HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Washougal (Bonneville/Duncan Creek) Chum (Integrated)
Species or Hatchery Stock:	Chum (*Oncorhynchus keta*) Columbia River Wild
Agency/Operator:	Washington Department of Fish and Wildlife
Watershed and Region:	Washougal River/Lower Columbia River and Lower Columbia Gorge
Date Submitted:	
Date Last Updated:	September 17, 2014

Executive Summary

The Washington Department of Fish and Wildlife (WDFW) is submitting a Hatchery and Genetic Management Plan (HGMP) for the Washougal Hatchery/Duncan Creek Chum Reintroduction program to the National Marine Fisheries (NMFS) for consultation under Section 4d or 10(a)(1)(A) of the Endangered Species Act (ESA). Hatchery and Genetic Management Plan (HGMP) 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 establish a self-sustaining population by a combination of juvenile supplementation and releases of wild chum salmon adults into renovated spawning habitat located in Duncan Creek. Program fish will be produced at two facilities: spawning and early incubation will take place at the Washougal Hatchery, located on the Washougal River (WRIA 28.0159), with final incubation and at rearing at Vancouver Trout Hatchery, located on Love Creek (WRIA 28.0148), tributary to the Columbia River. The program will annually release up to 400,000 fry to the Columbia River and tributaries near Bonneville Dam.

This 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 collecting broodstock in areas with known low, or zero, hatchery-origin spawners. Broodstock are collected in the mainstem Columbia River via beach seines and at the Duncan Creek dam/fishway trap throughout the run (early-November through December). All fish released through this hatchery program have been 100% mass-marked (thermal otolith-mark) since the program was initiated in 2001. Chum salmon fry produced from the Duncan Creek spawning channel have been 100% mass-marked (strontium-marked otoliths) since 2004.

Columbia River chum are listed as "Threatened" under the ESA, and includes the Grays River and Washougal/Duncan Creek artificial propagation programs.

Broodstock Collection:
Broodstock are collected from several sources (multiple mainstem Columbia River spawning areas, Duncan Creek and Hamilton Springs) and by several methods (beach seining at mainstem spawning areas, an adult ladder trap at the mouth of Duncan Creek and an adult "V"-weir trap in Hamilton Springs). Adults captured in excess of (or not suitable for) broodstock needs are tagged and released to spawn naturally. The maximum annual egg-take is not expected to exceed 400,000 (combination of fed-fry releases at Duncan Creek and production for a "salvage" scenario). Up to 150 adult pairs may be collected (combination of adults collected for direct adult releases into Duncan Creek spawning channel and broodstock).

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's 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.

1 SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1 Name of hatchery or program.

Washougal (Bonneville) Chum Program (Duncan Creek reintroduction)

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

Columbia River chum (*Oncorhynchus keta*)

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

Name (and title): Mark Johnson, Hatcheries Operations and Complex Manager
Agency or Tribe: Washington Department of Fish & Wildlife
Address: 165 Osprey Lane, Toledo WA 98591
Telephone: (360) 864-6135
Fax: (360) 864-6122
Email: Mark.Johnson@dfw.wa.gov

Fish Management Staff Lead Contact

Name (and title): Eric Kinne, Region 5 Hatchery Reform Coordinator
Agency or Tribe: Washington Dept. of Fish and Wildlife
Address: 2108 Grand Boulevard, Mail Stop: S-19, Vancouver, WA 98661-4624
Telephone: (360) 906-6747
Fax: (360) 906-6776
Email: Eric.Kinne@dfw.wa.gov

Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

The Washington Department of Fish and Wildlife (WDFW) provides general oversight, and supervises broodstock collection, spawning, rearing, incubation and final report writing.

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

Funding Source	Operation Information – FY 2013
BPA	Full time equivalent staff – 4.94
	Annual operating cost (dollars) - $615,815[a]

[a] Information for full-time equivalent staff and annual operating costs applies cumulatively to anadromous program facilities; funding includes other Federal sources, and cannot be broken out specifically by program.

1.5 Location(s) of hatchery and associated facilities.

Broodstock Source: Columbia River Chum

Table 1.5.1: Location of culturing phases, by facility.

Facility	Culturing Phase	Location
Duncan Creek Dam/Fishway trap	Broodstock collection,	The mouth of Duncan Creek (WRIA 28.0296); tributary to the Columbia River at RKm 226.1 (RM 140.5). See HGMP section 5.1.
Duncan Creek Spawning Channels	Natural spawning, Incubation, Rearing	Located in Duncan Creek (WRIA 28.0296) at RKm 0.8 (RM 0.5).
In-River	Broodstock collection	Mainstem Columbia River near Ives Island at RKm 228.5 (RM 142), downstream to approximately Multnomah Falls at ~RKm 218.8 (RM 136).

		Hamilton Creek (WRIA 28.0303) at Hamilton Springs spawning channel at RKm 1.8 (RM 1.1).
Washougal Hatchery	Adult holding/spawning, Early-incubation, Rearing	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.
Vancouver Trout Hatchery	Final-incubation, Rearing[a]	12208 SE Evergreen Hwy Vancouver, WA 98683. Located on Love Creek (WRIA 28.0148), tributary to the Columbia River at RKm 185.9 (R.M. 115.5), Lower Columbia River, Washington.

[a] Proposed in 2014.

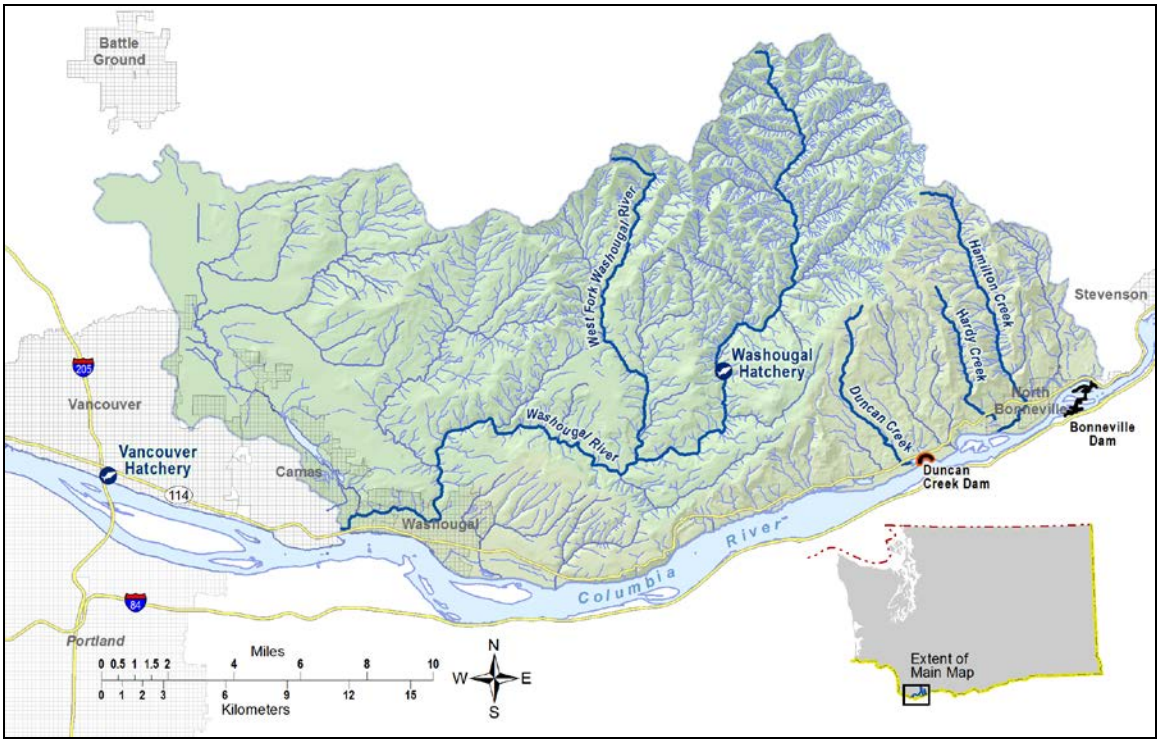

Figure 1.5.1: Map of Washougal Basin and Duncan Creek Chum Reintroduction Program facilities. Source: WDFW GIS 2014.

