HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Lewis Basin Chum Enhancement (Integrated)
Species or Hatchery Stock:	Chum (*Oncorhynchus keta*) Columbia River (I-205) Wild
Agency/Operator:	Washington Department of Fish and Wildlife
Watershed and Region:	Lewis River Basin/ Lower Columbia River and Lower Columbia Gorge
Date Submitted:	
Date Last Updated:	September 26, 2014

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Executive Summary

The Washington Department of Fish and Wildlife (WDFW) is submitting a Hatchery and Genetic Management Plan (HGMP) for the Lewis Basin Chum Enhancement program to the National Marine Fisheries (NMFS) for consultation under Section 4d or 10(a)(1)(A) of the Endangered Species Act (ESA) . NMFS will use the information in this HGMP to evaluate the hatchery impacts on salmon and steelhead listed under the Endangered Species Act (ESA). The primary goal of an HGMP is to devise biologically-based hatchery management strategies that ensure the conservation and recovery of salmon and steelhead populations. This HGMP focuses on the implementation of hatchery reform actions adopted by the Washington Fish and Wildlife Commission Policy on Hatchery and Fishery Reform C-3619.

The purpose of the program is to enhance the existing population. Enhancement will be accomplished by either juvenile supplementation, releases of chum salmon adults into constructed spawning habitat located in the Lewis River Basin or a combination of both strategies. Program fish will be produced at Washougal Hatchery, located on the Washougal River (WRIA 28.0159), with final incubation and rearing occurring at the Lewis River Hatchery, located on the Lewis River (WRIA 27.0168). Currently the program releases 100,000 -110,000 fry annually. Up to 200 adults may be used for direct supplementation into spawning channels in the Lewis River Basin.

This chum HGMP is built around the principles and recommendations of the Hatchery Scientific Review Group (HSRG). These principles and recommendations represent the best science available for operating hatchery facilities consistent with the conservation of salmonid species. The program will be operated as a "integrated type" program as defined by the HSRG. An "integrated" program is one in which natural-origin adults are used in the hatchery broodstock. Integration is achieved by collecting broodstock in an area with known low or zero, hatchery-origin spawner abundance. Broodstock for this program is collected in the mainstem Columbia River near the I-205 bridge (November through December). All fish released through this hatchery program have been 100% mass-marked (thermal otolith-mark) since the program was initiated in 2011. Beginning in 2014, this program will switch to Parentage-Based Tagging (PBT) to determine origin.

Columbia River chum are listed as "Threatened" under the ESA, and but does not include the Lewis River artificial propagation program (NMFS 2014 - 79FR20802).

Broodstock Collection:
The broodstock is derived from chum salmon collected via beach seines in the Columbia River, near the I-205 Bridge (RKm 182). The current egg-take goal for this program is 115,000 at Washougal Hatchery; up to 60 adult pairs may be collected. Direct adult supplementation may include up to an additional 100 pairs collected. Adults captured in surplus of broodstock needs are tagged and released to spawn naturally.

Harvest:
There are currently no Columbia River commercial fisheries which target chum. A rule change in 2013 made it illegal to land any commercially caught chum salmon in the Lower Columbia River (LCR). WDFW currently has no way to monitor for impacts of Lower Columbia commercial fisheries on chum salmon. The Columbia River system is also closed to recreational harvest of chum salmon.

Monitoring and Evaluation:
The RM&E plan for this program is based on the framework developed under the Integrated Status and Trend Monitoring (ISTM) program. It is focused on gathering data on Viable Salmonid Population (VSP) parameters – spawner abundance, including proportion of hatchery-origin spawners (pHOS), spatial distribution, diversity, and productivity. Monitoring protocols and analysis methods utilized are intended to produce unbiased estimates with measurements of precision in an effort to meet NOAA monitoring guidelines (Crawford and Rumsey 2009). Monitoring will occur as long as the program is producing hatchery origin returning adults. Reports will document all RM&E activities and make recommendations for modifications to the program and/or additions to research activities.

The program releases will use PBT to determine origin beginning in 2014.

Operation and Maintenance of Hatchery Facilities:
The Lewis Basin Chum Enhancement operates out of several different facilities.

Washougal Hatchery has water rights to divert water a total of 15,061 gpm from the four sources: two from Washougal River (10 and 12 cfs); one from Boyle Creek (spring water) at 5.5 cfs; and Bob Creek at 3.0 cfs. Both Boyle and Bob creeks are determined to be non-fish-bearing streams. Intake structures on the Washougal River were designed and constructed to specifications at the time the Washougal facility was built. The intake screens and velocity at Washougal Hatchery are not compliant with current NOAA fish screening standards; WDFW has requested funding for future scoping, design, and construction work of a new intake system.

Lewis River Hatchery has water rights totaling 38,613 gpm from the Lewis River. The Lewis River Settlement Agreement (SA 2004) outlined repairs and upgrades needed to the intake structures at Lewis River Hatchery. Modifications to upstream intake were completed in 2012; modifications to the downstream intake are scheduled for 2015.

The return water systems for both facilities operate under a National Pollutant Discharge Elimination System (NPDES) permit.

1 SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1 Name of hatchery or program.

Lewis Basin Chum Enhancement Program

1.2 Species and population (or stock) under propagation, and ESA status.

Columbia River (Lewis/EF Lewis River) chum (*Oncorhynchus keta*)

Columbia River (I-205/Washougal) chum

ESA Status: "Threatened" March 25, 1999 (64FR14507); reaffirmed on August 15, 2011 (76 FR 50448).

1.3 Responsible organization and individuals

Hatchery Operations Staff Lead Contact

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Fish Management Staff Lead Contact

Name (and title): Eric Kinne, Region 5 Hatchery Reform Coordinator
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Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

Fish First (non-profit 501c), aka "Friends of the Lewis" provides in-kind volunteer contribution work for fry releases on the East Fork (EF) Lewis River.

1.4 Funding source, staffing level, and annual hatchery program operational costs.

Funding Sources	Operation Information – FY 2013
GF-S	Full time equivalent staff – 4.94
	Annual operating cost (dollars) - $615,815

The above information for full-time equivalent staff and annual operating cost applies cumulatively to anadromous program facilities and cannot be broken out specifically by program.

1.5 Location(s) of hatchery and associated facilities.

Broodstock Source: Columbia River chum (I-205/Washougal population)

Columbia River chum (Lewis/EF Lewis River population)

Table 1.5.1: Location of culturing phases, by facility.

Facility	Culturing Phase	Location
In-River	Broodstock collection (via beach seining)	Woods and Rivershore spawning areas, Columbia River RKm 181.9 and 182.1, respectively.
	Acclimation, Release	Lewis River (WRIA 27.0168), Lewis sub-basin; tributary to the Columbia River at RKm 140, Lower Columbia River Washington.
		East Fork Lewis River (WRIA 27.0173) enters the Lewis River at RKm 5.6 (RM 3.5).
Washougal Hatchery*	Adult holding/spawning, Incubation	Washougal River (WRIA 28.0159) at RKm 32.2 (RM 20); tributary to the Columbia River via Camas Slough (WRIA 28.0154) at RKm 190.1 (RM 118.1), Lower Columbia River, Washington.
Lewis River Hatchery	Adult holding/spawning and Incubation (proposed*) Rearing	Located at RKm 24.95 on the Lewis River (WRIA 27.0168), Lewis sub-basin; tributary to the Columbia River at RKm 140, Lower Columbia River Washington.

* Spawning and incubation for this program occurred at Washougal Hatchery when the program was initiated in 2011. WDFW proposes moving these culturing phases to Lewis River Hatchery.

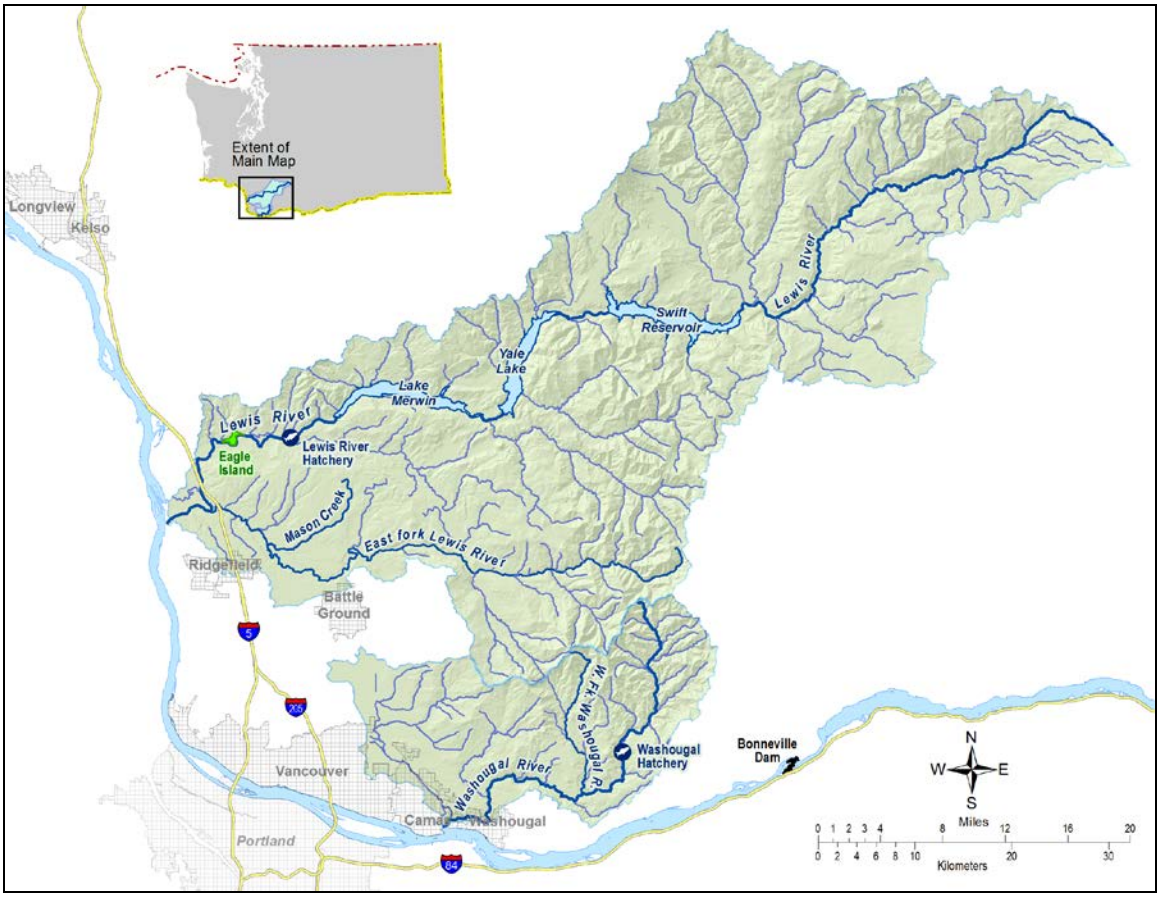

Figure 1.5.1: Map of Lewis and Washougal watersheds, and associated hatchery facilities. Source: WDFW GIS 2014.

1.6 Type of program.

Integrated Recovery

1.7 Purpose (Goal) of program.

Mitigation/Conservation. The goal of the Lewis Basin enhancement program is to enhance the existing population, jump-start usage of an existing spawning channel on the EF Lewis (Swanson Channel) and the Eagle Island spawning channel on the Lewis (to be built in the spring/summer of 2015). The approaches used will primarily be combinations of fed-fry releases and direct adult releases into spawning channels with possible use of remote site incubators (RSI) at select locations within the basin. Each program has monitoring and evaluation components to evaluate the effectiveness of these strategies.

See also HGMP section 11.

1.8 Justification for the program.

This program is part of a long-term recovery project for chum salmon initiated by WDFW in the late-1990s, and is currently funded through the Washington State General Funds (GF-S). A *Lower Columbia River Chum Supplementation Plan* is currently under development.

WDFW protects listed fish and provides harvest opportunity on hatchery fish through the Lower Columbia River-approved *Fish Management and Evaluation Plan* (FMEP) (WDFW 2001

To minimize impact on listed fish by this program and operations, the following risk aversions are included in this HGMP (**Table 1.8.1**).

Table 1.8.1: Summary of risk aversion measures for Lewis Basin chum enhancement program.

Potential Hazard	HGMP Reference	Risk Aversion Measures
Water Withdrawal	4.1	Water rights at Washougal and Lewis River hatcheries are formalized through trust water right from the Department of Ecology. Monitoring and measurement of water usage is reported in monthly NPDES reports.
Intake Screening	4.1	WDFW has requested funding for future scoping, design, and construction work of a new river intake system to meet NOAA compliance at the Washougal Hatchery (*Mitchell Act Intake and Screening Assessment* 2002).
Effluent Discharge	4.1	This facility operates under the "U*pland Fin-Fish Hatching and Rearing*" *National Pollution Discharge Elimination System* (NPDES) administered by the Washington Department of Ecology (DOE).
Broodstock Collection & Adult Passage	7.9	All hatchery-origin fish produced to date have been thermally otolith-marked during incubation. Future releases may be identified by Parental Based Tagging (PBT). Broodstock are collected per scientific protocols. Broodstock are collected from the river, and adults not affected disperse throughout the system to spawn.
Disease Transmission	7.9, 10.11	The *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006) and the *Fish Health Policy in the Columbia Basin* details hatchery practices and operations designed to stop the introduction and/or spread of any diseases within the Columbia Basin. Also, *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries* (Fish Health Policy Chapter 5, IHOT 1995).

Competition & Predation	2.2.3, 10.11	Fish are released at a time, size and the system and life history stage to foster rapid migration to marine waters, and to allow juvenile listed fish to grow to a size that reduces potential for predation. Current risk aversions and future considerations are being reviewed and evaluated for further minimizing impacts to listed fish.

1.9 List of program "Performance Standards".

See HGMP section 1.10. Standards and indicators are referenced from Northwest Power Planning Council (NPPC) Artificial Production Review (APR) (NPPC 2001).

1.10 List of program "Performance Indicators", designated by "benefits" and "risks."

1.10.1 "Performance Indicators" addressing benefits.

Table 1.10.1.1: "Performance Indicators" addressing benefits.

Benefits		
Performance Standard	**Performance Indicator**	**Monitoring & Evaluation**
3.1.2 Program contributes to mitigation requirements. Program provides mitigation for lost fish production due to development within the Columbia River Basin.	Number of fish released by program returning, or caught, as applicable to given mitigation requirements.	Annually estimate survival and contribution for each brood year released. This program provides mitigation for lost fish production due to development within the Columbia River Basin
3.1.3 Program addresses ESA responsibilities.	Program complies with Federal ESA-listed fish take authorizations for harvest and hatchery actions.	Hatchery program operation addresses ESA requirements through the development and review of this HGMP. HGMP updated and re-submitted to NOAA with significant changes or under permit agreement. Compliance with ESA is managed with sport fishery regulations that minimize impacts to ESA-listed fish and are monitored by WDFW law enforcement officers. The FMEP outlines anticipated encounter rates and expected mortality rates for these fisheries. Creel surveys are being implemented to verify. Natural populations are monitored annually to assess trends and compare with goals. HGMP updated and re-submitted to NOAA with significant changes or under permit agreement.
3.3.1. Artificial propagation program contributes to an increasing number of spawners returning to natural spawning areas.	Annual number of naturally-produced adults or redds on the spawning grounds or selected natural production index areas.	Annually monitor and report returns to the hatchery and spawning grounds.

3.3.2 Releases are sufficiently marked to allow statistically significant evaluation of program contribution to natural production, and to evaluate effects of the program on the local natural population.	Percentage of total hatchery releases are identifiable as hatchery-origin fish. Mass-mark (fin-clip, CWT, otolith-mark, other, etc., depending on species) production fish to identify them from naturally produced fish.	Annually monitor and report size, number, mass-mark type (otolith, PBT) and release date. Annually sample returning fish for the mass-mark (otolith, PBT) at the hatchery and on the spawning grounds; monitor and report numbers of estimated hatchery and natural fish.
3.4.1 Fish collected for broodstock are taken throughout the return or spawning period in proportions approximating the timing and age distribution of population from which broodstock is taken.	Temporal distribution of broodstock collection at point of collection.	Collect broodstock representatively and systematically throughout the return (November through December). Collect annual run timing, age and sex composition and spawning escapement timing data. Adhere to WDFW spawning guidelines (Seidel 1983; HSRG 2009).
3.5.2. Collection of broodstock does not adversely impact the genetic diversity of the naturally-spawning population.	Total number of natural spawners reaching the collection site. Timing of collection compared to overall run timing.	Collect broodstock representatively and systematically throughout the return (November through December). Annually monitor and report returns to the hatchery and spawning grounds. Genetic material will be collected from broodstock and natural spawning adults, origin determined via Parentage-based Tagging (PBT) to profile the population. Analysis pending funding availability.
3.5.5 Juveniles are released at fully-smolted stage to benefit juvenile to adult survival rates, and reduce the likelihood for residualism and negative ecological interactions with natural-origin fish.	Level of smoltification (size, appearance, behavior, etc.) at release compared to WDFW rearing and release guidelines. Release type (forced, volitional, or direct).	Monitor fish condition in the facilities throughout all rearing stages. Annually monitor and record size, number, and date of release.
3.6.1 The hatchery program uses standard scientific procedures to evaluate various aspects of artificial propagation.	Apply basic monitoring standards in the hatchery: food conversion rates, growth trajectories, mark rate error, weight distribution (CV).	Collect annual run timing, age and sex composition data upon adult return. Genetic material will be collected from broodstock and natural spawning adults to profile the population. Analysis pending funding availability. Annually record growth rates, mark rate and size at release and release dates.

		See also HGMP section 11 for program monitoring and evaluation.
3.8.3 Non-monetary societal benefits for which the program is designed are achieved.	Program is designed to help achieve the end goal of conserving and stabilizing natural salmon populations.	Long-term monitoring of system population will indicate success of program.

1.10.2 "Performance Indicators" addressing risks.

Table 1.10.2.1: "Performance indicators" addressing risks.

