent of genetic risks associated with integrated and segregated hatchery programs on naturally spawning listed populations in the North Fork Lewis River.

Key Questions

7A: Have the Lewis River hatchery programs impacted the among-population diversity of naturally spawning populations?

7B: Have the Lewis River hatchery programs impacted the within-population diversity of naturally spawning populations?

7C: Have the Lewis River hatchery programs increased the risk of domestication for naturally spawning populations?

7D: Have the Lewis River hatchery programs impacted the phenotypic diversity of naturally spawning populations?

Purpose

Developing and implementing a comprehensive genetic monitoring plan is key component in assessing the potential threats that hatchery programs may pose upon anadromous salmon and steelhead spawning in the North Fork Lewis River.

The monitoring of genetic risks and associated adverse effects is a requirement of both the Agreement and as part of pending HGMP submittals to NMFS. The long-term reintroduction outcome goal of the Agreement is to:

*…achieve **genetically viable**, self-sustaining, naturally reproducing, harvestable populations above Merwin Dam greater than minimum viable populations…*

The Agreement also directs that the Hatchery and Supplementation Plan include measures and methods to:

1. *minimize potential negative impacts of the Hatchery and Supplementation Program on ESA-listed species (Section 8.2.2.10) and,*

2. *prevent unacceptable adverse impacts, if any, of the hatchery program on the reintroduction program (Section 8.2.2.13)*

Additionally, the NMFS requires that HGMP's be developed for all hatchery production programs that may adversely affect ESA listed species. All hatchery programs pose genetic risks (e.g., loss of diversity, domestication, etc.) to natural populations. Thus, this objective provides guidance on assessing (1) the genetic risks posed by the hatchery production programs and (2) whether the H&S Program is achieving or capable of achieving 'genetic viability' of reintroduced stocks.

Recovery Monitoring Recommendations

- As a long-term strategy for monitoring genetic diversity, develop a Single Nucleotide Polymorphism (SNP) baseline for each population within each MPG and ESU/DPS. (16)
- The genotype and phenotype of every hatchery broodstock program should be monitored at least every third brood generation (F3) to determine effectiveness of maintaining the goals of the hatchery product. (43)
- For at least one primary population within each ESU where fish in and fish out are being quantified, more comprehensive information should be collected on species distribution, spawn timing, run timing, age distribution, fecundity, size, and sex ratios to determine status/trend in species diversity of natural populations (15).

Proposed Strategy

Hatcheries on the North Fork Lewis River operate both segregated and integrated programs (see Sections 2.3). The reintroduction program relies on these programs to provide adults for reintroduction upstream of Swift Dam. Because each program has different goals, each program poses different types of risks to listed populations. A genetic monitoring strategy should review each individual program to identify specific program risks and adapt a strategy to monitor these risks.

Risks

Generally, genetic risks on natural populations from the hatchery program include reduction in diversity and reduction in fitness through domestication. Realization of these risks may adversely affect the long-term resilience and genetic health of natural populations. Reduction in population genetic diversity include both (1) among-population diversity and (2) within-population diversity.

The term “population” can have many interpretations. Regarding genetics risks, the term population refers to a biological population, i.e., an aggregation of spawning fish isolated in space or time. Biological populations may or may not align with management populations, e.g., those designated for the purpose of recovery. For instance, adults spawning above and below Merwin Dam can be viewed as different biological populations. Similarly, segregated hatchery programs can be viewed as a biological population since the population is isolated from all other fish by using only hatchery produced fish as broodstock. On the other hand, fish derived from integrated hatchery programs are biologically the same population as those derived from natural spawning when natural origin fish are used as broodstock and hatchery fish spawn with natural origin fish on the spawning grounds. Thus, all fish, regardless of origin, belong to the same biological population. Genetic samples can be collected from biological and/or management populations while the results from the various analyses can shed light on the genetic

structure of these populations (e.g., the degree of alignment of biological and management populations) and subsequent genetic risks.

Among-population risks

Among-population diversity is related to local adaptation and is important for long-term resilience of the species. To minimize the risk of reducing among-population diversity (i.e., homogenizing populations), populations should be kept separate on the spawning grounds and in the hatchery. The determination of whether to monitor among-population diversity depends on whether the program is segregated or integrated. In general, more interbreeding of hatchery- and natural-origin fish is tolerated for integrated programs while less interbreeding is tolerated for segregated programs. Therefore, monitoring the impacts of a segregated hatchery on among-population diversity may be a higher priority given that segregated hatchery fish are intended to be a separate (i.e., genetically distinct) population relative to naturally spawning fish. Conversely, assessing among-population diversity is also important when integrated hatcheries are being operated if population structure exists. For example, winter steelhead that are part of the Lower Columbia River and Southwest Washington Distinct Population Segments (DPS) exhibit strong population structure. Therefore, the North Fork Lewis late winter steelhead program relies on genetic screening to ensure all broodstock assign to the North Fork Lewis River or Cascade Stratum (i.e., Lower Columbia River) to, in part, maintain among-population diversity. Lastly, monitoring the impacts of hatchery programs on among-population diversity is important if hatchery fish stray among populations, either within or among management basins, regardless of the program-type.

Within-population risks

Within-population diversity describes the amount of genetic diversity within a population and is important for the long-term resilience of the population (and by extension the species). Low within-population diversity leads to and can be a consequence of inbreeding. Inbreeding (increasing identity by descent and homozygosity) increases extinction risks by reducing available diversity for adaptation, increasing risks of genetic diseases or disorders, and a reduction in fitness (inbreeding depression). Hatchery production increases the risks of reducing within-population diversity because hatcheries spawn only a subset of the entire population. Therefore, hatchery returns that spawn successfully with their in-river natural origin cohorts have the potential to adversely affect within-population diversity and long-term viability of natural populations.

Domestication risks

Domestication reduces the long-term fitness of populations through the proliferation of alleles which improve performance in domestic settings (i.e., hatcheries) while reducing performance in natural settings (domestication selection). Adverse impacts on the natural origin populations occur when hatchery produced fish interbreed with naturally produced fish. Segregated programs, where every broodstock is of hatchery origin, have a very high likelihood of domestication selection. Integrated programs, where a portion or all

broodstock are of natural origin, are thought to have a much lower likelihood of domestication selection (HSRG 2014; Anderson et al. 2020).

Phenotypic diversity risks

A potential result of reduced genetic diversity and domestication include observable changes in phenotypic traits of naturally spawning populations. Phenotypes are, to some degree, a reflection of the underlying genetic diversity among individuals. Hatchery propagation has been shown to decrease the phenotypic variability of fitness traits in populations, though the degree to which the changes are genetic or plastic is unknown.

Table 4-1 Summary of the genetic risks posed by each individual hatchery program operating in the North Fork Lewis River Basin on natural origin populations

Population(s) of Concern	Hatchery programs	Risk type
NF Lewis NOR winter steelhead	Segregated (Chambers stock, Puget Sound origin)	Among Domestication
	Integrated	Among Within Domestication Phenotypic
NF Lewis NOR Coho	Segregated (early)	Among Within Domestication
	Integrated (late)	Among Within Domestication Phenotypic
NF Lewis NOR spring Chinook	Segregated	Among Within Domestication Phenotypic

Genetic Baselines

To monitor and assess the genetic risks associated with hatchery programs and identified in the key questions, we must first characterize the genetic makeup for the populations of interest. Genetic characterization is accomplished by genotyping a representative set of individuals (i.e., tissue samples) from each biological population at a representative suite of genetic markers (i.e., a panel of loci or locations in the genome) and using information contained in the genotypes (e.g., allele frequencies) to examine genetic relationships among individuals and populations. This representative suite of tissue samples and the genetic markers together define a genetic baseline, which can be used to identify spawning aggregations, establish baseline levels of genetic diversity, and with analysis of collections taken in future years can reveal genetic changes over time.

Baselines already exist for all three species (Chinook, Coho and steelhead), but only the steelhead baseline is well-developed using modern genetic technology. For steelhead, WDFW's Molecular Genetics Laboratory has two steelhead reference baselines using SNP (single nucleotide polymorphism) based marker panels (Omy379 and HW354); SNP panels are based on modern technology and, when designed properly, have been shown to be superior to previous technologies for most applications. The markers in the Omy379 SNP panel were chosen to be useful to evaluate diversity and genetic relationships among *O. mykiss* populations across most of their range. Those markers found in the HW354 panel were specifically chosen for their ability to distinguish among lower Columbia River steelhead populations and to discriminate Puget Sound ancestry hatchery steelhead from lower Columbia steelhead. Both steelhead baselines have been used for genetic stock identification within the NF Lewis Basin and could be used for the proposed genetic analyses in this objective.

SNP based baselines exists for Chinook salmon but not for Coho salmon. Specifically, there are several existing SNP based baselines for Chinook salmon that include some samples from lower Columbia populations (see https://www.fishgen.net/). For Coho salmon, a SNP panel for use range wide has been developed and efforts are under way to assemble a baseline for Coho populations in Washington, including populations in the lower Columbia River. However, unlike the existing steelhead SNP based baselines outlined above, the suitability of the existing Chinook SNP based baseline to address the risks identified in the key questions outlined in this objective has not been examined. Therefore, a more thorough exploration of existing baselines and subsequent data will be necessary to better understand their utility and highlight any potential issues. Based on the examination of the existing baselines, additional sampling and genotyping effort may be necessary to ensure that representative collections from all relevant biological populations are included in each baseline.

Monitoring Indicators by Risk Type

Among-population diversity

Among population diversity is measured as relative genetic differences among populations. Impacts of hatchery programs may be inferred by comparing baseline metrics to those measured in future generations. Among-population diversity is reduced when populations interbreed.

Common metrics used to evaluate population structure, i.e., among-population genetic diversity include F_{ST}, allele frequencies, or various genetic distance metrics in a matrix of all pairwise comparisons among populations. Genetic data are typically analyzed using multi-variate clustering algorithms including those with (e.g., STRUCTURE) and without (Principal Component Analysis, Principal Coordinate Analysis, or Factorial Correspondence Analysis) underlying population genetic models. Pairwise F_{ST} and genetic distance matrices are usually visualized as bifurcating dendrograms.

Within Population Diversity

Within population diversity is evaluated with several different metrics. Most commonly, average heterozygosity, effective population size (N_e) or effective number of breeders (N_b), F_{IS} (a measure of decrease in diversity due to inbreeding), standardized number of alleles, and minor allele frequency are tracked. Estimating full-sibling family number and sizes may also be illuminating.

Domestication

There are currently no genotypic techniques (e.g., domestication genes or markers) to assess the level of domestication within populations. Therefore, surrogate metrics are used to assess the potential of domestication due to artificial propagation and include Proportion Natural Influence (PNI), which is calculated from Proportion of Hatchery Origin Spawners (pHOS) and Proportion of Natural Origin Broodstock (pNOB) and Proportion Effective Hatchery Contribution (PEHC). The two measures estimate impacts at different stages. PNI estimates the potential for interbreeding interactions by looking at the composition of the spawners with interpretation reliant on the assumption that actual interbreeding is directly related to proportions of hatchery and natural origin spawners and broodstock. PEHC estimates the actual interbreeding that occurred based on analysis of genotypes using clustering algorithms of the program STRUCTURE[13].

Phenotypic Indicators

There are very few genetic markers with known allelic associations with phenotype. Genetic markers associated with sex, age at maturity, and recently discovered allelic associations with the run-timing in coastal lineage Chinook salmon and steelhead are examples (Hess et al. 2016, Prince et al. 2017, McKinney et al. 2020), so future phenotypic monitoring could include a genetic component.

[13] This method is available only when the hatchery and wild population are genetically distinct, and so is unavailable for use with integrated hatchery programs and may be unavailable for segregated programs depending on the degree of genetic differentiation of the segregated program and natural origin populations. More information can be found in (Warheit 2014) and (HSRG 2009b).

Table 4-2 Summary of monitoring indicators by genetic risk type and frequency of analysis

Risk Type	Monitoring Indicators	Frequency
Among	- F_{ST} - genetic distance metrics combined with dendrograms - multi-variate clustering analyses	Generational (f3)
Within	- Effective Population Size (N_e) - Average F_{IS} (among loci, within population) - Average heterozygosity (expected and observed, among loci, within population) - Average per locus minor allele frequencies - Average number of alleles (within population)	Generational (f3)
Domestication	- PNI (pHOS, pNOB) - PEHC	Annual
Phenotypic	- Timing of juvenile outmigration, adult run and spawn timing - Size and age of juvenile outmigrates and returning adults - Fecundity of female spawners	Annual

Frequency

Generally, monitoring occurs on an annual basis for all metrics. For genotypic metrics sampling may occur on an annual basis, but analysis of those samples would occur on a generational scale except for genetic screening of broodstock. NOAA recommended that analysis occurs for every third generation (f3). Phenotypic and domestication metrics are routinely monitored as these metrics are used to answer key questions from other objectives and can provide early warning indications that natural populations are subject to higher levels of domestication than previously thought.

Limitations or Concerns

It is expected that reintroduction programs will remain in the re-colonization phase well past the next rewrite of this plan (scheduled in 2025). It is also expected that the reintroduction program will continue to be dependent on hatchery supplementation for the near future.

Correct interpretation of results of genetic tests relies heavily on tissue collections being representative of the populations or groups they are intended to represent. Uncertainty of genetic tests is dependent on the number of samples collected and successfully processed. Among and within population genetic variation may change due to factors other than hatchery production, including gene flow (straying) from other populations and natural selection. The SNP markers intended to be used here may, with adequate baseline data, allow detection of gene flow from outside into the NF Lewis River. Most of the SNP markers are assumed to be neutral, which means they cannot be used to detect signatures of selection. Genomic methods are available, which allow for experiments to look for regions of the genome that may be under selection, and, if data are collected properly, to associate environmental variables with those genomic regions. However, these methods are not

currently part of routine hatchery monitoring, so interpretation assumes that there is no selection.

4.4.2 *Objective 8.0*

Determine the percent hatchery-origin spawners (pHOS), proportionate natural influence (PNI) and pNOB (for integrated programs)

Key Questions

8A: What are the trends in pHOS, PNI, pNOB and PEHC and do they meet HSRG recommendations by program (when applicable)?

Purpose

The proportion of hatchery-origin spawners, or pHOS, is a metric used to monitor the genetic influence that hatchery-produced fish may have on a naturally spawning population(s). PNI is an estimate of the proportion of natural influence on a population composed of hatchery and natural origin fish (i.e., integrated program). This metric is influenced substantially by the proportion of natural origin fish used in the broodstock. For example, if the broodstock incorporates 100 percent natural origin fish, PNI estimates cannot be less than 50 percent.

This objective intends to monitor this influence, determine annual trends in pHOS and PNI and to determine if these metrics meet HSRG targets (Table 4-3).