1.6 Type of program.

Integrated Recovery

1.7 Purpose (Goal) of program.

Mitigation/Conservation. The Duncan Creek reintroduction program has three overarching goals. The first is to establish a self-sustaining population by a combination of juvenile supplementation and releases of wild chum salmon adults into renovated spawning habitat located in Duncan Creek. The second is to implement a salvage operation, as conditions warrant. Specifically, to preserve genetic diversity within the population by ensuring adequate numbers of chum salmon spawn successfully, either naturally or artificially, in the event that natural climate events (e.g. extremely low rainfall) or hydropower operations prevent access to spawning mainstem and tributary spawning areas near Bonneville Dam. The Columbia River Chum Salvage Plan scenarios and their specifics details are presented in **Tables 1.7.1 and 1.7.2**. To date, no salvage plan activities have been needed. The third goal is to rigorously evaluate different reintroduction strategies (natural straying, direct adult releases, and releases of hatchery-origin fed-fry) to inform future reintroduction programs.

Table 1.7.1: Summary of strategies for Columbia River Chum Salmon Salvage Plan.

Case	Stream Flow			Strategy
	Columbia R.	Tributaries	Spawning Areas	
1	low	low	low	Juvenile supplementation in the mainstem Columbia River and tributaries.
2	low	low	adequate	Adult supplementation in tributaries and juvenile supplementation in the mainstem Columbia River.
3	adequate	low	low	Juvenile supplementation in tributaries and no action in the mainstem Columbia River.
4	low	adequate	adequate	Juvenile supplementation in the mainstem Columbia River, and no action in tributaries.
5	adequate	adequate	adequate	No intervention. Rely on natural production, and monitor.

Source: Chum Salmon Salvage Plan: Fall 2001 (WDFW 2001).

Table 1.7.2: Specifics of strategies for Columbia River chum salvage plan, by case.

Case 1	
1.0. Conditions	Extreme low flows in the Mainstem Columbia River limit or prevent access to spawning areas near Ives Island. Flows in Hardy, Hamilton, and Duncan Creeks are very low, preventing access into the creeks themselves. Flows from springs/seeps are too low to support successful spawning. This is an extreme situation and artificial propagation is needed to minimize a brood year failure.
1.1. Reintroduction Action	Capture a total of 35 pairs of adult chum salmon for use in the Duncan Creek chum salmon re-introduction program. These fish may be collected from the mainstem Columbia River focusing on the Ives Island Area. Adults are taken to Washougal Hatchery for artificial spawning, incubation and rearing. Fed fry are released into Duncan Creek.
1.2. Salvage Action	Capture a maximum of 120 adult pairs from the mainstem Columbia River focusing on the Ives Island Area. Transport adults to Washougal Hatchery for artificial spawning and rearing.
1.3. Juvenile Releases	Release fed fry into Hamilton, Hardy and Duncan creeks and near Ives Island in the mainstem Columbia. The capture of 150 females is expected to produce a take of 450,000 eggs. Eggs from each female will be divided into four treatment groups, allowing the progeny equivalent of 37 pairs to be replaced into each of the four release sites. Treatment groups will be differentially thermally marked for identification before release. We have taken this approach so that eggs from each of the females spawned will be incorporated into each release group thereby maximizing the genetic diversity of each release group.
Case 2	
2.0. Conditions	Extreme low flows in the Mainstem Columbia River limit or prevent access to spawning areas near Ives Island. Flows in Hardy, Hamilton, and Duncan Creeks are adequate to support successful spawning. However, Columbia River flows or low tributary flows prevent access to these tributaries. This is an extreme situation and artificial propagation is needed to minimize the brood year failure.
2.1. Reintroduction Action	Capture a minimum of 60 pairs of adult chum salmon for use in Duncan Creek chum salmon re-introduction program. These fish may be collected from the mainstem Columbia River focusing on the Ives Island Area. A total of 30 adult pairs are taken to Washougal Hatchery for artificial spawning, incubation and rearing. Fed fry are released into Duncan Creek.

	The remaining adults are released above the Duncan Creek weirs for natural spawning
2.2. Salvage Action	Capture as many adult chum as possible that have entered the lower reaches of Hardy, Hamilton, and Duncan Creeks and possibly mainstem Columbia River and transport these fish across any existing anadromous barriers to spring/seep spawning areas, allowing them to spawn naturally. Adult densities in these tributaries would not exceed their spawning capacity. Capture additional pairs (30) of adult chum salmon from the mainstem Columbia River. Transport these adults to the Washougal Hatchery for artificial spawning and rearing. Release fed fry into Duncan Creek and the Ives Island area.
2.3. Juvenile Releases	Release fed fry into Duncan Creek and near Ives Island in the mainstem Columbia. Eggs from each female will be divided into two treatment groups, allowing the progeny equivalent of 35 pairs to be replaced into each of the two release sites. Treatment groups will be differentially thermally marked for identification before release. We have taken this approach so that eggs from each of the females spawned will be incorporated into each release group, maximizing the genetic diversity of each release group.
Case 3	
3.0. Conditions	Adequate flows in the mainstem Columbia River allow access to spawning areas. Flows in Hardy, Hamilton, and Duncan Creeks are very low and prevent access into the creeks themselves. Flows from springs/seeps are too low to support successful spawning. This is an extreme situation and artificial propagation is needed to minimize the brood year failure in Columbia River tributaries.
3.1. Reintroduction Action	Capture a minimum of 35 pairs of adult chum salmon for use in the Duncan Creek chum salmon re-introduction program. These fish may be collected from the mainstem Columbia River focusing on the Ives Island Area. A total of 30 adult pairs will be taken to the Washougal Hatchery for artificial spawning, incubation and rearing. Fed fry are released into Duncan Creek.
3.2. Salvage Action	Capture a maximum of 120 adult pairs from the mainstem Columbia River focusing on the Ives Island Area. Transport adults to Washougal Hatchery for artificial spawning and rearing.
3.3. Juvenile Releases	Release fed fry into Hamilton, Hardy and Duncan creeks and near Ives Island in the mainstem Columbia. The capture of ~150 females is expected to produce a take of 450,000 eggs. Eggs from each female will be divided into four treatment groups, allowing the progeny equivalent of 37 pairs to be replaced into each of the four release sites. Treatment groups will be differentially thermally marked for identification before release. We have taken this approach so that eggs from each of the females spawned will be incorporated into each release group, maximizing the genetic diversity of each release group.
Case 4	
4.0. Conditions	Low flows in the Mainstem Columbia River limit or prevent access to spawning areas near Ives Island. Densities in mainstem spawning areas exceed capacity. Flows in Hardy, Hamilton, and Duncan Creeks are adequate to support successful spawning and access to these spawning areas. Artificial propagation is needed to minimize the brood year failure.
4.1. Reintroduction Action	Capture a minimum of 60 pairs of adult chum salmon for use in Duncan Creek chum salmon re-introduction program. These fish may be collected from the mainstem Columbia River focusing on the Ives Island Area. A total of 30 adult pairs will be taken to Washougal Hatchery for artificial

	spawning, incubation and rearing. Fed fry will be released into Duncan Creek. The remaining adults will be released above the Duncan Creek weirs for natural spawning.
4.2. Salvage Action	Capture up to 120 adult chum pairs from the mainstem Columbia River. Transport these adults to the Washougal Hatchery for artificial spawning and rearing. Release fed fry into Duncan Creek and the Ives Island area. If adult densities in tributaries are below their spawning capacity, some adults may be placed in these spawning areas.
4.3. Juvenile Releases	Release fed fry into Duncan Creeks and near Ives Island in the mainstem Columbia. Eggs from each female will be divided into two treatment groups, allowing the progeny equivalent of 35 pairs to be replaced into each of the two release sites. Treatment groups will be differentially thermally marked for identification before release. This approach allows eggs from each of the females spawned to be incorporated into each release group, maximizing the genetic diversity of each release group.
Case 5	
5.0. Conditions	Flows in the mainstem Columbia River allow access to spawning areas in the Columbia River. Flows in Hardy, Hamilton, and Duncan Creeks are adequate to support successful spawning. Under these conditions, natural spawners should be able to replace themselves and the primary action strategy is natural production.
5.1. Reintroduction Action	Capture a minimum of 60 pairs of adult chum salmon for use in Duncan Creek chum salmon re-introduction program. These fish may be collected from the mainstem Columbia River focusing on the Ives Island Area. A total of 30 adult pairs are taken to Washougal Hatchery for artificial spawning, incubation and rearing. Fed fry are released into Duncan Creek. The remaining adults are released above the Duncan Creek weirs for natural spawning
5.2. Salvage Action	No action is anticipated except to monitor natural spawning populations.
5.3. Juvenile Releases	Release fed fry into Duncan Creek. Eggs will be thermally marked and represent one treatment group, allowing the progeny equivalent of 35 pairs to be released at the Duncan Creek sites. As in the other cases, naturally produced fry originating from the Duncan channels will be marked by using strontium immersion. The fish will be held in 1,000-ppm solutions of strontium chloride hexahydrate for four hours. They will be liberated into Duncan Creek at darkness the same day they are marked.