Risks		
Performance Standard	**Performance Indicator**	**Monitoring & Evaluation**
3.1.3 Program addresses ESA responsibilities	Program complies with Federal ESA-listed fish take authorizations for harvest and hatchery actions.	HGMP is updated to reflect any major changes in program and resubmitted to NOAA fisheries. Program risks have been addressed in this HGMP through best available science hatchery management actions. WDFW staff annually reviews Future Brood Document (FBD) for stock, size, number, date and location of releases from all production programs. Monitor and record juvenile hatchery fish size, number, date of release and mass-mark quality; monitor contribution of hatchery adult fish to fisheries and escapement.
3.3.2 Releases are sufficiently marked to allow statistically significant evaluation of program contribution to natural production and to evaluate effects of the program on the local natural population.	All hatchery production is identifiable in some manner (fin-marks, tags, otolith, PBT, etc.) consistent with information needs.	Annually monitor and record size, number, date of release and mass-mark (otoliths, PBT) of hatchery releases. Sample returning fish encountered for the mass-mark (otoliths, PBT) at the hatchery and on the spawning ground. Annually record numbers of estimated hatchery- and natural-origin adults.
3.4.1 Fish collected for broodstock are taken throughout the return or spawning period in proportions approximating the timing and age distribution of population from which broodstock is taken.	Temporal and age distribution of broodstock collected, compared to that of naturally-produced population at collection point.	Collect annual run timing, age and sex composition and return timing data.
3.5.1 Patterns of genetic variation within and among natural populations do not change significantly as a result of artificial production.	Within and between populations, genetic structure is not affected by artificial production.	Genetic material will be collected from broodstock and natural spawning adults to profile the population via PBT. Analysis pending funding availability. See HGMP section 11 for M&E

		information.
3.5.2 Collection of broodstock does not adversely impact the genetic diversity of the naturally-spawning population.	Total number of natural-origin spawners (if any) reaching the collection facility. Timing of collection compared to overall run timing.	All on-station hatchery releases are identifiable in some manner (otolith-marks, PBT). Collect annual run timing, origin, and age and sex composition data. Sample returning fish encountered for the mass-mark (otoliths, PBT) at the hatchery and on the spawning ground. Annually record numbers of estimated hatchery- and natural-origin adults. Genetic material will be collected from broodstock and natural spawning adults to profile the population. Analysis pending funding availability.
3.5.4 Juveniles are released on-station, or after sufficient acclimation to maximize homing ability to intended return locations.	Location of release (on-station, acclimation pond, direct plant). Release type (forced, volitional or direct stream release).	Annually record and report release information, including location, method (direct, forced) and age class in hatchery data systems (WDFW Hatcheries Headquarters Database).
3.5.5 Juveniles are released at fully-smolted stage.	Level of smoltification at release. Release type (forced, volitional or direct).	Annually monitor and record size, number, date of release and release type.
3.7.1 Hatchery facilities are operated in compliance with all applicable fish health guidelines and facility operation standards and protocols (IHOT, PNFHPC, *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State*).	Annual reports indicating levels of compliance with applicable standards and criteria. Periodic audits indicating level of compliance with applicable standards and criteria.	Pathologists from WDFW's Fish Health Section monitor program monthly. Exams performed at each life stage may include tests for virus, bacteria, parasites and/or pathological changes, as needed. See also **Attachment 1** for pre-release Fish Health History. The program is operated consistent with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006), *Fish Health Policy in the Columbia Basin*, and *Procedures for Columbia Basin Anadromous Salmonid Hatcheries* (Fish Health Policy Chapter 5, IHOT 1995).
3.7.2 Effluent from hatchery facility will not detrimentally affect natural populations.	Discharge water quality compared to applicable water quality standards by NPDES permit. WDFW water rights permit compliance.	Flow and discharge reported in monthly NPDES reports.
3.7.3 Water withdrawals and in-	Water withdrawals compared to	Barrier and intake structure

stream water diversion structures for artificial production facility operation will not prevent access to natural spawning areas, affect spawning behavior of natural populations, or impact juvenile rearing environment.	NMFS, USFWS and WDFW applicable passage and screening criteria for juveniles and adults.	compliance assessed and needed fixes are prioritized.
3.7.4 Releases do not introduce pathogens not already existing in the local populations, and do not significantly increase the levels of existing pathogens. Follow the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, revised 2006).	Necropsies of fish to assess health, nutritional status, and culture conditions.	DFW Fish Health Section inspect adult broodstock yearly for pathogens and monitor juvenile fish on a monthly basis to assess health and detect potential disease problems. A fish health database will be maintained to identify trends in fish health and disease and implement fish health management plans based on findings.
	Release and/or transfer exams for pathogens and parasites.	Examine fish 1 to 6 weeks prior to transfer or release, in accordance with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006).
	Inspection of adult broodstock for pathogens and parasites.	At spawning, lots of 60 adult broodstock are examined for pathogens.
	Inspection of off-station fish/eggs prior to transfer to hatchery for pathogens and parasites.	Controls of specific fish pathogens through eggs/fish movements are conducted in accordance to the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006).
3.7.6 Adult broodstock collection operation does not significantly alter spatial and temporal distribution of any naturally-produced population.	Spatial and temporal spawning distribution of natural populations above and below broodstock collection site is currently compared to historic distribution.	Traps at the spawning channels, if used, will be checked regularly. Current collection method is seining at mainstem Columbia River spawning areas. Non-target listed fish, when encountered, are returned to the river.
3.7.7 Weir/trapping operations do not result in significant stress, injury or mortality in natural populations.	Mortality rates in trap and during seining events. Pre-spawning mortality rates of captured fish in the hatchery and/or after release.	Traps at the spawning channels, if used will be checked regularly. Current collection method is seining at mainstem Columbia River spawning areas. Annually record and report abundances and observations of natural- origin fish at hatchery facilities.
3.7.8 Predation by artificially produced fish on naturally – produced fish does not	Hatchery juveniles are raised to smolt-size and released from the hatchery at a time that fosters	Chum salmon emigrate as fry. Predation on naturally produced fish, even fed-fry sized hatchery

significantly reduce numbers of natural fish.	rapid migration downstream.	origin fry (~55mm in FL) is very unlikely.
3.8.2. Juvenile production costs are comparable to or less than other regional programs designed for similar objectives.	Total cost of program operation.	Annually monitor and report feed costs and fish health actions.

1.11 Expected size of program.

1.11.1 Proposed annual broodstock collection level (maximum number of adult fish).

Up to 60 adult pairs are needed to achieve the egg-take goal of 115,000 for this program (FBD 2014). This assumes an average fecundity of ~2,900 eggs/female.

A maximum of 200 adults will be collected if direct adult supplementation is being used in the spawning channels.

1.11.2 Proposed annual fish release levels (maximum number) by life stage and location.

Table 1.11.2.1: Proposed annual fish release levels (maximum number) by life stage and location.

Life Stage	Max. No.	Release Location	Watershed	Eco-Province
Fry	125,000	EF Lewis River (WRIA 27.0173)	Lewis	Lower Columbia
	125,000	Lewis River (WRIA 27.0168)		
Adults	200	Lewis River (WRIA 27.0168)		

Source: Future Brood Document 2014.

Direct adult supplementation into the spawning channel may also be used. Adults would be collected (seined) and transported to the Lewis River spawning channel to spawn naturally in the channels.

1.12 Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data.

No data available - program was initiated in 2011. First returning adults (age-3) are expected in the fall 2014.

1.13 Date program started (years in operation), or is expected to start.

Washougal Hatchery began operations in 1958. The Lewis Basin Enhancement program was initiated in 2011.

1.14 Expected duration of program.

Lewis Basin Enhancement. The EF Lewis enhancement project is expected to last three complete generations (15 years), starting in 2011, unless a self-sustaining population establishes earlier. The other potential programs mentioned in the HGMP (fed-fry releases, use of RSIs to produce un-fed fry and/or direct adult supplementation into a spawning channel on the Lewis River) would have the same expected duration: three complete generations unless a self-sustaining population establishes sooner.

1.15 Watersheds targeted by program.

E.F. Lewis (WRIA 27.0173) and Lewis rivers (WRIA 27.0168), Lewis sub-basin; Lower Columbia Province

1.16 Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.

1.16.1 Brief Overview of Key Issues.

Lewis Basin Enhancement. Chum salmon are still present in the Lewis River Basin, however, spawning ground surveys in 2008-2013 indicated that the population is very small (<20-40 adults per year in the Lewis River), with none detected in the EF Lewis River in recent years. Habitat improvements (spawning channels) have been, or will be, constructed in both the EF Lewis and North Fork Lewis rivers to provide quality/highly productive off-channel spawning areas. Without enhancement releases the investments made in habitat improvements (spawning channels) would likely be largely wasted/severely under-seeded for several generations. Combining habitat improvements with enhancement releases in these highly productive areas will help jump-start/rebuild the population by providing a source of adults to seed the less productive spawning areas in the basin. Small *et al* (2011) presents the most recent analysis of the genetic stock structure of Lower Columbia River (LCR) chum salmon. This report also indicated preferred populations to use if reintroduction or enhancement programs were initiated based on genetic linkage/distance and the population sizes of the existing and donor populations. The I-205 population of chum salmon was identified as the appropriate donor stock to use for the Lewis River basin.

1.16.2 Potential Alternatives to the Current Program

Alternative 1: Use natural re-colonization (*Lewis Basin enhancement*). Natural re-colonization of the rejuvenated Swanson Spawning Channel is not a viable option. The abundance of chum salmon returning to spawn in the Lewis Basin is very small (10-50 adults per year), and these primarily return to the Lewis River, not the EF Lewis River.

Alternative 2: Unfed-fry releases (*Lewis Basin enhancement*). Fed-fry have a proven survival advantage over un-fed and naturally-produced fry in early ocean survival and adult return rates.

1.16.3 Potential Reforms and Investments

None at this time.

2 SECTION 2. PROGRAM EFFECTS ON NMFS ESA-LISTED SALMONID POPULATIONS. (USFWS ESA-Listed Salmonid Species and Non-Salmonid Species are addressed in Addendum A)

2.1 List all ESA permits or authorizations in hand for the hatchery program.

None currently. This HGMP is submitted to the NOAA Fisheries for ESA consultation and take prohibition exemption under ESA section 4(d) or 10.

2.2 Provide descriptions, status, and projected take actions and levels for NMFS ESA-listed natural populations in the target area.

2.2.1 Description of NMFS ESA-listed salmonid population(s) affected by the program.

- Identify the NMFS ESA-listed population(s) that will be directly affected by the program.

Columbia River chum salmon (*Oncorhynchus keta*). Listed as threatened on March 25, 1999 (64FR14507); threatened status reaffirmed on June 28, 2005 (70FR37160); reaffirmed threatened by five-year status review, completed August 15, 2011 (76 FR 50448).

- Identify the NMFS ESA-listed population(s) that may be incidentally affected by the program.

Lower Columbia River Chinook (*Oncorhynchus tshawytscha*). Listed as "threatened" on March 24, 1999 (64FR14308); threatened status reaffirmed on June 28, 2005 (70FR37160); reaffirmed threatened by five-year status review, completed August 15, 2011 (76 FR 50448).

Lower Columbia River coho (*Oncorhynchus kisutch*). Identified as a candidate species on June 25, 1995 (60FR38011). Listed as threatened on June 28, 2005 (70FR37160); reaffirmed threatened by five-year status review, completed August 15, 2011 (76 FR 50448).

Lower Columbia River steelhead (*Oncorhynchus mykiss*). Listed as a threatened species on March 19, 1998 (63FR13347); threatened status reaffirmed on January 5, 2006 (70FR37160); reaffirmed threatened by five-year status review, completed August 15, 2011 (76 FR 50448).

2.2.2 Status of NMFS ESA-listed salmonid population(s) affected by the program.

- Describe the status of the listed natural population(s) relative to "critical" and "viable" population thresholds.

Lower Columbia River Chinook: In Washington, the LCR Chinook ESU includes all naturally spawned Chinook populations from the mouth of the Columbia to a transitional point between Washington and Oregon east of the Hood River and the White Salmon River, as well as fifteen artificial propagation programs. Excluded are upper Columbia River bright hatchery stocks that spawn in the mainstem Columbia River below Bonneville Dam and in other tributaries upstream from the Sandy River to the Hood and White Salmon rivers (NMFS 2014 - 79FR20802).

Status: Currently, only two of 32 historical populations in the ESU – the North Fork Lewis and Sandy late-fall populations –are considered viable. Most populations (26 out of 32) have a very low probability of persistence over the next 100 years, and some populations are extirpated, or nearly so. Five of the six strata fall significantly short of the Willamette- Lower Columbia Technical Recovery Team (WLC TRT) criteria for viability. One stratum – Cascade late fall – meets the WLC TRT criteria (Dornbusch and Sihler 2013). Dam construction eliminated habitat for a number of populations leading to the extirpation of spring Chinook salmon populations in the Upper Cowlitz, Cispus, Tilton, North Fork Lewis , Big White Salmon rivers, and fall Chinook populations in the Upper Cowlitz and Big White Salmon rivers (SHIEER, NMFS 2004). Projects to allow access have been initiated in the Cowlitz and Lewis systems but these are not close to producing self-sustaining populations; Condit Dam on the Big White Salmon River was breached October 26, 2011. Based on the 2010 recovery plan analyses, all of the 14 Tule populations (**Table 2.2.2.1**) are considered very high risk except one that is considered at high risk. The modeling conducted in association with Tule harvest management suggests that three of the populations (Coweeman, Lewis and Washougal) are at a somewhat lower risk.

Table 2.2.2.1: Baseline viability status, viability and abundance objectives, and productivity improvement targets for lower Columbia River Chinook populations.

		Baseline viability					Prod.	Abundance		
Population	Contribution	A&P	S	D	Net	Obj.	target	Historical	Baseline	Target
Coast Fall										
Grays/Chinook	Contributing[2]	VL	H	VL	VL[2]	M+	+500%	800	<50	1,000
Eloch/Skam [C]	Primary	VL	H	L	VL[2]	H	+150%	3,000	<50	1,500
Mill/Aber/Germ	Primary[1]	VL	H	L	VL[2]	H	+155%	2,500	50	900
Youngs Bay (OR)	Stabilizing	--[3]	--[3]	--[3]	L	L	--[3]	--[3]	--[3]	--[3]
Big Creek (OR) [C]	Contributing[1]	--[3]	--[3]	--[3]	VL	L	--[3]	--[3]	--[3]	--[3]
Clatskanie (OR)	Primary	--[3]	--[3]	--[3]	VL	H	--[3]	--[3]	--[3]	--[3]
Scappoose (OR)	Primary[1]	--[3]	--[3]	--[3]	L	H	--[3]	--[3]	--[3]	--[3]
Cascade Fall										
Lower Cowlitz [C]	Contributing	VL	H	M	VL[2]	M+	+50%	24,000	500	3,000
Upper Cowlitz	Stabilizing	VL	VL	M	VL	VL	--	28,000	0	--
Toutle[C]	Primary[1]	VL	H	M	VL[2]	H+	+265%	11,000	<50	4,000
Coweeman [G]	Primary	VL	H	H	VL[2]	H+	+80%	3,500	100	900
Kalama	Contributing[2]	VL	H	M	VL[2]	M	+110%	2,700	<50	500
Lewis [G]	Primary	VL	H	H	VL[2]	H+	+280%	2,600	<50	1,500
Salmon	Stabilizing	VL	H	M	VL	VL	--	n/a	<50	--
Washougal	Primary	VL	H	M	VL[2]	H+	+190%	2,600	<50	1,200
Clackamas (OR) [C]	Contributing	--[3]	--[3]	--[3]	VL	M	--[3]	--[3]	--[3]	--[3]
Sandy (OR)	Contributing[1]	--[3]	--[3]	--[3]	VL	M	--[3]	--[3]	--[3]	--[3]
Cascade L Fall										
Lewis NF [C,G]	Primary	VH	H	H	VH[1]	VH	0%	23,000	7,300	7,300
Sandy (OR) [C,G]	Primary	--[3]	--[3]	--[3]	H	VH	--[3]	--[3]	--[3]	--[3]
Cascade Spring										
Upper Cowlitz [C,G]	Primary	VL	L	M	VL[2]	H+	>500%	22,000	300	1,800
Cispus [C,G]	Primary	VL	L	M	VL[2]	H+	>500%	7,800	150	1,800
Tilton	Stabilizing	VL	VL	VL	VL	VL	0%	5,400	<100	--
Toutle	Contributing	VL	H	L	VL	M	>500%	3,100	100	1,100
Kalama	Contributing[2]	VL	H	L	VL	L	>500%	4,900	100	300
Lewis NF [C]	Primary	VL	L	M	VL	H	>500%	15,700	300	1,500
Sandy (OR) [C,G]	Primary	--[3]	--[3]	--[3]	M	H	--[3]	--[3]	--[3]	--[3]
Gorge Fall										
L. Gorge (WA/OR)	Contributing	VL	M	L	VL[2]	M	>500%	n/a	<50	1,200
U. Gorge (WA/OR) [C]	Contributing[1]	VL	M	L	VL[2]	M	>500%	n/a	<50	1,200
White Salmon [C]	Contributing	VL	L	L	VL	M	>500%	n/a	<50	500
Hood (OR)	Primary[4]	--[3]	--[3]	--[3]	VL	H	--[3]	--[3]	--[3]	--[3]
Gorge Spring										
White Salmon [C]	Contributing	VL	VL	VL	VL	L+	>500%	n/a	<50	500
Hood (OR)	Primary	--[3]	--[3]	--[3]	VL	VH	--[3]	--[3]	--[3]	--[3]

Source: LCFRB 2010.
L = Low; M = Moderate; H = High; VH/E = Very High/Extinct.
[1] Increase relative to interim Plan.
[2] Reduction relative to interim Plan.
[3] Addressed in Oregon Management Unit plan.
[C] Designated as a historical core population by the TRT.
[G] Designated as a historical legacy population by the TRT.

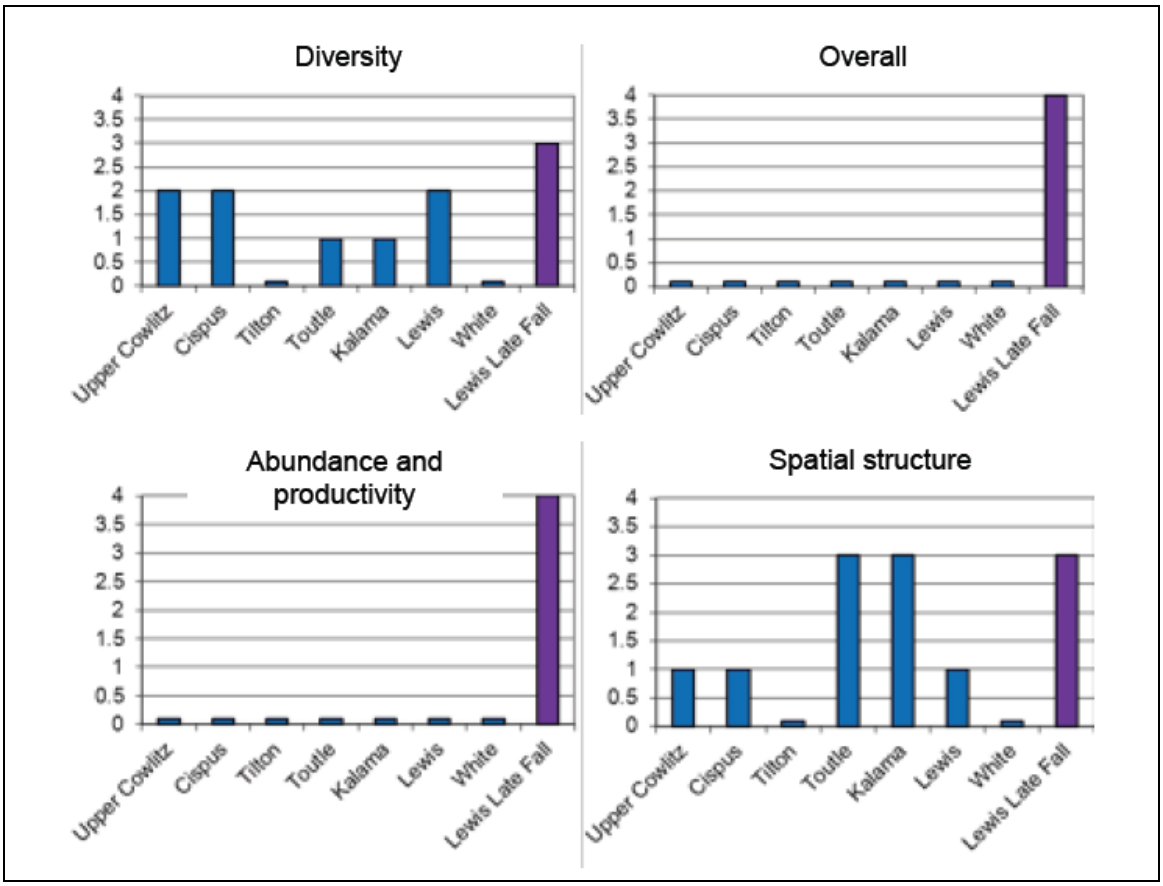

Figure 2.2.2.1: Current status of Washington lower Columbia River spring Chinook and late fall-run (bright) Chinook salmon populations for the VSP parameters and overall population risk. (LCFRB Recovery Plan 2010, chapter 6). A population score of zero indicates a population extirpated or nearly so, a score of 1 is high risk, 2 is moderate risk, 3 is low risk ("viable") and 4 is very low risk (Ford 2011).

Lower Columbia River Steelhead *(Oncorhynchus mykiss*): The DPS includes all naturally spawned anadromous *O. mykiss* (steelhead) populations below natural and manmade impassable barriers in streams and tributaries to the Columbia River between the Cowlitz and Wind Rivers, Washington (inclusive), and the Willamette and Hood Rivers, Oregon (inclusive). The DPS includes seven artificial propagation programs: the Cowlitz Trout Hatchery Winter-late (Lower Cowlitz), Kalama River Wild (winter- and summer-run), and Lewis River Wild Winter (NMFS 2014 – 79FR20802). Merwin Hatchery steelhead programs are not considered part of the DPS listing.