Table 4-3 Current population designations (LCFRB 2010), hatchery program types, and HSRG recommended targets for pHOS and PNI for the North Fork Lewis River salmonid populations.

Population	Current Hatchery Program Type	Current Population Designation	HSRG pHOS Target	HSRG PNI Target
Spring Chinook	Segregated	Primary	< 5%	NA
Fall Chinook	None	Primary	< 5%	NA
Coho	Integrated (Late)	Contributing	< 30%	≥ 0.50
Coho	Segregated (Early)	Contributing	< 5%	NA
Winter Steelhead	Integrated (Late)	Contributing	< 30%	≥ 0.50
Winter Steelhead	Segregated (Early)	Contributing	< 5%	NA
Summer Steelhead	Segregated	Stabilizing	< 5%	NA
Chum	None	Primary	< 5%	NA

Recovery Monitoring Recommendations

- Monitor ratio of marked hatchery-origin salmon and steelhead to unmarked natural origin fish in all adult spawner surveys (7). The states and tribes should be able to determine annually the percent hatchery-origin spawners (pHOS) and natural origin spawners (pNOS) for each population. Estimates should be evaluated to determine

their precision and ability to detect changes and to determine the trend toward reaching HGMP targets (36).

- The proportion of natural influence (PNI) for primary populations within the ESU for supplementation programs should be calculated periodically (37).

Proposed Strategy

Steelhead

Estimating pHOS for steelhead is particularly challenging due to their iteroparous spawning strategy. The number of fish of each origin cannot be confirmed through post-spawning carcass surveys, which are routine for semelparous Pacific salmon. Instead estimates must be made based on observations of live steelhead.

In late 2016, a draft multi state mark-recapture model was developed by the U.S. Geological Survey to estimate pHOS in the population of late winter steelhead that spawn in the North Fork Lewis River downstream of Merwin Dam (the pHOS model). The model is based upon a study design that takes advantage of existing field efforts to collect broodstock by tangle-netting, and the capture of all fish that migrate upstream to the Merwin Trap and Lewis Hatchery Ladder. In 2017, the draft pHOS model was reviewed by the Lewis River Hatchery and Supplementation Subgroup (now ATS), which made recommendations to modify the pHOS model and test the model fit. In 2018, in response to these recommendations and in consultation between U.S. Geological Survey and Anchor QEA, the pHOS model was revised to account for residuals (non-anadromous individuals) observed either through tangle-netting or capture at the Merwin Trap. A description of the revised pHOS model is included in the Final Annual Operating Plan for 2019. Continued use of this model is the proposed strategy to estimate pHOS for steelhead and should be detailed in the AOP with annual review of estimates to determine if modifications to the model are necessary.

Chinook and Coho Salmon

Chinook and Coho salmon that spawn downstream of Merwin Dam may be HORs or NORs. A significant portion of adult spring Chinook and Coho returns are collected at the MCF and Lewis Hatchery ladder and thus do not contribute to the number of actual spawners downstream of Merwin Dam. Hatchery production of fall Chinook was terminated in 1986, and this population has remained self-sustaining since termination of the hatchery program. However, stray hatchery-origin fall Chinook do enter the Lewis River and are observed during annual carcass spawner surveys.

In the mainstem North Fork Lewis River, seasonal surveys of Chinook and Coho salmon carcasses are performed from Merwin Dam downstream to the downstream end of Eagle Island. Tributary surveys for Coho use a GRTS method to define survey reaches (panels) each year. GRTS survey reaches identified each year in the North Fork Lewis River tributaries are developed as part of the overall Lower Columbia River ESU sampling and thus not specific to the North Fork Lewis River Coho population.

To estimate the proportion of HOR spawners, study designs should incorporate established methods already in place to estimate abundance using sampled carcasses. As part of

abundance surveys, carcasses are directly handled and sampled weekly throughout the spawning periods for Chinook and Coho salmon. The origin (NOR, HOR, or Unknown) is recorded for sampled carcasses. If the carcasses are sampled in a representative manner, the origin data can be used to estimate pHOS. However, given that the number and composition of carcass recoveries is a direct result of the recovery probability for each individual carcass, which are influenced by many factors (e.g., spawning timing, spatial distribution, sex and size of carcass), total estimates of pHOS will be derived by weighting of raw recovery data by relative abundance.

Monitoring Indicators

- pHOS
- pNOB (integrated hatchery programs)
- PNI
- PEHC

Frequency

Annual

Limitations or Concerns

Steelhead

The current steelhead model assumes that capture efficiency at the Merwin Trap is 100 percent and that all fish are correctly identified and recorded (e.g. noting residuals that migrate to the Merwin Trap). Additionally, while this model does not address all possible contingencies (e.g. capture efficiency varying among groups, or different rates of residualism among hatchery and natural populations), the posterior predictive check demonstrates that the model is adequate for the main goal of estimating the proportion of hatchery-origin spawners. However, the possibility for extensions or variations of the model to be evaluated in the future with more formal model comparison techniques remains.

The early winter steelhead program has an earlier return and spawn time than the natural origin late winter steelhead program, thus, there is generally a high degree of temporal separation of spawners between the hatchery and natural origin populations.

Chinook Salmon

There is substantial temporal and spatial overlap between spring and fall runs of Chinook in the North Fork Lewis River. This overlap may reduce the ability to reliably differentiate between fall and spring run Chinook in the field. Misidentification of carcasses as either spring or fall runs will affect pHOS estimates as the pHOS rate between spring and fall runs differs significantly. That is the vast majority of fall run Chinook are of natural origin whereas the spring run is predominantly of hatchery-origin from the segregated hatchery program.

Coho Salmon

A substantial portion of returning Coho either are trapped or spawn in tributaries of the mainstem North Fork Lewis River. Because most of the carcass recovery effort is focused on the mainstem, sampling may not be representative of the total returns to the basin.

4.4.3 *Objective 9.0*

Monitor the post-release behavior of hatchery smolts and their potential impacts on native and ESA-listed species present downstream of Merwin Dam.

Key Questions

Not available

Purpose

This objective provides means for direct monitoring of ecological interactions between HOR and NOR juveniles if in-hatchery monitoring metrics described under Objective 4 are not achieved.

Proposed Strategy

This objective shall remain inactive for as long as the metrics described in Objective 4 remain measurable and within the targets provided each year in the AOP. The ATS may recommend at any time that this objective become active if monitoring results derived from Objective 4 are found to be inconsistent with established targets. Activation of this objective shall require approval by the ACC prior to its implementation. If approved, the ATS shall develop and include key questions, a proposed strategy, monitoring designs and indicators to be included in the AOP and consistent with the format of other objectives in this plan.

Limitations or Concerns

Interactions between juvenile hatchery and natural-origin fish are not observable and therefore attempts to quantify ecological interactions may be biased and unreliable.

While it is possible to indirectly measure some effects of these interactions (e.g., predation via lavaging) through direct capture and sampling of juveniles, concerns remain regarding the ability to quantify and apply these effects to the affected population.

5.0 FISH MARKING AND TAGGING STRATEGIES

A fish marking strategy is needed to identify the origin (NOR or HOR) of adults returning to adult collection facilities, and as a means to identify program fish that will be transported upstream (e.g., late winter steelhead).

Currently, juvenile fish released from North Fork Lewis River hatchery facilities are marked to quantify overall survival rates, contribution to fisheries (ocean and freshwater), stray rates, and the proportion of hatchery-origin fish that spawn naturally in the basin. Fish released from the hatchery are generally distinguished through a combination of marks:

- Adipose Clip: This mark is used to inform fishers and managers that the fish is of hatchery-origin. These fish can be retained in selective fisheries. Nearly all hatchery fish released in the North Fork Lewis River are mass marked in this manner: the two exceptions being DIT groups and late winter steelhead smolt releases.
- Adipose Clip + CWT: A subset of the spring Chinook and Coho salmon released are also marked with a CWT inserted into the snout. The CWT is primarily used to determine overall survival rates of release groups, stock composition on spawning grounds, harvest rates, and stray rate into other basins.
- Adipose Present + CWT: This group is referred to as the DIT group and is used to estimate the impact mark selective fisheries have on natural populations. In these fisheries, fish captured with intact adipose fins are released while adipose clipped fish are retained. The difference in survival between these groups quantifies harvest impacts to hatchery stocks.
- Adipose Present + BWT: This group represents late winter steelhead juvenile releases from Merwin Hatchery. Adult steelhead possessing an adipose fin AND wire tag in the snout identifies these fish as hatchery program fish for reintroduction and thus they are transported upstream upon capture at the MCF or Lewis River Hatchery traps to spawn naturally.
- PIT tagging: PIT tags are recommended for small differential marking programs such as trapping or collection efficiency, or to evaluate rearing strategies and residualism for hatchery released smolts. Adults captured either through late winter steelhead tangle netting or returns to lower river traps may also be marked with PIT tags to support pHOS estimates or to meet monitoring objectives of the AMEP.

As natural production upstream of Swift Dam increases it is suggested that the DIT group be eliminated and replaced by marking natural origin migrants. By using natural outmigrants, instead of hatchery smolt surrogates, the accuracy of ocean recruits estimates (as provided by the AMEP) is improved for the natural production component.

The proposed marking scheme for hatchery, supplementation and natural origin fish is presented in Table 5-1. The marking program emphasizes the use of CWTs for spring Chinook and Coho and blank wire snout tags for steelhead, because few steelhead are captured in ocean fisheries, and Columbia River mainstem and tributary fisheries (including the North Fork Lewis River) are mark-selective for steelhead.

Table 5-1 Fish marking and tagging for the hatchery program, supplementation program and natural outmigrants collected at the Swift FSC.

	RELEASE LOCATION	
	Downstream of Merwin Dam	**Swift Reservoir**
HATCHERY PROGRAM		
Spring Chinook	1,050,000 AD clip only	
	150,000 CWT only (DIT)	
	150,000 CWT + AD clip	
Coho	1,700,000 AD clip only	
	150,000 CWT only (DIT)	
	150,000 CWT + AD clip	
Steelhead (winter and summer)	100% AD clip	
Rainbow		100% AD clip
Kokanee		
SUPPLEMENTATION PROGRAM		
JUVENILES		
Late Winter Steelhead	100% blank wire snout tag (BWT)	
ADULTS		
Late Winter Steelhead	A portion of adult returns trapped (or netted) downstream of Merwin Dam may be PIT tagged for specific evaluations	
Coho		
Spring Chinook		
NATURAL OUTMIGRANTS (captured in the Swift FSC)		
Late Winter Steelhead	A portion of captured outmigrants are PIT tagged for specific evaluations (e.g., trapping efficiency, ocean recruit analysis, etc.)	
Early Coho		
Spring Chinook		

* AD = Adipose Fin; CWT = Coded Wire Tag; BWT = Blank Wire Tag; DIT = Double Index Tag

6.0 REINTRODUCTION OUTCOME GOAL

The H&S Program officially began in 2010 after the first H&S Plan was submitted to the FERC in December 2009. Since then, an increasing amount of empirical data exist to begin assessing whether the program is meeting the anadromous reintroduction outcome goal stated in the Agreement:

> *"…to achieve genetically viable, self-sustaining, naturally reproducing, harvestable populations above Merwin Dam greater than minimum viable populations"*

Empirical data related to adult and juvenile collection, transportation and collection efficiency for each transport species are summarized in this section.

Ultimately, the Services will determine whether the reintroduction outcome goal has been achieved. Per the Agreement, this determination will most likely be required in year 2025, which represents the 12th year after reintroduction of anadromous fish upstream of Swift Dam in 2013 (Figure 6-1).

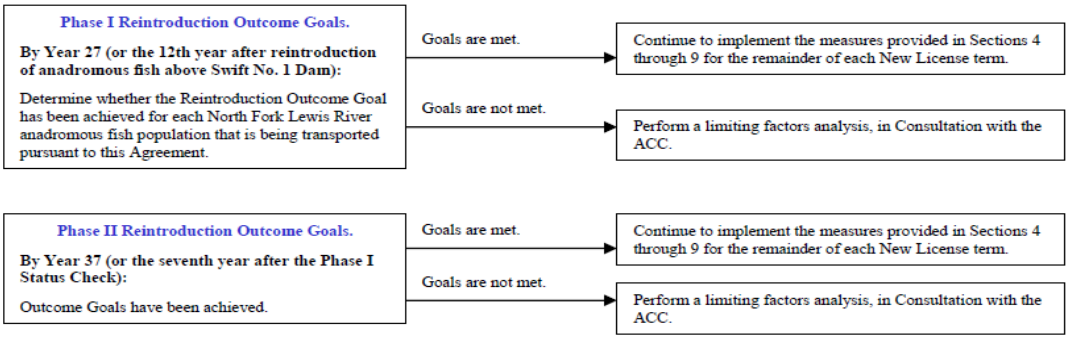


Figure 6-1 Schedule per Section 3 of the Agreement for determining whether the reintroduction outcome goal has been achieved.

To evaluate whether the program is successful, the Services will rely, in part, on results reported for each of the H&S Plan or AMEP monitoring objectives, including evaluating reported results and trends associated with VSP metrics. To facilitate this process, the H&S Plan has developed several key questions related to the reintroduction program that are fundamental in evaluating whether the program is successful (Section 6.5). As part of this determination, the Services will also consider external factors that influence program success (i.e., ocean survival, freshwater survival and performance, harvest management, etc.).

6.1 SPRING CHINOOK

The spring Chinook supplementation program relies solely on adult returns to the MCF and Lewis River ladder for transport upstream of Swift Dam. Adult returns are currently predominantly HORs from the segregated hatchery program.

Initially, the hatchery program was expected to provide sufficient returns to support both the harvest program and the reintroduction effort upstream of Swift Dam. However, since 2013, spring Chinook returns to the MFC and Lewis River hatchery ladder have averaged about 1,600 fish (Table 6-1). After hatchery broodstock needs are met (about 1,400 adults), the number of adults remaining for supplementation has failed to meet the transport target (3,000 adults) since the program began in 2013 (Table 6-1). In some years, no adults have been transported upstream. Because there is not a consistent source of adults for reintroduction, the future success of the spring Chinook supplementation program remains uncertain, which delays the program's ability to move beyond the re-colonization phase. If adult returns continue to fall short of targets (as provided in the AOP), managers could suspend the program, prioritize supplementation over hatchery production, or implement temporary use of Cowlitz River stock as stated in the Agreement, or Kalama River stock as recommended by the ATS.

Juvenile collection efficiency and total numbers has continued to improve at the Swift FSC (Table 6-2) despite the low numbers of adults transported each year. There is some evidence that progeny from reintroduced Chinook adults are expressing an adfluvial life history (such as bull trout), using Swift Reservoir to reach sexual maturity and then spawning in tributaries. Stream surveyors have observed Chinook salmon (less than 300 mm) spawning with transported adults during foot spawning surveys.