Source: Chum Salmon Salvage Plan: Fall 2001 (WDFW 2001).

See also HGMP section 11.

1.8 Justification for the program.

The program is funded by the BPA for the purpose of mitigation for lost fish production due to development within the Columbia River Basin. This program was first identified as a Reasonable and Prudent Alternative (RPA) in the 2004 *Federal Columbia River Power System* (FCRPS) BiOp (NMFS 2004), and has been included in all subsequent versions.

WDFW protects listed fish and provides harvest opportunity on hatchery fish through the Lower Columbia River- *Fish Management and Evaluation Plan* (FMEP) (WDFW 2001). All mainstem and tributary fisheries are managed as mark-selective (no wild retention) fisheries to minimize the impact on listed wild fish. A *Lower Columbia River Chum Supplementation Plan* is currently under development.

Drought and hydro-system water management are the primary factors influencing chum salmon spawning and incubation success in the Lower Gorge and Washougal populations. The salvage

plan is in place to preserve the genetic diversity of Lower Columbia River chum salmon; specifically the Lower Gorge and Washougal populations, by ensuring that adequate numbers of returning adults survive to spawn successfully, either naturally or artificially. The Lower Gorge population is most at risk because low water may create a complete barrier for fish passage into Hamilton and Hardy Creeks. Moreover, low water may eliminate or substantially reduce mainstem spawning in the Ives Island area, another important spawning location for this population. In some years it is uncertain if adequate mainstem Columbia River flows can be maintained throughout the entire incubation and emergence period. Without intervention, these populations will have access to a very restricted spawning area and redd superimposition may occur due to overcrowding. In some years redds may also be dewatered which would lead to high pre-emergent mortality. See also HGMP section 11.1.

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 Washougal Hatchery chum programs.

Potential Hazard	HGMP Reference	Risk Aversion Measures
Water Withdrawal	4.1	Water rights at Washougal and Vancouver 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	4.2	WDFW has requested funding for future scoping, design, and construction work of a new river intake system to meet NOAA compliance (*Mitchell Act Intake and Screening Assessment* 2002).
Effluent Discharge	4.2	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 fish are otolith-marked during incubation. 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 <u>“Performance Indicators” addressing benefits.</u>

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 quality (mark rate) and date of all hatchery releases by mark type. Annually sample returning fish for the mass-mark (otoliths, PBT) at the hatchery and on the spawning grounds; monitor and report numbers of estimated hatchery (marked) and natural (unmarked) 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 to profile the population. However, funding for analysis has not yet been secured. Samples will be archived for future analysis.
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. Samples will be archived for future analysis when funding is secured. 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 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, etc.) consistent with information needs.	Annually monitor and record size, number, date of release and mass-mark quality (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 (marked) and natural (unmarked).
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.
3.4.3 Life history characteristics of the natural population do not change as a result of the hatchery program.	Life history characteristics are measured in adult and juvenile hatchery fish: return timing, age and sex composition, spawning timing, and size in returning hatchery adults; size, growth rates, and survival to release in juvenile production. Life history patterns of juvenile and adult NOR are stable.	Collect annual run timing, origin, and age and sex composition data. Annually monitor and record juvenile hatchery fish size, growth rates, number released, mass-mark type, survival-to-release rates, and date of release. Sample returning fish for the mass-mark (otoliths, PBT) at broodstock collection points and on the spawning grounds. Annually record and report numbers of estimated hatchery

		(marked) and natural (unmarked).
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. Samples will be archived for future analysis when funding is secured. 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 program releases are identifiable in some manner (fin-marks, otolith-marks, etc.). Collect annual run timing, origin, and age and sex composition data. Sample returning fish for the mass-mark (otoliths, PBT) at broodstock collection points and on the spawning grounds. Annually record and report numbers of estimated hatchery (marked) and natural (unmarked). Genetic material will be collected from broodstock and natural spawning adults, origin determined via Parentage-based Tagging (PBT) to profile the population.
3.5.3 Hatchery-origin adults in natural production areas do not negatively affect the total natural spawning population.	The ratio of observed and/or estimated total numbers of artificially-produced fish on natural spawning grounds, to total number of naturally-produced fish (pHOS).	This program is projected to meet HSRG standards for pHOS. See also HGMP section 7.5.
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 (direct plant), method (forced) and age class (fry) 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, release site, and release type (forced).
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*	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**

Washington State).		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 *Policies 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 right permit compliance.	Flow and discharge reported in monthly NPDES reports.
3.7.3 Water withdrawals and in-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.	Water withdrawals compared to NMFS, USFWS and WDFW applicable passage and screening criteria for juveniles and adults.	Barrier and intake structure 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 inspects 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.	Trap is checked regularly. 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. Pre-spawning mortality rates of captured fish in the hatchery and/or after release.	Traps checked regularly. 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 significantly reduce numbers of natural fish.	Hatchery juveniles are raised to smolt-size and released from the hatchery at a time that fosters rapid migration downstream.	Chum salmon emigrate as fry. Predation on naturally produced fish, even fed-fry sized hatchery 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).

For juvenile supplementation, from 30 to 150 adult pairs would be collected for reintroduction at Duncan Creek. From 30 to 150 pairs may be collected for the salvage plan.

Both the reintroduction and salvage plans have an adult collection and release component. The recently renovated Duncan Creek channels can hold up to 360 adult pairs, the maximum number of fish that would be collected and released. Assuming half of these fish are females, approximately 1,080,000 eggs could be deposited. Egg-to-fry survival rates in spawning channels are typically at least two times higher than riverine sites (see also HGMP section 9.1).

If the salvage plan is implemented, up to 1,000 adults may be collected. These fish would be distributed in such a manner that the carrying capacity of each tributary would not be exceeded.

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	Project	Max. No.	Release Location
Fry	Reintroduction	400,000	Columbia River and tributaries near Bonneville.

Source: Future Brood Document 2014.

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

Table 1.12.1: Estimated fry-to-adult survival for marked hatchery chum fry, Duncan Creek Chum Reintroduction program.

Brood Year	Number		Estimated Fry-to-Adult Survival (%)
	Hatchery Spawners	Marked Fry Released	
2001	51	45,046	0.13
2002	169	217,436	0.00
2003	74	75,995	0.00
2004	----	----	----
2005	20	19,817	0.36
2006	56	54,390	0.01
2007	----	----	----
2008	----	----	----
2009	22	25,813	*
2010	40	59,238	*
2011	62	55,901	*
2012	51	57,538	*

Source: Table 49 in Hillson 2011.
Note: No hatchery production in brood years 2004, 2007 or 2008.
Data from brood year 2005-2009 is incomplete.
* = not available, adult returns still incomplete

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

Washougal Hatchery began operations in 1958. The Duncan Creek chum reintroduction program was initiated in 2001.

1.14 Expected duration of program.

Re-introduction efforts into Duncan Creek were initially scheduled to last for 15 years, three complete generations, unless a self-sustaining population is established earlier. However, gaps in funding for the hatchery portion of the reintroduction (brood years 2004, 2007 and 2008) and extremely low SAR values have made it difficult to evaluate the fed-fry release reintroduction strategy. It's likely that the program will need to be extended beyond 2016 to answer critical questions concerning reintroduction strategies.

Salvage Operations would only take place during those years when mainstem flows are low enough to prevent Lower Gorge chum from successfully utilizing traditional spawning sites or when flows have restricted the size of such areas to such an extent that overcrowding is expected to occur (**Table 1.7.1**). An annual review of tributary and mainstem flows would occur to ascertain whether such a program should be instituted.

1.15 Watersheds targeted by program.

See HGMP section 1.11.2.

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.

Duncan Creek Chum Reintroduction Program. An earthen dam at the mouth of Duncan Creek presented a barrier to returning salmon and blocked access to the spawning grounds from the early-1960s through the 1990s. Historically, up to five hundred chum salmon spawned in seeps located in the Duncan Creek drainage prior to dam construction. Some of these seeps were

renovated in 2001, and are now suitable chum spawning areas. The introduction of chum (either adults or fry) to these locations will expedite their use.

Because chum salmon in the Lower Columbia River ESU are listed as "Threatened" under the ESA, extensive reintroduction and rebuilding programs need to be developed for tributaries to the Lower Columbia River. Monitoring and evaluation for the Duncan Creek chum re-introduction efforts will evaluate the success of both adult and juvenile release strategies and apply the results to other reintroduction programs. The current Duncan Creek program calls for releasing adults and hatchery-reared juveniles into Duncan Creek. All hatchery-origin juveniles produced under this program have been otolith-marked (thermally) through brood year 2013. Juveniles produced from the spawning channels have been otolith-marked (strontium) since the 2003 brood. Beginning in brood year 2014, all program fish will be Parentage-Based Tagged (PBT). An adult sampling program will recover salmon carcasses and collect samples for origin determination (otoliths or tissue samples).