Status: Currently, 16 of the 26 steelhead populations in the ESU have low or very low probability of persisting over the next 100 years, and six populations have a moderate probability of persistence. Only the summer-run Wind population is considered viable. All four strata in the DPS fall short of WLC TRT criteria for viability (Dornbusch and Sihler 2013). Populations in the upper Lewis and Cowlitz watersheds remain cut-off from access to essential spawning habitat by hydroelectric dams. Projects to allow access have been initiated in the Cowlitz and Lewis systems but these have not yet produced self-sustaining populations (Ford 2011). Condit Dam on the White Salmon River was breached October 26, 2011. WDFW is currently developing watershed-specific management plans in accordance with the SSMP. As part of this planning process, WDFW is proposing to complete a thorough review of current steelhead stock status using the most up to date estimates of adult abundance, juvenile production and genetic information.

Table 2.2.2.2: Baseline viability status, viability and abundance objectives, and productivity improvement targets for lower Columbia River steelhead populations.

		Baseline viability					Prod.	Abundance		
Population	Contribution	A&P	S	D	Net	Obj.	target	Historical	Baseline	Target
Coast Winter										
Grays/Chinook	Primary	VH	VH	M	M[1]	H	0%[4]	1,600	800	800
Eloch/Skam	Contributing	VH	VH	M	M[1]	M+	0%[4]	1,100	600	600
Mill/Ab/Germ	Primary	H	VH	M	M[1]	H	0%[4]	900	500	500
Youngs Bay (OR)	Primary	--[3]	--[3]	--[3]	VH	VH	--[3]	--[3]	--[3]	--[3]
Big Creek (OR)	Primary	--[3]	--[3]	--[3]	H	VH	--[3]	--[3]	--[3]	--[3]
Clatskanie (OR)	Primary	--[3]	--[3]	--[3]	VH	VH	--[3]	--[3]	--[3]	--[3]
Scappoose (OR)	Primary	--[3]	--[3]	--[3]	VH	VH	--[3]	--[3]	--[3]	--[3]
Cascade Winter										
Lower Cowlitz	Contributing	L	M	M	L	M	+5%	1,400	350	400
Upper Cowlitz [C,G]	Primary	VL	M	M	VL[2]	H[1]	>500%	1,400	<50	500
Cispus [C,G]	Primary	VL	M	M	VL[2]	H[1]	>500%	1,500	<50	500
Tilton	Contributing	VL	M	M	VL	L	>500%	1,700	<50	200
S.F. Toutle	Primary	M	VH	H	M	H+	+35%	3,600	350	600
N.F. Toutle [C]	Primary	VL	H	H	VL[2]	H	+125%		120	600
Coweeman	Primary	L	VH	VH	L[2]	H	+25%	900	350	500
Kalama	Primary	L	VH	H	L[2]	H+	+45%	800	300	600
N.F. Lewis [C]	Contributing	VL	M	M	VL[2]	M	>500%	8,300	150	400
E.F. Lewis	Primary	M	VH	M	M[1]	H	+25%	900	350	500
Salmon	Stabilizing	VL	H	M	VL[2]	VL	0%	na	<50	--
Washougal	Contributing	L	VH	M	L[2]	M	+15%	800	300	350
Clackamas (OR) [C]	Primary	--[3]	--[3]	--[3]	M	H	--[3]	--[3]	--[3]	--[3]
Sandy (OR) [C]	Primary	--[3]	--[3]	--[3]	L	VH	--[3]	--[3]	--[3]	--[3]
Cascade Summer										
Kalama [C]	Primary	H	VH	M	M[1]	H	0%[4]	1,000	500	500
N.F. Lewis	Stabilizing	VL	VL	VL	VL	VL	0%	na	150	--
E.F. Lewis [G]	Primary	VL	VH	M	VL[2]	H	>500%	600	<50	500
Washougal [C,G]	Primary	M	VH	M	M[1]	H	+40%	2,200	400	500
Gorge Winter										
L. Gorge (WA/OR)	Primary	L	VH	M	L[2]	H	+45%	na	200	300
U. Gorge (WA/OR)	Stabilizing	L	M	M	L[2]	L	0%	na	200	--
Hood (OR) [C,G]	Primary	--[3]	--[3]	--[3]	M	H	--[3]	--[3]	--[3]	--[3]
Gorge Summer										
Wind [C]	Primary	VH	VH	H	H[1]	VH	0%[4]	na	1,000	1,000
Hood (OR)	Primary	--[3]	--[3]	--[3]	VL	H	--[3]	--[3]	--[3]	--[3]

Source: LCFRB 2010.
L = Low; M = Moderate; H = High; VH/E = Very High/Extinct.
[1] Increase relative to interim Plan.
[2] Reduction relative to interim Plan.
[3] Addressed in Oregon Management Unit plan.
[4] Improvement increments are based on abundance and productivity; however, this population will require improvement in spatial structure or diversity to meet recovery objectives.
[C] Designated as a historical core population by the TRT.
[G] Designated as a historical legacy population by the TRT.

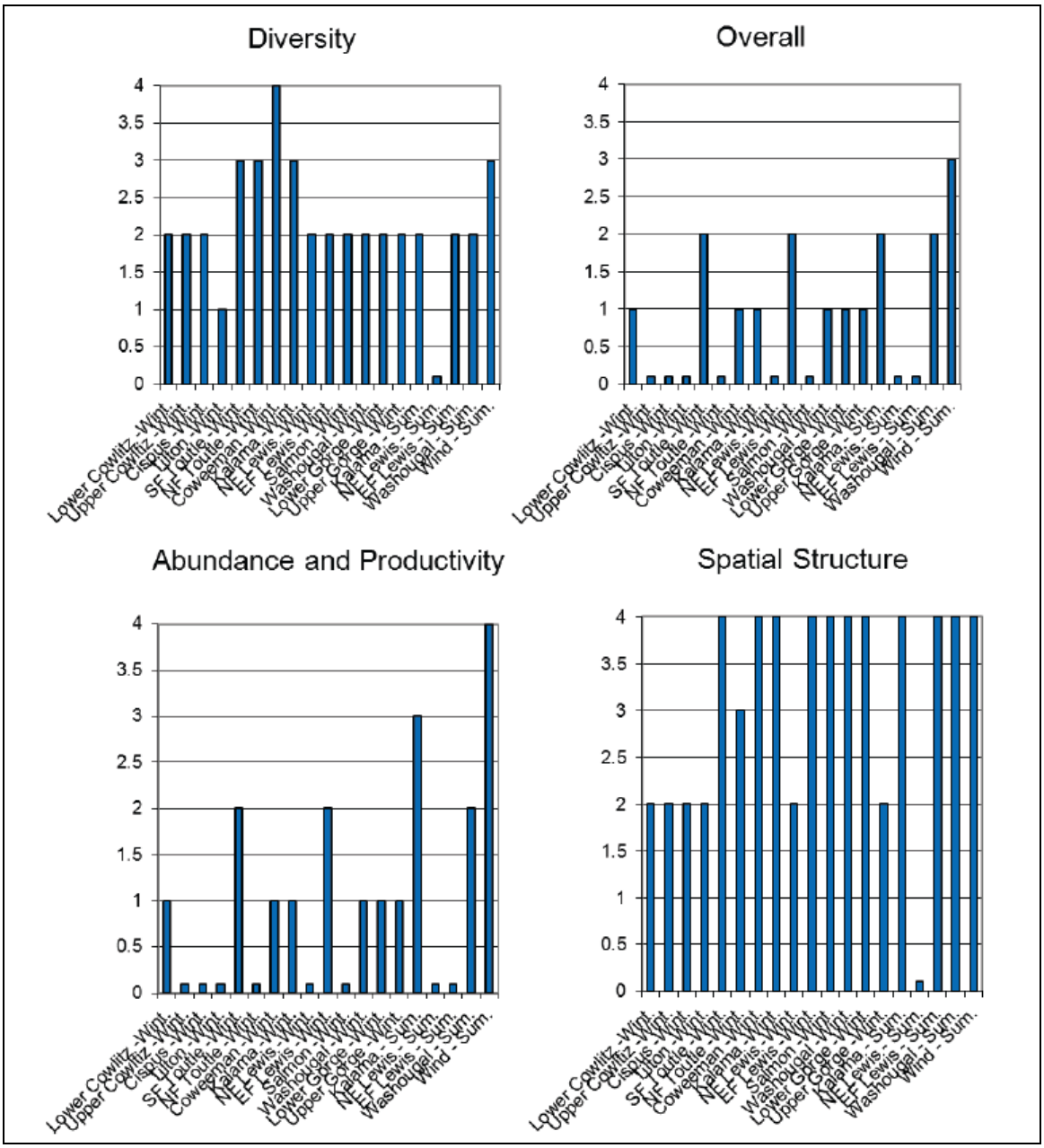

Figure 2.2.2.2: Current status of Washington LCR steelhead populations for the VSP parameters and overall population risk. (LCFRB 2010 Recovery Plan, chapter 6). A population score of zero indicates a population extirpated or nearly so, a score of 1 is high risk, 2 is moderate risk, 3 is low risk ("viable") and 4 is very low risk (Ford 2011).

Lower Columbia River coho *(Oncorhynchus kisutch)*: Originally part of a larger Lower Columbia River/Southwest Washington ESU, Lower Columbia coho were identified as a separate ESU and listed as threatened on June 28, 2005. The ESU includes all naturally spawned populations of coho salmon in the Columbia River and its tributaries in Washington and Oregon, from the mouth of the Columbia up to and including the Big White Salmon and Hood Rivers. The twenty-one artificial propagation programs include: the Grays River, Peterson Coho Project, Cowlitz Type-N Coho Program in the upper and lower Cowlitz Rivers, Cowlitz Game and Anglers Coho Program, Friends of the Cowlitz Coho Program, North Fork Toutle River Hatchery, Kalama River Type-N and Type-S Coho programs, Fish First Wild and Type-N Coho

programs, Syverson Project Type-N Coho Program,and Washougal Hatchery Type-N Coho Program (NMFS 2014 – 79FR20802).

Status: Status evaluations of LCR coho status, all based on WLC-TRT criteria, have been conducted since the last BRT status update in 2005 (McElhany et al. 2007, Beamesderfer et al. 2010, LCFRB 2010, Dornbusch and Sihler 2013). All of these evaluations concluded that the ESU is currently at very high risk of extinction. All of the Washington side populations are considered at very high risk, although uncertainty is high because of a lack of adult spawner surveys. The 2005 BRT evaluation noted that smolt traps indicate some natural production in Washington populations, though given the high fraction of hatchery origin spawners suspected to occur in these populations it is not clear that any are self-sustaining (Ford 2011). Since this time WDFW has implemented an ESU-wide monitoring program for LCR coho which began in 2010. Preliminary results indicate that natural-origin population abundance may be higher than previously thought for certain populations (WDFW, unpublished). Results from the first three years of monitoring should be available in the near future. Currently, 21 of the 24 Lower Columbia River coho salmon populations are considered to have a very low probability of persisting over the next 100 years, and none is considered viable (Dornbusch and Sihler 2013). All three strata in the ESU fall significantly short of the WLC TRT criteria for viability.

Table 2.2.2.3: Baseline viability status, viability and abundance objectives, and productivity improvement targets for lower Columbia River coho populations.

		Baseline viability					Prod.	Abundance		
Population	Contribution	A&P	S	D	Net	Obj.	target	Historical	Baseline	Target
Coast										
Grays/Chinook [L]	Primary	VL	H	VL	VL[2]	H	+370%	3,800	<50	2,400
Eloch/Skam [L]	Primary	VL	H	VL	VL[2]	H	+170%	6,500	<50	2,400
Mill/Ab/Germ [L]	Contributing	VL	H	L	VL[2]	M	>500%	2,800	<50	1,800
Youngs (OR) [L]	Stabilizing	--[3]	--[3]	--[3]	VL	VL	--[3]	--[3]	--[3]	--[3]
Big Creek (OR) [L]	Stabilizing[2]	--[3]	--[3]	--[3]	VL	VL	--[3]	--[3]	--[3]	--[3]
Clatskanie (OR) [L]	Primary[1]	--[3]	--[3]	--[3]	L	VH	--[3]	--[3]	--[3]	--[3]
Scappoose (OR) [L]	Primary	--[3]	--[3]	--[3]	M	VH	--[3]	--[3]	--[3]	--[3]
Cascade										
Lower Cowlitz [L]	Primary	VL	M	M	VL[2]	H	+100%	18,000	500	3,700
Upper Cowlitz [E, L]	Primary[1]	VL	M	L	VL	H[1]	>500%	18,000	<50	2,000
Cispus [E, L]	Primary[1]	VL	M	L	VL	H[1]	>500%	8,000	<50	2,000
Tilton [E, L]	Stabilizing[2]	VL	M	L	VL	VL[2]	0%	5,600	<50	--
Toutle SF [E, L]	Primary	VL	H	M	VL[2]	H	+180%	27,000	<50	1,900
Toutle NF [E, L]	Primary	VL	M	L	VL[2]	H	+180%		<50	1,900
Coweeman [L]	Primary	VL	H	M	VL[2]	H	+170%	5,000	<50	1,200
Kalama [L]	Contributing	VL	H	L	VL[2]	L	>500%	800	<50	500
NF Lewis [E, L]	Contributing	VL	L	L	VL[2]	L	+50%	40,000	200	500
EF Lewis [E, L]	Primary	VL	H	M	VL[2]	H	>500%	3,000	<50	2,000
Salmon [L]	Stabilizing	VL	M	VL	VL	VL	0%	na	<50	--
Washougal [L]	Contributing	VL	H	L	VL[2]	M+	>500%	3,000	<50	1,500
Clackamas (OR) [E, L]	Primary	--[3]	--[3]	--[3]	M	VH	--[3]	--[3]	--[3]	--[3]
Sandy (OR) [E, L]	Primary	--[3]	--[3]	--[3]	VL	H	--[3]	--[3]	--[3]	--[3]
Gorge										
L Gorge (WA/OR) [L]	Primary	VL	M	VL	VL[2]	H	+400%	na	<50	1,900
U Gorge (WA) [L]	Primary[1]	VL	M	VL	VL[2]	H	+400%	na	<50	1,900
U Gorge/Hood (OR)[E]	Contributing[4]	--[3]	--[3]	--[3]	VL	H	--[3]	--[3]	--[3]	--[3]

Source: LCFRB 2010.
L = Low; M = Moderate; H = High; VH/E = Very High/Extinct.
[1] Increase relative to interim Plan.
[2] Reduction relative to interim Plan.
[3] Addressed in Oregon Management Unit plan.
[4] Improvement increments are based on abundance and productivity; however, this population will require improvement in spatial structure or diversity to meet recovery objectives.
[E] Early run (Type S) coho stock.
[L] Late run (Type N) coho stock.
(Core and Legacy populations not designated by the TRT for coho).

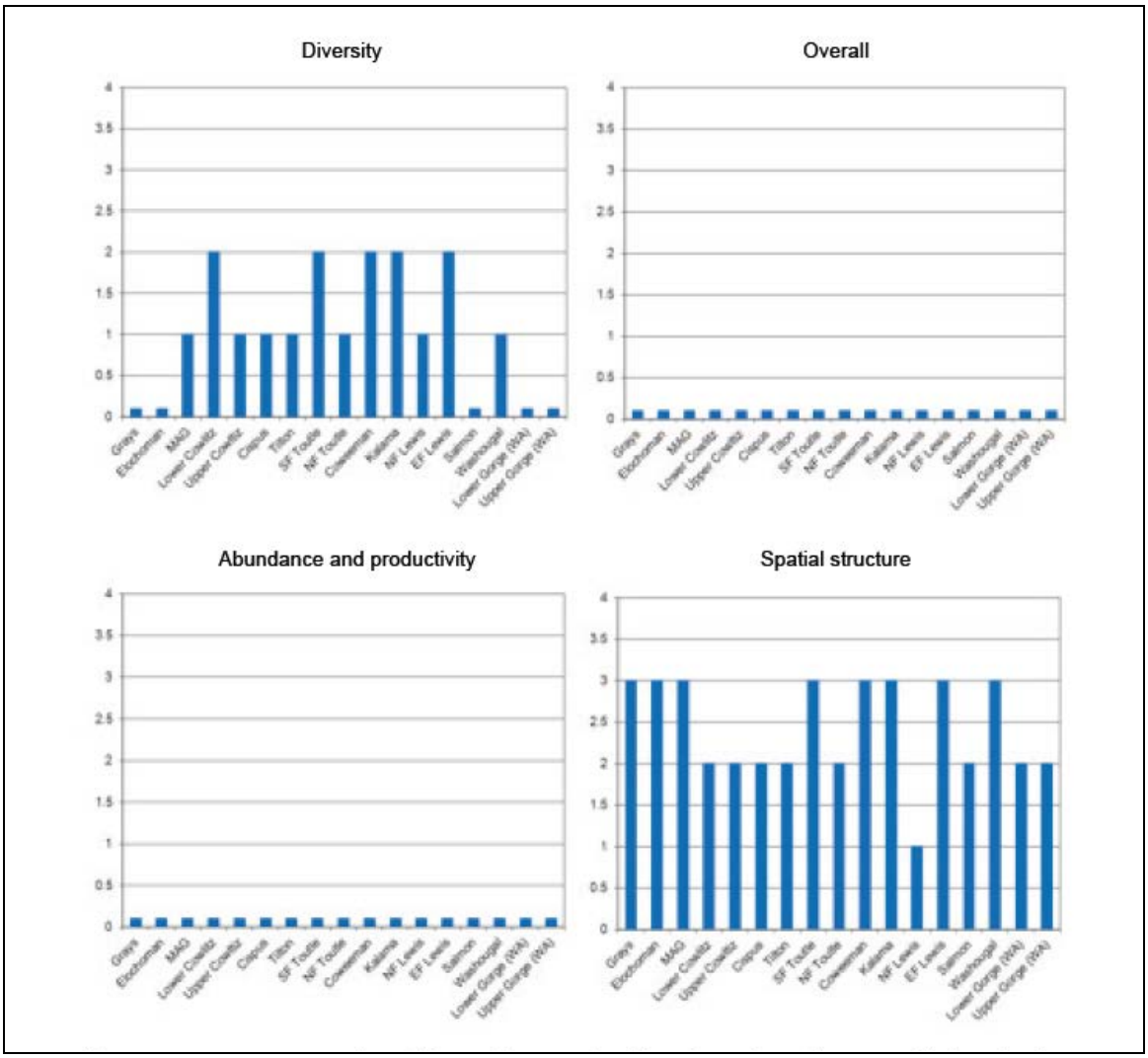

Figure 2.2.2.3: Current status of Washington LCR coho populations for the VSP parameters and overall population risk. (LCFRB 2010 recovery plan, chapter 6). A population score of zero indicates a population extirpated or nearly so, a score of 1 is high risk, 2 is moderate risk, 3 is low risk ("viable") and 4 is very low risk (Ford 2011).

Columbia River chum salmon (*Oncorhynchus keta*). ESU includes all naturally spawned populations of chum salmon in the Columbia River and its tributaries in Washington and Oregon, as well as artificial propagation programs: Grays River and Washougal River/Duncan Creek (NMFS 2014 – 79FR20802).

Status: The LCFRB completed a revision recovery plan in 2010 that includes Washington populations of Columbia River chum salmon. This plan includes an assessment of the current status of Columbia River chum populations, which relied and built on the viability criteria developed by the WLC-TRT (McElhany et al. 2006) and an earlier evaluation of Oregon WLC populations (McElhany et al. 2007). This evaluation assessed the status of populations with regard to the VSP parameters of abundance, productivity, spatial structure, and diversity (McElhany et al. 2000). The result of this analysis is shown in **Figure 2.2.2.4**. The analysis indicates that all of the Washington populations with two exceptions are in the overall very high risk category (also described as extirpated or nearly so). The Grays River population was considered to be at moderate risk and the Lower Gorge population to be at low risk. The very high risk status assigned to the majority of Washington populations (and all the Oregon populations) reflects the very low abundance observed in these populations (e.g., <10 fish/year)

(Ford 2011). Currently, 15 of the 17 populations that historically made up this ESU are so depleted that either their baseline probability of persistence is very low or they are extirpated or nearly so; this is the case for all six of the Oregon populations. Currently almost all natural production occurs in just three populations: Grays/Chinook, Washougal (with 99% of that production occurring at the I-205 spawning areas in the mainstem Columbia River) and the Lower Gorge. All three strata in the ESU fall significantly short of the WLC TRT criteria for viability (Dornbusch and Sihler 2013).

Table 2.2.2.4: Baseline viability status, viability and abundance objectives, and productivity improvement targets for lower Columbia River chum populations.