Table 6-1 Annual number of spring Chinook adults trapped and transported upstream of Swift Dam.

	YEAR						
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
HOR Chinook							
Males	814	422	482	218	1,006	1,470	510
Females	930	524	419	211	1,317	1,134	327
Jacks	163	51	44	118	548	64	228
Subtotal	***1,907***	***997***	***945***	***547***	***2,871***	***2,668***	***1,065***
NOR Chinook							
Males	16	6	20	7	23	17	14
Females	25	11	17	8	13	8	13
Jacks	0	5	5	1	4	1	9
Subtotal	***41***	***22***	***42***	***16***	***40***	***26***	***36***
TOTAL TRAPPED	**1,948**	**1,019**	**987**	**563**	**2,911**	**2,694**	**1,101**
ADULT SPRING CHINOOK TRANSPORT UPSTREAM[1]							
Males	270	0	0	0	370	491	10
Females	243	0	0	0	430	177	11
Jacks	66	0	0	0	310	32	88
TOTAL TRANSPORTED	**579**	**0**	**0**	**0**	**1,110**	**700**	**109**

1 Includes captures from the Lewis River Hatchery trap and sorting facility.
Note: Broodstock target = 1,400; Transport target = 3,000; Collection target = 4,400

Table 6-2 Annual Number of Spring Chinook Juveniles collected at the Swift FSC and transported downstream of Merwin Dam, including associated Swift FSC collection efficiency (when available).

	YEAR						
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
SPRING CHINOOK COLLECTED AT THE SWIFT FSC							
Fry	0	0	0	6	0	31	64
Parr	0	0	230	673	278	469	2,834
Smolt	1,431	2,195	5,305	3,114	5,523	4,250	8,053
TOTAL	**1,431**	**2,195**	**5,535**	**3,793**	**5,801**	**4,750**	**10,951**
SPRING CHINOOK TRANPORTED DOWNSTREAM							
Fry	0	0	0	6	0	31	64
Parr	0	0	227	673	278	462	2,828
Smolt	1,431	2,164	5,174	3,114	5,523	4,187	7,994
TOTAL	**1,431**	**2,164**	**5,401**	**3,793**	**5,801**	**4,680**	**10,886**
SWIFT FSC SMOLT COLLECTION EFFICIENCY (Pce)							
AVERAGE	NA	NA	NA	NA	11%	24%	51%

To improve survival and adult returns of spring Chinook, the ATS recommended two measures. First, the ATS recommended suspending the Swift juvenile fish acclimation program beginning in 2019 and instead releasing the 100,000 acclimation program smolts downstream of Merwin Dam as part of the overall hatchery plant. Smolts released downstream of Merwin Dam are likely to achieve higher outmigration survival rates than acclimation fish due to low FSC efficiency. Second, the ATS initiated a comprehensive evaluation of rearing and release strategies for spring Chinook in an effort to determine optimal release timing and rearing protocols (ATS 2019). The ACC approved these measures in 2018.

Any benefit from these efforts will not be realized until 2020 when the first adult returns (3-year-olds) are expected at the traps. Poor return rates may be unrelated to North Fork Lewis River hatchery operations or fishery management, and thus beyond the scope and influence of this plan.

Despite these challenges, the Plan recommends that efforts continue to improve hatchery operations and implement strategies that lead to improved fish health and survival.

6.2 COHO SALMON

The Coho hatchery program has averaged over 32,000 adult coho returns to the MCF and Lewis River hatchery ladder since 2013 (Table 6-3). The Agreement does not require a juvenile acclimation program, and the supplementation program relies solely on transport of adults upstream of Swift Dam. Based on revised 2018 EDT estimates of juvenile productivity and capacity upstream of Swift Dam (Table 6-5), the Coho supplementation program has the potential to achieve the stated outcome goal of the program. This expectation relies on collection efficiency at the Swift FSC (>95 percent) that is adequate to

reach an Overall Downstream Survival (ODS) rate of 80 percent or more as required by the Agreement. Currently, the program does not meet this target; however, collection efficiency at the Swift FSC has increased from 27 percent in 2017 to 64 percent in 2019 (Table 6-4). Improved efficiencies are the result of both operational and physical modifications to the Swift FSC in recent years. It is expected that collection efficiencies will continue to improve at the Swift FSC and that adult return rates will continue to provide the needed supplementation fish to meet program transport targets. As the program matures, it is expected that adult trap returns will begin to show an increasing proportion of NOR captures from naturally produced smolts upstream of Swift Dam.

Table 6-3 Annual number of Coho adults trapped and transported upstream of Swift Dam.

	YEAR						
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
HOR Coho							
Males	12,668	34,946	9,880	16,299	9,883	8,506	6,720
Females	9,804	30,484	7,671	14,106	9,068	5,937	5,120
Jacks	6,280	7,417	3,902	2,926	4,113	6,783	2,195
Subtotal	***28,752***	***72,847***	***21,453***	***33,331***	***23,064***	***21,226***	***14,035***
NOR Coho							
Males	115	1,073	95	781	1,157	323	745
Females	102	976	72	806	1,409	292	720
Jacks	1	49	35	422	47	396	260
Subtotal	***218***	***2,098***	***202***	***2,009***	***2,613***	***1,011***	***1,725***
TOTAL TRAPPED	**28,970**	**74,945**	**21,655**	**35,340**	**25,677**	**22,237**	**15,760**
ADULT COHO TRANSPORT UPSTREAM[1]							
Males	3,858	4,788	2,030	3,430	3,254	3,999	2,946
Females	3,104	4,217	1,694	3,377	3,494	2,659	2,373
Jacks	73	174	30	539	65	402	36
TOTAL TRANSPORTED	**7,035**	**9,179**	**3,754**	**7,346**	**6,813**	**7,060**	**5,355**

1 Includes captures from the Lewis River Hatchery trap and sorting facility.
Note: Broodstock target = 2,150; Transport target = 6,800; Collection target = 8,950

Table 6-4 Annual number of Coho juveniles collected at the Swift FSC and transported downstream of Merwin Dam, including associated Swift FSC collection efficiency (when available).

	YEAR						
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
COHO JUVENILES COLLECTED AT THE SWIFT FSC							
Fry	0	1,520	5,860	836	3,597	998	2,792
Parr	0	0	6,729	11,307	9,576	4,964	4,521
Smolt	15,074	7,659	25,555	48,833	14,924	36,039	91,744
TOTAL	**15,074**	**9,179**	**38,144**	**60,976**	**28,097**	**42,001**	**99,057**
COHO JUVENILES TRANPORTED DOWNSTREAM OF MERWIN DAM							
Fry	0	0	0	836	3,597	998	2,734
Parr	0	0	6,478	11,307	9,576	4,843	4,510
Smolt	15,074	7,588	25,441	48,833	14,924	35,880	89,573
TOTAL	**15,074**	**7,588**	**31,919**	**60,976**	**28,097**	**41,721**	**96,817**
SWIFT FSC SMOLT COLLECTION EFFICIENCY (Pce)							
Average	NA	29%	12%	31%	27%	40%	64%

Table 6-5 Revised EDT Estimates (in 2018) of Juvenile Productivity, Capacity and Abundance upstream of Swift Dam.

Species	**Productivity** *(smolts/spawner)*	**Capacity** *(maximum # of smolts)*	**Abundance** *(estimated # of smolts produced)*
Spring Chinook	350.6	523,614	323,552
Coho	148.7	381,018	260,757
Late Winter Steelhead	162.7	39,972	34,473

Note: estimates assume current (baseline) habitat conditions upstream of Swift Dam and Overall Downstream Survival (ODS) of 80%

6.3 LATE WINTER STEELHEAD

The North Fork Lewis River late winter steelhead supplementation program is an integrated hatchery program (100 percent NOR brood) to produce adults for reintroduction upstream of Swift Dam. Harvests in fisheries downstream of Merwin Dam are expected to remain minimal as selective fisheries are assumed to remain in place. Broodstock will continue to be taken from adult NOR returns to the trap instead of using progeny from the hatchery program in order to maintain the effective population size of the spawners upstream of Swift Dam.

The number of adults transported upstream annually has averaged over 800 since 2012 (Table 6-6). EDT modeling estimates that the current habitat upstream of Swift Dam can support up to 1,700 adult steelhead (Table 3-2). The program has not yet achieved this number of transported adults. However, if collection efficiency continues to improve at the Swift FSC, the number of juvenile NOR late winter steelhead trapped and transported downstream should also improve (Table 6-7). Thus, increasing adult returns, and the

numbers of transported steelhead over time. Currently, collection of steelhead kelts at the Swift FSC is difficult. If kelt collection efficiency improves, increases in adult returns from repeat spawners could help achieve transport targets and improve population diversity.

For the steelhead program to meet the outcome goals, the number of transported steelhead and Swift FSC collection efficiency must improve. The integrated hatchery program size is not expected to change due to concerns about broodstock mining and founder effect risks to the native population downstream of Merwin Dam.

Table 6-6 Annual number of adipose clipped, BWT and NOR winter steelhead adults trapped and transported upstream of Swift Dam.

	YEAR							
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
HOR (AD CLIP) Winter Steelhead								
Males	413	245	318	1,636	1,360	1,541	552	319
Females	419	382	285	1,317	1,627	1,426	926	428
Subtotal	**832**	**627**	**603**	**2,953**	**2,987**	**2,967**	**1,478**	**747**
HOR (BWT) Winter Steelhead								
Males	146	417	462	748	411	346	683	514
Females	50	297	586	504	440	288	534	478
Subtotal	**196**	**714**	**1,048**	**1,252**	**851**	**634**	**1,217**	**992**
NOR Winter Steelhead								
Males	0	7	17	41	29	48	47	51
Females	0	12	12	31	25	47	73	25
Subtotal	**0**	**19**	**29**	**72**	**54**	**95**	**120**	**76**
TOTAL TRAPPED	**1,028**	**1,360**	**1,680**	**4,277**	**3,892**	**3,696**	**2,815**	**1,815**
ADULT BWT and NOR WINTER STEELHEAD TRANSPORT UPSTREAM[1]								
Males	141	440	452	746	382	331	685	527
Females	48	301	581	477	390	261	540	482
TOTAL TRANSPORTED	**189**	**741**	**1,033**	**1,223**	**772**	**592**	**1,225**	**1,009**

1 Includes captures from the Lewis River Hatchery trap and in-river tangle netting; represents BWT and NOR stocks only.
Note: Late Winter Steelhead Broodstock target = 75; Transport target = 1,700; Collection target = 1,775

Table 6-7 Annual number of winter steelhead juveniles collected at the Swift FSC and transported downstream of Merwin Dam, including associated swift FSC collection efficiency (as available).

	YEAR						
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
WINTER STEELHEAD JUVENILES COLLECTED AT THE SWIFT FSC							
Fry	0	3	5	32	19	14	8
Parr	0	0	47	74	73	18	63
Smolt	166	539	1,282	2,095	1,724	7,869	2,950
Kelts	9	7	31	66	9	19	64
TOTAL	**175**	**549**	**1,365**	**2,267**	**1,825**	**7,920**	**3,085**
WINTER STEELHEAD JUVENILES (NOR) TRANPORTED DOWNSTREAM							
Fry	0	0	0	32	19	13	8
Parr	0	0	47	74	73	18	63
Smolt	166	539	1,277	2,095	1,724	7,863	2,941
Kelts	9	7	28	66	9	19	47
TOTAL	**175**	**546**	**1,352**	**2,267**	**1,825**	**7,913**	**3,059**
SWIFT FSC SMOLT COLLECTION EFFICIENCY (Pce)							
AVERAGE	NA	NA	NA	NA	20%	49%	27%

6.4 RAINBOW TROUT AND KOKANEE

The proposed resident rainbow trout and kokanee programs are expected to maintain the existing recreational fisheries in Swift Reservoir and Lake Merwin; however, the potential adverse effects of these programs on reintroduced salmon and steelhead are not fully known. Resident trout plants in Swift Reservoir should be evaluated periodically to identify risks to reintroduced anadromous fish and their out-migrating progeny. In addition, fishery managers should develop strategies that minimize the number of stocked rainbow trout that enter the Swift FSC and are inadvertently transported downstream of Merwin Dam as part of downstream transport operations. Decisions to modify the rainbow trout stocking program at Swift Reservoir will be made in consultation with the ACC using a new decision process implemented in 2020.

6.5 KEY QUESTIONS RELATED TO THE OUTCOME GOAL

A primary assumption being tested in this plan is whether hatchery-origin fish can be used to restore anadromous fish production upstream of the North Fork Lewis River dams to achieve the outcome goals of the Agreement:

1. Self-sustaining, naturally producing, harvestable native anadromous salmonid species throughout their historical range in the North Fork Lewis River Basin, and
2. The continued harvest of resident and native anadromous fish species.

Several key questions need to be addressed to determine whether the reintroduction component of the H&S Program is meeting the outcome goals. To be successful, the reintroduction program must not only become self-sustaining (i.e., meet minimum viability

targets), but remain so in the presence of harvest. The level of harvest is not defined in the Agreement. Therefore, the ACC along with harvest managers should develop a harvest policy that is compatible with the goal of achieving and maintaining self-sustaining runs while providing harvest of anadromous and resident fish species in the basin.

A series of programmatic level key questions are provided below which relate directly to the outcome goal of the Agreement (i.e., success of the H&S Program).

1. **Are the hatchery programs operated consistent with HSRG guidelines to meet recovery goals?**

The H&S Plan relies on HSRG guidelines as the scientific basis for hatchery operations. These guidelines represent HSRG understanding of best management practices for hatcheries attempting to achieve conservation or harvest goals.

2. **Are the number of adult returns adequate to achieve transport targets for each transport species?**

Ultimately, success of the program relative to the outcome goals will be based on the number of NOR adult returns to the North Fork Lewis River. The number of returning adults (abundance) is affected by and dependent on how well the program is implemented and whether it is meeting viability targets for abundance, productivity, diversity and spatial distribution.

3. **Is productivity from transported adult spawners adequate to support self-sustaining populations?**

The H&S Plan relies on adult supplementation to reintroduce steelhead, Coho and spring Chinook upstream of Swift Dam. Recent EDT estimates of productivity suggest that the habitat available upstream of Swift Dam is adequate to support the outcome goal. Results from the Eagle Cliff screw trapping efforts (since 2013) indicate large numbers of Coho, spring Chinook (when available) and steelhead juveniles passing the trap which suggests transported adults are spawning successfully upstream of Swift Reservoir.

Monitoring the productivity of the naturally spawning population above Swift Dam provides managers with the ability to track recovery progress as reintroduction efforts mature. This is also an important metric for determining when populations move from the re-colonization to the local adaptation phase.

The ATS should determine whether annual productivity estimates (provided by the AMEP) are sufficient to support the outcome goals of the program. If not, the ATS should provide recommended strategies to the ACC to improve overall productivity for all three transport species.