Salvage Plan. If low flows continue to occur in the mainstem of the Columbia River the amount of useable spawning area for chum will decrease and overcrowding on the spawning grounds will occur. Two types of adult density occur on spawning grounds: **instantaneous density**, which is the number of fish present at any given instant and; **overall density**, which is simply the total number of fish that utilize a particular location over the course of a single spawning season. High instantaneous densities ($\leq$1.5 sq.mi./per female) cause high egg retentions and promote superimposition of redds (Schroder 1973), which impair egg-to-fry survival rates. When overall density is high, redd superimposition may occur, and eggs can be destroyed by mechanical agitation or uplifted out of nests by the digging activities of later arriving females (Schroder 1977). The intent of the salvage operation is to allow chum to spawn at acceptable instantaneous and overall densities, and thereby maximize the survival of naturally-spawned eggs, as well as the survival of the eggs collected during the course of the broodstocking process.

Finally, if droughts continue or hydro needs upstream supersede those for chum salmon below Bonneville Dam, incubation and rearing flows in the Columbia River and its tributaries may not be adequate in spawning areas that are traditionally used the Lower Gorge and Washougal chum salmon populations. The renovated habitat at Duncan Creek, along with existing habitat in Hardy and Hamilton creeks, will provide important refugia for these populations when such conditions occur. As with the reintroduction plan, WDFW will evaluate both adult and juvenile release strategies (see also HGMP section 1.7).

1.16.2 Potential Alternatives to the Current Program

Alternative 1: *Use natural re-colonization* (*reintroduction program*). Relying on natural re-colonization of Duncan Creek is likely not a viable option. The abundance of chum salmon returning to spawn in nearby mainstem Columbia River spawning areas and tributaries (Hamilton and Hardy creeks) is usually relatively small (often fewer than 1,500 adults per year). Natural re-colonization requires that some of these fish stray into the Duncan system and utilize it as a spawning site. Stream surveys made in this area from 1996 through 1999 indicated that one or no chum entered Duncan Creek during each of these years. An adult trap has been operated at the mouth of Duncan Creek since 2004; results of origin analysis for chum salmon that have volunteered to the trap indicate a very low stray rate into the system. A strategy that relied on strays to re-colonize the area and take advantage of the highly productive spawning habitat in the channel would likely take decades before the area reached anywhere near its full potential.

Alternative 2: Rear unfed fry at Vancouver Hatchery. Fed-fry have a proven survival advantage over un-fed and naturally-produced fry in early ocean survival and adult return rates. Marked fed-fry release originating from a genetically suitable donor stock was chosen as the primary strategy.

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.

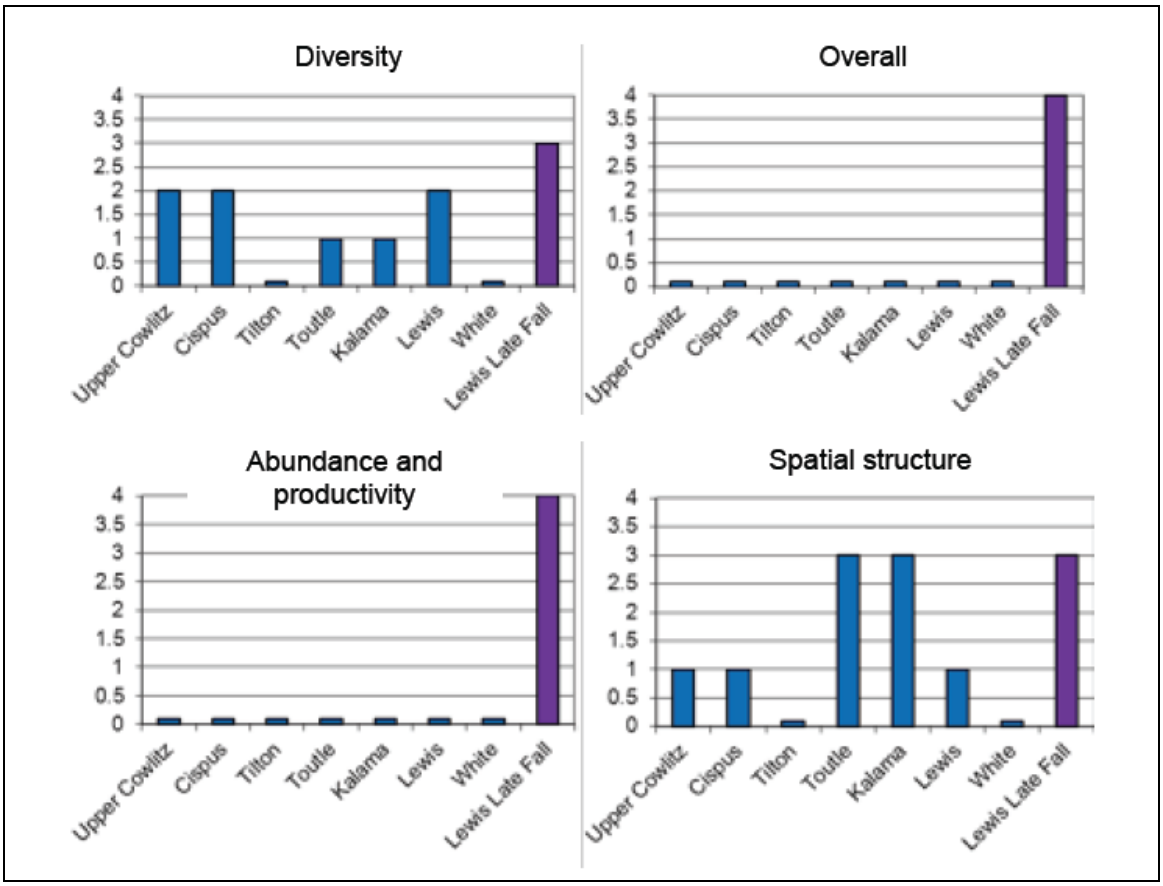

Figure 2.2.2.1: Current status of Washington lower Columbia River spring Chinook and late fall-run (bright) Chinook salmon populations for the VSP parameters and overall population risk. (LCFRB Recovery Plan 2010, chapter 6). A population score of zero indicates a population extirpated or nearly so, 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.