		Baseline viability					Prod.	Abundance		
Population	Contribution	A&P	S	D	Net	Obj.	target	Historical	Baseline	Target
Coast										
Grays/Chinook [C,G]	Primary	VH	M	H	M[1]	VH	0%[4]	10,000	1,600	1,600
Eloch/Skam [C]	Primary	VL	H	L	VL[2]	H	>500%	16,000	<200	1,300
Mill/Ab/Germ	Primary	VL	H	L	VL	H	>500%	7,000	<100	1,300
Youngs (OR) [C]	Stabilizing[2]	--[3]	--[3]	--[3]	VL	VL	--[3]	--[3]	--[3]	--[3]
Big Creek (OR) [C]	Stabilizing[2]	--[3]	--[3]	--[3]	VL	VL	--[3]	--[3]	--[3]	--[3]
Clatskanie (OR)	Primary[1]	--[3]	--[3]	--[3]	VL	H	--[3]	--[3]	--[3]	--[3]
Scappoose (OR)	Primary[1]	--[3]	--[3]	--[3]	VL	H	--[3]	--[3]	--[3]	--[3]
Cascade										
Cowlitz (Fall) [C]	Contributing	VL	H	L	VL	M	>500%	195,000	<300	900
Cowlitz (Summer) [C]	Contributing	VL	L	L	VL	M	>500%	n/a	n/a	900
Kalama	Contributing	VL	H	L	VL	M	>500%	20,000	<100	900
Lewis [C]	Primary	VL	H	L	VL	H	>500%	125,000	<100	1,300
Salmon	Stabilizing	VL	L	L	VL	VL	0%	n/a	<100	--
Washougal	Primary	VL	H	L	VL[2]	H+	>500%	18,000	<100	1,300
Clackamas (OR) [C]	Contributing	--[3]	--[3]	--[3]	VL	M	--[3]	--[3]	--[3]	--[3]
Sandy (OR)	Primary	--[3]	--[3]	--[3]	VL	H	--[3]	--[3]	--[3]	--[3]
Gorge										
L. Gorge (WA/OR) [C,G]	Primary	VH	H	VH	H[1]	VH	0%[4]	6,000	2,000	2,000
U. Gorge (WA/OR)	Contributing	VL	L	L	VL	M	>500%	11,000	<50	900

Source: LCFRB 2010.
L = Low; M = Moderate; H = High; VH/E = Very High/Extinct.
[5] Increase relative to interim Plan.
[6] Reduction relative to interim Plan.
[7] Addressed in Oregon Management Unit plan.
[8] Improvement increments are based on abundance and productivity; however, this population will require improvement in spatial structure or diversity to meet recovery objectives.
[C] Designated as a historical core population by the TRT.
[G] Designated as a historical legacy population by the TRT.

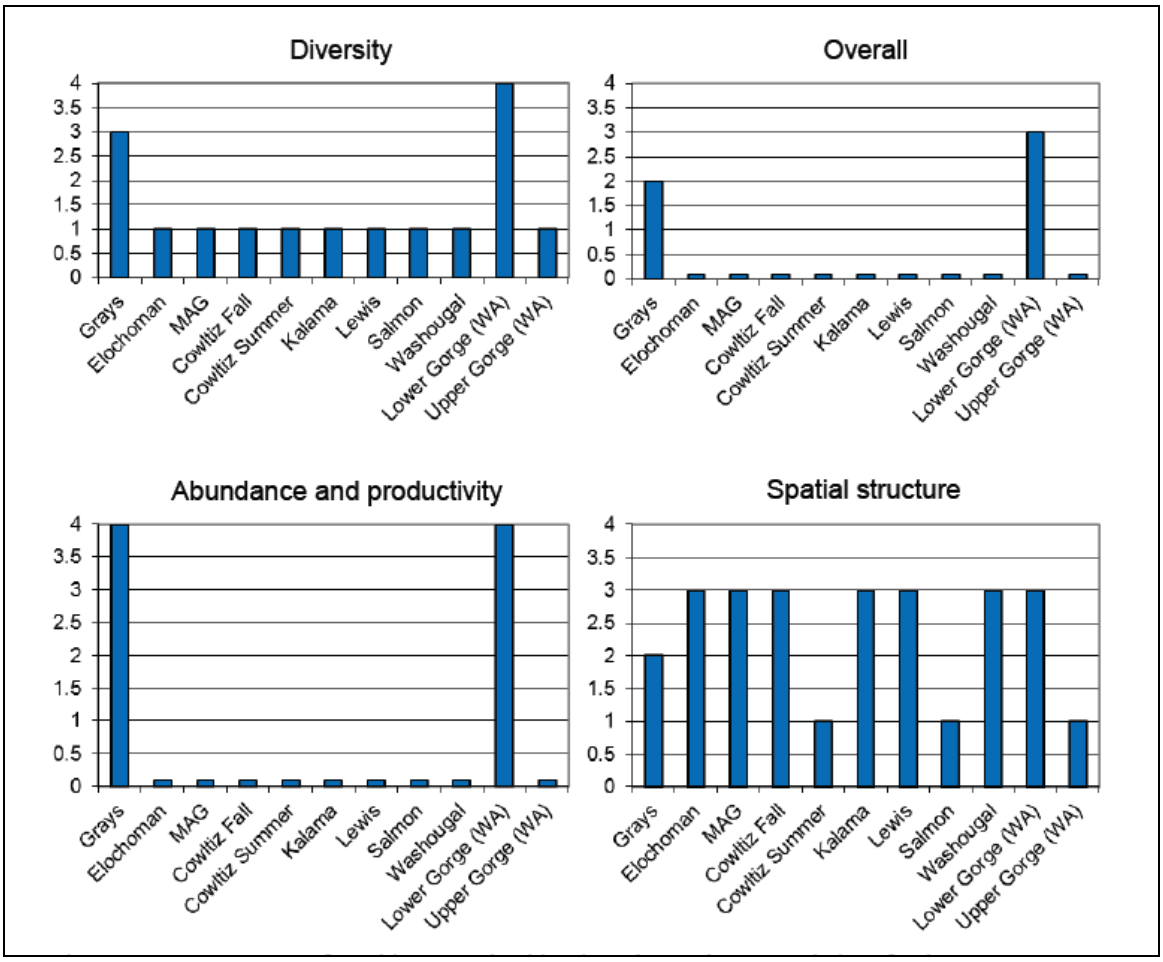

Figure 2.2.2.4: Current status of Washington CR chum populations for the VSP parameters and overall population risk. (LCFRB 2010 Recovery Plan, Chapter 6). A population score of zero indicates a population extirpated or nearly so, a score of 1 is high risk, 2 is moderate risk, 3 is low risk ("viable") and 4 is very low risk (Ford 2011).

- Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population.

See HGMP section 11.1 for planned M&E.

Table 2.2.2.5: Results of preliminary Recruit/Spawner (R/S) analysis, by origin, for chum returns to Grays River Basin, brood years 1998--2012.

Brood Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
# Hatchery Spawners	93	95	174	276	328	305	304	132	117	134	87	108	287	293	219
Age-2 R/S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.00	---	---
Age-3 R/S	6.26	11.74	0.75	0.28	0.62	0.22	0.13	0.23	0.33	1.28	0.00	0.13	---	---	---
Age-4 R/S	3.15	11.51	3.43	0.68	1.36	0.38	0.66	0.51	0.99	5.80	0.16	---	---	---	---
Age-5 R/S	0.07	0.02	0.38	0.01	0.01	0.00	0.00	0.20	0.09	2.10	---	---	---	---	---
Age-6 R/S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	---	---	---	---	---	---
Total Hatchery BY R/S	9.48	23.28	4.55	0.97	1.98	0.60	0.79	1.13	1.41	9.18	0.16	0.13	0.00	---	---
# Natural Spawners	---[1]	---[1]	---[1]	4,159	10,305	15,439	14,177	3,736	5,602	3,649	2,489	2,620	5,798	10,436	10,144
Age-2 R/S	---	---	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	---	---
Age-3 R/S	---	---	---	0.22	0.11	0.08	0.03	0.17	0.33	0.16	0.18	0.39	---	---	---
Age-4 R/S	---	---	---	0.49	0.42	0.19	0.13	0.18	0.97	2.74	3.47	---	---	---	---
Age-5 R/S	---	---	---	0.04	0.03	0.01	0.02	0.02	0.05	0.54	---	---	---	---	---
Age-6 R/S	---	---	---	0.00	0.00	0.00	0.00	0.00	0.00	---	---	---	---	---	---
Total Natural BY R/S	---	---	---	0.74	0.56	0.28	0.18	0.37	1.35	3.44	3.65	0.39	0.00	---	---

Source: Table 14 in Hillson 2013

Table 2.2.2.6: Lower Columbia River Washington tributary coho smolt production estimates, 1997-2011 (WDFW, Region 5).

Year	Cedar Creek	Mill Creek	Abernathy Creek	Germany Creek	Cowlitz Falls Dam	Mayfield Dam
1997	-----	-----	-----	-----	3,700	700
1998	38,400	-----	-----	-----	110,000	16,700
1999	28,000	-----	-----	-----	15,100	9,700
2000	20,300	-----	-----	-----	106,900	23,500
2001	24,200	6,300	6,500	8,200	334,700	82,200
2002	35,000	8,200	5,400	4,300	166,800	11,900
2003	36,700	10,500	9,600	6,200	403,600	38,900
2004	37,000	5,700	6,400	5,100	396,200	36,100
2005	58,300	11,400	9,000	4,900	766,100	40,900
2006	46,000	6,700	4,400	2,300	370,000	33,600
2007	29,300	7,000	3,300	2,300	277,400	34,200
2008	36,340	9,097	5,077	3,976	-----	38,917
2009	61,140	6,283	3,761	2,576	-----	29,718
2010	-----	-----	-----	-----	-----	49,171
2011	-----	-----	-----	-----	-----	43,831

Source: LCR FMEP Annual Report 2010 and WDFW data 2012.

- Provide the most recent 12 year annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.

Table 2.2.2.7: Spring Chinook salmon total spawner abundance estimates in LCR tributaries, 2000-2012.

Year	Cowlitz	Kalama	Lewis
2000	266	34	523
2001	347	578	754
2002	419	898	498
2003	1,953	790	745
2004	1,877	358	529
2005	405	380	122
2006	783	292	857
2007	74	2,150	264
2008	425	364	40
2009	763	34	80
2010	711	0	160
2011	1,359	26	120
2012	1,359	28	200

Source: Joe Hymer, WDFW Annual Database 2012

Table 2.2.2.8: Fall Chinook salmon total spawner abundance estimates in LCR tributaries, 2000-2011[a].

Year	Elochoman River	Coweeman River[a]	Grays River	Skamokawa Creek	Cowlitz River	Green River (Toutle)	SF Toutle River	Kalama River	EF Lewis River	NF Lewis River	Washougal River
2000	884	424	80	482	2,100	1,580	204	3,877	391	6,504	2,757
2001	230	251	104	3	1,979	1,081	102	3,451	245	4,281	1,704
2002	332	566	390	7	3,038	5,654	216	10,560	441	5,518	2,728
2003	2,204	753	149	529	2,968	2,985	327	9,272	607	11,519	2,678
2004	4,796	1,590	745	2,109	4,621	4,188	618	6,680	918	13,987	10,597
2005	6,820	1,090	387	588	10,329	13,846	140	24,782	727	18,913	3,444
2006	7,581	900	82	372	14,427	7,477	450	18,952	1,375	17,106	6,050
2007	194	140	99	36	2,724	961	30	1,521	308	10,934	2,143
2008	782	95	311	253	1,334	824	45	2,617	236	4,268	3,182
2009	231	147	93	139	2,156	1,302	66	4,356	110	6,112	2,995
2010	1,883	1,330	12	268	2,762	605	NE	3,576	314	8,908	4,529
2011	508	2,148	353	41	1,616	668	NE	10,639	334	14,033	2,961

Source: Ron Roler, WDFW Natural Spawn Progress Reports 2012.

* Estimates of total adult and jack fall Chinook. May include fish put upstream of hatchery weirs.

Table 2.2.2.9: Wild winter steelhead escapement estimates for select SW Washington DPS populations, current WDFW escapement goals and LCSRP abundance targets.

Location	Grays River	Elochoman/ Skamokawa	Mill/Abernathy/ Germany
WDFW Escapement Goal	**1,486**	**853**	**508**
LCSRP Abundance Target	**800**	**600**	**500**
2000	1,064	650	380
2001	1,130	656	458
2002	724	370	354
2003	1,200	668	342
2004	1,132	768	446
2005	396	376	274
2006	718	632	398
2007	724	490	376
2008	764	666	528
2009	568	222	396
2010	422	534	398
2011	318	442	270
3-year average	**436**	**399**	**355**
5-year average	**559**	**471**	**394**
10-year average	**697**	**517**	**378**

Source: WDFW data 2012

Table 2.2.2.10: Wild winter steelhead escapement estimates for select SW Washington DPS populations, current WDFW escapement goals and LCSRP abundance targets.

Location	Coweeman	SF Toutle	NF Toutle/ Green	Kalama	EF Lewis	Washougal
WDFW Escapement Goal	**1,064**	**1,058**	**NA**	**1,000**	**1,243**	**520**
LCSRP Abundance Target	**500**	**600**	**600**	**600**	**500**	**350**
2000	530	490	----	921	NA	NA
2001	384	348	----	1,042	377	216
2002	298	640	----	1,495	292	286
2003	460	1,510	----	1,815	532	764
2004	722	1,212	----	2,400	1,298	1,114
2005	370	520	388	1,856	246	320
2006	372	656	892	1,724	458	524
2007	384	548	565	1,050	448	632
2008	722	412	650	776	548	732
2009	602	498	699	1,044	688	418
2010	528	274	508	961	336	232
2011	408	210	416	622	308	204
3-year average	**513**	**327**	**541**	**876**	**444**	**285**
5-year average	**529**	**388**	**568**	**891**	**466**	**444**
10-year average	**487**	**648**	***588**	**1374**	**515**	**523**

Source: WDFW data 2012.
* 7-year average for NF Toutle/Green.

Table 2.2.2.11: Wild summer steelhead population estimates for LCR populations from 2001 to 2011, current WDFW escapement goals, and LCSRP abundance targets.

Location	Kalama	EF Lewis	Washougal	Wind
WDFW Escapement Goal	**1,000**	**NA**	**NA**	**1,557**
LCSRP Abundance Target	**500**	**500**	**500**	**1,000**
2001	286	271	184	457
2002	454	440	404	680
2003	817	910	607	1,096
2004	632	425	NA	861
2005	400	673	608	587
2006	387	560	636	632
2007	361	412	681	737
2008	237	365	755	614
2009	308	800	433	580
2010	370	602	787	788
2011	534	1,084*	956*	1,468
3-year average	**404**	**829**	**725**	**945**
5-year average	**362**	**653**	**722**	**837**
10-year average	**450**	**627**	**652**	**804**

Source: WDFW data 2012.
* Preliminary estimates.

Table 2.2.2.12: Population estimates in monitored locations of chum salmon in the Lower Columbia River.

Location	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Crazy Johnson Creek	---	---	1,051	1,418	3,819	870	1,093	996	865	2,304	3,475
WF Grays River	---	---	6,970	1,407	1,377	1,902	793	1,130	1,814	5,996	2,817
Mainstem Grays River	---	---	5,696	1,379	1,510	1,227	721	750	3,701	2,509	1,717
I-205 area	3,160	2,932	2,324	923	869	576	644	1,154	2,148	4,912	2,586
Multnomah area	1,627	1,174	733	214	321	148	31	106	458	647	120
St Cloud area	---	220	126	97	180	3	1	29	126	343	1
Horsetail area	---	---	115	13	65	25	36	6	54	119	92
Ives area[a]	4,344	808	357	288	466	132	295	171	214	162	230
Duncan Creek[b]	13	16	2	7	42	9	2	26	48	85	4
Hardy Creek	343	413	52	74	109	12	3	46	175	157	75
Hamilton Creek	1,000	435	497	178	251	133	118	142	404	542	352
Hamilton Spring Channel	794	386	220	88	227	47	114	94	190	325	137
Grays return[c]	12,041	16,974	14,020	4,336	6,824	4,133	2,695	2,984	6,667	11,104	8,229
I-205 to Bonneville return	11,280	6,384	4,427	1,882	2,531	1,086	1,244	1,773	3,818	7,291	3,597
Lower Columbia River Total	23,321	23,358	18,447	6,218	9,355	5,219	3,939	4,757	10,485	18,395	11,826

Source: Todd Hillson - WDFW Chum Program 2014

[a] Ives area counts are the carcass tagging estimate plus fish removed for broodstock, except for 2010 through 2013, which were done by a subtraction method.

[b] Totals for Duncan Creek do not include broodstock brought in from mainstem spawning areas, adult trap catch or surveys below monitoring weirs only.

[c] Grays return totals include natural spawners and removed for broodstock.

- Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

Chum salmon in the Lewis have been designated as a "primary" population (LCFRB 2010). The proportion of effective hatchery-origin spawners (pHOS) should be less than 30% of the naturally spawning population for this integrated program per HSRG guidelines (2009). To date, no known hatchery-origin chum salmon adults have been found. As adult returns from this program are not expected until fall 2014, it is likely safe to assume that pHOS has been 0%. See HGMP section 11.1 for planned M&E.

2.2.3 Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of NMFS listed fish in the target area, and provide estimated annual levels of take.

- Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.

Broodstock Program:

Broodstock Collection (*Lewis Basin enhancement program*): Although chum salmon are still present in the Lewis River basin, spawning ground surveys indicate that the population is very small in numbers, likely <20-40 adults spawning per year in the Lewis River and none detected in the EF Lewis River. Small et al (2011) indicated the I-205 population of chum salmon was the genetically appropriate donor stock to use for the Lewis River basin. Broodstock collection is done via seining at the mainstem Columbia River staging/spawning areas. Any non-targeted ESA listed adult salmonds captured during seining are enumerated and released immediately. Up to 160 pairs will be collected via beach seining from the I-205 spawning population to provide hatchery broodstock and if needed adults for direct supplementation into spawning channels. Adults that recruit to either of the hatchery adult traps in the basin could be included in that years' broodstock, or more likely transported to one of the spawning channels and allowed to spawn naturally.

Fish selected for broodstock will be immediately placed into holding tubes and transported to the Washougal Hatchery, where they will be placed in a holding pond until ripe. A similar procedure has been used successfully in the chum recovery project at Grays River, where fish mortality has been less than 3% during the entire project. Modifications to the design of the fish-holding tubes have been made and these improvements appear to have reduced mortality further. Pre-spawning mortalities are estimated at <2%. Broodstock will be lethally-spawned.

Genetic introgression: When hatchery and wild salmon interbreed, genetic material is exchanged between both groups. Mass-marking enables known levels of integration. Indirect "take" from genetic introgression is unknown. Egg-takes are representative of adult arriving throughout the run and the current collection protocol preserves the range of historical return timing for chum salmon in the system. There are no known genotypic, phenotypic, or behavioral differences between the hatchery and natural stock. Indirect take from genetic introgression is unknown.

Rearing:

Operation of Hatchery Facilities: Facility operation impacts include water withdrawal, effluent, and intake compliance (see HGMP sections 4.1 and 4.2). Effluent at outfall areas is rapidly diluted with mainstem flows and operation is within permitted NPDES guidelines.

WDFW has proposed moving hatching and rearing phases to Lewis River Hatchery (beginning in 2014), with spawning and early-incubation phases still taking place at Washougal Hatchery.

RSI locations. Eggs may be transferred to RSIs after sampling at the eyed-egg stage. If used, the proportion of eggs placed in RSIs will be small (5,000 to 50,000), with the bulk of the program

being released as fed-fry. As RSI locations and their contributions are evaluated, the proportion of the release utilizing RSIs may increase.

Indirect take from this program is unknown.

Disease: Over the years, rearing densities, disease prevention and fish health monitoring have greatly improved the health of the hatchery programs. *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries*-Chapter 5 (IHOT 1995) have been instrumental in reducing disease outbreaks. Although pathogens occur in the wild and fish might be affected, they are believed to go undetected with predation quickly removing those fish.