4. **Do transported adults effectively distribute and use available spawning habitat?**

Relates to whether adults can achieve production and capacity estimated by EDT.

5. Is survival and collection efficiency of juveniles produced above Swift Dam sufficient to meet program goals?

For this program to be successful, juveniles from natural spawners must not only survive and be available for capture, but also be effectively collected, transported and released downstream of Merwin Dam at a rate that is sustainable. This metric is generally referred to as ODS, and is critical for achieving the outcome goals as it affects the number of adult returns. Without an acceptable capture efficiency or ODS, the outcome goal cannot be achieved.

6. Is harvest management a threat to supplementation and recovery programs upstream of Merwin Dam?

Because harvest removes potential spawners (including transported adults) from the population, which in turn reduces the number of eggs deposited and the potential number of emergent fry available to occupy the habitat, it is important to understand the effect harvest regimes are having on the rate of population recovery in terms of abundance, spatial and temporal distribution. If the number of available spawners is fully capable of seeding all available habitats, recovery rates will depend upon improvements in habitat or some other limiting factor. Unless sufficient spawners are available to fully seed the habitat, any harvest will potentially prolong the recovery process. Monitoring of natural origin adults should demonstrate that harvest rates on natural origin ESA-listed populations do not jeopardize achieving minimum viability goals of the reintroduction program as determined by NOAA Fisheries and status of VSP monitoring indicators.

At a minimum, harvest managers should provide the following to monitor whether management actions are adequate to control threats of overharvest and incidental impacts to NOR ESA-listed stocks (Crawford and Rumsey 2011):

- Implement marking strategies that reflect impacts to NOR listed stocks rather than hatchery surrogates (i.e., DIT programs)
- Provide data indicating that harvest restrictions regulating incidental take (exploitation rates) support meeting recovery of natural populations (e.g., meet viability escapement goals for reintroduction)
- Demonstrate that pre-harvest forecasts of run size and incidental take of listed species are accurate and track with “in-season” and post-season” analysis
- Demonstrate compliance with adopted fishery regulations designed to minimize incidental take of listed species (e.g., monitoring of illegally retained fish)
- Report the percentage of fishers reporting total catch by turning in annual commercial, tribal, and sport results (by fishery)
- Identify numeric harvest goals for the North Fork Lewis River terminal fishery (HSRG 2009).
- Provide annual estimates of actual exploitation or escapement rates

7. Is the H&S Program producing population level VSP data sufficient to meet NOAA guidelines?

The ability to determine whether the strategies included in the H&S Plan are effective relative to the outcome goal depends in part on the quality of data collected and analyzed though monitoring. Data collected as part of this plan and the AOP should, when practical, strive to meet guidance provided by NOAA Fisheries (Crawford and Rumsey 2011). Data collected and analyzed using this guidance allows NOAA Fisheries to assess 1) the viability metrics of listed North Fork Lewis River populations over time, 2) compliance with related HGMPs, and 3) determine the status of the H&S Program relative to achieving the outcome goals of the Agreement.

8. When is it appropriate and how do reintroduction programs transition from recolonization to local adaptation phases to full recovery?

The H&S Plan began supplementation for all species upstream of Swift Dam in 2012. Juvenile collection at Swift Dam began in 2013. Juvenile collection is improving at the Swift Downstream Collector, and increasing numbers of adult salmonids (both HOR and NOR) are being transported to the upper basin. The ATS has identified the need to develop an objective set of criteria for determining when transitions between recovery phases are warranted. Early within the duration of this revised H&S Plan, the ATS will develop these criteria, incorporating biological, logistical, and management considerations. Additionally, in preparation for changes in hatchery management objectives, the ATS will develop detailed plans outlining the transition from segregated to integrated hatchery programs. These criteria and hatchery transition plans will allow for adaptive management of reintroduction programs as recovery in the Upper Lewis Basin progresses.

7.0 ANNUAL OPERATING PLAN AND REPORT

The Agreement and FERC operating licenses specify that the Licensees shall produce an H&S Program AOP and AOR. The AOP represents the annual planning efforts of the ATS to adaptively and proactively implement the H&S Plan. The AOR compiles all information gathered pursuant to the implementation of the H&S Plan. Because the AOP is essentially the implementation strategy of the H&S Plan, reporting follows the format and structure of the H&S Plan, especially as it pertains to monitoring objectives.

7.1 INTEGRATION OF THE H&S AND AMEP REPORTING

The ACC has expressed concerns that very limited integration exists between the H&S and AMEP programs. Specifically, annual results of the two programs are difficult to compare and inconsistent with regional recovery planning efforts (LCFRB 2010) that do not differentiate populations upstream or downstream of the North Fork Lewis River hydroelectric projects. Rather, the LCFRB identifies a single population for each species (steelhead, Coho and spring Chinook) in the North Fork Lewis River.

To facilitate annual review of both the H&S and AMEP reporting, the ACC added a new objective in the first revision of the AMEP (PacifiCorp and Cowlitz PUD 2017) that requires development of a master table that combines the results of both programs sorted by objective. This master table will be included each year in the Aquatic Monitoring and Evaluation Report (Tables 2.0-1 and 2.0-2) and, at a minimum, include the following:

1. Each objective and number
2. Where detailed results can be found for each objective
3. The type of analysis or method used to obtain results or estimate
4. The numerical result or estimate and associated confidence (where appropriate)
5. Whether the objective was met (where appropriate)

7.2 ANNUAL OPERATING PLAN (AOP)

The Agreement calls for the development of an AOP, which will be designed to implement the H&S Plan. The AOP provides the following information as stipulated in the Agreement:

1. Production Plan: Specifies the species to be reared and broodstock source.
2. Hatchery and Juvenile Production Targets: Identifies adult and juvenile targets by species for each hatchery program.
3. Fish Release Schedule: Identifies by species the rearing schedule and planned distribution of fish and the schedules and locations of release. Hatchery release schedules are developed annually using WDFW's Future Brood Document (https://wdfw.wa.gov/fishing/management/hatcheries/future-brood). The timing or start of volitional release windows may vary depending on fish condition or disease outbreaks, but the duration of the volitional release windows is consistent and generally over a period of two to four weeks depending on species.

4. List of Hatchery Facility Upgrades: Identifies upgrades implemented at each hatchery facility during the respective year. Includes timeline of hatchery upgrades completed as part of Section 8.7 of the Agreement.
5. Broodstock Collection and Spawning: Describes specific collection and spawning protocols for juvenile supplementation programs of late winter steelhead, spring Chinook and Coho salmon. A substantial portion of the AOP describes the broodstock collection and spawning of late winter steelhead used for supplementation. The AOP is intended to adapt as necessary to protect native stocks of winter steelhead by limiting collection and ensuring that only native stocks are used within the Cascade Stratum for spawning. Spring Chinook and Coho broodstock collection and spawning protocols follow WDFW guidelines depending on whether the stocks are managed as segregated or integrated. Handling protocols for all species returning to lower river adult traps shall be updated and provided in each final AOP.
6. Monitoring and Evaluation: The AOP is designed to provide specific guidance on how each of the H&S Plan objectives and selected key questions are to be monitored. Specifics included for each objective include: a general approach, the field and analytical methods to be employed, relevant assumptions regarding the methods or estimator, specific deliverables and any limitations or concerns associated with the selected field or analytical methods.

The AOP is intended to be an implementation plan for the H&S Plan. In 2019, the ATS agreed that it was more appropriate to move much of the species background information included in previous AOP versions to the H&S Plan. This action was intended to reduce the text in the AOP to enhance focus on specific actions needed to meet the goals and objectives of the H&S Plan.

7.3 ANNUAL OPERATING REPORT (AOR)

Section 8.2.4 of the Agreement specifies that an annual report compiling all information gathered pursuant to implementation of the H&S Plan shall be provided to the ACC for review.

The H&S Annual Operating Report will contain, at a minimum, the following sections and subsections for each H&S transport species:

1. Hatchery Operations

    - Broodstock collection and timing
    - Smolt production tables to include release numbers, size and location
    - Genetic Analysis (late winter steelhead)
    - Mating Crosses (late winter steelhead)
    - Spawning and egg take (actual vs. goals)
    - Rearing mortality
    - Tagging data

2. Total numbers by species transported upstream of Swift Dam

3. Monitoring and Evaluation

    - Presentation of the results or estimates obtained for each objective and key question addressed as part of the relevant AOP.
    - Reference to the completed master table that integrates results from both the H&S and AMEP programs.
    - Results from special or temporary studies (e.g., spring Chinook rearing evaluation, water quality evaluations, PIT tagging evaluations, etc.)

4. Recommendations for ongoing H&S Plan implementation including any adaptive management priorities

5. Description of hatchery upgrades completed for the reporting year.

6. Reporting on diversity metrics (if possible) for each species handled including spawn timing, run timing, age distribution, fecundity, size and sex ratios

8.0 REFERENCES

Aquatic Coordinating Committee (ACC). 2015. Final meeting notes for August 13, 2015.

ACC. 2019. Final meeting notes for June 14, 2019.

Anderson, J. H., et al. (2020). A review of hatchery reform science in Washington State. Washington Dept. of Fish and Wildlife, Olympia, WA: 168 pp. https://wdfw.wa.gov/publications/02121

Aquatic Technical Subgroup (ATS). 2019. 2019 Annual Operating Plan, Hatchery and Supplementation Program, North Fork Lewis River. August 6, 2019.

Bentley, K., D. Rawding, S. Hawkins, J. Holowatz, S. Nelsen, J. Grobelny, and T. Buehrens. 2018. Estimates of escapement and an evaluation of abundance methods for North Fork Lewis River fall-run Chinook salmon, 2013 – 2017. Washington Department of Fish and Wildlife, Olympia, Washington. FPT 18-03

Cramer, S.P. & Associates, Inc. 2004. Lewis River fish planning document. PacifiCorp and Cowlitz PUD, Gresham, Oregon.

Crawford and Rumsey. 2011. Guidance for Monitoring Recovery of Pacific Northwest Salmon and Steelhead Listed Under the Federal Endangered Species Act. NOAA Fisheries Service, Northwest Region.

Hess, J. E., J. S. Zendt, A. R. Matala, and S. R. Narum. 2016. Genetic basis of adult migration timing in anadromous steelhead discovered through multivariate association testing. Proceedings of the Royal Society B: Biological Sciences 283:1-10. https://doi.org/10.1098/rspb.2015.3064

Hatchery Scientific Review Group (HSRG). 2014. On the science of hatcheries: an updated perspective on the role of hatcheries in salmon and steelhead management in the Pacific Northwest. Available from www.hatcheryreform.us

Hatchery Scientific Review Group (HSRG). 2009a. Columbia River Hatchery Reform System-Wide Report. February, 2009.

Hatchery Scientific Review Group (HSRG). 2009b. Columbia River hatchery reform system-wide report. Appendix A, White Paper No. 1. Predicted fitness effects of interbreeding between hatchery and natural populations of Pacific salmon and steelhead. Available from www.hatcheryreform.us

Hatchery and Supplementation Subgroup (H&S Subgroup). 2019. 2018 Annual Operating Plan – Final. Hatchery and Supplementation Program, North Fork Lewis River.

Lower Columbia Fish Recovery Board (LCFRB). 2010. Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan, 2010. Volume II, Chapter K, North Fork Lewis Subbasin.

Lower Columbia Fish Recovery Board (LCFRB). 2004. Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan, Volume 1. LCFRB, Longview, Washington.

Malone, K. 2018. Memorandum from Kevin Malone to Todd Olson (PacifiCorp) re: revised Lewis River EDT runs. November 9, 2018.

McKinney, G. J., J. E. Seeb, C. E. Pascal, D. E. Schindler, S. E. Gilk-Baumer, and L. W. Seeb. 2020. Y-chromosome haplotypes are associated with variation in size and age at maturity in male Chinook salmon. Evolutionary Applications 00:1-16. https://doi.org/10.1111/eva.13084

National Marine Fisheries Service (NMFS). 2017. Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Consultation. NOAA's National Marine Fisheries Service's implementation of the Mitchell Act Final Environmental Impact Statement preferred alternative and administration of Mitchell Act hatchery funding. NMFS Consultation Number: NWR-2014-697 Action Agency: NOAA's National Marine Fisheries Service (NMFS). January 15, 2017.

Northwest Power and Conservation Council (NPCC). 2005. Artificial Production Review and Evaluation Report to Congress. Council Document 2005-11. June 16, 2005.

PacifiCorp and Cowlitz PUD. 2004. Lewis River Hydroelectric Projects: Final Technical Studies Status Reports. PacifiCorp, Portland, OR and Cowlitz PUD, Longview, WA. April 2004.

PacifiCorp and Cowlitz PUD. 2014. Lewis River Hatchery and Supplementation Plan (FERC Project Nos. 935, 2071, 2111, 2213). December 26, 2014. Version 2.0.

PacifiCorp and Cowlitz PUD. 2017. Aquatic Monitoring and Evaluation Plan (AMEP) for the Lewis River – First Revision. April 3, 2017.PacifiCorp and Cowlitz PUD. 2004a. Settlement Agreement for the Lewis River Hydroelectric Projects. November 30, 2004.

PacifiCorp and Cowlitz PUD. 2019. Annual Summary of License Implementation and Compliance, Aquatic and Terrestrial Resources - 2018 Annual Report. Lewis River Hydroelectric Projects, FERC Project Nos. 935, 2071, 2111, 2213. April 12, 2019.

PacifiCorp and Cowlitz PUD. 2020. ACC and TCC Ground Rules Document. https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/hydro/lewis-river/license-implementation/meetings/06102020%20FINAL%20ACC_TCC_GroundRules.pdf

Prince, D. J., S. M. O'Rourke, T. Q. Thompson, O. A. Ali, H. S. Lyman, I. K. Saglam, T. J. Hotaling, A. P. Spidle, and M. R. Miller. 2017. The evolutionary basis of premature migration in Pacific salmon highlights the utility of genomics for informing conservation. Science Advances 3: e1603198.

Regional Assessment of Supplementation Project (RASP). 1992. Regional assessment of supplementation project. Mobrand Biometrics, Inc., Vashon, Washington.

Stevens, D. L., and A. R. Olsen. 2004. Spatially balanced sampling of natural resources. Journal of the American Statistical Association 99:262–278.

Warheit, K. 2014. Measuring reproductive interaction between hatchery-origin and wild steelhead (Oncorhynchus mykiss) from northern Puget Sound populations potentially affected by segregated steelhead programs. Washington Department of Fish and Wildlife. Unpublished report, Olympia, WA.

Washington Department of Fish and Wildlife (WDFW). 2006. Salmonid Disease Policy of Co-managers.