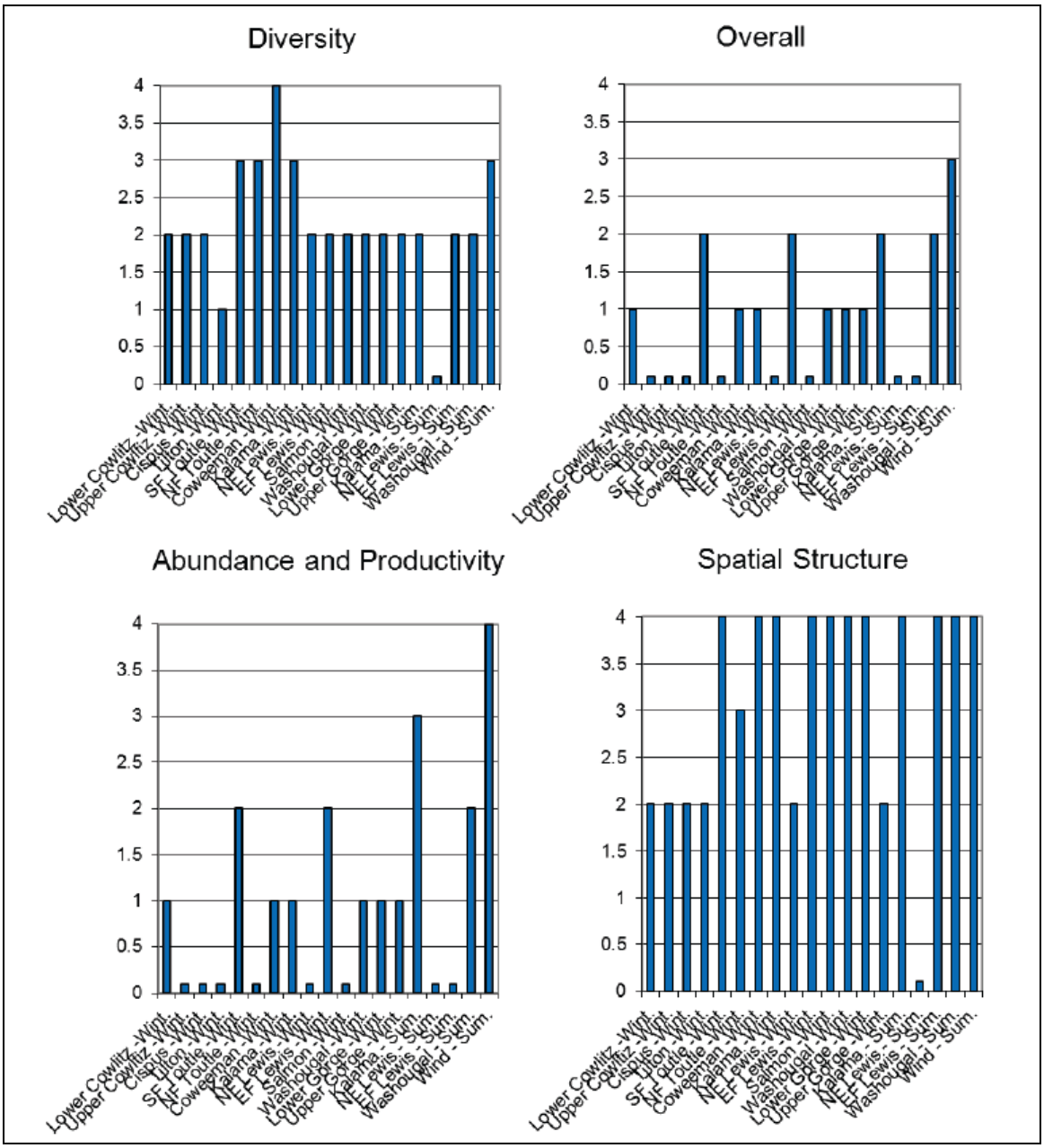

Figure 2.2.2.2: Current status of Washington LCR steelhead populations for the VSP parameters and overall population risk. (LCFRB 2010 Recovery Plan, chapter 6). A population score of zero indicates a population extirpated or nearly so, a score of 1 is high risk, 2 is moderate risk, 3 is low risk ("viable")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

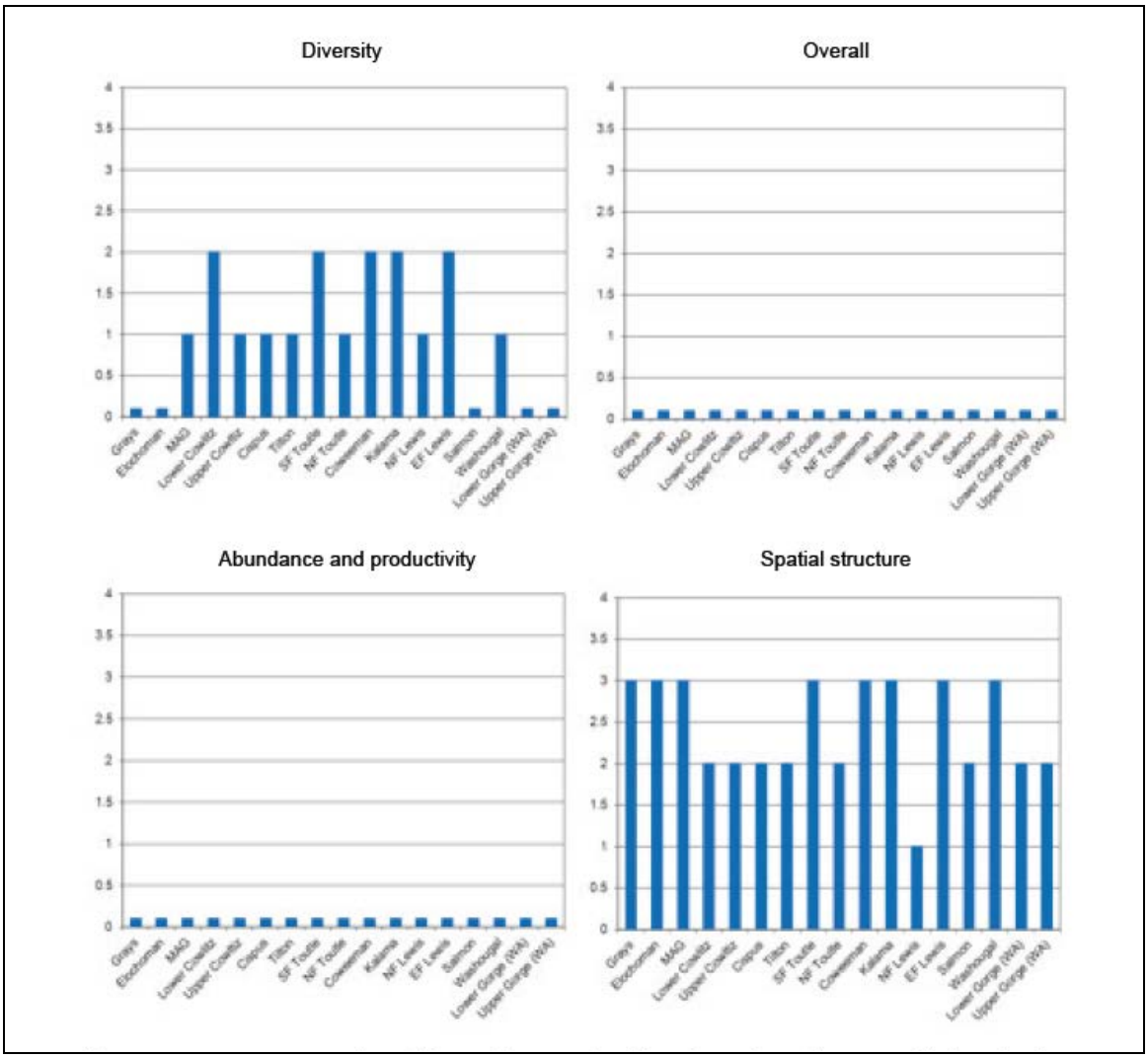

Figure 2.2.2.3: Current status of Washington LCR coho populations for the VSP parameters and overall population risk. (LCFRB 2010 recovery plan, chapter 6). A population score of zero indicates a population extirpated or nearly so, a score of 1 is high risk, 2 is moderate risk, 3 is low risk ("viable")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

Small et al (2011) assessed the genetic structure in Lower Columbia River chum salmon to guide and support recovery. Chum genetic variation showed strong eco-regional structure in the Columbia River and its tributaries. Gene flow was greatest within eco-region, and minimal among eco-regions.

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.