In addition, although pathogens may cause post release mortality in fish from hatcheries, there is little evidence that hatchery origin fish routinely infect natural populations of salmon and steelhead in the Pacific Northwest (Enhancement Planning Team 1986 and Steward and Bjornn 1990). Prior to release, the hatchery population health and condition is established by the Area Fish Health Specialist. This is commonly done one to three weeks pre-release, and up to six weeks on systems with pathogen-free water and little or no history of disease. Indirect take from disease is unknown.

Release:
Transport. Chum are reared at the Lewis River Hatchery to fed-fry size (50-55 mm fork length at 1.0-1.5 g) and eventual release at select locations in the Lewis and EF Lewis rivers. Some mortalities (<100 fry) are expected when juveniles are transported to release sites, as a few individuals may be crushed or injured.

Hatchery Production/Density-Dependent Effects-on-station releases: Hatcheries can release numbers of fish that can exceed the density of the natural productivity in a limited area for a short period of time and can compete with listed fish. Hatchery fish are released as active smolts that will emigrate quickly from the system.

Indirect take from density dependent effects is unknown.

Potential chum predation and competition effects on listed salmonids and eulachon (*Lewis Basin Enhancement program*). All hatchery-origin chum fry are released as fed-fry (250-450 fpp, ~55 mm fork length); newly emerged natural-origin chum fry migrate almost immediately to estuary/marine areas, and range in size from 32- 41 mm (Salo 1991). Due to lack of opportunity, size and life history traits, predation impact on natural-origin salmonids would be low. Indirect take from predation and competition is unknown.

Table 2.2.3.1: Size range (fork length (mm)) during peak migration timing for juvenile chum salmon captured in outmigrant monitoring traps, Lower Columbia River.

Stream/Trap location	Chum Salmon Juvenile Outmigrants	
	Size Range (mm)	Peak Outmigration Time Frame
Grays River mainstem (2008-12)	36-42	March 19-27
Hamilton Springs Spawning Channel (2011-14)	36-42	March 17-April 8

Source: Todd Hillson, WDFW, unpublished data.

Residualism: Juvenile chum salmon smolt and out-migrate as fry, so there are no concerns about residualism.

Monitoring:
Associated monitoring Activities: Interaction between hatchery and wild adult salmonids will be managed by monitoring key tributary escapements of coho, steelhead, cutthroat and chum. Hatchery staff will pay close attention to the recruitment of fish into the adult traps (see also **Broodstock Program** above) and the accumulation of fish below the trap. The following monitoring baseline activities are conducted in the Lower Columbia Management Area (LCMA) for adult steelhead and salmon: redd surveys are conducted for fall Chinook in the SF Toutle,

Coweeman, EF Lewis and Washougal rivers. Redd surveys are also conducted in the Cowlitz River for fall and spring Chinook. Snorkel surveys provide data for summer steelhead populations in the Wind and Kalama rivers. Mark-recapture carcass surveys are conducted to estimate populations of Chinook salmon in Grays, Elochoman, Coweeman, SF Toutle, Green, Kalama, NF Lewis, EF Lewis, rivers and Skamokawa, Mill, Abernathy, and Germany creeks, and for all significant chum salmon populations (>25 spawning pairs annually). In areas with low chum abundance (<25 spawning pairs annually), stream surveys are done to collect data for either Area-Under-the-Curve (AUC) or Peak Count estimates. Snorkel surveys are conducted for summer steelhead in the EF Lewis and Washougal rivers. Trap counts are conducted on the Cowlitz, NF Toutle, Kalama, and Wind rivers, and Cedar Creek (tributary of the NF Lewis River). All sampling of carcasses and trapped fish include recovery of coded-wire tags (CWTs), otoliths or genetic samples for hatchery or wild stock evaluation. Downstream migrant trapping occurs on the Grays, Cowlitz, Coweeman, Kalama, NF Lewis, and Wind rivers, Crazy Johnson (Grays Basin), Mill, Abernathy, Germany, Cedar (Lewis Basin) and Hamilton creeks, as well as in the Duncan Creek and Hamilton Springs chum salmon spawning channels. Juvenile trapping will expand to other basins as part of a salmonid life cycle monitoring program, to estimate freshwater production and wild smolt to adult survival rates. Any take associated with monitoring activities is unknown but all follow scientific protocols designed to minimize impact.

- Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish.

Table 2.2.3.2: Disposition of chum salmon encountered during broodstock seining events.

Brood Year	Spawned	Holding Mortality	Surplus	Released
2011	111	0	0	815
2012	88	0	0	449
2013	102	0	0	481

Source: Todd Hillson - WDFW Chum Program, 2014.

- Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).

Table 2.2.3.2: Projected annual take levels for listed fish by life stage (only includes "take" for I-205 (Lewis Basin Enhancement) chum program.

Type of Take	Description and Range of Takes per Year
Observe or Harass:	*Adults*. WDFW will conduct stream surveys to determine the chum abundance and also to recover carcasses for otolith sampling. "Take" values for stream surveys could range from ~0 (no adults observed) up to several thousand, depending on run size of adults spawning in the I-205 area. Staff will recover otoliths from carcasses to determine whether fish produced from this project home to release locations or show a proclivity to stray; take for otolith sampling could range up to 400 adults. Surveys will occur annually, and continue throughout the project. In addition, scales and genetic samples will be collected from a representative proportion of carcasses. No eggs, fry, or smolts will be subjected to this type of take.
Collect for Transport:	Up to 160adults may be needed for activities relating to the enhancement program.
Capture, Handle, Tag/Mark/Tissue Sample and Release:	*Adults.* When using seines to collect broodstock, a large number of additional adults that are either unsuitable, or not needed, for broodstock are also captured. In big return years the number of "extra" adults captured may reach 2,500. All maiden captures will be measured (FL) and then tagged prior to

	release for mark/recapture population estimation. In addition, a portion of the tagged and released adults will have scale and genetic samples collected prior to release. *Juveniles.* If spawning channels are seeded to capacity with adults, up to 1.25 million fry may be produced. Spawning channels will be monitored to document productivity (egg-to-fry survival rates) resulting in some or all of the fry produced being captured during out-migrant monitoring.
Intentional Lethal Take:	*Egg/Fry*: At spawning, five eggs from each female used in the re-introduction program will not be fertilized. These eggs will be allowed to water-harden before being weighed. The weights will be used in the predictive fecundity regression analysis needed to estimate egg-fry survival rates for adults that spawned naturally in the spawning channels. All artificially-produced fish from this recovery project will receive thermal otolith-marks or be identified via PBT. If thermal marks are applied, samples will need to be collected from each mark group (voucher samples). Otoliths from the voucher fry are extracted, photographed to confirm mark presence and clarity. A total of up to 200 such voucher samples may be collected. Whenever possible we will use abnormal fish for such samples, i.e. those with obvious deformities (e.g. twisted spines, twins, albinos, and so on). Such fish would not normally survive upon release but their otoliths still reflect the artificial bar code patterns induced. *Adult*: Approximately 80-120 adults will be lethally spawned annually.
Unintentional Lethal Take:	*Egg/Fry*: "Take" can range from 0 to around 200 eggs. Eggs may be accidentally damaged during artificial-spawning operations. *Out migrant juveniles*: Fry will be transported to various release areas; "take" can range from 0 up to 100 artificially-produced fry. Some (<0.1% of total fry production) may be injured or killed by dip nets, buckets etc. during this process. Historically, indirect mortalities as a result of fry trapping operations at the Duncan Creek spawning channels range from only a few to <2% of the total out-migrating fry. The magnitude of this take will depend on the number of naturally-spawning chum salmon in the spawning channels above the monitoring weirs. *Adults*: Pre-spawning mortalities are expected to be no more than a one or two adults. The collection and holding tubes used in this project have been employed in other recovery programs, with extremely low mortality rates observed. However, inadvertent injuries caused by how a fish was captured or other stresses may cause adult fish to die while being held. The chum collected for broodstock are mature or very close to spawning stage, resulting in a holding period of only a few days. Such a short holding period will minimize pre-spawning mortality. Chum held in similar tubes at the Grays River and Washougal hatcheries have consistently had very low mortality rates during holding, less than 2%.

The range of values in **Table 2.2.3.1** are based on the assumption that fish in a hatchery situation are not "observed or harassed" during typical operations (e.g., when eggs are shocked, picked, and fry are ponded). The same approach was taken for the other types of takes except for the unintentional lethal takes. Clearly some mortalities will occur in hatchery operations that are above and beyond what might be expected: eggs inadvertently lost during spawning operations; fry accidentally killed during transport; etc. Finally, the ranges primarily represent different levels of intervention. The lowest values would be those we anticipate occurring when only 50 pairs of chum salmon are collected from the I-205 spawning area and the highest represent those expected to occur when 160 pairs are collected for artificial spawning and direct adult supplementation.

See also "take" tables at the end of this HGMP.

- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.

No situations are expected to occur where take would exceed ESA limits. If significant numbers of wild salmonids are observed impacted by this operation, then staff would inform the WDFW Region 5 Species Biologist and District Biologist who, along with the Hatchery Complex Manager, would determine an appropriate plan and consult with NOAA-NMFS for adaptive management review and protocols.

1) This program is an attempt to enhance the existing natural spawning population using the Lewis basin. A minimum collection goal of 35 pairs, was recommended (Schroder 2000) to maintain genetic diversity. This goal will significantly reduce the upper bound of the take levels described in **Table 2.2.3.2**.
2) Broodstock collection and tagging will be activities that will be reduced or curtailed if direct mortalities are observed in the field or pre-spawn mortality increases at the hatchery.
3) If mortality during rearing noticeably increases, a state fish pathologist will be called to evaluate the fry and recommend treatment actions.
4) The protocols used in this project have been tried and evaluated in numerous chum salmon recovery efforts. As this project proceeds, improvements to these techniques will be implemented on as needed basis.

3 SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1 Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. Hood Canal Summer Chum Conservation Initiative) or other regionally accepted policies (e.g. the NPPC Annual Production Review Report and Recommendations - NPPC document 99-15). Explain any proposed deviations from the plan or policies.

This program is consistent with the *Columbia Basin System Planning Salmon and Steelhead Production Plan* for chum salmon in the lower Columbia Sub-basin. Planners recommended that a combination of natural and hatchery production would be the optimal way to produce the most rapid sustainable improvement in chum runs. It assumed the quickest way to rebuild the run would be to combine releases of an appropriate stock into improved habitat (WDF 1990). This approach is being applied in this program.

WDFW has several policies/plans that help inform management decisions regarding the HGMPs currently under review. These policies include:

1. Hatchery and Fishery Reform Policy (Commission Policy C3619)
2. The Conservation and Sustainable Fisheries Plan (draft)
3. The Hatchery Action Implementation Plans (HAIP)
4. Lower Columbia Salmon Recovery Plan (LCSRP)
5. Summer Chum Salmon Conservation Initiative (SCSCI).
6. Lower Columbia River Chum Salmon Reintroduction/Enhancement Plan (in development)

Descriptions of these policies and excerpts are shown below:

Policies/Plans – Key Excerpts

Hatchery and Fishery Reform Policy: Washington Department of Fish and Wildlife Commission Policy C-3619. WDFW adopted the Hatchery and Fishery Reform Policy C-3619 in 2009. Its purpose is to advance the conservation and recovery of wild salmon and steelhead by promoting

and guiding the implementation of hatchery reform. The intent of hatchery reform is to improve hatchery effectiveness, ensure compatibility between hatchery production and salmon recovery plans and rebuilding programs, and support sustainable fisheries. WDFW Policy C-3619 works to promote the conservation and recovery of wild salmon and steelhead and provide fishery-related benefits by establishing clear goals for each state hatchery, conducting scientifically defensible-operations, and using informed decision making to improve management. It is recognized that many state operated hatcheries are subject to provisions under *U.S. v Washington* (1974) and *U.S. v Oregon* and that hatchery reform actions must be done in close coordination with tribal co-managers. Washington Fish and Wildlife Commission Policy: POL-C3619.

Guidelines from the policy include:

1. Use the principles, standards, and recommendations of the Hatchery Scientific Review Group (HSRG) to guide the management of hatcheries operated by the Department.
2. Develop watershed-specific action plans that systematically implement hatchery reform as part of a comprehensive, integrated (All-H) strategy for meeting conservation and harvest goals at the watershed and Evolutionarily Significant Unit (ESU)/Distinct Population Segment (DPS) levels. Action Plans will include development of stock (watershed) specific population designations and application of HSRG broodstock management standards.

Conservation and Sustainable Fisheries Plan (*CSFP*)*:* The CSFP is a draft plan that has been developed to meet WDFW's responsibilities outlined in the Lower Columbia Salmon Recovery Plan (LCSRP) and address the HSRG suggested solutions and achieve HRSG standards for primary, contributing and stabilizing populations. The plan describes the implementation of changes to hatchery and harvest programs and how they assist in recovery and achieve HSRG guidelines. The draft plan also identifies Viable Salmonid Population (VSP) parameters that will be addressed.

Hatchery Action Implementation Plans (*HAIP*)*:* The HAIPs illustrate how WDFW is implementing hatchery programs to incorporate the HSRG guidelines. The plans provide the current programs and explain the future goals.

Lower Columbia Salmon Recovery Plan (*LCSRP*)*:* Some sub-basins will be free of hatchery influence and hatchery programs. In other sub-basins, hatchery programs will serve specific conservation and harvest purposes consistent with goals for naturally-spawning populations. The mosaic of programs is designed to ensure that overall each DPS will be naturally self-sustaining.

Summer Chum Salmon Conservation Initiative (*SCSCI*). Summer chum supplementation, habitat restoration and harvest management measures are integrated as presented in the *Summer Chum Salmon Conservation Initiative* (WDFW and PNPTT 2000). The SCSCI provides a standardized approach to determine freshwater and estuarine limiting factors in each summer chum watershed. The goal of the habitat protections and restoration strategy is to maintain and recover the full array of watershed and estuarine-nearshore processes critical to the survival of summer chum across all life stages. See also *Lower Columbia River Chum Salmon Reintroduction/Enhancement Plan*.

Lower Columbia River Chum Salmon Reintroduction/Enhancement Plan (*LCRCREP*)*:* This document is a work in progress. It will follow the framework established in the *Summer Chum Salmon Conservation Initiative*. The overarching goal is to improve the VSP parameters for Lower Columbia River chum salmon by reestablishing populations in historical usage areas or enhancing existing populations that have persisted at low abundance levels. This will be accomplished by using one or more of the following strategies: 1) releases of fed-fry from hatcheries, 2) releases of unfed-fry from RSIs or 3) adult releases into spawning channels. Regardless of the strategy(s) used, the source population will be from a genetically appropriate

stock (Small *et al*, 2011). Reintroduction or enhancement releases will phased to take advantage of habitat restoration activities in basins as they occur or are planned.

Strategies:

1. Reconfigure production-based hatchery programs to minimize impacts on natural populations and complement recovery objectives.
2. Adaptively manage hatcheries to respond to future knowledge, enhance natural production, and improve operational efficiencies.

3.2 List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.

Future Brood Document. Hatchery salmon and steelhead production levels are detailed in the annual Future Brood Document, a pre-season planning document for fish hatchery production in Washington State for the upcoming brood stock collection and fish rearing season (July 1 – June 30).

See also HGMP section 3.1.

3.3 Relationship to harvest objectives.

The Columbia River historically contained large runs of chum salmon that supported a substantial commercial fishery in the first half of this century. These landings represented a harvest of half a million chum salmon in the Columbia River in some years (NMFS Status Review 1996). By 1955, harvest had diminished to 10,000 fish and by 1965, less than 2,000 fish per year were harvested.

The parties to *U.S. v Oregon* negotiated a plan covering fisheries from January 2008 through December 2017. This agreement, titled "2008-2017 *U.S. v Oregon* Management Agreement" (2008-2017 MA), provides specific fishery management constraints for fall Chinook, steelhead, and coho. A Biological Assessment concerning Columbia River treaty Indian and non-Indian fisheries, as described in the 2008-2017 MA, was submitted to the NMFS. NMFS issued a Biological Opinion (BiOp), which covers mainstem fisheries through December 31, 2017. Guidelines from the 2008-2017 Management Agreement stated that "non-Indian fisheries will be managed for an impact of less than 5% for Columbia chum salmon" (WDFW/ODFW 2009).

Commercial harvest rates from 2009-2013 averaged less than 2% on the minimum chum run size (WDFW/ODFW 2009-2013). Possession and sales of chum salmon was prohibited by Compact Action on September 26, 2013 for non-treaty commercial fisheries beginning in October 2013.

3.3.1 Describe fisheries benefitting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available.

There are no Columbia River commercial fisheries which target chum. WDFW currently has no way to monitor for impacts of Lower Columbia commercial fisheries on chum salmon.

Angling for and retaining chum has been closed on the Oregon side of the Columbia River since 1992 and on the Washington side since 1995.

3.4 Relationship to habitat protection and recovery strategies.

The following processes have included habitat identification problems, priority fixes and evolved as key components to the *Salmon-Washougal and Lewis Watershed Plan WRIAs 27-28* (July 21, 2006), the *Lower Columbia Salmon Recovery and Fish and Wildlife Sub-basin Plans* (LCFRB 2010), and the *Lower Columbia River Salmon and Steelhead ESA Recovery Plan* (Dornbusch and Sihler 2013).

Sub-Basin Planning - Regional sub-basin planning processes include the Lewis River Sub-basin Salmon and Steelhead Production Plan, September 1, 1990 with a more recent Draft Lewis River Sub-basin Summary (May 17, 2002) was prepared for the Northwest Power Planning Council (NPPC). The Sub-basin efforts provided initial building blocks for the LCFRB regional recovery plan. The Lower Columbia fish Recovery Board (LCFRB) has adopted the *Lower Columbia Salmon Recovery and Fish and Wildlife Sub-basin Plans* (LCFRB 2010) with the understanding that implementation of the schedule and actions for local jurisdictions depends upon funding and other resources.

Habitat Treatment and Protection - Ecosystem Diagnosis and Treatment (EDT) compares habitat today to that of the basin in a historically unmodified state. WDFW is also conducting a *Salmon Steelhead Habitat Inventory Assessment Program* (SSHIAP), which documents barriers to fish passage. WDFW's habitat program issues hydraulic permits for construction or modifications to streams and wetlands. This provides habitat protection to riparian areas and actual watercourses within the watershed.

Limiting Factors Analysis (LFA) - A WRIA 27 (Kalama, North Fork Lewis River, and East Fork Lewis River/Salmon Creek) LFA was conducted by the Washington State Conservation Commission (Wade 2000).

3.5 Ecological interactions.

(1) *Salmonid and non-salmonid fishes or species that could negatively impact the program:* Outmigrant hatchery fish can be preyed upon through the entire migration corridor from the river sub-basin to the mainstem Columbia River and estuary. Northern pikeminnows and introduced spiny rays, as well as avian predators, including gulls, mergansers, cormorants, belted kingfishers, great blue herons and night herons in the Columbia mainstem sloughs, can prey on chum fry. Mammals that can take a heavy toll on migrating smolts and returning adults include: harbor seals, sea lions, river otters and orcas.

(2) *Salmonid and non-salmonid fishes or species that could be negatively impacted by the program:* Co-occurring natural salmon and steelhead populations in local tributary areas and the Columbia River mainstem corridor areas could be negatively impacted by program fish. Of primary concern are the ESA listed endangered and threatened salmonids: Snake River fall-run Chinook salmon ESU (threatened); Snake River spring/summer-run Chinook salmon ESU (threatened); Lower Columbia River Chinook salmon ESU (threatened); Upper Columbia River spring-run Chinook salmon ESU (endangered); Columbia River chum salmon ESU (threatened); Snake River sockeye salmon ESU (endangered); Upper Columbia River steelhead ESU (endangered); Snake River Basin steelhead ESU (threatened); Lower Columbia River steelhead ESU (threatened); Middle Columbia River steelhead ESU (threatened); and the Columbia River distinct population segment of bull trout (threatened). Listed fish can be impacted through a complex web of short and long term processes and over multiple time periods which makes evaluation of this a net effect difficult. WDFW is unaware of studies directly evaluating adverse ecological effects to listed salmon. In addition the program may have unknown impacts on eulachon populations in the basin.

(3) *Salmonid and non-salmonid fishes or other species that could positively impact the program.* Multiple programs including fall Chinook, coho and steelhead programs are released from the Lewis Hatchery Complex, and limited natural production of Chinook, coho, chum and steelhead occurs in this system along with non-salmonid fishes (sculpins, lampreys and sucker etc.).