Appendix A

Section 8 of the Lewis River Settlement Agreement

SECTION 8: HATCHERY AND SUPPLEMENTATION PROGRAM

8.1 Hatchery and Supplementation Program. The Licensees shall undertake a hatchery and supplementation program. The goals of the program are to support (i) self-sustaining, naturally-producing, harvestable native anadromous salmonid species throughout their historical range in the North Fork Lewis River Basin, and (ii) the continued harvest of resident and native anadromous fish species (the "Hatchery and Supplementation Program"). The Hatchery and Supplementation Program shall be consistent with the priority objective of recovery of wild stocks in the basin to healthy and harvestable levels. The intention of the foregoing sentence is not necessarily to eliminate the hatchery program but it recognizes the importance of recovering wild stocks and a potential that hatchery production may adversely affect recovery. The Hatchery and Supplementation Program shall be consistent with the ESA, applicable state and federal fisheries policies, and regional recovery plans, and should be consistent with recommendations of the Hatchery Science Review Group and the Northwest Power Planning Council's Hatchery Review (Artificial Production Review & Evaluation) to the extent practicable. The supplementation portion of the program shall be a part of the reintroduction program (in addition to fish passage) and shall be limited to spring Chinook, steelhead and coho as provided in this Section 8.

To ensure that the Hatchery and Supplementation Program is meeting its goals, the Licensees, in Consultation with the ACC and with the approval of the Services, shall develop and implement a hatchery and supplementation plan to adaptively manage the program and guide its management as set out in Section 8.2 below ("Hatchery and Supplementation Plan" or "H&S Plan"). The Licensees shall incorporate best methodologies and practices into the Hatchery and Supplementation Plan. The Hatchery and Supplementation Plan shall be designed to achieve the numeric Hatchery Targets provided for in Section 8.3 below, and those targets shall be calculated in terms of ocean recruits of hatchery origin, taking into account harvest and escapement. For purposes of this Agreement, "Ocean Recruits" shall mean total escapement (fish that naturally spawned above Merwin and hatchery fish) plus harvest (including ocean, Columbia River, and Lewis River harvest). Subject to the ESA, applicable federal and state fisheries policies, regional recovery plans, other applicable laws and policies, and the terms of this Agreement, the Licensees shall provide for the implementation of the Hatchery and Supplementation Program for the terms of the New Licenses.

As of the Effective Date, WDFW owns the existing Lewis River Hatchery facility. Use and operation of the Lewis River Hatchery is subject to agreements between PacifiCorp and WDFW. The Licensees shall ensure the existing Lewis River, Merwin, and Speelyai hatchery facilities (the "Hatchery Facilities") are modified pursuant to Section 8.7 below to meet their obligations under this Section 8. The Licensees shall ensure the Hatchery Facilities, including the relevant or necessary support facilities (e.g., employee housing, shops, hatcheries, and related infrastructure), as modified, are maintained as necessary to consistently deliver a high-quality hatchery product that will meet their obligations. The Licensees' hatchery production obligations as set forth in Section 8.4 below, including both anadromous and resident fish shall be limited by the combined production capacity of the Hatchery Facilities ("Hatcheries Capacity Limit") as established after implementation of upgrades as set forth in Section 8.7. The Licensees may, after Consultation with the ACC, use different hatcheries than those described above; provided that such different hatcheries (a) have equal or greater capacity than the Hatchery Facilities if that capacity is still required to meet the Licensees' obligations under this Section 8, (b) are of quality equal to or greater than that of the Hatchery Facilities, and (c) comply with transfer and disease protocols and other requirements of the H&S Plan.

8.2 Hatchery and Supplementation Plan. The Licensees, in Consultation with the ACC and subject to the approval of the Services, shall develop a Hatchery and Supplementation Plan to address hatchery operations, supplementation, and facilities as provided in Section 8.2.1 below. Until implementation of the Hatchery and Supplementation Plan, PacifiCorp shall continue to implement the hatchery program set forth in Articles 50 and 51 of the 1983 Merwin license, as amended.

The Hatchery and Supplementation Plan will address both anadromous and resident fish. The Licensees shall incorporate best methodologies and practices into all components of the H&S Plan, including, but not limited to, the Hatchery Facilities and supplementation facilities. When developing the H&S Plan, the Licensees and the ACC shall be guided, at a minimum, by the Fish Planning and Hatchery Review

Documents (submitted as AQU-18 with the Licensees' applications for the Merwin, Swift No. 1, and Swift No. 2 Projects in April 2004), and shall take into consideration the results of ongoing relevant hatchery reviews and the experience of other supplementation programs in the region, such as the Yakama Nation's Cle Elum facility. The Licensees shall transition from the hatchery program set forth in Articles 50 and 51 of the 1983 Merwin license, as amended, to implementing the Hatchery and Supplementation Plan as soon as practicable after Issuance of the New License(s) for the Merwin Project or the Swift Projects, whichever occurs earlier, provided that supplementation will commence as provided in Section 8.5. When finalized, the Licensees shall submit the Hatchery and Supplementation Plan to WDFW and NOAA Fisheries for consideration in their development of applicable hatchery genetic management plans ("HGMPs").

8.2.1 Development of Plan/Timing. The Licensees, in Consultation with the ACC, shall produce and distribute a draft Hatchery and Supplementation Plan to the ACC by the first anniversary of the Effective Date. The Yakama Nation may chair a subgroup of interested members of the ACC for purposes of coordinating the ACC's input regarding the supplementation elements of the draft H&S Plan. The members of the ACC shall have 60 days to comment on the draft H&S Plan. The Licensees shall provide a 60-day period for the public to provide written comments. The Licensees shall consider and address in writing the written comments provided by the members of the ACC, including the rationale behind the Licensees' decision to not address a comment in the final H&S Plan. The Licensees shall consider comments and submit a revised H&S Plan to the Services for approval within 120 days of the first anniversary of the Effective Date.

8.2.2 Hatchery and Supplementation Plan Contents. The H&S Plan shall address the means by which the Licensees shall use the Hatchery Facilities to accomplish the goals and requirements of the Hatchery and Supplementation Program, including, without limitation, the Hatchery Targets. It shall also be consistent with the objective of restoring and recovering wild stocks in the basin to healthy and harvestable levels. The H&S Plan shall address, at a minimum, the following topics:

8.2.2.1 A description of the Hatchery Facilities, including the upgrades identified in Schedule 8.7;

8.2.2.2 Identification of species and broodstock sources to be used for the Hatchery and Supplementation Program;

8.2.2.3 The quantity and size of fish to be produced;

8.2.2.4 The allocation of smolts and adults between the hatchery and supplementation programs and a description of how the two programs are to be implemented at the same facility without causing unacceptable adverse impacts on each other;

8.2.2.5 Rearing and release strategies for each stock including, but not limited to, timing, planned distribution, locations for release, procedures to transport smolts to acclimation sites for supplementation purposes, and upward and downward production adjustments to accommodate natural returns;

8.2.2.6 The Ocean Recruits Methodology referenced in Section 8.3.2.2 below;

8.2.2.7 Plans and protocol for supplementation stocks;

8.2.2.8 Broodstock collection and breeding protocols;

8.2.2.9 Policies in effect regarding in-basin and out-of-basin stock transfers;

8.2.2.10 Measures to minimize potential negative impacts of the Hatchery and Supplementation Program on ESA-listed species;

8.2.2.11 Measures to protect production processes from predators, e.g., netting, consideration of evolving hatchery practices to condition fish to avoid predators;

8.2.2.12 A description of how the Hatchery and Supplementation Program monitoring and evaluation requirements will be implemented, including, but not limited to, marking strategies;

8.2.2.13 A description of the methods to prevent unacceptable adverse impacts, if any, of (1) the hatchery program on the reintroduction program, and (2) the supplementation program on native resident species; and

8.2.2.14 Fish health protocols.

8.2.3 Annual Operating Plan. The Licensees shall provide for the implementation of the Hatchery and Supplementation Plan through an annual plan ("Annual Operating Plan"). The Annual Operating Plan shall be consistent with the Hatchery and Supplementation Plan. The Licensees, in Consultation with the hatchery managers and with the approval of the Services, shall develop the initial Annual Operating Plan as part of the Hatchery and Supplementation Plan. The Licensees shall develop subsequent Annual Operating Plans in Consultation with the hatchery managers and subject to the approval of the Services. The Annual Operating Plan may
be included as part of the detailed annual reports of the ACC activities required by Section 14.2.6.

The Annual Operating Plan shall, at a minimum, contain: (1) a production plan, which shall specify the species and broodstock sources; (2) the current Hatchery Target and Juvenile Production Target for each species to be produced at the Hatchery Facilities; (3) a release plan which shall identify by species the rearing schedule and planned distribution of fish and the schedules and locations for releases; (4) a list of facility upgrades to be undertaken that year; and (5) a description of relevant monitoring and evaluation to be undertaken that year.

8.2.4 Reporting Requirements. On an annual basis, the Licensees shall provide to the ACC for review and comment a report compiling all information gathered pursuant to implementation of the Hatchery and Supplementation Plan. The report also will include recommendations for ongoing management of the Hatchery and Supplementation Program. The ACC shall have 60 days to comment on the annual report. Within 60 days of the close of the comment period, the Licensees shall finalize the report after consideration of all comments. The Licensees shall also provide the comprehensive periodic review undertaken pursuant to Section 8.2.6 below to the ACC. The Licensees shall provide final annual reports and the comprehensive periodic review to the Services during the development of any required ESA permit or authorization for hatchery operations, including NOAA Fisheries' HGMP process. The report may be included as part of the detailed annual reports of the ACC activities required by Section 14.2.6.

8.2.5 Plan Modifications. The Licensees shall update the Hatchery and Supplementation Plan every five years or earlier if required by the HGMP, in Consultation with the ACC and with the approval of the Services, using the process set out in Section 8.2 above in order to adaptively manage the Hatchery and Supplementation Program. The Licensees shall consider recommendations from members of the ACC and the comprehensive review set forth below, and identify those recommendations that have not been incorporated into the H&S Plan with a brief statement as to why the changes were not made.

8.2.6 Comprehensive Periodic Review. The Licensees shall undertake a comprehensive periodic review within 5 years after reintroduction above Swift No. 1 Dam, within 5 years after reintroduction into Yale Lake, and within 5 years after reintroduction into Lake Merwin, and then every 10 years after that. This schedule is to be followed even in the event that reintroduction into either Yale Lake or Lake Merwin does not occur. The Licensees, in Consultation with the ACC, shall hire an independent consultant to review the Hatchery and Supplementation Program to assess (i) the Program's impact on the reintroduction program and on listed species, (ii) the Program's effectiveness in achieving the goals set out in Section 8.1 above, and (iii) efficiency of hatchery operations. Factors to be considered in the review include current federal and state policies and plans, relevant best practices, and existing information regarding recent scientific advances. The reviewer will provide recommendations regarding ongoing management of the Hatchery and Supplementation Program and, if needed, recommend amendments to the Hatchery and Supplementation Plan. The Licensees shall incorporate recommendations for ongoing management of the Hatchery and Supplementation Program set forth in the review into the Hatchery and

Supplementation Plan pursuant to Section 8.2.5 or explain why the recommendation is not being adopted.

8.3 Anadromous Fish Hatchery Adult Ocean Recruit Target by Species. The Licensees shall develop and implement the Hatchery and Supplementation Plan to achieve hatchery adult Chinook, steelhead, and coho ocean recruit targets ("Hatchery Targets") as described below.

8.3.1 Hatchery Targets. The following Hatchery Targets shall be in effect at the commencement of the Hatchery and Supplementation Program:

Table 8.3.1 – Hatchery Targets

	Spring Chinook	Steelhead	Coho	Total
Hatchery Targets (adult Hatchery Ocean Recruits)	12,800	13,200	60,000	86,000

8.3.2 Modifications to Hatchery Targets.

8.3.2.1 Hatchery Targets. The Licensees shall not increase any of the Hatchery Targets above the Hatchery Targets in Table 8.3.1 above during the terms of the New Licenses without the unanimous approval of the ACC.

8.3.2.2 Methods to Document Ocean Recruits. The Licensees, in Consultation with the ACC, shall determine the methods to document the number of Ocean Recruits and to separately identify Hatchery Ocean Recruits and Ocean Recruits from natural spawning in the Hatchery and Supplementation Plan ("Ocean Recruits Methodology"). The Ocean Recruits Methodology shall identify the appropriate assessment time frame over which to measure Hatchery Ocean Recruits and Natural Ocean Recruits.

8.3.2.3 Reductions in Hatchery Targets. When the Licensees determine, in Consultation with the ACC, through application of the Ocean Recruits Methodology that the number of Ocean Recruits from natural spawning grounds of any species exceeds the relevant natural production threshold(s) for that species identified in Table 8.3.2 ("Natural Production Threshold"), the Licensees shall decrease the appropriate Hatchery Target(s) identified in Table 8.3.1 on a fish-for-fish (1:1) basis. The Licensees shall not apply the amount of excess numbers of one species against another species' Hatchery Target. The Licensees shall not decrease the Hatchery Targets below the hatchery target floor ("Hatchery Target Floor") specified in Table 8.3.2.

8.3.2.4 Unacceptable Adverse Impacts on Reintroduction Program or Fisheries Management Objectives. If the Services determine that there are unacceptable impacts from hatchery production on the reintroduction program or fishery management objectives including, but not limited to, the recovery of wild stocks in the basin, then the Licensees, in Consultation with the ACC, shall identify and consider options to mitigate or avoid such unacceptable impacts. In Consultation with the ACC and at the direction of the Services, the Licensees shall implement options necessary to address such unacceptable adverse impacts, including, without limitation, modifying hatchery practices, reducing Hatchery Targets, or implementing other options that are identified pursuant to this Section 8.3.2.4.

8.3.2.5 Increases in Previously Reduced Hatchery Targets. If the Licensees reduce Hatchery Targets based on the number of Natural Ocean Recruits as determined by the Ocean Recruits Methodology, but the number of Ocean Recruits subsequently declines under such methodology, the Licensees, in Consultation with the ACC and at the direction of the Services, shall increase the Hatchery Targets on a fish-for-fish (1:1) basis, provided that the increased Hatchery Targets shall not exceed the initial Hatchery Targets in Table 8.3.1, and available data demonstrates that the hatchery fish are not the cause of decline or a significant

limiting factor to self-sustaining, naturally producing, harvestable native anadromous salmonid species.

Table 8.3.2 – Numbers Governing Modifications to Hatchery Targets

	Spring Chinook	Steelhead	Coho	Total
Natural Production Threshold for Hatchery Reduction	2,977	3,070	13,953	20,000
Hatchery Target Floor	2,679	2,763	12,558	18,000

8.4 Anadromous Fish Hatchery Juvenile Production. Each year, the Licensees shall provide for the production of spring Chinook salmon smolts, steelhead smolts, and coho salmon smolts at levels specified below ("Juvenile Production"). The Licensees shall use the Juvenile Production to provide (1) juveniles for the supplementation program under Section 8.5, and (2) juveniles for harvest opportunities. To the extent that there are not sufficient juveniles for the Hatchery and Supplementation Program and to ensure that enough adults will return to ensure adequate broodstock for the Hatchery and Supplementation Program in future years, the Licensees shall, in Consultation with the ACC and subject to the approval of the Services, determine how best to allocate juveniles.