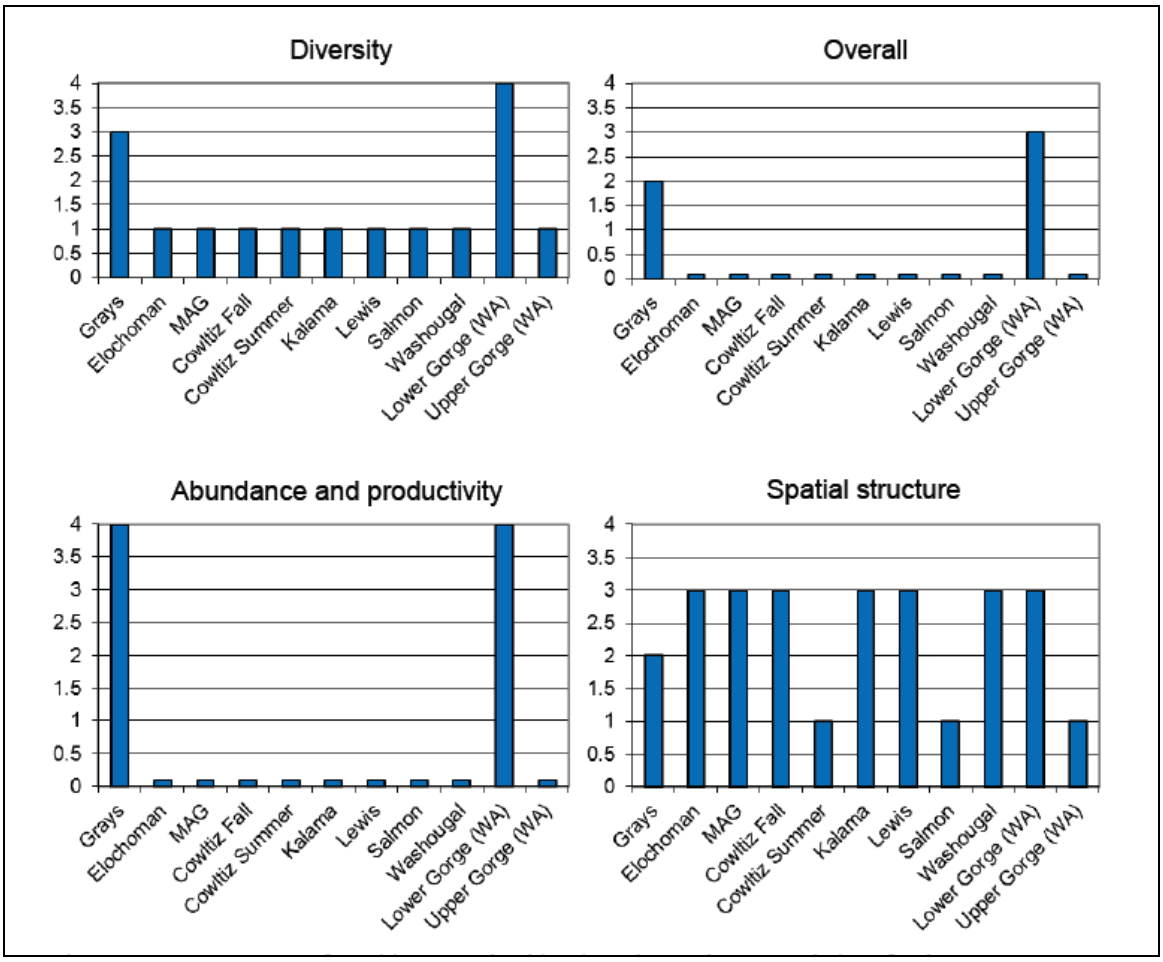

Figure 2.2.2.4: Current status of Washington CR chum populations for the VSP parameters and overall population risk. (LCFRB 2010 Recovery Plan, Chapter 6). A population score of zero indicates a population extirpated or nearly so, a score of 1 is high risk, 2 is moderate risk, 3 is low risk ("viable")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

Not available for most species. See HGMP section 11.1 for planned M&E. Juvenile coho production estimates is the one measure of production in the Lower Columbia system.

Table 2.2.2.5: Lower Columbia River Washington tributary coho smolt production estimates, 1997-2009 (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 2.2.2.6: 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 2.2.2.7: 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 2.2.2.8: 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 2.2.2.9: 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**	**1,374**	**515**	**523**

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

Table 2.2.2.10: 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 2.2.2.11: Population estimates in monitored areas 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 2012

[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.

Table 2.2.2.12: Estimated progeny per parent values for natural-origin chum salmon spawning in both the mainstem Columbia River and its tributaries between the I-205 Bridge and Bonneville Dam, 2000-2012.

Brood/Return Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
# Natural origin spawners	1,265	2,000	11,093	6,379	4,425	1,784	2,492	1,055	1,162	1,633	4,256	7,111	3,579
Age-2 Progeny-per-Parent (P:P)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Age-3 Progeny-per-Parent (P:P)	0.20	0.72	0.02	0.01	0.04	0.20	0.30	1.05	0.28	0.09	0.00	0.00	0.00
Age-4 Progeny-per-Parent (P:P)	1.85	0.76	0.22	0.09	0.18	0.46	1.24	6.24	2.11	0.00	0.00	0.00	0.00
Age-5 Progeny-per-Parent (P:P)	0.03	0.01	0.02	0.00	0.02	0.02	0.08	0.94	0.00	0.00	0.00	0.00	0.00
Age-6 Progeny-per-Parent (P:P)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Progeny-per-Parent (P:P)	2.09	1.48	0.27	0.11	0.24	0.68	1.62	8.23	2.39	0.09	0.00	0.00	0.00

= missing return data for brood year
= no data yet

Source: Hillson 2014 in prep

- 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.

Not available for most species. See HGMP section 11.1 for planned M&E. 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 (2004). See **Table 2.2.2.12** for annually reported values.

Table 2.2.2.12: Preliminary estimates of origin contributions (pNOS, pHOS-Hatchery and pHOS-Channels) at mainstem Columbia River and tributary spawning areas, I-205 Bridge to Bonneville Dam, 2000-2012.

	Brood Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Hamilton Springs	pNoS	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	93.6%	87.1%	98.7%	96.9%	97.4%
	pHoS - Hatchey-origin	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.3%	9.4%	0.0%	0.0%	0.0%
	pHoS - Channels-origin	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.1%	3.5%	1.3%	3.1%	2.6%
Hamilton Creek	pNoS	100.0%	100.0%	100.0%	100.0%	100.0%	94.8%	100.0%	100.0%	89.7%	90.6%	97.1%	96.5%	99.3%
	pHoS - Hatchey-origin	0.0%	0.0%	0.0%	0.0%	0.0%	5.2%	0.0%	0.0%	5.9%	7.5%	0.0%	0.0%	0.0%
	pHoS - Channels-origin	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.4%	1.9%	2.9%	3.5%	0.7%
Hardy Creek	pNoS	100.0%	100.0%	100.0%	100.0%	100.0%	95.5%	100.0%	100.0%	100.0%	96.7%	90.2%	91.8%	89.2%
	pHoS - Hatchey-origin	0.0%	0.0%	0.0%	0.0%	0.0%	4.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	pHoS - Channels-origin	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.3%	9.8%	8.2%	10.8%
Duncan Creek[1]	pNoS	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	75.0%	50.0%	68.0%	71.7%	57.3%	33.3%
	pHoS - Hatchey-origin	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	pHoS - Channels-origin	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	25.0%	50.0%	32.0%	28.3%	42.7%	66.7%
Ives	pNoS	100.0%	100.0%	100.0%	100.0%	100.0%	91.1%	99.8%	97.9%	90.0%	96.3%	98.8%	95.2%	99.5%
	pHoS - Hatchey-origin	0.0%	0.0%	0.0%	0.0%	0.0%	8.9%	0.2%	0.0%	5.0%	2.9%	0.0%	0.0%	0.0%
	pHoS - Channels-origin	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.1%	5.0%	0.7%	1.2%	4.8%	0.5%
Horsetail	pNoS	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	90.6%	100.0%
	pHoS - Hatchey-origin	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	pHoS - Channels-origin	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	9.4%	0.0%
Multnomah	pNoS	100.0%	100.0%	100.0%	100.0%	100.0%	99.5%	100.0%	100.0%	100.0%	100.0%	100.0%	96.9%	100.0%
	pHoS - Hatchey-origin	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	pHoS - Channels-origin	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.1%	0.0%
St Cloud	pNoS	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	87.7%	100.0%
	pHoS - Hatchey-origin	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	pHoS - Channels-origin	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	12.3%	0.0%
I-205	pNoS	100.0%	100.0%	100.0%	100.0%	100.0%	97.7%	100.0%	100.0%	100.0%	95.4%	98.9%	99.6%	100.0%
	pHoS - Hatchey-origin	0.0%	0.0%	0.0%	0.0%	0.0%	2.3%	0.0%	0.0%	0.0%	3.1%	0.0%	0.0%	0.0%
	pHoS - Channels-origin	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.5%	1.1%	0.4%	0.0%
Combined	pNoS	100.0%	100.0%	100.0%	100.0%	100.0%	96.8%	100.0%	99.6%	96.2%	94.7%	98.2%	97.5%	99.5%
	pHoS - Hatchey-origin	0.0%	0.0%	0.0%	0.0%	0.0%	3.2%	0.0%	0.0%	2.1%	3.4%	0.0%	0.0%	0.0%
	pHoS - Channels-origin	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	1.7%	2.0%	1.8%	2.5%	0.5%

[1] These values were estimated using only adults that returned to, or were recovered in, Duncan Creek and does not include adults released into channels (direct adult supplementation) that were collected from mainstem spawning locations.

Source: Todd Hillson, 2014 in prep.

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 (*reintroduction program*): Adults to be used for broodstock or direct adult supplementation are primarily collected using beach seines from mainstem Columbia River spawning areas near Bonneville Dam. Males tend to be caught in such nets more readily than females because of their hooked kypes and prominent teeth. Female chum that have already spawned (fully-spent or partially spawned-out) are also caught by this gear. Such fish are territorial and are guarding their redd sites. Consequently, in order to meet the broodstock collection goal of 150 pairs, up to 3,500 or so adults could be collected over the six-week spawning period that would not meet broodstock needs (excess males and spent females). Adults not needed for broodstock are quickly examined, sampled, tagged and released. Any non-targeted ESA listed adult salmonids captured during seining are enumerated and released immediately. In addition to seining, adults used in this program may also come from adult traps operated in Duncan Creek and the Hamilton Springs spawning channel.

Fish selected for broodstock will be immediately placed into holding tubes made of 10-inch diameter (25 cm) PVC pipe, 36 to 48 inches long (91 – 122 cm), perforated with 1.5 inch (3.8 cm) holes. Each tube will be marked (in pencil) with the fish's sex, date, and location of capture.

The fish will be transported to the Washougal Hatchery in their tubes and placed, still in the tube, in a holding pond until ripe. A similar procedure has been used successfully in the chum recovery project at Grays River where fish mortality was 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 (up to 300 fish).