(4) *Salmonid and non-salmonid fishes or species that could be positively impacted by the program.* Hatchery fish provide an additional food source to natural predators (see #1 in this section) that might otherwise consume listed fish and may overwhelm established predators providing a beneficial, protective effect to co-occurring wild fish. Hatchery releases can also

behaviorally encourage mass emigration of multiple species through the watershed, reducing residency. Many watersheds in the Pacific Northwest appear to be nutrient-limited (Gregory et al. 1987; Kline et al. 1997) and salmonid carcasses can be an important source of marine derived nutrients (Levy 1997). Carcasses from returning adult salmonids have been found to elevate stream productivity through several pathways, including:

a) the releases of nutrients from decaying carcasses has been observed to stimulate primary productivity (Wipfli et al. 1998);

b) the decaying carcasses have been found to enrich the food base of aquatic invertebrates (Mathisen et al. 1988); and

c) Juvenile salmonids have been observed to feed directly on carcasses (Bilby et al. 1996).

4 SECTION 4. WATER SOURCE

4.1 Provide a quantitative and narrative description of the water source (spring, well, surface), water quality profile, and natural limitations to production attributable to the water source.

Table 4.1.1: Water sources for Washougal and Lewis River hatcheries.

Facility	Water Source	Water Right		Available Water Flow	Avg Water Temp. (ºF)	Usage	Limitations
		Record/Cert. No.	Permit No.				
Washougal Hatchery	Washougal River (surface)	S2-*13405C WRIS/ 07058	10084	10.0 cfs	48.7	Rearing	Limited water during summer months due to low flows. Temps in lower river can reach the 70s in the summer.
		S2-25274C WRIS	-----	12.0 cfs			
	Boyles Cr. (spring water)	S2-CV2P694/ 07316	07327	5.5 cfs	49.3	Rearing	Low water flows in summer July-Sept
	Bob Creek (surface)	S2-*09760CWRIS/ 07314	07325	3.0 cfs	48-49	Rearing, incubation	None.
Lewis River Hatchery	Lewis R (lower intake)	S2-CV2P903/ 01084	01590	6 cfs	48-50	Adult holding/ spawning, incubation, rearing	Elevated water temperatures in the summer.
		S2-23233C WRIS	-----	2 cfs			
	Lewis R (upper intake)	S2-24939C WRIS	-----	60 cfs			

Washougal Hatchery. Water rights total 15,061 gpm from four sources.

Four electric pumps deliver river water to the hatchery at 1,600 gpm each from intakes on the Washougal River. Two turbine-driven pumps can also provide water at up to 2,000 gpm each; the turbine pumps provided up to 700 gpm prior to replacement in 2012. An emergency generator located in the pump house can run the electric pumps in case of power outage. During lower-use periods (November/December), the river intake supplies 3,500 gpm (7.8 cfs); from March through August, use increases to 7,500 gpm (16.7 cfs).

Spring water from Boyles Creek, located approximately 75 yards from the hatchery, supplies 2,300 gpm (5.1 cfs) non-turbid and minimal silt-laden water to the hatchery during high flow river events and is used for ponds 1 thru 6 as well as 25, 26 & 27 for fall Chinook rearing. Since this is a short stream from a spring source, the agency has determined there are no fish

populations within this stretch and does not need a screen intake. A gravity intake on Bob Creek is located 1/3 mile from the grounds and supplies 2.5 cfs for incubation. "C-Creek", another small spring source, is not used anymore (Richard Johnson, pers. comm., 2004).

The water right permit for the Washougal Hatchery is formalized through the Washington Department of Ecology (see **Table 4.1.1**), and were obtained in 1950.

Lewis River Hatchery Water rights total 38,613 gpm from the Lewis River via the upstream reservoirs. All river water flow to the Lewis facility is provided via pumps. Water clarity is usually good, but can be water temperatures in the summer may be elevated. Ambient river temperatures during June through October can exceed 60°F (pers. comm. Mike Chamberlain 2014).

The Lewis River Settlement Agreement (2004) outlined repairs and upgrades needed to the intake structures at Lewis River Hatchery. Modifications to upstream intake were completed in 2012; modifications to the downstream intake are scheduled for 2015.

The water right permit for the Lewis River Hatchery is formalized through the Washington Department of Ecology (see **Table 4.1.1**), and were obtained in 1930, 1974 and 1978.

NPDES Permits:
These facilities operate under the "*Upland Fin-Fish Hatching and Rearing*" *National Pollution Discharge Elimination System* (NPDES) general permit which conducts effluent monitoring and reporting and operates within the limitations established in its permit administered by the Washington Department of Ecology (DOE).

Discharges from the cleaning treatment system are monitored as follows:

- *Total Suspended Solids* (*TSS*) 1 to 2 times per month on composite effluent, maximum effluent and influent samples.
- *Settleable Solids* (*SS*) 1 to 2 times per week on effluent and influent samples.
- *In-hatchery Water Temperature* - daily maximum and minimum readings.

Table 4.1.2: Record of NPDES permit compliance.

Facility/ Permit #	Reports Submitted Y/N			Last Inspection Date	Violations Last 5 yrs	Corrective Actions Y/N	Meets Compliance Y/N
	Monthly	Qtrly	Annual				
Washougal WAG13-1026	Y	Y	Y	07/25/2012	0	N	Y
Lewis WAG13-1040	Y	Y	Y	5/2/2013	0	N	Y

Source: Ann West, WDFW Hatcheries Headquarters Database 2014.

4.2 Indicate risk aversion measures that will be applied to minimize the likelihood for the take of listed natural fish as a result of hatchery water withdrawal, screening, or effluent discharge.

Washougal Hatchery. Washougal Hatchery withdraws water from the river at two locations (see HGMP section 4.1), which can reduce low flows in late-summer and early-fall from the sections between the intake to where the non-consumptive water rejoins the river (a distance of 0.5 mile) (Mitchell Act Hatcheries Intake and Passage Study -April 2003).

The intake structures were designed and constructed to specifications at the time the Washougal facility was built. The *Mitchell Act Intake and Screening Assessment* (2002) determined that the intake screens and velocity at Washougal Hatchery are not compliant with NOAA fish screening standards. The allowable velocity of 0.40 fps is exceeded and the backup pump is too close to the screen area, causing high approach velocities. WDFW has requested funding for future scoping, design, and construction work of a new intake system.

Feeder creek streams are spring-fed and determined to be non-fish bearing streams, therefore, of no impact. Due to the steep elevation and grade, the stream is a natural barrier to fish and Bob Creek in not a fish-bearing stream.

Lewis River Hatchery. Fish rearing activities meet State water quality guidelines and satisfy all required permits.

- Program fish are confined in structures until an active smolting phase and time is achieved.
- Discharge effluents are under NPDES permit guidelines for monthly feed limits and total program production.

5 SECTION 5. FACILITIES

5.1 Broodstock collection facilities (or methods).

Beach seines (200' x 12' with ¼ inch mesh "sinking" type) are used to collect broodstock from the I-205 spawning population; the sinking style net allows fishing in deeper water. Adults are captured as they staged and spawned in shallow water (< 18' deep). Seines are set on foot or by boat, depending on flow conditions and water depths.

5.2 Fish transportation equipment (description of pen, tank truck, or container used).

Table 5.2.1: Transportation equipment available, Washougal Hatchery.

Equipment Type	Capacity (gallons)	Supp. Oxygen (y/n)	Temp. Control (y/n)	Chemical(s) Used	Dosage (ppm)
F450- flatbed pick-up with fry tank	400	Y	N	Sodium Chloride (Salt)	5,000 ppm (~0.5%)

Adults. Upon capture, each fish will be placed into its own holding tube. The tubes will be a 10-inch wide (25.4 cm) by 3-ft long (91 cm) PVC pipe, perforated with 1.5" (4 cm) in diameter holes and equipped with removable end pieces or caps. At the end of the collection day, the tubes will be placed live in a 400-gallon tank truck and transported the Washougal Hatchery for artificial spawning. The transport truck is equipped with an oxygen supply. Transport time from collection site to Washougal Hatchery is 30 minutes.

Eggs. Eyed-eggs will be transferred from Washougal Hatchery to Lewis River Hatchery for the remaining incubation time frame. Transport time to Lewis River Hatchery is approximately 90 minutes.

Juveniles. Lewis River Hatchery uses Washougal Hatchery's 400-gallon tank truck to transport fry from Lewis River Hatchery to their release sites. Supplemental oxygen is used during transport. Transport time from the hatchery to the EF Lewis release site is ~35 minutes.

5.3 Broodstock holding and spawning facilities.

Table 5.3.1: Broodstock holding and spawning facilities available, Washougal Hatchery.

Type	Units (number)	Volume (cu.ft.)	Size (ft)			Flow (gpm)
			Length	Width	Depth	
Asphalt Adult holding pond	1	100,825	185	109	5	11,225

Washougal Hatchery. Adults kept in their holding tubes in the asphalt-lined pond. Spawning occurs under cover, in the incubation room. All biological data collections, factorial matings, and PVP (iodine) treatment will take place in the incubation room.

5.4 Incubation facilities.

Table 5.4.1: Incubation vessels available, Washougal Hatchery..

Type	Units (number)	Size			Flow (gpm)	Volume (cu.ft.)	Loading (eggs/unit)
		Length	Width	Depth			
Vertical Stack Tray Units (16 trays/stack)	72 (1,152 trays)	24-in	25-in	4-in	4-5	0.55/tray	8,000
Fiberglass DeepTroughs w/ cell baffles (9-cells/trough)	4	14-ft	3-ft	25-in	8-12	87	10,000
Concrete ShallowTroughs	2	15-ft	1-ft	8-in		10	

Washougal Hatchery. Eggs from two females are combined in a single tray in the vertical stack incubators. Water chillers and flex hoses have been installed at the hatchery to enable thermal-marking, if needed, while the eggs are incubating.

Table 5.4.2: Incubation vessels available at Lewis Hatchery.

Facility	Type	Units (number)	Size	Flow (gpm)	Volume (cu.ft.)	Loading (eggs/unit)
Lewis	Vertical Stack Tray Units	50 units (16 tray stacks)	24" x 25' 'x 4"	5.0	n/a	8,000

Lewis River Hatchery. The facility has an egg-eyeing capacity of 11-million, and utilizes FAL verticals and bulk eyeing troughs. Incubation water is supplied from the Lewis River via pumps and is equipped with a de-gassing tower to be used when total gas levels exceed the accepted standard. A backup pump is available if needed and the system is alarmed at several points to provide backup if one system fails. In case of power failure, the system is fully served by one of two auxiliary generators. Eggs are incubated on North Fork Lewis River water. Water temperature ranges from 48-50°F with a DO of 10.5ppm.

5.5 Rearing facilities.

Table 5.5.1: Rearing facilities at Lewis River Hatchery.

Ponds (No.)	Pond Type	Volume (cu.ft)	Length (ft.)	Width (ft.)	Depth (ft.)	Flow (gpm)	Max. Density Index
3	Fiberglass intermediate tanks	105.2	15.8	3.33	2	40	0.3
12	Concrete Raceways	4,000	100	10	4	300	0.3
2	Concrete raceways (Pond 13)	26,000	190	20	7	4,000	0.3
2	Concrete raceways (Pond 13)	28,000	200	20	7	4,000	0.3
4	Concrete raceways (Pond 14)	24,500	175	20	7	4,000	0.3
3	Concrete raceways (Pond 16)	15,600	120	20	6.5	2,000	0.3
3	Concrete raceways (Pond 16)	12,480	120	16	6.5	2,000	0.3

Note: Raceways are not used for chum rearing.

Lewis River Hatchery. Chum fry are reared at Lewis River Hatchery in fiberglass deep troughs that are set on the ground next to the raceway de-gassing tower. The water supply plumbed is into a water manifold straight from the raceway de-gassing tower to provide flow to individual troughs.

5.6 Acclimation/release facilities.

Lewis Basin Enhancement: There are two options for rearing and releasing fry artificially produced for Lewis/EF Lewis river enhancement:

1. Fry will be reared at the Lewis River Hatchery to final rearing to size and are then direct-released into select sites in the Lewis and EF Lewis:

Swanson's spawning channel was constructed in 2002, in an existing side channel connected to the EF Lewis River. It is located at RKm 10.5, on private property east of La Center. This site is maintained by various volunteer conservation and cooperative enhancement groups, including Fish First and Friends of the EF Lewis River. The channel is approximately 121.9-m long and 9.1-m wide.

Eagle Island spawning channel. Eagle Island is located in the mainstem Lewis River between RKms 16.1 and 19.3, where the river splits into north and south channels around the island. This spawning channel is scheduled for construction in the spring/summer 2015, and will be built on State-owned land, on the south shore of the Lewis River near the upper end of Eagle Island (~ RKm 18.2). The channel will be ~ 1,400 feet long and have the capacity for ~700 spawning pairs (spawner density of one female per m^2 of spawning area).

Dave Brown's Northwest Wild Fish Rescue. Privately-owned facility on Mill Creek, near Battleground, tributary to the EF Lewis River at RKm 15.1, this program has been operating since 1992. Under permits from WDFW and NOAA, the program rescues fry from dried-up creeks in the Clark County (EF Lewis and Salmon Creek), and raises them in rearing pens in spring-fed concrete-lined ponds, until they are released back into their natal streams. The ponds, constructed in 2007, includes shelter, predator netting, automatic fish feeders, and double-filtered spring water to maintain water temperatures. This project is supported by WDFW and Fish First (volunteer co-operative enhancement group). Chum fry are transferred to this site two to three weeks before release.

2. PBT-marked eyed-eggs may be transported into RSIs at select locations in the Lewis/EF Lewis basin. RSIs would be plumbed with a water source (either direct flow or pumped) and monitored via an alarm system. After hatching, swim-up fry would be funneled into a catchment container for enumeration prior to release into the system.

5.7 Describe operational difficulties or disasters that led to significant fish mortality.

No operational difficulties or disasters have led to significant fish mortality.

5.8 Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.

Washougal Hatchery:

- All pumps, broodstock holding, incubation and rearing receptacles have water loss alarms.
- One main river pump is kept specifically as a back-up in case of mechanical failure.
- Backup generator system is automatic in case of power loss.
- Multiple water sources (Boyles and Bob Creeks) are gravity-fed and can be used in case of total power and/or backup generator failure.
- Staff is available 24/7 to respond to pump failure, water loss, and flooding events.
- Aeration pumps are used to maximize the water conditions in the adult collection pond during periods of low water quality which benefits fish held until sorting can be accomplished.
- Fish health protocols through broodstock collection, incubation and rearing phases are followed and monitored monthly.
- Staff monitors the trap operation daily to keep the numbers of fish stacking in the trap area to manageable volumes. Heavy volumes can create density problems for listed fish if they are not removed expeditiously.

Because the water supply at Washougal Hatchery is a gravity fed system, the likelihood of a disruption in water service is very low. If that were to occur, several management steps will take place.

1. If the fish are still in the egg stage, all water in the incubator trays will be drained off and the eggs will be kept moist for up to twenty-four hours or until the water supply is reconnected. If the water supply cannot be restored after twenty-four hours, the trays will receive re-circulated water that has been aerated and passed through a charcoal filter system until the eggs hatch, the water supply restored or stage of development allows for the eggs to be moved to another facility.
2. If water loss occurs after hatching then all the trays would be held in one of the hatchery's raceways until repairs are made.
3. If the water supply is interrupted during the rearing period, pumps would be installed to re-circulate raceway water and compressed air will be delivered to the raceways if necessary. This would continue until repairs were made, if repairs were impossible to make, fry would be moved off station to another facility or reared in seep areas located in Hardy, Hamilton, and Duncan creeks.

Lewis River Hatchery:
A prolonged loss of hatchery water supply would result in catastrophic loss of all rearing units, with incubation and the raceways being most vulnerable. Under a temporary cessation of the surface water supply, water can be re-directed from other supply sources as first pass or re-use to the units. Hatchery is staffed 24/7 and ready to react to system failure and WDFW has emergency procedures and plans in place. All systems are alarmed to alert us of failure.

IHOT fish health guidelines are followed. WDFW fish health specialists conduct inspections monthly and problems are managed promptly to limit mortality and reduce possible disease transmission. In the event of possible virus outbreak, WDFW facilities follow very strict disinfection procedures and comprehensive lab analysis of all egg-takes for culling, if needed.

6 SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

Describe the origin and identity of broodstock used in the program, its ESA-listing status, annual collection goals, and relationship to wild fish of the same species/population.

6.1 Source.

Broodstock are collected from adults using the I-205 spawning areas (Woods and Rivershore), both located just upstream of the I-205 Bridge.

6.2 Supporting information.

6.2.1 History.

Lewis Basin Enhancement. The broodstock for this program will be constructed from chum spawning in the mainstem Columbia River at the I-205 spawning locations. Adults at these locations are expected to be nearly 100% natural-origin, as there have been no hatchery releases made in these areas and few recoveries of hatchery-origin adults (recent five-year average pHOS >0.3%). Small et al. (2011) identified the I-205 population as the most appropriate donor stock to use for an enhancement program in the Lewis Basin if the existing local stock was not available. Ideally, broodstock collected from in-basin sources would be used, but the annual returns of chum salmon to this basin are too low (20-50 adults) to support broodstock collection efforts.

6.2.2 Annual size.

Annual broodstock collection totals will vary, but at a minimum will likely be ~80 adults with a maximum of 320 adults if direct adult supplementation is being used in the spawning channels.

6.2.3 Past and proposed level of natural fish in broodstock.

The proposed level of natural fish in the broodstock is 100%. However, since returning adults origins are determined by either otolith decoding or PBT, rather than external fin-clips, the proportion is unknown until after spawning. However, pNOB has been very high for the first two years of the program (99.1% and 98.8% for brood years 2011 and 2012 respectively).

6.2.4 Genetic or ecological differences.

There are no known genotypic, phenotypic, or behavioral differences between the natural spawning and fish collected for broodstock. The most recent genetic stock analysis can be found in Small et al (2011).

6.2.5 Reasons for choosing.

Small et al. (2011) identified the I-205 population as the most appropriate donor stock, based on genetic linkages and distance, to use for an enhancement program in the Lewis Basin if the existing local stock was not available.

6.3 Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.

Broodstock collection will span the months of November and December to preserve the temporal integrity of the run. The total number of broodstock needed will be divided into weekly collection goals based on arrival/spawn timing curves. A minimum of 35 pairs will be collected for to maintain genetic diversity, per Schroder (2000). When possible, fry will be acclimated at their release sites.

7 SECTION 7. BROODSTOCK COLLECTION

7.1 Life-history stage to be collected (adults, eggs, or juveniles).

Adults

7.2 Collection or sampling design.

Broodstock will be randomly collected throughout the entire run (November through December) using beach seines (see HGMP section 5.1). Females included in the broodstock need to be in good condition, show no, or little, signs of redd digging activity, and have a firm belly indicating a complete egg-mass. Males needed to be at least in fair condition and produce milt when checked for ripeness.

Broodstock collection goals are set before the season begins, using abundance data from Columbia River tributary spawning locations over previous seasons. This total is then divided up into weekly goals; if weekly goals are not met, additional adults could be collected during the following weeks to meet the cumulative collection total.

7.3 Identity.

Chum salmon spawning at the mainstem Columbia River I-205 areas have been shown to be genetically distinct from those spawning farther upstream near Bonneville Dam (Small et al, 2011). It is likely that a few adults from the near Bonneville Dam population are present every year in the I-205 spawning area. Hatchery-origin chum produced for the Duncan Creek Chum Reintroduction Program have been also been adipose fin-clipped from brood years 2009-2013, in addition to the thermal otolith-mark, to allow for visual identification and would be excluded for broodstock selection. However, channel-origin adults produced from the Duncan Creek spawning channel were only otolith-marked (Strontium), and are not visually identifiable. The recent five-year pNOB for the I-205 spawning area is 98.8%.

Starting in 2014, genetic material will be collected from broodstock and natural spawning adults, origin will be determined via Parentage-based Tagging (PBT) to profile the population.

Program goal (assuming 1:1 sex ratio for adults): ~80-320 dependent on strategies used.

See HGMP section 6.2.2.