8.4.1 Juvenile Production Targets. The Licensees shall provide for the implementation of the following Juvenile Production targets ("Juvenile Production Targets") when the Hatchery and Supplementation Program commences. The following Juvenile Production Targets shall be used unless and until modified by the Licensees pursuant to Section 8.4.2 as part of the Hatchery and Supplementation Plan in accordance with Section 8.2.5:

Table 8.4 – Juvenile Production Targets

Smolt Production	Spring Chinook	Steelhead	Coho
H&S Plan Years 1 – 3	1.35 million	275,000	1.8 million
H&S Plan Years 4 – 5	1.35 million	275,000	1.9 million
H&S Plan Years 6 – 50	1.35 million	275,000	2.0 million

8.4.2 Adjustment of Juvenile Production. The Licensees, in Consultation with the ACC, shall adjust the Juvenile Production as needed to achieve the Hatchery Targets subject to the Hatcheries Capacity Limit, e.g., at some point in the future a smaller number of juveniles may be needed to get the same number of returning adults. When determining whether adjustments should be made, the Licensees, in Consultation with the ACC, shall consider the hatchery practices component of the Hatchery and Supplementation Plan (e.g., density, best management practices), data from the Monitoring and Evaluation Plan identified in Section 9 (including, but not limited to, fish quality and adult return requirements), the periodic comprehensive review described in Section 8.2.6 above, and the terms of Section 8.1.

8.4.3 Stock Selection. The Licensees shall select stocks for the production of juveniles that are the most appropriate for the basin. The stock selected and the rationale shall be set forth in the Hatchery and Supplementation Plan. The following stocks shall be used unless and until modified by the Licensees as part of the Hatchery and Supplementation Plan in accordance with Section 8.2.5:

Table 8.4.3 – Broodstock

	Spring Chinook	Steelhead	Coho
Juveniles for Supplementation (release above Merwin)	Lewis River hatchery stock with Cowlitz River hatchery stock as contingency	Lewis River wild winter stock with Kalama hatchery stock as contingency	Lewis River hatchery early (type S) stock
Juveniles for Harvest (release below Merwin)	Same as for supplementation	Same as for supplementation **and** existing Lewis River hatchery summer and winter stock	Same as for supplementation **and** Lewis River hatchery late (type N) stock

8.5 Supplementation Program.

8.5.1 Juvenile Salmonids Above Swift No. 1 Dam. The Licensees shall, for the purpose of supplementation, provide for the transport of juvenile anadromous salmonids to acclimation sites selected pursuant to Section 8.8.1, for the following periods of time:

(1) Spring Chinook and Steelhead. The Licensees shall provide the means to supplement juvenile spring Chinook and steelhead for a period of 15 years commencing upon completion of the Swift Downstream Facility pursuant to Section 4.4.1; and

(2) Coho. The Licensees shall provide the means to supplement juvenile coho salmon for a period of 9 years commencing upon completion of the Swift Downstream Facility.

At the end of these time periods, the Licensees shall assess on a year-by-year basis whether to extend the supplementation of juvenile salmonids. Upon ACC agreement and subject to the Services' approval, the Licensees shall continue to supplement juvenile salmonids. In evaluating whether to extend the supplementation of juveniles, the ACC shall consider, among other things, the impact of continuing supplementation on the overall reintroduction program and on ESA-listed species.

8.5.2 Juvenile Salmonids to Yale Lake and Lake Merwin. PacifiCorp shall, for the purposes of supplementation, provide for the transport of juvenile anadromous salmonids to appropriate release sites in Yale Lake and Lake Merwin, as described in Section 8.8.2 below, for the following periods of time:

(1) Spring Chinook and Steelhead. PacifiCorp shall provide the means to supplement juvenile spring Chinook and steelhead for a period of 15 years to Yale Lake commencing upon completion of the Yale Downstream Facility as provided in Section 4.5; and for a period of 15 years to Lake Merwin commencing upon completion of the Merwin Downstream Facility as provided in Section 4.6; and

(2) Coho. PacifiCorp shall provide the means to supplement juvenile coho salmon into Yale Lake for a period of 9 years commencing upon completion of the Yale Downstream Facility and into Lake Merwin for a period of 6 years commencing upon completion of the Merwin Downstream Facility.

At the end of these time periods, PacifiCorp shall assess on a year-by-year basis whether to extend the supplementation of juvenile salmonids. Upon ACC agreement and subject to the Services' approval, the Licensees shall continue to supplement juvenile salmonids. In evaluating whether to extend the supplementation of juveniles, the ACC shall consider, among other things, the impact of continuing supplementation on the overall reintroduction program and on ESA-listed species.

8.5.3 Adult Salmonids. The Licensees shall begin providing for the supplementation of adult fish one year prior to completion of the Swift Downstream Facility. Throughout the terms of the New Licenses, the Licensees shall provide for the transport and release of supplementation stocks of adult spring

Chinook, coho, and steelhead above Swift No. 1 as directed by the ACC. Throughout the terms of the New Licenses, PacifiCorp shall provide for the transport and release of supplementation stocks of adult spring Chinook, coho, and steelhead into Yale Lake and Lake Merwin as directed by the ACC. The ACC shall determine the timing for initiating supplementation into Yale Lake and Lake Merwin. The ACC, subject to the approval of the Services, may recommend discontinuing or recommencing the supplementation of such supplementation stocks, provided that any such recommendations are biologically based and not contrary to the goals of the ESA.

8.5.4 Supplemental Juveniles. The Licensees shall not mark supplementation juveniles in the same manner as hatchery fish are marked for harvest.

8.6 Resident Fish Production.

8.6.1 Rainbow Trout Production. Each year, for the terms of the New Licenses, subject to Section 8.6.3, the Licensees shall provide for the production of 20,000 pounds of resident rainbow trout. When the New License is Issued for either the Merwin Project or the Swift Projects, whichever is earlier, the Licensees shall fulfill their obligation by providing for the production of 800,000 juveniles with an estimated weight of 40 juvenile fish per pound, or an equivalent number, in pounds, of resident rainbow trout of a different life stage as directed by WDFW, following Consultation with the ACC. The Licensees shall provide for the stocking of such rainbow trout in Swift Reservoir. Resident rainbow trout will be managed separately from steelhead and shall not significantly interfere with the recovery of self-sustaining, naturally producing, harvestable populations of native steelhead.

8.6.2 Resident Kokanee Production. Each year, for the terms of the New Licenses, subject to Section 8.6.3, PacifiCorp shall provide for the production of 12,500 pounds of resident kokanee. When the New License is Issued for either the Merwin Project or the Swift Projects, whichever is earlier, PacifiCorp shall fulfill its obligation by providing for the production of 93,000 juveniles of various sizes which have an estimated weight of 12,500 pounds or an equivalent number, in pounds, of resident kokanee of a different life stage as directed by WDFW, following Consultation with the ACC. Unless otherwise determined by the ACC through the Hatchery and Supplementation Plan, PacifiCorp shall provide for the annual stocking of such resident kokanee in Lake Merwin.

8.6.3 Modifications in Resident Rainbow Trout and Kokanee Production. The Licensees shall modify resident rainbow trout and kokanee production numbers as part of the Hatchery and Supplementation Plan, in Consultation with the ACC and subject to the approval of the Services and WDFW, to address other management goals, including, without limitation, harvest considerations and impacts of the resident fish hatchery program on the reintroduction program; provided that the Licensees shall not increase (i) resident rainbow trout production above a cap of 20,000 pounds and, (ii) resident kokanee production above a cap of 12,500 pounds.

8.7 Hatchery and Supplementation Facilities, Upgrades, and Maintenance. The Licensees shall, in collaboration with the hatchery managers and hatchery engineers and in Consultation with the ACC, undertake or fund facility additions, upgrades, and maintenance actions as provided in Schedule 8.7, consistent with best methodologies and practices. The Licensees, in collaboration with the hatchery managers and hatchery engineers, and in Consultation with the ACC, shall design these facilities, upgrades, and maintenance actions to include elements that ensure usefulness of the facilities for supplementation and production fish culturing practices and to accommodate the facility additions, upgrades, and maintenance actions identified in Schedule 8.7. The Licensees shall complete the upgrades or actions by the deadlines identified in Schedule 8.7, provided that the Licensees shall schedule the updates or actions consistent with (i) the required hatchery production or (ii) the reintroduction program. The Licensees shall not be required to construct new hatchery facilities or to expand the existing Hatchery Facilities except as provided pursuant to this Section 8.7. WDFW retains the right and authority to operate its hatchery and conduct other or additional fish production activities that do not impact the goals set forth in Section 8.1 at the state-owned Lewis River Hatchery at no additional cost to the Licensees.

8.8 Juvenile Acclimation Sites.

8.8.1 Above Swift No. 1 Dam. Beginning upon completion of the Swift Downstream Facility, the Licensees shall place juvenile salmonid acclimation sites in areas reasonably accessible to fish hauling trucks and in practical areas in the upper watershed above Swift No. 1 Dam, as determined by the Licensees in Consultation with the Yakama Nation and the ACC. The acclimation sites shall consist of fish containment areas that allow juvenile fish to acclimate in natural or semi-natural waterways and allow necessary pre-release juvenile fish management; such sites will not consist of or include concrete-lined ponds or waterways, but may include other concrete structures necessary for facility functionality and structural integrity during the supplementation program.

8.8.2 In Yale Lake and Lake Merwin. Beginning upon completion of the Yale Downstream Facility and the Merwin Downstream Facility, respectively, PacifiCorp shall provide in-stream enclosures to confine juvenile salmonids in tributaries to Yale Lake and Lake Merwin after they are transported from rearing facilities for the purpose of allowing juveniles to adjust to the natural environment for a short period of time, to be determined by the Licensees, in Consultation with the ACC and with the approval of the Services, prior to being exposed to natural mortality factors such as predators. These enclosures are intended to provide an opportunity for the juveniles to acclimate to the natural environment prior to being exposed to predators. While it is assumed that there will be sufficient food in the natural stream, if evidence suggests, prior to placing juveniles in the enclosures, that this is not the case, the Licensees will Consult with the ACC to determine if feeding of juveniles in the enclosures should occur. Prior to completion of the Yale Downstream Facility and the Merwin Downstream Facility, respectively, the Licensees shall, in Consultation with the ACC, evaluate whether Hatchery and Supplementation Program goals will be cost-effectively served by establishing and operating acclimation sites for any of the targeted stocks in Yale Lake, Lake Merwin, or their tributaries. In the event that funding becomes available for acclimation facility establishment and operation in Yale Lake, Lake Merwin or their tributaries from Parties other than the Licensees or from third parties, the Licensees shall amend the H&S Plan, subject to the approval of the Services, to provide for placing of juvenile anadromous salmonids in such acclimation facilities for so long as the funding continues to be available and placement does not negatively impact the supplementation program or otherwise alter the obligations of the Licensees.

Appendix B

Monitoring and Evaluation Objectives Summary Table

CATEGORY	No.	OBJECTIVES	KEY QUESTIONS
Administrative	**1.0**	NOAA acceptance of a Hatchery and Genetic Management Plan (HGMP) for each hatchery program on the North Fork Lewis River	NA
	1.1	Receive Biological Opinion for all submitted HGMPs	NA
	2.0	Finalize a Hatchery and Supplementation Plan every 5 years	NA
	2.1	Finalize an annual operating plan (AOP)	NA
	2.2	Finalize and Annual Operations Report (AOR)	NA
	2.3	Finalize an annual hatchery operations report	NA
Hatchery Monitoring	**3.0**	Determine whether hatchery production protocols incorporate best available management practices to support program targets and goals.	A. Do hatchery broodstock collection protocols support program goals?
			B. Do spawning, rearing and release strategies support program goals?
			C. Are adult collection, handling and disposition (as defined in the AOP) protocols consistent with HSRG recommendations?
			D. What are the estimated smolt-to-adult returns (SAR's) for each hatchery stock or rearing treatment group?
			E. Is the fish health monitoring and disease prevention strategy effective at reducing infections and limiting mortalities?
			F. Do hatcheries incorporate new scientific advances to improve fish culture effectiveness and efficiency?
	4.0	Adopt strategies that limit potential post-release ecological interactions between hatchery and NOR listed species	A. Do current hatchery releases result in spatial and temporal overlap between HOR and NOR juveniles?
			B. Does the migration rate of HOR juveniles result in overlap with NOR juveniles or spawning adults?
			C. Are the number of hatchery released juveniles equal to or less than production targets?
			D. Are the sizes (length and weight) of released hatchery juveniles equal to or less than program targets?
			E. What is the precocity rate for hatchery juveniles by release group prior to scheduled releases?