In addition, female carcasses in Duncan Creek will be examined for egg retention to calculate actual egg deposition. This take is not explicitly listed in the take tables, since take from these females is already accounted for in the broodstock collection.

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 either the hatchery stock or the natural stock in the basin. Indirect take from genetic introgression is unknown.

Rearing Program:

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.

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. 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 from 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: Chum fry for the reintroduction program will be released at 200 fpp (~60 mm fl). 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 Chum Program, unpublished data.

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

Monitoring:
See HGMP section 11.1.1

Associated monitoring activities: WDFW has implemented an expanded monitoring program for Chinook, coho, chum and steelhead populations in the Lower Columbia River (LCR) region of Southwest Washington (WDFW's Region 5) and fishery monitoring in the lower mainstem of the Columbia River. The focus of this expanded monitoring is to: 1) gather data on Viable Salmonid Population (VSP) parameters – spawner abundance, including proportion of hatchery-origin spawners (pHOS), spatial distribution, diversity, and productivity; 2) to increase the coded-wire tag (CWT) recovery rate from spawning grounds to meet regional standards; and 3) to evaluate the use of PIT tags to develop harvest rates for salmon and steelhead populations. Additionally, key watersheds are monitored for juvenile salmonid out-migrant abundance. Coupled with adult abundance information, these data sets allow for evaluation of freshwater productivity and development of biological reference points, such as seeding capacity. 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).

- 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	Lethally Spawned	Transported to Spawning Channel	Holding/Collection Mortality	Surplus	Released
2002	169	65	0	0	1,353
2003	74	58	0	0	1,008
2004	n/a	69	0	0	945
2005	20	39	0	0	532
2006	56	30	1	0	561
2007	n/a	30	2	0	89
2008	n/a	40	0	0	231
2009	22	25	0	0	213
2010	40	25	0	0	285
2011	65	69	0	0	1,041
2012	51	46	0	0	409

Source: Todd Hillson - WDFW Chum Program 2014.
n/a = No hatchery program that year.

Table 2.2.3.3: Disposition of chum salmon captured at Duncan Dam adult trap.

Brood Year	Lethally Spawned	Transported to Spawning Channel	Mortality in trap	Surplus
2002	0	n/a	n/a	0
2003	0	n/a	n/a	0
2004	0	2	0	0
2005	0	7	0	0
2006	0	n/a	n/a	0
2007	0	n/a	n/a	0
2008	0	2	0	0
2009	0	26	0	0
2010	0	48	0	0
2011	5	85	3	0
2012	0	4	0	0

Source: Todd Hillson - WDFW Chum Program 2014.
n/a = No trap in place.

- 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 2.2.3.4: Projected annual take levels for listed fish by life stage.

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 Bonneville area. Staff will make extra effort to 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 removed from each carcass. No eggs, fry, or smolts will be subjected to this type of take.
Collect for Transport:	Up to 480 adults may be needed for activities relating to the re-introduction program. In addition, the salvage program may collect and transport up to 820 adults.
Capture, Handle, Tag/Mark/Tissue Sample and Release:	*Adults.* The beach seine sampling gear will capture adult chum salmon that will not be used as broodstock. Up to 3,500 chum not used for broodstock or salvage operations may be released alive. All or part of these released fish will be sampled (lengths measured, scales taken and fin tissue removed for genetic sampling) and tagged prior to release. Up to 400 adults may be released to spawn naturally in the newly restored Duncan Creek channels. *Juveniles.* If channels are seeded with adults, up to 480,000 fry may be expected to outmigrate. Capture rate for the juvenile fence trap is 100%.
Removal:	*Adults.* From 60 to 300 adult fish will be removed for artificial spawning. Up to 400 fish maybe released to spawn naturally in the Duncan Spawning Channels. Additional fish may be released in tributaries if mainstem Columbia River flows are forecast to be too low for spawning adequate spawning.
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 Duncan Creek channels. All artificially-produced fish from this recovery project through brood year 2013 received thermal otolith-

	marks. Samples were removed from each mark group to confirm that appropriate thermal marks have been induced into these fish. Otoliths are extracted, photographed and used as "voucher" samples. A total of up to 100 such fish 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. Beginning with brood year 2014, PBT will be employed and voucher samples will no longer be necessary. *Out-migrant juveniles*: The re-introduction program calls for juveniles to be trapped as they out-migrate from the channels so that they can be marked via strontium immersion which will allow them to be identified when they return as adults. Beginning in 2004 all fry trapped were marked prior to release. Beginning with brood year 2014, PBT will be employed and voucher samples will no longer be necessary. *Adult*: From 60 to 300 adult fish may be sacrificed for artificial spawning.
Unintentional Lethal Take:	*Egg/Fry*: "Take" can range from 0 to around 200 eggs. Eggs may be accidentally damaged during artificial-spawning operations. *Outmigrants 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. Mortalities as a result of fry trapping operations at the Duncan Creek channels are estimated at <2% of the total out-migrating fry. The magnitude of this take depends on the number of naturally-spawning chum salmon in Duncan Creek above the weir. *Adults*: Pre-spawning mortalities are estimated at three to twelve 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 Hatchery have consistently had very low mortality rates, <2%.

The range of values in **Table 2.2.3.4** 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 mortality 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 35 pairs of chum salmon are collected from below Bonneville Dam and the highest represent those expected to occur when 120 pairs are collected for artificial spawning. In addition, up to 400 fish may be collected to spawn naturally in the newly restored Duncan Creek Channels.

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 protect extant chum stocks using spawning areas adjacent to the Bonneville Dam. 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 2.2.3.4**.
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. A *Lower Columbia River Chum Supplementation Plan* is currently under development.

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 (WDFW and PNPTT 2000).
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.

This HGMP is consistent with the *Monitoring and Evaluation Plan for Duncan Creek* (WDFW 2001).

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 (BA) 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 salmon. WDFW currently has no way to monitor for impacts of Lower Columbia commercial fisheries on chum salmon. The Columbia River system is closed to recreational harvest of chum salmon (see also HGMP section 3.3).

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).

Re-Introduction of Lower Columbia River Chum Salmon into Duncan Creek Project. This project responds to Action 157 in the December 2000 FCRPS Biological Opinion. That action requires BPA to fund projects that improve and restore tributary and mainstem habitat for Columbia River chum salmon in the reach between The Dalles Dam and the mouth of the Columbia River to compensate for effects of water management operations in the Ives Island area. The Biological Opinion also states the Action Agencies shall operate the FCRPS to provide flows to support chum salmon spawning in the Ives Island area below Bonneville Dam.

A three-pronged approach is being used to once again produce a self-sustaining chum salmon population in Duncan Creek. This approach includes modifying the dam to provide adult fish passage, enhancing spawning habitat to allow successful incubation, and using local broodstock to re-introduce chum back into the basin. The first objective was accomplished in November 2000 when the dam was modified to allow free fish passage. The second objective was completed in 2002, under the *Re-Introduction of Lower Columbia River Chum Salmon into Duncan Creek Project*. The third objective is covered in this HGMP.

Sub-Basin Planning - 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 28 LFA was conducted by the Washington State Conservation Commission (Wade 2001). Major impacts include fish habitat degradation from the upper Washougal River system reaches downstream to the mouth in Camas. The Yacolt Burn deforested large tracts of land in the upper reaches causing an increase in sediment transport, a reduction in hydrologic retention, and a general decline in habitat quality. Gravel extraction in the lower 20 miles of the river has caused a loss in suitable spawning substrate through this reach. Water quality remains a problem and the Washougal River is listed on the 303d list (WDOE) along with several of its' tributaries..

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 steelhead smolts. 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 Washougal Hatchery 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 Hatchery.

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			
	Boyle Cr. (spring water)	S2-CV2P694/ 07316	07327	5.5 cfs	49.3	Rearing	Limited water during summer months due to low flows.
	Bob Creek (surface)	S2-*09760C WRIS/ 07314	07325	3.0 cfs	48.9	Rearing, incubation	None. Not used for incubation in the summer.
Vancouver Hatchery	Well	G2-22597C WRIS	-----	300 gpm	51	Incubation and rearing	200 gpm for rearing fish
	Columbia Spring	S2-CV1P289/ vested	-----	6 cfs	51		No pathogens present

	West Biddle Lk (surface)	S2-*09596C WRIS/ 03900	06668	2 cfs	51		

Source: Phinney 2006, WDOE Water Resources Explorer 2014, WDFW hatchery data.

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 68.6 m 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 13 thru 24, as well as 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 0.54 km from the grounds and supplies 2.5 cfs for incubation. Water temperature stays fairly constant year-round (see **Table 9.2.2**), and it is not used for incubation in the summer months. "C-Creek", another small spring source, is no longer used (Richard Johnson, pers. comm., 2004).