7.3.1 Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:

Table 7.4.2.1: Broodstock and resulting egg-take, by sex and origin, Lewis Basin Enhancement program (I-205 chum).

Brood Year	I-205						
	Estimated Green Egg-Take	Females			Males		
		Natural-Origin	Hatchery-Origin	Channel-Origin	Natural-Origin	Hatchery-Origin	Channel-Origin
2011	115,782	57	0	0	53	0	1
2012	111,396	43	0	1	44	0	0
2013	112,204	51*			51*		

Source: Todd Hillson – WDFW Chum Program, 2014.
* Origin analysis not complete as of September 2014.

7.4 Disposition of hatchery-origin fish collected in surplus of broodstock needs.

Adults captured in excess of broodstock needs are tagged and released to spawn naturally. The tagging operation is essential to estimate population status and take.

7.5 Fish transportation and holding methods.

Selected fish will be held in perforated 25 cm diameter x 122 cm long PVC holding tubes, placed in a truck mounted tank and supplied with oxygen, and hauled about 30 miles to the Washougal Hatchery; transport time is about 30 minutes. The tubes are placed into the asphalt-lined adult holding pond, and will remain in the tube until it is spawned, generally within two days of capture.

7.6 Describe fish health maintenance and sanitation procedures applied.

WDFW facilities follow Integrated Hatchery Operations Team (IHOT), Pacific Northwest Fish Health Protection Committee (PNFHPC), WDFW's *Fish Health Manual* (November 1966, updated March 1998, revised March 2010) or tribal guidelines. Fish Health Specialists make monthly visits and consult with staff. The adult holding area is separated from all other hatchery operations.

At spawning, ovarian fluids (females) and kidney/spleen tissues (males and females) are collected and later assayed for viral pathogens. Whenever abnormal behavior or mortality is observed, a WDFW Fish Health Specialist will examine the affected fish, make a diagnosis, and recommend the appropriate remedial or preventative measures.

Disinfection procedures that prevent pathogen transmission between stocks of fish are implemented during spawning: all equipment and personnel use disinfection procedures (iodophor) upon entering or exiting the area. The spawning area and spawning implements are disinfected at the end the spawning day. All eggs brought to the facility are surface-disinfected with iodophor, per *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006). All equipment (nets, tanks, rain gear) will be disinfected with iodophor at the end of every spawning session.

Eggs collected on each spawning day will be physically isolated from one another by separate incubation units. Incubation units are further isolated by plastic curtains. The intent of these activities is to prevent the horizontal spread of pathogens by splashing water.

Tanks used to transport adults and fry will be disinfected after each use. Footbaths containing iodophor will be strategically located on the hatchery grounds (i.e. entrance to the hatchery building) to prevent spread of pathogens.

7.7 Disposition of carcasses.

All carcasses (spawned and un-spawned) from the hatchery portions of either program will either disposed of by contracted fish buyer, or used for nutrient enhancement in the Washougal River watershed.

7.8 Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.

The risk of fish disease amplification will be minimized by following *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006) guidelines. Genetic risks will be minimized by collecting and spawning over the entire run. The reintroduction program has a maximum duration of three generations (12 years). Domestication selection should be minimized by making an effort to incorporate wild fish every year.

8 SECTION 8. MATING

Describe fish mating procedures that will be used, including those applied to meet performance indicators identified previously.

8.1 Selection method.

Washougal Hatchery. Fish used for broodstock will be collected from the spawning grounds in a random fashion throughout the duration of the spawning run (November through December). The number of fish spawned per day and with whom they are mated will depend upon which fish are ripe on a given collection date. No effort is being made to cross fish with particular phenotypic attributes (e.g. size- and age-at-maturity) in any systematic fashion.

8.2 Males.

Backup males will be used to ensure that fertilization has been maximized. A factorial mating scheme, either 2x2 or, more commonly, 3x3 will be employed.

Chum salmon do not produce precocious males (jacks) and they are semelparous. Two-year-old males have been observed in some chum populations but they are very rare. Established broodstock collection protocols for males should result in the broodstock males having a similar age structure when compared to the return at large.

8.3 Fertilization.

Nine separate egg lots are created in a 3x3 mating: three from each female. The total weight of the eggs mass from each female is weighed and then divided into the number of aliquots necessary to make the cross. Each male then fertilizes one egg lot from each female. Fertilization is achieved by adding milt from a male directly onto the eggs of a female. Water is then added and the gametes are gently stirred for 20 seconds. Milt from one of the other males is then added to the egg/water/milt mixture 20 seconds after milt from a primary male, and the eggs are once again gently mixed. This addition of milt from a second male is done to ensure that high fertilization rates take place by providing any unfertilized eggs with a new batch of sperm and allowing the first male an opportunity to fertilize 100% of the eggs within an egg lot. Each male used in a 3x3 cross is used as a backup male for one of the other males. After the gametes were mixed, water added, and backup milt applied, the eggs are allowed to sit for two minutes.

Individual lots are then recombined, if needed, and placed into a Heath incubation tray. Each tray is labeled with the females' number and spawn date.

8.4 Cryopreserved gametes.

Cryopreserved gametes are not used.

8.5 Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

- Mating cohorts are randomly selected.
- Protocols for population size, fish health disinfection and genetic guidelines followed.
- Spawn all collected mature broodstock if possible without regard to age, size, color or other physical characteristics. If not spawning all collected mature adults over the season, apply the same rationale to individual spawn days.
- Randomize mating and avoid selectivity beyond ripeness on a given spawn day.
- A factorial mating scheme tends to protect the effective population size of the cultured fish by buffering them from having all of their gametes affected by a single infertile partner (Busack pers. comm. 2004).
- Do not mix milt from multiple males and add to eggs (pooling prior to mixing) in order to eliminate disproportionate genetic male contributions.
- Do not re-use males except as part of specific spawning protocols. A given male should be used as the first mate for only one female total.

9 SECTION 9. INCUBATION AND REARING -Specify any management *goals* (e.g. "egg to smolt survival") that the hatchery is currently operating under for the hatchery stock in the appropriate sections below. Provide data on the success of meeting the desired hatchery goals.

9.1 Incubation:

9.1.1 Number of eggs taken and survival rates to eye-up and/or ponding.

This program is expected to have 90% or better survival from green-egg stage to ponding (Schroder, 2000).

Table 9.1.1.1: Survival rates (%) from egg-take to ponding.

Brood Year	Egg-Take	% Survival Rate	
		Green-to-Eyed	Eyed-to-Ponding
2011	115,782	92.4	95.8
2012	111,396	94.9	99.1
2013	112,204	93.8	95.6

Source: WDFW hatchery records 2014.

9.1.2 Cause for, and disposition of surplus egg takes.

In the event that egg survival is higher than expected, WDFW Regional Managers will be contacted for instructions for disposition of the surplus in accordance with Regional policy and guidelines set forth in management plans/agreements and ESA permits.

9.1.3 Loading densities applied during incubation.

Standard water flows at 4-5 gpm (15 to 19 liters) will be provided to each incubator tray. The eggs from each female are either incubated individually or in pairs in vertical trays. Average

fecundity is ~2,900 eggs/female, resulting in loading densities well below than those recommended in Piper et al. (1982).

9.1.4 Incubation conditions.

IHOT species-specific incubation recommendations are followed for water quality, flows, temperature, substrate and incubator capacities. Incubation water temperature is monitored by thermograph and recorded and temperature units (TU) are tracked for embryonic development. Harmful silt and sediment is cleaned from incubation systems regularly while eggs are monitored to determine fertilization and mortality.

All fish released under this hatchery program for brood years 2011-2013 were thermally-marked (otoliths) via methods described in Volk et al. (1990, 1994 and 1999). The bar codes are determined and a schedule established for chilled water applications by personnel in the WDFW Otolith Lab. Beginning in brood year 2014, Parental Based Tagging (PBT) will be used to identify project origin adults; with otolith-marking discontinued, WDFW plans to move eggs to Lewis River Hatchery for final incubation to hatching.

Washougal Hatchery. All eggs incubated at the Washougal Hatchery will receive water from Bob's Creek. This spring-fed source of water has a temperature that ranges between 48° and 49°F. Standard low water level alarms are present in the hatchery and water temperatures will be recorded using Tidbit temperature loggers. No silt management is necessary, and influent and effluent gas concentrations, including dissolved oxygen are within parameters optimal for salmonid egg and juvenile survival. The eyed-eggs are placed into incubator trays supplied with folded Vexar®.

Lewis River Hatchery. WDFW has proposed transferring eggs to Lewis River Hatchery for final incubation to hatching. Eggs will be incubated on North Fork Lewis River water; water temperature ranges from 48-50°F with a DO of 10.5ppm.

9.1.5 Ponding.

Chum salmon are transferred into their rearing ponds after yolk absorption is almost complete. Individual weight and length samples on 10 to 20 fry per female will be taken when only a small slit of yolk material is visible (usually around 1,700 TUs) to determine KD values. The fish will be ponded when KD values average around 1.9.

9.1.6 Fish health maintenance and monitoring.

A drip system applies daily formalin treatments, 15 minutes per day at 470 ml/minute to control fungus (*Saprolegnia*) during incubation, from Day 2 until hatching. At eyeing, the eggs will be shocked and dead eggs removed by hand. The eyed-eggs will then be placed into incubator trays supplied with folded Vexar®; this rugose substrate reduces yolk sac deformations and maximizes yolk material utilization rates. Since each female's eggs will be incubated separately from one another, mortality data (from eyeing to ponding) for each female will be collected and recorded. At ponding, all mortalities and deformities are also removed by hand, counted, and described. Throughout the incubation period, fish health will be continuously monitored in compliance with *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* standards (WDFW and WWTIT 1998).

See also **Attachment 1** for health monitoring information.

9.1.7 Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation.

- The factorial-mating scheme used ensures that each fish chosen as broodstock will have an almost equal opportunity to contribute genes into the next generation.

- The incubation conditions are designed to maximize egg-to-fry survival: for example, the water source is silt-free, and therefore catastrophic egg losses caused by siltation are not expected.
- Egg-loading densities in each tray are relatively low ensuring that adequate water exchange can occur.
- The incorporation of a rugose substrate (Vexar®) into the trays just prior to hatching.
- Fungal infestations on dead eggs are controlled by routine formalin drips.
- Heavy plastic curtains are used to separate the trays holding chum eggs from the rest of the production trays in use at the hatchery to help prevent any horizontal disease transfers from occurring.

9.2 Rearing:

9.2.1 Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years (1988-99), or for years dependable data are available.

Table 9.2.1.1: Survival rates (%) from ponding to release.

Brood Year	Survival Rate (%)
2011	99.7
2012	99.1
2013	97.9

Source: WDFW hatchery records 2014.

9.2.2 Density and loading criteria (goals and actual levels).

Loading and density levels at WDFW hatcheries conform to standards and guidelines set forth in *Fish Hatchery Management* (Piper et. al. 1982), the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006). IHOT standards are followed for water quality, alarm systems, predator control measures to provide the necessary security for the cultured stock, loading and density.

Densities are kept at or below 3.3 lbs /gpm and 0.5 lbs /cu ft. before the last loading reduction in the fall of the year. Trough maximum loading is 40 lbs at 12 gpm (3.33 lbs/gpm). Tank and raceway maximum loading for early rearing is 132 lbs for the tanks at 40 gpm (3.3 lbs/gpm) and 800 lbs per raceway at 300 gpm.(2.66 lbs/gpm). The final loading per raceway is approximately 3,200 lbs. at 300 gpm (10.6 lbs/gpm).

The loading density is less than 2 pounds of fish per gpm during rearing, approximately 33,300 fry per tank.

9.2.3 Fish rearing conditions

Table 9.2.3.1: Monthly average surface water temperature (°F), Lewis River.

Month	Average Water Temperature (ºF)
January	41-44
February	41-42
March	40-46
April	42-48
May	44-52
June	49-56
July	52-58
August	53-59

September	55-59
October	56-60
November	50-57
December	45-51

Source: WDFW hatchery records 2014.

IHOT standards are followed for water quality, alarm systems, predator control measures (netting), loading and density.

Fish are reared in on river water at an initial flow rate of 25 gpm, adjusted by hatchery staff to maintain flow index within an acceptable range as fry grow. Temperature, dissolved oxygen and pond turnover rate are monitored. IHOT standards are followed for: water quality, alarm systems, and predator control measures (netting) to provide the necessary security for the cultured stock. Settleable solids, unused feed and feces are removed regularly to ensure proper cleanliness of rearing containers.

9.2.4 Indicate biweekly or monthly fish growth information (*average program performance*), including length, weight, and condition factor data collected during rearing, if available.

All fish are released as fry after a short rearing period.

Table 9.2.4.1: Summary of average size (g) and number of fish per pound (fpp), sampled by week, Lewis chum enhancement project at Washougal Hatchery, brood year 2011.

Rearing Period	Trough 1		Trough 2		Trough 3		Trough 4	
	Size (g)	fpp	Size (g)	fpp	Size (g)	fpp	Size (g)	fpp
Week 1	0.272	1,668	-----	-----	-----	-----	-----	-----
Week 2	0.344	1,319	-----	-----	-----	-----	-----	-----
Week 2	0.484	937	0.320	1,417	-----	-----	-----	-----
Week 4	0.514	882	0.363	1,250	0.333	1,362	-----	-----
Week 5	0.665	682	0.544	834	0.363	1,250	0.423	1,072
Week 6	0.786	577	0.635	714	0.454	999	0.454	999
Week 7	0.847	536	0.907	500	0.514	882	0.635	714
Week 8	1.150	394	1.210	375	0.786	577	0.816	556

Source: WDFW hatchery records.

Table 9.2.4.2: Summary of average size (g) and number of fish per pound (fpp), sampled by week, Lewis chum enhancement project at Lewis River Hatchery, brood year 2012.

Rearing Period	Intermediate 1		Intermediate 2		Intermediate 3	
	Size (g)	fpp	Size (g)	fpp	Size (g)	fpp
Week 1	0.362	1,253	0.346	1,310	-----	-----
Week 2	0.507	895	0.380	1,193	-----	-----
Week 2	0.583	778	0.484	937	.390	1,144
Week 4	0.735	617	0.564	804	.435	,1042
Week 5	0.932	487	0.774	586	.590	765
Week 6	1.08	418	0.936	485	.718	632
Week 7	1.17	386	1.01	446	.989	459

Source: WDFW hatchery records.

9.2.5 Indicate monthly fish growth rate and energy reserve data (average program performance), if available.

See HGMP section 9.2.4.

9.2.6 Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (*average program performance*).

Fry are given dry diet with no fines; the food brand used may vary, depending on cost and vendor contracts. Fish are fed at a rate of 3% body weight/day in six to eight feedings over the course of a day. Mechanical auto-feeders are used in addition to hand-feeing. Feed size is increased as the fish grow, but pellet size never exceeds $^{1}/_{40}$ fork length. While not calculated, expected fed conversion rates are > 1.2. Feeding is discontinued two to three days before release.

9.2.7 Fish health monitoring, disease treatment, and sanitation procedures.

Monitoring. Policy guidance includes: *Fish Health Policy in the Columbia Basin*. Details hatchery practices and operations designed to stop the introduction and/or spread of any diseases within the Columbia Basin. Also, *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries* (Fish Health Policy Chapter 5, IHOT 1995). A fish health specialist inspects fish monthly and checks both healthy and presence of symptomatic fish. Based on pathological or visual signs by the crew, age of fish and the history of the facility, the pathologist determines the appropriate tests. External signs such as lesions, discolorations, and fungal growths will lead to internal examinations of skin, gills and organs. Tests for virus or parasites are done if warranted (see **Attachment 1** for Virology Sampling reports, and **Attachment 2** - Fish Health Monitoring history for Washougal Hatchery).

Disease Treatment. As needed, appropriate therapeutic treatment will be prescribed to control and prevent further outbreaks. Mortality is collected and disposed of at a landfill. Fish health and/or treatment reports are kept on file (see also **Attachment 2**: Fish Health Monitoring summaries for Washougal Hatchery).

Sanitation. All eggs brought to the facility are surface-disinfected with iodophor (as per disease policy). Every effort is made to prevent the horizontal spread of pathogens by splashing water. All equipment (nets, tanks, boots, etc.) is disinfected with iodophor between different fish/egg lots. Different fish/egg lots are physically isolated from each other by separate ponds or incubation units. Footbaths containing disinfectant are strategically located on the hatchery grounds to prevent spread of pathogens. Mortalities are collected daily and disposed of at a landfill. Fish Health and/or treatment reports are kept on file (see **Attachment 1** for Fish Health monitoring history).

The bottom of the troughs will be cleaned on a once-a-week basis with a vacuum or siphon. If necessary, the tank sidewalls will be cleaned with a stiff brush if algae growth starts to entrap food or feces. To prevent disease or pathogen transfer from one raceway to the next, the vacuum/siphon and any tools used are soaked in a PVP solution for several minutes before using it another trough.

9.2.8 Smolt development indices (e.g. gill ATPase activity), if applicable.

Gill ATPase activity is not measured. Chum fry are physiologically able to move directly to seawater upon emergence. No formal measurements on degree of smoltification are conducted.

9.2.9 Indicate the use of "natural" rearing methods as applied in the program.

Not applicable.

9.2.10 Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation.

See HGMP sections 5.8, 6.3, 7.9 and 9.1.7.

10 SECTION 10. RELEASE

Describe fish release levels, and release practices applied through the hatchery program.

10.1 Proposed fish release levels.

Table 10.1.1: Proposed release levels (maximum number).

Age Class	Project	Max. Number	Size (fpp)	Release Date(s)	Location
Fry	Enhancement	Up to 250,000	250-450	Apr-May	Lewis River

Source: WDFW Future Brood Document 2014
Note: 450 fpp = 53 mm fork length (fl).

10.2 Specific location(s) of proposed release(s).

There are three possible release locations for this enhancement program: 1) just below Swanson's Spawning Channel on the EF Lewis (**Table 10.2.1**); 2) from Dave Brown's Fish Rescue facility, located on Mill Creek (WRIA 27.0218), tributary of the EF Lewis (**Table 10.2.2**); and 3) the Eagle Island Spawning Channel on the mainstem Lewis River (WRIA 27.0168), scheduled for construction in 2015 (**Table 10.2.3**).

Table 10.2.1: Swanson's Spawning Channel

Stream, river, or watercourse:	EF Lewis River (WRIA 27.0173)
Release point:	~RKm 10.46 (RM 6.5)
Major watershed:	Lewis
Basin or Region:	Lower Columbia River

Table 10.2.2: Dave Brown's Fish Rescue Facility

Stream, river, or watercourse:	Mill Creek (WRIA 27.0218)
Release point:	Tributary to EF Lewis at ~RKm 15.13 (RM 9.4)
Major watershed:	Lewis
Basin or Region:	Lower Columbia River

Table 10.2.3: Eagle Island Spawning Channel

Stream, river, or watercourse:	Lewis River (WRIA 27.0168)
Release point:	~RKm 18.21 (RM 11.5)
Major watershed:	Lewis
Basin or Region:	Lower Columbia River

10.3 Actual numbers and sizes of fish released by age class through the program.

Table 10.3.1: Number of fry released, size, CVs and release date, by age and year.

Release Year	Number	Avg Size (fpp)	CV	Date
2012	109,396	450.0	n/a	May 1, 15[a]
2013	89,698	411.7	6.36	May 15

2014	98,586	430.3	6.01	May 14

Source: WDFW Headquarters Hatcheries Database 2014.

[a] In 2012, a total of 99,347 fry were released below Swanson Channel on May 1, and 10,049 fry were released from Mill Creek on May 15.

10.4 Actual dates of release and description of release protocols.

Release based on fish size, when the average weight of fry in a trough reaches 1.0-1.5 grams (50-55 mm fl). Release type is a forced, as fry are trucked from the hatchery and released in-mass at the selected sites.

10.5 Fish transportation procedures, if applicable.

Fry are dip-netted from the rearing troughs and into a truck bed-mounted 400-gallon tank. Supplemental oxygen is used during transport. Transport time is approximately 45 minutes to release site(s). Fry are loaded to a maximum of one-half pound fish per gallon. Release from the tank is done via a section of flex hose to accomplish a water-to-water transfer. Temperatures are measured to determine if any acclimation is needed before release; this generally does not occur because temperature differences have been less than 2-3°F.