Abundance Monitoring	**5.0**	Estimate spawner abundance of late winter steelhead, Coho, chum and Chinook downstream of Merwin Dam	A. Are estimates of spawner abundance unbiased and meeting precision targets?
			B. Are annual estimates of natural origin spawner abundance increasing, decreasing or stable?
	5.1	Determine the spatial and temporal distribution of spawning late winter steelhead, coho, chum and Chinook downstream of Merwin Dam	C. Are annual trends in temporal and spatial spawning distribution increasing, decreasing or stable?
	6.0	Estimate juvenile outmigrant abundance for late winter steelhead, coho, and Chinook downstream of Merwin Dam	A. Are estimates of NOR juvenile outmigrant abundance unbiased and meeting precision targets?
			B. Is the abundance of NOR juvenile outmigrants by species and outmigration year increasing, decreasing, or stable?
			C. What are the morphological characteristics of outmigrating NOR juveniles relative to their conspecific HOR juveniles?
Risk Assessment	**7.0**	Monitor the extent of genetic risks associated with integrated and segregated hatchery programs on naturally spawning listed populations in the North Fork Lewis River	A. Have the Lewis River hatchery programs impacted the among-population diversity of naturally spawning populations?
			B. Have the Lewis River hatchery programs impacted the within-population diversity of naturally spawning populations?
			C. Have the Lewis River hatchery programs increased the risk of domestication for naturally spawning populations?
			D. Have the Lewis River hatchery programs impacted the phenotypic diversity of naturally spawning populations?
	8.0	Determine the percent hatchery-origin spawners (pHOS), proportionate natural influence (PNI) and pNOB (for integrated programs)?	A. What are the trends in pHOS, PNI, pNOB and PEHC and do they meet HSRG recommendations by program (when applicable)?
	9.0	Monitor the post-release behavior of hatchery smolts and their potential impacts on native and ESA-listed species present downstream of Merwin Dam.	Contingent on meeting monitoring goals related to Objective 4, or as determined by the ATS

Appendix C

Recommendations matrix from the Comprehensive Periodic Review including review of the program key questions– June 2020

Comment Number	Location in June 2020 Review Draft	Comment	Action Taken
1	General Recommendation	The Lewis River Hatchery and Supplementation Plan (H&S Plan) can be changed upon the completion of **amendments** to the plan. Possible sources for amendments include: 1) An approved HGMP, 2) Plan updates occurring as a result of Alternative Dispute Resolution decisions, 3) ACC agreement of the population level monitoring parameters if substantive and impactful, and 4) Settlement Agreement amendments. If the H&S Plan is changed due to plan amendments, we recommend the amended plan be resubmitted to an outside reviewer for a Comprehensive Periodic Review prior to implementation.	This decision will be made by the ATS or ACC with adequate justification that supports the need for additional review or amendment.
2	General Recommendation	We recommend that the distinct goal of recovery and restoration for NOR fish, and the dual goals of harvest for HOR fish and restoration for integrated HOR fish be clarified.	None
3	General Recommendation	The ACC should develop a comprehensive fish handling protocol for **all** salmonids returning to the Merwin Collection Facility (MCF) and the Lewis River Hatchery. Appendix A of the 2019 AOP has a protocol established for steelhead. A similar protocol should be developed and agreed to for all adult salmonids handled at the collection facilities.	A requirement to include fish handling and disposition (e.g., transport, broodstock, etc.) protocols for all transport species was added to Section 7.2 (AOP)
4	General Recommendation	The Lewis River Settlement Agreement is referred to as the Agreement in most of the document. In places, the document refers to the 'SA' or the Settlement Agreement. We edited these references so that 'Agreement' is used consistently throughout the document.	Edits completed by reviewer
5	General Recommendation	We edited references to related documents (AOR, AOP, and AMEP) for consistency throughout the document.	Edits completed by reviewer

Comment Number	Location in June 2020 Review Draft	Comment	Action Taken
6	General Recommendation	We suggested several edits to the Definitions of Terms and Acronyms. We added definitions of Annual Operating Report, Artificial Production Review and Evaluation, Coded-wire Tag, Distinct Population Segment, Double Index Tag, Endangered Species Act, Evolutionarily Significant Unit, Floating Surface Collector, GRTS, juvenile, Licensees, Major Population Group, Monitoring and Evaluation, Overall Downstream Survival, Single Nucleotide Polymorphism, Utilities, viable salmonid population, and Washington Department of Fish and Wildlife. We revised the definition of natural-origin to clarify that these are progeny of fish that spawn naturally, including progeny of HORs.	Definitions updated including definitions by the ATS (included links where appropriate)
7	General Recommendation	To assist the ACC parties with the population monitoring level parameters needed to define a self-sustaining population for the H&S Plan we recommend using the NMFS definition of a viable population.[14] Monitoring and evaluation activities should provide data on trends in abundance, productivity, diversity and structure.	VSP and self-sustaining definitions updated to incorporate NMFS guidance
8	General Recommendation	This program has a different definition of supplementation than other reports. Usually supplementation doesn't refer to adult outplants. Perhaps a better title for the H&S Plan is 'Hatchery and Reintroduction Plan'.	Added additional text in the Executive Summary explaining that 'reintroduction' may be used where appropriate when referring to adults
9	Executive Summary, p. ES-1	We added background material from the 2014 H&S Plan to the Executive Summary.	Edits completed by reviewer

[14] A viable ESU or population has been defined by NMFS as having a negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100-year time frame.

Comment Number	Location in June 2020 Review Draft	Comment	Action Taken
10	Executive Summary, H&S Plan Contents	The text states, 'When selecting between actions, deference will be given to those that provide the greatest benefit to the protection and recovery of natural origin fish populations.' This point is not strongly emphasized elsewhere and we recommend using the language from the Agreement (ES 3.5.2) '…the priority objective of recovery of wild stocks in the basin to healthy and harvestable levels.'	Edits completed by reviewer
11	Executive Summary, Table E-1	We updated items listed in the 'location' column of Table E-1, Summary of H&S Topics Required by Section 8.2.2 of the Agreement. We also added WDFW 2006, Salmonid Disease Policy of Co-managers, to the Item 9 location column.	Edits completed by reviewer
12	Executive Summary, Deviations from Settlement Agreement	We made edits and clarifications to the list of Deviations for the Settlement Agreement.	Edits completed by reviewer
13	Section 1.0	We added background material from the 2014 H&S Plan to the beginning of Section 1.	Edits completed by reviewer
14	Section 1.0, Figure 1-1	The H&S Plan, the annual plan (AOP), the annual report (AOR), and the monitoring and evaluation plan (AMEP) are inter-connected and have relevance and interdependence upon each other for the Lewis River Program. An orderly flow diagram is needed to clearly define the relationships of the plans, reports and other documents with completion dates and scheduled updates in order to fully understand the relevance and connectedness of each plan or report. We revised Figure 1-1 showing the relationship between the Agreement and required plans and regulatory documents.	Edits completed by reviewer

Comment Number	Location in June 2020 Review Draft	Comment	Action Taken
15	Section 1.0, various subsections	We added a description of the relationship between the H&S Plan and related regulatory and planning documents (AMEP, AOP, HGMPs and BiOp). While this duplicates some material in Section 7 of the H&S Plan, we found this information necessary to understand the references to these other documents throughout the H&S Plan.	Edits completed by reviewer
16	Section 1.1	We made edits and clarifications to Section 1.1., Adaptive Management. We added a description of the role of the ACC and ATS in this process. We recommend that this section be developed further – for example, decision rules stated in different sections of the plan could be listed/summarized here. We added a table (Table 1-1) to this section summarizing decision rules described in other sections of the Plan.	Edits completed by reviewer and ATS. The ATS agreed that decision rules and triggers shall be part of the AOP and reviewed annually as part of AOP development
17	Section 1.27	We made edits and clarifications to Section 1.2., Plan Format.	Edits completed by reviewer
18	Section 2.0	We recommend adding a Project Area map to Section 2.0 with the location of the project area dams, hatchery facilities, and fish collection facilities.	Updated project area map added to Section 1.3
19	Section 2.1	The 2014 H&S plan described hatchery facility upgrades in detail. Do any recent upgrades need to be listed here, or should there be a reference to the 2014 H&S plan for a list of the most recent upgrades?	Hatchery upgrades shall be referenced in the reporting section and all upgrades completed for the reporting year will be documented in the Annual Operating Report

Comment Number	Location in June 2020 Review Draft	Comment	Action Taken
20	Section 2.2	To fully understand the impact of the hatchery rainbow trout releases into Swift Reservoir, and the relationship of those fish to the downstream fish passage survival of NOR smolts from the upper Lewis River basin, we recommend a study of the predation of the Swift Reservoir rainbow trout plants be conducted. Consistent with the priority objective of the Settlement Agreement, the final evaluation report of this study should include a list of potential management actions – ranging from no change to the current program to elimination of the current program.	This was originally an objective of the H&S Plan; however, this was moved to the AMEP in 2017. Results from this objective relate to the 'Reintroduction Outcome Goal' and should be used in developing supplementation strategies of the H&S Program. Updates related to modification of the Swift rainbow plants was added to Sections 2.2.2 and 6.4
21	Section 2.3	We made edits and clarifications to Section 2.3, Integrated and Segregated Hatchery Management. We added HSRG recommendations for pHOS and PNI levels for integrated hatchery programs. PNI levels are dependent on pHOS and pNOB levels, and we discussed potential pNOB levels to meet the PNI targets.	Edits completed by reviewer. Additional text added by ATS indicating transition plans will be developed by the ATS
22	Section 2.3.3	We suggest defining 'sustainable survival' for hatchery releases or either removing or editing this text. The SAR is strongly influenced by factors beyond the control of managers (early marine survival, out-of-basin harvest, etc.).	Edits completed by reviewer
23	Section 2.4-2.6	We reorganized much of Section 2 by species (Spring Chinook, Coho, and steelhead) for consistency with Section 3 and related documents (AOP, etc.). We added tables summarizing key elements of each hatchery program, including population designation, ESA status, and pNOB target.	Edits completed by reviewer. Additional text added by ATS.

Comment Number	Location in June 2020 Review Draft	Comment	Action Taken
24	Section 2.4.2	The H&S Plan should note that the Ocean Recruits analysis has been deferred until 2024 per the 2019 Annual Upstream Fish Passage Report. The adjustments to hatchery production are not possible until the analysis is completed. Thus, the current hatchery production plan will continue unchanged unless superseded by the HGMP.	Clarification added to Section using language from the 2019 Aquatic M&E Report
25	Section 2.5.1	We suggest providing more information on why the Type-N program is operated as an integrated program (with pNOB target of 30 percent) versus operating the Type-S program as segregated (no NORs in broodstock). The document doesn't provide information on NOR vs. HOR returns in the early vs. late run, so there is no context provided. If sufficient Type S NORs are available, we recommend that the Type-S program be integrated.	Data added to tables 6.X including returns for both NOR and HOR returns for all species. Additional text added by ATS regarding transition plan development needed.
26	Section 2.5.1	The H&S Plan has separate broodstock targets for the Type-N and Type-S programs, but a single smolt release target. The AOP has separate juvenile release and broodstock targets for each group. We recommend resolving this discrepancy – is Coho managed as a single population or as two groups (early and late run)?	Text added regarding the need for transition plans prior to implementing integrated programs. ATS agreement that Coho are managed as one population

Comment Number	Location in June 2020 Review Draft	Comment	Action Taken
27	Section 3.0	The H&S Plan has numerical adult transport (supplementation) goals, but does not specify how returning NORs should be allocated between broodstock and the supplementation program. The Plan should include numerical targets for integrating NORs into spring Chinook broodstock. We recommend using the HSRG guidelines in Section 2.3 for transitioning to an integrated program given the population's status as a Primary population.	Additional text was added to the H&S plan regarding the need for developing transition plans for moving from segregated to integrated programs. The H&S plan defers to the AOP for developing the priorities and numerical targets to be used when transitioning to integrated programs.
28	Section 3.0	We noted that the supplementation programs also transport natural-origin adults.	Edits completed by reviewer
29	Section 3.0	It would be helpful to include a timeline for the supplementation programs in the introduction to this section. Throughout Section 3, different dates/years are cited that refer to either the beginning of the hatchery portion of the supplementation program (2009) or transport portion of the program (2012 or 2013), which makes it confusing to understand when 'year 15' of the program will be reached. The timeline could be included in the Adaptive Management Plan (discussed above).	Timeline added (Figure E-1)
30	Section 3.0	We suggest replacing the text 'reestablishment of self-sustaining natural-origin populations in future years through natural selection pressure and local adaptation' with 'reestablishment of self-sustaining, locally adapted natural-origin populations'.	Edits completed by reviewer

Comment Number	Location in June 2020 Review Draft	Comment	Action Taken
31	Section 3.0	We recommend that program managers consider adjusting adult transport targets to reflect declining fecundity rates, e.g. in spring Chinook.	Edits completed by reviewer
32	Section 3.1.1	The text states there are 'no anticipated trigger points that would discontinue the program…' but does not provide any examples of potential trigger points. We recommend clarifying the text by stating that the reintroduction program will continue regardless of the number of adult returns.	Edits completed by reviewer
33	Section 3.1.1	The text notes that 'because NORs are currently rare, the program will continue transporting mostly HORs.' We recommend including the spring Chinook adult returns (NORs and HORs) data somewhere in the report. Section 6 (Outcomes) shows the total number of adults trapped, but data is not split into NORs and HORs.	Tables in Section 6 were revised
34	Section 3.1.2	We corrected the total number of adults needed for broodstock and supplementation – 4,400 instead of 3,000 as stated in the text.	Edit completed by reviewer
35	Section 3.1.2	The text notes that 'the adult supplementation program may need to be extended beyond year 15… assuming that future total spring Chinook adult returns to traps downstream of Merwin Dam exceed the minimum target of 4,400 adults for both broodstock and supplementation.' Why would a decision to extend the program be linked to meeting (or exceeding) the brood and transport adult targets? We suggest deleting the latter portion of this sentence.	Edit completed by reviewer

Comment Number	Location in June 2020 Review Draft	Comment	Action Taken
36	Section 3.1.3	The text notes 'NOR returns in excess of broodstock or upstream transport needs shall either be transported upstream or released downstream of Merwin Dam'. We recommend that all NORs in excess of broodstock needs should always go upstream. The same comment applies to Coho (Section 3.2.1) and late winter steelhead (Section 3.3.4).	The following sentence was added for each transport species in Section 3: *NOR returns in excess of broodstock or upstream transport goals shall continue to be transported upstream subject to recommendation* by *the ATS and approval by the ACC.*
37	Section 3.3.1	The data presented in the H&S Report and the 2019 Annual Operations Report show that the tangle netting broodstock capture effort for late winter steelhead in the lower Lewis River results in a very minimal catch and therefore contribution to the NOR broodstock program. The collection results (less than 6 percent of broodstock utilized resulted from tangle net captures) and the resultant egg takes do not support continuing the transport of these NOR fish to the hatchery. The data presented indicates there are sufficient adult returns for the integrated hatchery program collected at the MCF. We recommend ending the tangle netting broodstock collection.	This practice ended in 2016 and tangle netting efforts are currently used for pHOS estimation and all fish tangle netted are returned to river (exception - AD clip green winter steelhead)
38	Section 3.3.1	The document states, 'a plan for evaluating the success of this strategy in achieving recovery goal objectives **should be** developed by the ATS during the duration of this H&S Plan." This phrasing (**should be**) is used in several places in the document. This is confusing. Is this PacifiCorp's recommendation, and is it consistent with the Agreement? We recommend using '**will be**' here and in several other places noted in the document comments.	Edits completed by reviewer

Comment Number	Location in June 2020 Review Draft	Comment	Action Taken
39	Section 3.3.2	The current H&S Plan has limitations in place for the use of lower river NOR steelhead for the integrated broodstock program based on the presumptive genetic analysis of stock composition of individual fish. We recommend that the licensees make arrangements with an independent provider of genetic analysis to ensure timely and accurate delivery of this crucial genetic information.	Comment noted
40	Section 3.3.4	We recommend the AOP Appendix A steelhead protocol should be reviewed and edited to allow for NOR steelhead collected at the MCF that are excess to bloodstock needs to be transported directly to the upper Lewis River basin and **not** be transported to the hatchery. The only exception would be fish collected for broodstock, fish visibly infected with a transmittable disease and fish needed for scientific assessments or studies. All surplus NOR steelhead meeting the above listed criteria should be released into the upper Lewis River basin in order to maximize adult supplementation efforts.	Additional text added to supplementation section (see response to No. 36) to allow for all NOR's that volunteer into the traps shall be passed upstream when broodstock goals or weekly targets are achieved (i.e., all surplus NOR are transported upstream). Handling protocols in the AOP (see response to No. 3) will include allocation targets or guidance.
41	Section 3.3.4	We recommend the Program consider using reconditioned steelhead kelts for the NOR broodstock program. This would be one way to maximize reproductive success and utilize fish that are otherwise handled at the MCF.	The program since 2009 has been successful with incorporating NOR returns as broodstock. The use of reconditioned kelts is unnecessary.