10.6 Acclimation procedures (methods applied and length of time).

Fish are reared on Lewis River water during their six-week rearing period at Lewis River Hatchery. Chum fry are transported to their release sites on the EF Lewis River (see also HGMP section 10.2). Fry released from Dave Brown's Fish Rescue Facility are transferred 2-3 weeks before release.

10.7 Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

Table 10.7.1: Marks applied, by brood year, age class and mark-type.

Brood Year	Fed Fry	Mark Type and Proportion
2011	109,396	Otolith – Thermal, 100%
2012	89,698	Otolith – Thermal, 100%
2013	98,586	Otolith – Thermal, 100%

Source: WDFW Future Brood Document 2014.

Otolith-mark. All chum fry released to date from this artificial propagation have had their otoliths thermally-marked in the incubators via methods described in Volk et al. (1990, 1994 and 1999).

Scale and otolith samples taken at the hatchery and on the spawning grounds are read at WDFW Headquarters Olympia to verify hatchery- or natural-origin.

Parentage-based tagging (*PBT*). Starting in 2014, thermal otolith marking will discontinued and genetic material will be collected from broodstock and natural spawning adults via Parentage-based Tagging (PBT) to profile the population, and to identify origin of returning adults.

10.8 Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.

Anticipated broodstock collection is consistent with scope and magnitude of this program. There are therefore no surplus fish.

10.9 Fish health certification procedures applied pre-release.

All fish are examined for the presence of "reportable pathogens" as defined in the P*acific Northwest Fish Health Protection Committee* (PNFHPC) disease control guidelines, within three weeks prior to release. Fish transfers into the sub-basin are inspected and accompanied by notifications as described in IHOT and PNFHPC guidelines.

Prior to release, the population health and condition is established by the Area Fish Health Specialist. This is commonly done 1-3 weeks pre-release and up to six weeks on systems with pathogen-free water and little or no history of disease. Prior to this examination, whenever abnormal behavior or mortality is observed, staff also contacts the Area Fish Health Specialist. The fish specialist examines affected fish, and recommends the appropriate treatment. Reporting and control of selected fish pathogens are done in accordance with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006) and IHOT guidelines.

10.10 Emergency release procedures in response to flooding or water system failure.

There have been no instances of flooding or water system failure leading to early releases, however, policies the water systems at all of the Lewis River facilities are backed-up either by generator power or a secondary system. Lewis River Hatchery also has the ability to flush release the fish into the lower river, should it be necessary. Every attempt to keep the fish alive and healthy throughout the entire rearing-release cycle will be accommodated and all appropriate resource managers from the complex level to the federal level will be informed of the actions taken.

10.11 Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.

- The restoration program supplements productivity due to mainstem flow loss that prohibits access to historical habitat.
- Dispersal and emigration from multiple sites reduces competition in the area.
- All releases will occur after dark and on a falling tide (when possible) to protect the fish from in-stream predation and expedite their movement toward the Columbia Estuary.
- Returning fish from this program are not targeted for harvest.
- WDFW fish health and operational concerns are communicated to WDFW Region 5 staff for any risk management or needed treatment. See also HGMP section 9.7.
- WDFW proposes to continue monitoring, research and reporting of hatchery smolt migration performance behavior, and intra and interspecific interactions with wild fish to access, and adjust if necessary, hatchery production and release strategies to minimize effects on wild fish.

11 SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

11.1 Monitoring and evaluation of "Performance Indicators" presented in Section 1.10.

11.1.1 Describe plans and methods proposed to collect data necessary to respond to each "Performance Indicator" identified for the program.

The following is a list of M&E activities designed to support monitoring of the Performance Indicators identified in this HGMP, collect data to support VSP monitoring and provide the data needed to evaluate the success, or failure, of the program in reaching its goals.

1. **Adult related M&E**
   A. *Marking, sampling and releasing of adults captured, but not used for broodstock, during mainstem Columbia River seining at the I-205 spawning areas and at adult traps in spawning channels (Eagle Island and Swanson's Spawning Channel).* A well-designed Jolly-Seber (JS) mark/recapture program provides unbiased estimates of spawners. Biological data collected to support assumption testing of JS analysis

(scales for aging, sex, size and condition) in addition to tissue samples collected for genetic origin (PBT) and stock-analysis, provides data needed to annually profile VSP parameters (adult abundance, diversity and adult spatial distribution), estimate annual rates of pNOB and pHOS, detect/track trends, measure/detect impacts of the hatchery program, and assess the populations status.

B. *Spawning ground surveys.* Spawning ground surveys at the I-205 area and in the Lewis and EF Lewis rivers and their tributaries provides data to support the live mark/recapture analysis and additional biological data. To produce unbiased estimates in areas where live tagging isn't done (mainstem Lewis and EF Lewis rivers, Cedar Creek, etc.), carcasses are used to generate a JS estimate for spawners. Biological data collected to support assumption testing of JS analysis (scales for aging, sex, size and condition) in addition to tissue samples collected for genetic origin (PBT) and stock-analysis, provides data needed to annually profile VSP parameters (adult abundance, diversity and adult spatial distribution), estimate annual rates of pNOB and pHOS, detect/track trends, measure/detect influence of the hatchery program, and assess the populations status.

C. *Sampling of adults used for broodstock and adults released to spawn naturally in spawning channels*. Sample 100% of these adults to collect biological data: scales for aging, sex, size, fork lengths, weights (hatchery broodstock only) and condition, collect tissue samples for genetic origin (PBT) and stock-analysis. This sampling provides data needed to annually profile VSP parameters (adult abundance, diversity and adult spatial distribution), estimate annual rates of pNOB, pHOB and PNI, detect/track trends, measure/detect influence of the hatchery program, and supports population status analysis.

2. Juvenile related M&E

A. *Operate fence weir and live box trap(s) at the monitoring weir(s) in the Eagle Island spawning channel*. Juvenile abundance estimates from this monitoring can be paired with adult abundance estimates to estimate the VSP parameter of productivity for chum salmon at this location for the Cascade strata. In addition, data is collected to measure diversity at this location (juvenile outmigration timing, juvenile size and growth). Juvenile monitoring at this location provides data to evaluate channel performance by estimating and tracking annual egg-to-fry survival rates.

B. *Operate fence weir and live box trap(s) at the monitoring weir in the Swanson's Spawning Channel*. Juvenile abundance estimates from this monitoring can be paired with adult abundance estimates to estimate the VSP parameter of productivity for chum salmon for a second estimate in the Cascade strata. In addition, data is collected to measure diversity at this location (juvenile outmigration timing, juvenile size and growth). Juvenile monitoring at this location provides data to evaluate channel performance by estimating and tracking annual egg-to-fry survival rates.

C. *Sampling of eggs and fry, done in addition to standard sampling for routine aquaculture practices, produced from chum salmon adults spawned at Washougal Hatchery*. Samples are collected at spawning to collect data on egg size and fecundity. Data is collected to estimate individual female reproductive effort values (green egg mass weight / total weight). For all females that were trayed-down individually in incubation stacks: sampling is done at the eyed-egg stage to estimate individual fecundity with 95% confidence intervals. At ponding mortalities and monstrosities are recorded by type.

Table 11.1.1.1: Crosswalk table of Performance Indicators from HGMP section 1.10 and the M&E activities covered under this HGMP designed to address the Performance Indicators.

Performance Standard	Addressed by M&E Activities included in this HGMP
3.1.2 Program contributes to mitigation requirements. Program provides mitigation for lost fish production due to development within the Columbia River Basin.	Annually estimate survival and contribution for each brood year released. M&E activities: 1.A, 1.B and 1.C
3.1.3 Program addresses ESA responsibilities.	Natural populations are monitored annually to assess trends and compare with goals. M&E activities: 1.A, 1.B and 1.C
3.3.1. Artificial propagation program contributes to an increasing number of spawners returning to natural spawning areas.	Annually monitor and report returns to the hatchery and spawning grounds. M&E activities: 1.A, 1.B and 1.C
3.3.2 Releases are sufficiently marked to allow statistically significant evaluation of program contribution to natural production, and to evaluate effects of the program on the local natural population.	Annually sample returning fish for the mass-mark (otolith, PBT) at the hatchery and on the spawning grounds; monitor and report numbers of estimated hatchery and natural fish. M&E activities: 1.A, 1.B and 1.C
3.4.1 Fish collected for broodstock are taken throughout the return or spawning period in proportions approximating the timing and age distribution of population from which broodstock is taken.	Collect annual run timing, age and sex composition and spawning escapement timing data. M&E activities: 1.A, 1.B and 1.C
3.5.2. Collection of broodstock does not adversely impact the genetic diversity of the naturally-spawning population.	Annually monitor and report returns to the hatchery and spawning grounds. Genetic material will be collected from broodstock and natural spawning adults, origin determined via Parentage-based Tagging (PBT) to profile the population. M&E activities: 1.A, 1.B and 1.C
3.5.5 Juveniles are released at fully-smolted stage to benefit juvenile to adult survival rates, and reduce the likelihood for residualism and negative ecological interactions with natural-origin fish.	Annually monitor and record size, number, and date of release. M&E activity: 2.C
3.6.1 The hatchery program uses standard scientific procedures to evaluate various aspects of artificial propagation.	Collect annual run timing, age and sex composition data upon adult return. Genetic material will be collected from broodstock and natural spawning adults. Analysis pending funding availability. M&E activities: 1.A, 1.B and 1.C
3.8.3 Non-monetary societal benefits for which the program is designed are achieved.	Long-term monitoring of system population will indicate success of program. M&E activities: 1.A, 1.B, 1.C, 2.A, 2.B and 2.C

11.1.2 Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.

Except for a risk involving genetic introgression, all other aspects of the M&E outlined in HGMP section 1.10 are currently funded (see also HGMP section 11.1.1). Funding, staffing and support logistics are in place to provide a broodstock collection crew five days/ week throughout

November and December. A full-time employee (in addition to normal hatchery personnel) is available to monitor operations at the Washougal and Lewis River hatcheries. This level of staffing will allow for the monitoring and evaluation of all activities from the beginning of brood stock collection through the subsequent release of thermally-marked fry.

11.2 Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.

Monitoring, evaluation and research follow scientific protocols with adaptive management process if needed. WDFW will take risk aversion measures to eliminate or reduce ecological effects, injury, or mortality as a result of monitoring activities See HGMP section 1.10 Monitoring and Evaluation for additional plans and methods to collect data necessary, In addition, we will adaptively manage all aspects of the program to continue to minimize associated risks using the more recent available scientific research.

12 SECTION 12. RESEARCH

12.1 Objective or purpose.

Research programs associated with this HGMP are described in the monitoring and evaluation sections above. Research will be directed at determining whether this program is successfully increasing chum salmon abundance in the Lewis Basin.

12.2 Cooperating and funding agencies.

Washington Department of Fish and Wildlife

12.3 Principle investigator or project supervisor and staff.

The contact information for this data provided in this HGMP is Todd Hillson (Todd.Hillson@dfw.wa.gov).

12.4 Status of stock, particularly the group affected by project, if different than the stock(s) described in Section 2.

Not applicable.

12.5 Techniques: include capture methods, drugs, samples collected, tags applied.

Not applicable.

12.6 Dates or time period in which research activity occurs.

Not applicable.

12.7 Care and maintenance of live fish or eggs, holding duration, transport methods.

Not applicable.

12.8 Expected type and effects of take and potential for injury or mortality.

Not applicable.

12.9 Level of take of listed fish: number or range of fish handled, injured, or killed by sex, age, or size, if not already indicated in Section 2 and the attached "take table" (Table 1).

Not applicable.

12.10 Alternative methods to achieve project objectives.

Not applicable.

12.11 List species similar or related to the threatened species; provide number and causes of mortality related to this research project.

Not applicable.

12.12 Indicate risk aversion measures that will be applied to minimize the likelihood for adverse ecological effects, injury, or mortality to listed fish as a result of the proposed research activities.

Not applicable.

13 SECTION 13. ATTACHMENTS AND CITATIONS

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Attachment 1: WDFW Virology Sampling 2006-2007 through 2012-2013: Washougal and Lewis River hatcheries.

Source: WDFW Fish Health Lab data 2014 (John Kerwin)

Hatchery/ Collection site	Stock	Species	Date Sampled	Results	Comments	Life Stage	Sample number	NUMBER OF SAMPLES				CELL LINE	ID	FRZ DATE	INOC DATE
								OF	POOL	K/S	POOL				
WASHOUGAL	DUNCAN CR	CHUM	11/16/11	NEV		AD	1117-5/6	5	2	13	11				
WASHOUGAL	DUNCAN AND IVE'S CR	CHUM	11/30/11	NEV	OF: #12-14, 15-17, 18, 20-22, 23-25, 26-28; K/S: F #12-15, 16-19, 20-23, 24-28 & M #13-17, 18-22, 23-26	AD	1201-3/4	16	6	31	7				
WASHOUGAL	COLUMBIA R/VANCOUVER	CHUM	12/02/11	NEV	frozen; OF's:F11-13,F14-16,F17-19,F20-21 & K/S's: F/M 11-15,16-20, 21-22	AD	1208-6/7	11	4	24	6				
WASHOUGAL	IVE'S CR	CHUM	12/07/11	NEV	OF: #29-31, 32&34 K/S: F#29-33, M#27-32	AD	1208-8/9	5	2	11	2				
WASHOUGAL	COLUMBIA R/VANCOUVER	CHUM	12/08/11	NEV	OF: F#23-28, 29-34; K/S: F#23-27, 28-32, 33-34, M#23-27, 28-32, SAMPLES CAME IN FROZEN	AD	1214-9/10	12	2	22	5				
WASHOUGAL	COLUMBIA R/VANCOUVER	CHUM	12/13/11	NEV	OF: F#35-40, 41-46, 47-49; K/S: F#35-39, 40-44, 45-48, M#33-37, 38-42, 43-46	AD	1215-5/6	15	3	29	6				
WASHOUGAL	COLUMBIA R/VANCOUVER	CHUM	12/16/11	NEV	I-205 collection site, OF and K/S came in frozen, OF:F#50-54, 55-57; K/S; F350-54, 55-57, M#47-51, 52-59	AD	1221-9/10	8	2	16	4				
WASHOUGAL	DUNCAN CR	CHUM	11/14/12	NEV	Sent frozen	AD	1127-7/8	5	1	10	2				11/28
WASHOUGAL	DUNCAN CR	CHUM	11/07/12	NEV	Sent frozen	AD	1127-9/10	1	1	4	2				11/28
WASHOUGAL	COLUMBIA R/VANCOUVER	CHUM	11/21/12	NEV	Sent frozen, I-205 collection site	AD	1127-11/12	10	2	20	4				11/28
WASHOUGAL	IVE'S CR	CHUM	11/7,11/14	NEV	Sent frozen	AD	1127-13/14	6	2	14	4				11/28
WASHOUGAL	DUNCAN CR	CHUM	11/28/12	NEV		AD	1129-4/5	11	2	22	4				11/30
WASHOUGAL	I-205, WASHOUGAL R	CHUM	11/30/12	NEV	Samples previously frozen	AD	1212-5/6	14	3	28	6				12/12
WASHOUGAL	I-205, WASHOUGAL R	CHUM	12/07/12	NEV	Samples previously frozen	AD	1212-7/8	17	4	33	8				12/12
WASHOUGAL	I-205, WASHOUGAL R	CHUM	12/11/12	NEV		AD	1212-9/10	3	1	7	2				12/12

Attachment 2 – Fish Health Summaries: Washougal Hatchery, April 1, 2007 through September 30, 2007 to April 1, 2013 through Septmber 30, 2013.

Juveniles: Chum

2009 brood Chum – Duncan Creek stock

They were healthy, with normal loss levels until their release in May 2010.

2010 brood Chum – Duncan River stock

They were healthy and vigorous, until their release in May 2011, with light levels of *Ichthyobodo*.

2011 brood Chum – Duncan Creek stock

They were healthy, with normal loss levels until their release in May 2012.

2011 brood Chum – I-205 stock

They were healthy, with normal loss levels until their transfer to Lewis River Hatchery .

2012 brood Chum – Duncan Creek stock

They were healthy, except for some handling loss during fin-clipping, until their release in May 2013.

2012 brood Chum – I-205 stock

They were healthy, with normal loss levels until their transfer to Lewis River Hatchery .

14 SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

"I hereby certify that the information provided is complete, true and correct to the best of my knowledge and belief. I understand that the information provided in this HGMP is submitted for the purpose of receiving limits from take prohibitions specified under the Endangered Species Act of 1973 (16 U.S.C.1531-1543) and regulations promulgated thereafter for the proposed hatchery program, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or penalties provided under the Endangered Species Act of 1973."

Name, Title, and Signature of Applicant:

Certified by_____ Date:_____

15 ADDENDUM A. PROGRAM EFFECTS ON OTHER (AQUATIC OR TERRESTRIAL) ESA-LISTED POPULATIONS. (Anadromous salmonid effects are addressed in Section 2).

15.1 List all ESA permits or authorizations for USFWS ESA-listed, proposed, and candidate salmonid and non-salmonid species associated with the hatchery program.

The WDFW and the USFWS have a Cooperative Agreement pursuant to section 6(c) of the Endangered Species Act that covers the majority of the WDFW actions, including hatchery operations.

> *"The department is authorized by the USFWS for certain activities that may result in the take of bull trout, including salmon/steelhead hatchery broodstocking, hatchery monitoring and evaluation activities and conservation activities such as adult traps, juvenile monitoring, spawning ground surveys..."*

15.2 Describe USFWS ESA-listed, proposed, and candidate salmonid and non-salmonid species and habitat that may be affected by hatchery program.

Several USFWS listed and candidate species are found in Cowlitz County, however the hatchery operations and facilities for this program do not fall within the critical habitat for any of these species. As such there are no effects anticipated for these species.

Listed or candidate species:
"No effect" for the following species:

Bull trout (*Salvelinus confluentus*) – Threatened (Critical Habitat Designated)
Nelson's checker-mallow (*Sidalcea nelsoniana*) –Threatened
Marbled murrelet (*Brachyramphus marmoratus*) –Threatened (Critical Habitat Designated)
Columbian White-Tailed deer (*Odocoileus virginianus leucurus*) – Endangered
Gray Wolf (*Canis lupus*) –Threatened
Northern Spotted owl (*Strix occidentalis caurina*) –Threatened (Critical Habitat Designated)

Candidate Species
North American wolverine *(Gulo gulo luteus)* – contiguous U.S. DPS

15.3 Analyze effects.

Not applicable.

15.4 Actions taken to minimize potential effects.

Program coho are released fully smolted to foster rapid outmigration from the basin and to minimize predation and residualism risks.

15.5 References

Not applicable.

16 "Take Table"

Table 1. Estimated listed salmonid take levels of by hatchery activity.

Listed species affected: Chum (*Oncorhynchus keta*)	**ESU/Population:** Columbia River Chum	**Activity:** Lewis Basin Chum Enhancement Project	
Location of hatchery activity: Lewis River Hatchery, Lewis River (WRIA 27.0168) at RKm 25.0 Washougal Hatchery, Washougal River (WRIA 28.0159) at RKm 22.0	**Dates of activity:** November-May	**Hatchery program operator:** WDFW	
Type of Take	**Annual Take of Listed Fish By Life Stage *(Number of Fish)***		
	Egg/Fry	**Juvenile/Smolt**	**Adult**	**Carcass**
Observe or harass [a]	TBD	TBD	TBD	TBD
Collect for transport [b]	TBD	TBD	TBD	TBD
Capture, handle, and release [c]	TBD	TBD	TBD	TBD
Capture, handle, tag/mark/tissue sample, and released[d]	TBD	TBD	TBD	TBD
Removal (e.g. broodstock) [e]	TBD	TBD	TBD	TBD
Intentional lethal take [f]	TBD	TBD	TBD	TBD
Unintentional lethal take [g]	TBD	TBD	TBD	TBD
Other Take (specify) [h]	TBD	TBD	TBD	TBD

* Contact with listed fish through stream surveys, carcass and mark recovery projects, or migrational delay at weirs.

a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migrational delay at weirs.
b. Take associated with weir or trapping operations where listed fish are captured and transported for release.
c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.
e. Listed fish removed from the wild and collected for use as broodstock.
f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.
g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
h. Other takes not identified above as a category.

See also Washougal (Duncan Creek) Chum HGMP for other species.