Comment Number	Location in June 2020 Review Draft	Comment	Action Taken
42	Section 4.0	The H&S Monitoring and Evaluation Objectives do not seem to align with the same objectives in the either the 2014 H&S Plan or the objectives in the 2019 AOP. We recommend that the 2020 H&S Plan Objectives align with the AOP and that differences between the 2020 and 2014 H&S Plan Objectives be reconciled or explained.	The 2021 AOP will be aligned with this version of the H&S Plan (assuming it is approved and submitted to the FERC on time). No action taken regarding providing justification for changes to the objectives as these were developed collaboratively with the ATS.
43	Section 4.1.1	We recommend including the status of the HGMPs here.	Comment noted. The AOR will provide a status update to this objective
44	Section 4.1.2	Format outlined for the M&E section shows Key Questions after Purpose (reorder for consistency).	Edits completed by reviewer
45	Section 4.2.1	We added HSRG hatchery operations monitoring recommendations here.	Edits completed by reviewer
46	Section 4.3.2	We recommend adding another Key Question – do the populations studied downstream of Merwin Dam utilize the available habitat? High/medium/low usage?	Edits completed by reviewer
47	Section 4.4.1	The text refers to a 'draft multi state mark-recapture model' to estimate pHOS for late winter steelhead downstream of Merwin Dam. Please provide a reference or more explanation.	Edits completed by technical editing by reviewer

Comment Number	Location in June 2020 Review Draft	Comment	Action Taken
48	Section 4.4.1	The document states, 'To estimate the proportion of HOR spawners, study designs **should** incorporate established methods already in place to estimate abundance using sampled carcasses.' The use of '**should**' is problematic. What if they don't? We recommend replacing should with 'must'. How much weight does the H&S Plan have?	Edits completed by technical editing by reviewer
49	Section 4.4.2	Objective 8.0: Genotypic Diversity, states, 'Determine if genetic diversity, population structure, and effective population size have changed between segregated and integrated programs.' We suggest editing the end of this sentence as follows, '…. Have changed between natural-origin and hatchery-origin fish.' Under the 'Purpose' of this Objective, we suggest changing 'segregated and integrated populations' to 'hatchery-origin and natural-origin populations.'	Comment noted. Section is undergoing final review by ATS and WDFW geneticist
50	Section 4.4.4	The Key Questions for Objective 9.0 would be the same as for Objective 4.0. See Section 4.2.2. Objective 9.0 appears to be redundant with Objective 4.0. We recommend eliminating Objective 9.0 as the key questions are identical to those under Objective 4.0.	This objective remains inactive and edits were added to clarify that this objective will only be activated if Objective 4 metrics are not measurable or achievable.
51	Section 6.1	The text states, 'If adult returns continue to fall short of targets, managers could suspend the program, prioritize supplementation over hatchery production, or implement temporary use of Kalama River stock…' The Agreement identifies Cowlitz River spring Chinook as an alternative broodstock. We recommend that this be identified in the Plan. Also, the Plan needs to describe how or when a decision would be made to use an alternative broodstock source.	Edits completed identifying Cowlitz as an alternative broodstock.

Comment Number	Location in June 2020 Review Draft	Comment	Action Taken
52	Section 6.1	The text states, 'Despite these challenges, it is recommended that efforts continue to improve hatchery operations…" We suggest clarifying who made this recommendation.	Edits completed by reviewer
53	Section 6.2	The text states, 'Based on revised 2018 EDT estimates of juvenile productivity and capacity upstream of Swift Dam (Table 6-3), the Coho supplementation program has the potential to achieve the stated outcome goal of the program.' Comment - Table 6-3 shows juvenile EDT estimates -- since program goals are stated in terms of adult returns it is difficult to see the connection between juvenile capacity and adult returns. We recommend that this be clarified in the Plan. Clearly state the number of juvenile recruits needed to meet the Plan's targeted number of adult returns based on smolt-to-adult survival assumptions.	Agreed. However, this analysis as it pertains to the upstream outcome goal is addressed in the AMEP and in 2025 by the Services as required by the Agreement.
54	Section 6.5 (Question 3)	The text states, 'The ATS should determine whether annual productivity estimates (provided by the AMEP) are sufficient to support the outcome goals of the program.' Comment - NMFS wants 12 years of data to determine productivity estimate. *Note: A review of "Key Questions Related to the Outcome Goal" is provided after this table.*	Comment noted (see response to No. 53)
55	Section 6.5 (Question 6)	The text states, 'If the number of available spawners is fully capable of seeding all available habitats, recovery rates will depend upon improvements in habitat or some other limiting factor.' Should this topic be added to the M&E program? Are the spawners utilizing all the available habitat? Lower river basin? Upper river basin? High/medium/low usage. *Note: A review of "Key Questions Related to the Outcome Goal" is provided after this table.*	This objective or topic is contained in the AMEP. The H&S program (and eventually the Services) will rely on these results to determine if the program is meeting the outcome goal in year 2025. Related to comment No. 53 and 54).

Comment Number	Location in June 2020 Review Draft	Comment	Action Taken
56	Section 6.5 (Question 6)	The text states, 'Monitoring of natural origin adults should demonstrate that harvest rates on natural origin listed populations do not jeopardize achieving **minimum viability goals** of the reintroduction program.' Are minimum viability goals of the reintroduction program the same as the VSP goals from the LCRFRB Plan? If so, we recommend stating this here. *Note: A review of "Key Questions Related to the Outcome Goal" is provided after this table.*	Edits complete to state that minimum viability goals are defined by status of VSP monitoring indicators
57	Section 6.5 (Question 8)	The text states, 'The H&S Plan began supplementation for all species upstream of Swift Dam in 2012.' Comment - According to Table 6-1, spring Chinook transport began in 2013. *Note: A review of "Key Questions Related to the Outcome Goal" is provided after this table.*	Edits completed (late winter steelhead reintroduction began in 2012 upstream of Swift Dam)
58	Section 7.1	The reference providing the location of the master tables is confusing. Currently, the master tables are found in the 2019 AMEP Annual Report (Tables 2.0-1 and 2.0-2). We suggest clarifying this (report names are confusing).	Edits completed by reviewer

REVIEW OF
KEY QUESTIONS RELATED TO THE OUTCOME GOAL

Review Task: "……review these questions and determine whether they are appropriate. By appropriate, I mean are we asking the right questions, are they clear or specific enough to be of value, are there other questions we are not asking and things of that nature rather than trying to answer these difficult questions."

Responses to the review of each key question are included below in *blue italics*.

Draft 2020 H&S Plan, Section 6.5

1. Are the hatchery programs operated consistent with HSRG guidelines to meet recovery goals?

The H&S Plan relies on HSRG guidelines as the scientific basis for hatchery operations. These guidelines represent HSRG understanding of best management practices for hatcheries attempting to achieve conservation or harvest goals.

Yes, this is an appropriate question. Agreement recovery goals involving NOR fish are dependent upon HOR F_1 production from the hatcheries. HSRG guidelines are intended to ensure NOR populations drive fitness in order to maximize recovery success.

2. Are the number of adult returns adequate to achieve transport targets for each transport species?

Ultimately, success of the program relative to the outcome goals will be based on the number of NOR adult returns to the North Fork Lewis River. The number of returning adults (abundance) is affected by and dependent on how well the program is implemented and whether it is meeting viability targets for abundance, productivity, diversity and spatial distribution.

Yes, this is an appropriate question. Adult returns and successful spawning are key metrics for upper Lewis River basin population persistence.

Currently, spring Chinook and steelhead adult returns earmarked for the upper Lewis River basin are not meeting the updated and revised adult return goals specified in the plan.

3. Is productivity from transported adult spawners adequate to support self-sustaining populations?

The H&S Plan relies on adult supplementation to reintroduce steelhead, Coho and spring Chinook upstream of Swift Dam. Recent EDT estimates of productivity suggest that the habitat available upstream of Swift Dam is adequate to support the outcome goal. Results from the Eagle Cliff screw trapping efforts (since 2013) indicate large numbers of Coho, spring Chinook (when available) and steelhead juveniles passing the trap which suggests transported adults are spawning successfully upstream of Swift Reservoir.

Monitoring the productivity of the naturally spawning population above Swift Dam provides managers with the ability to track recovery progress as reintroduction efforts mature. This is also an important metric for determining when populations move from the re-colonization to the local adaptation phase.

The ATS should determine whether annual productivity estimates (provided by the AMEP) are sufficient to support the outcome goals of the program. If not, the ATS should provide recommended strategies to the ACC to improve overall productivity for all three transport species.

Yes, this is an appropriate question.

Adult returns and their survival to the spawning grounds in the upper Lewis River basin are one of the key metrics for population persistence, i.e., an adult productivity value > 1.0.

4. Do transported adults effectively distribute and use available spawning habitat?

Relates to whether adults are able to achieve production and capacity estimates by EDT.

No, this question is less important in determining the self-sustainability of the upper Lewis River basin populations.

If the populations are able to take advantage of discontinuous or patchy, but highly productive habitat and life history strategies, they may be able to achieve self-sustainability without utilizing all the available spawning habitat in the upper Lewis River basin.

5. Is survival and collection efficiency of juveniles produced above Swift Dam sufficient to meet program goals?

For this program to be successful, juveniles from natural spawners must not only survive and be available for capture, but also be effectively collected, transported and released downstream of Merwin Dam at a rate that is sustainable. This metric is generally referred to as Overall Downstream Survival (ODS), and is critical for achieving the outcome goals as it affects the number of adult returns. Without an acceptable capture efficiency or ODS, the outcome goal cannot be achieved.

Yes, this is one of the most important questions for determining success in achieving Program goals in the upper Lewis River basin.

The production of juveniles from the upper Lewis River basin (the numbers produced and the numbers collected at the FSC combined) is the single most important factor within the control of the Program that can lead to achieving Program and Agreement adult population goals.

6. Is harvest management a threat to supplementation and recovery programs upstream of Merwin Dam?

Because harvest removes potential spawners (including transported adults) from the population, which in turn reduces the number of eggs deposited and the potential number of emergent fry available to occupy the habitat, it is important to understand the effect harvest regimes are having on the rate of population recovery in terms of abundance, spatial and temporal distribution. If the number of available spawners is fully capable of seeding all available habitats, recovery rates will depend upon improvements in habitat or some other limiting factor. Unless sufficient spawners are available to fully seed the habitat, any harvest will potentially prolong the recovery process. Monitoring of natural origin adults should demonstrate that harvest rates on natural origin listed populations do not jeopardize achieving minimum viability goals of the reintroduction program.

At a minimum, harvest managers should provide the following to monitor whether management actions are adequate to control threats of overharvest and incidental impacts to NOR listed stocks (Crawford and Rumsey 2011):

Implement marking strategies that reflect impacts to NOR listed stocks rather than hatchery surrogates (i.e., DIT programs)
Provide data indicating that harvest restrictions regulating incidental take (exploitation rates) support meeting recovery of natural populations (e.g., meet viability escapement goals for reintroduction)
Demonstrate that pre-harvest forecasts of run size and incidental take of listed species are accurate and track with "in-season" and post-season" analysis
Demonstrate compliance with adopted fishery regulations designed to minimize incidental take of listed species (e.g., monitoring of illegally retained fish)
Report the percentage of fishers reporting total catch by turning in annual commercial, tribal, and sport results (by fishery)
Identify numeric harvest goals for the North Fork Lewis River terminal fishery (HSRG 2009).
Provide annual estimates of actual exploitation or escapement rates

No, this question is not as important in assessing Program success.

As long as current fish management regulations remain in place, steelhead populations are generally protected from harvest. Coho returns (and ocean recruits) are consistently robust, and sufficient numbers of adults return annually to fully seed the upper basin. The spring Chinook population is the most susceptible to harvest management impacts - primarily in ocean fisheries targeting immature adults. Current ocean management regulations lump this population with other Chinook populations and the current conservative harvest levels afford a high degree of protection.

7. Is the H&S Program producing population level VSP data sufficient to meet NOAA guidelines?

The ability to determine whether the strategies included in the H&S Plan are effective relative to the outcome goal depends in part on the quality of data collected and analyzed though monitoring. Data collected as part of this plan and the AOP should, when practical, strive to meet guidance

provided by NOAA (Crawford and Rumsey 2011). Data collected and analyzed using this guidance allows NOAA to assess 1) the viability metrics of listed North Fork Lewis River populations over time, 2) compliance with related HGMPs, and 3) determine the status of the H&S Program relative to achieving the outcome goals of the Agreement.

No, this question is less important in determining the self-sustainability of the upper Lewis River basin populations.

Like many Pacific Northwest programs, the Lewis River H&S Program is only beginning to provide sufficient VSP data to determine whether the populations are self-sustaining. It is unknown if future data sets will be sufficient to give answers, but collecting VSP metrics can only ever partially answer the question of Program success. Only a high adult productivity value (>1.0) allows for sufficient adult returns from the upper basin supplementation efforts, and for harvest of these populations, both of which are Program goals.

7. When is it appropriate and how do reintroduction programs transition from recolonization to local adaptation phases to full recovery?

The H&S Plan began supplementation for all species upstream of Swift Dam in 2012. Juvenile collection at Swift Dam began in 2013. Juvenile collection efficiency continues to improve at the Swift FSC, and increasing numbers of adult NOR salmonids are being trapped and transported upstream of Swift Dam. The ATS has identified the need to develop an objective set of criteria for determining when transitions between recovery phases are warranted. Early within the duration of this revised H&S Plan, the ATS should develop these criteria, incorporating biological, logistical, and management considerations. Additionally, in preparation for changes in hatchery management objectives, the ATS should develop detailed plans outlining the transition from segregated to integrated hatchery programs, where appropriate. These criteria and hatchery transition plans will allow for adaptive management of reintroduction programs as recovery in the Upper Lewis Basin progresses.

Yes, this is an important question for determining the success of achieving Program goals in the upper Lewis River basin.

A timeline and a series of decision points (Decision Rules) should be developed to assess whether the Program is meeting targets. Based on those results, a decision tree can be followed to change population management actions.

Appendix D

ACC comments received and responses on Version 3 Draft Hatchery and Supplementation Plan

No comments were received by the ACC during a 60-day comment period provided between July 9 and September 9, 2020.