During summer, water from the river intake reflects elevated temperatures. Water temperature data collected at the Washougal Salmon Hatchery between 1987 and 1991 also documents high water temperatures in the upper Washougal basin. During this five-year recording period, water temperatures at the hatchery frequently exceeded 17.8°C during July, August and September; in some cases for as long as 17 days in a row (see also **Table 9.2.2**).

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.

Vancouver Trout Hatchery. Columbia Springs, West Biddle Lake and one well are the primary water sources for this facility. Two additional wells were drilled, but the water was found to have a very high iron content and was deemed unsuitable for fish rearing. Columbia Springs provides pathogen-free water supply for all incubation needs, as well as the round rearing vessels and one $^{1}/_{8}$-acre rearing pond. West Biddle Lake supplies water to four raceways used for rearing until fish are transferred. The one well with water suitable for rearing fish can supply up to 300 gpm to the $^{1}/_{8}$-acre pond as well as the four raceways. Water rights total 5,892 gpm from all sources combined. In recent years, however, the overall amount of water from Columbia Springs and West Biddle Lake has diminished considerably due to residential development and the water table decreasing. Overall water quality is good and pathogen free. Actual water used averages 1,900 gpm from the used sources.

The water right permits are formalized through the Washington Department of Ecology (**Table 4.1.1**), and were obtained by WDFW in 1950 (surface), and in 1974 (well).

Duncan Creek spawning channels. The spawning channels at Duncan Creek were originally constructed in 2002 on the site of a rehabilitated chum spawning area at Duncan Springs (Hillson 2002); two of the three spawning channels were re-engineered in 2008 (Hillson 2011). Water quality (temperatures and DO), water levels/depth and velocity are monitored during spawning through emigration (November through May).

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 (WDOE) (**Table 4.1.2**).

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 (see Table 4.1.3)	Corrective Actions Y/N	Meets Compliance Y/N
	Monthly	Qtrly	Annual				
Washougal WAG13-1044	Y	Y	Y	07/25/2012	0	N	Y
Vancouver WAG13-1032	Y	Y	Y	01/30/2014	3	N	Y

Source: Ann West, WDFW Hatcheries Headquarters Database 2014.

Table 4.1.3: List of NPDES violations at Vancouver Hatchery over the last five years (2010-2014).

Month/ Year	Parameter	Sample Type	Result/ Violation	Permit Limit	Comment	Action
April 2012	Reporting	n/a	n/a	n/a	Late Report to WDOE	Report submitted to WDOE
May 2012	Reporting	n/a	n/a	n/a	Late Report to WDOE	Report submitted to WDOE
June 2012	Reporting	n/a	n/a	n/a	Late Report to WDOE	Report submitted to WDOE

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).

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.

Vancouver Trout Hatchery. No impact to listed natural fish.

Duncan Creek Spawning Channels. No impact to listed natural fish.

5 SECTION 5. FACILITIES

5.1 Broodstock collection facilities (or methods).

Adult chum broodstock collection methods will depend on water levels and fish location. Conditions will range from shallow water areas in the lower reaches of tributaries to deeper areas in the mainstem Columbia River. Successful broodstock collection will require some experimentation and a combination of the following methods:

Beach Seining. Adults are captured as they staged and spawned in shallow water (< 10' deep). Tangle nets (200' x 12' x 2" "floating" type) were used during fall 2001 and 2002. Tangle nets catch adults by their maxillary bones and teeth, which, while effective, makes fish removal very labor intensive and may be selective for more mature adults, particularly males. During fall 2003, WDFW evaluated beach seines (200' x 12' with 1/2 inch mesh "sinking" type) as an alternative method to capture adults. The beach seine did not appear to be selective and allowed for faster processing of adults out of the nets. Tangle nets required all adults to be removed and placed into a second holding net before any could be processed. Using the beach seine eliminated this step since the adults could be left crowded up in the beach seine without fear of additional injury or mortality, thus increasing efficiency in the field. After minimal testing, beach seining was identified as the most effective method to collect broodstock from mainstem spawning areas, and use of the tangle net was discontinued (Hillson 2011).

Adult Traps. Broodstock may be collected from the adult traps installed on Hardy, Hamilton and Duncan creeks.

An adult "V" weir trap and live box in the Duncan Creek Dam structure is used to enumerate adult chum salmon that enter Duncan Creek. The dam structure, located at the mouth of Duncan Creek, provides the only solid ground near the mouth of the creek where a trap could be placed. The left side of the dam is a concrete sluiceway with two vertical weir gates. These gates are closed to maintain the lake during the summer, then held in the raised position during the fall, winter and early-spring to provide fish passage. This sluiceway provided the best location to place the adult trap.

The trap consists of three pieces and a lifting beam. The downstream piece acts as a fish barrier with a gated finger weir opening at the bottom. The upstream piece acts as a fish barrier and trash rack. The centerpiece consists of an open sided box with only a floor and ladder. A lifting boom used to raise and lower the trap box. The upstream and downstream pieces were attached to the walls of the sluiceway with just enough room for the trap box between them. In 2003, sets of plastic finger weirs (Neptune Marine Products Inc., Seattle WA) were used to prevent adults from exiting the trap box once inside. However, high velocity flow and debris caused these weirs to fail several times over the season. These plastic weirs were replaced in 2004 with a "V" weir structure made from lumber and steel pipe. High water velocities were moderated using cross weirs made of stacked sand bags. Also in 2004, the sluiceway gates were not fully opened, were only raised to a level that provided good flow through the trap. To compensate for this, one set of three dam boards on the spill side of the dam were removed to let excess water out. When operating, the trap box sits in the floor of the sluiceway, and the gate on the downstream weir is opened to allow adults to pass through the finger weirs and into the trap box. To process adults in the trap box, the gate on the downstream weir is closed to hold fish in the trap box. If mainstem Columbia River water levels are high (more than two feet deep in sluiceway), the downstream gate is closed, and the trap box can be lifted until the water depth over the bottom is shallow enough to process adults. The gate on the downstream weir also prevents adults from getting under the trap box when in the raised position. This ability to raise the trap box allows for trap operation during high water events (Hillson 2006, 2011).

A severe storm in early-November 2006, with near-record levels of precipitation, resulted in high amounts of water and debris passing through the adult trap at the dam. The trap unable to withstand the pressure created by the debris load on the upstream weir, and was torn from its mounting bolts. The trap was pushed down the sluiceway, removing the downstream cross-weirs.

The new adult trap, installed in fall 2008, followed the same design principle, to remain operational over a wide range of water depths, but included a few key changes: the stronger frame and mounting points were made of steel instead of aluminum; upstream and downstream weirs were made with four aluminum panels instead of being a single, piece; and a more robust floor-lifting system was installed. The new design allows for installation and removal by a single

person without needing heavy equipment; the original adult trap required at least three people and a large boom truck to install and remove. The steel framework and mounting points creates both a stronger trap and the ability for the framework to remain in place year-round, adult trapping can be initiated or stopped by installing or removing the individual weir panels. A series of three steel cross-weirs were installed below the trap in the sluiceway to provide both holding water depth in the trap and easier access to the sluiceway when mainstem Columbia River water levels were lower than what would provide unimpeded access into Duncan Creek (tailwater elevations of 11.2-5 at the Tanner Creek gauge are required to match the lip elevation at the sluiceway).

In fall 2013, a temporary "V"-weir and holding/trapping area was installed at the mouth of Hamilton Springs spawning channel, and was used as a broodstock collection point. The weir was only fished one or two days per week, and was left "open" the rest of the time so adults could freely enter or leave the spawning channel. The weir was constructed of PVC pipe and rigid plastic stringers, it was held in place with t-post driven into the gravel. The weir was installed in early-November and removed in early-January.

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 the 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.

Juveniles. The 400-gallon truck is used to transport fry to their release sites. Supplemental oxygen is used during transport. Transport time is approximately 30 minutes to release site(s).

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 solution treatment will take place in the incubation room.

Duncan Creek spawning channels. The spawning channels at Duncan Creek were originally constructed in 2002 (Hillson 2002) (**Figure 5.3.1**), approximately 0.8 km upstream from the Duncan Creek Dam/fishway; two of the three spawning channels were re-engineered in 2008 (Hillson 2011). In 2011 the spawning channel was extended to increase capacity. Water temperature, DO levels, vertical hydraulic gradients (VHG), and velocities are monitored from before adults are introduced until fry emigrate. Redd superimposition and egg retention due to overcrowding is controlled by limiting spawner densities to one female per two square meters of available spawning area.

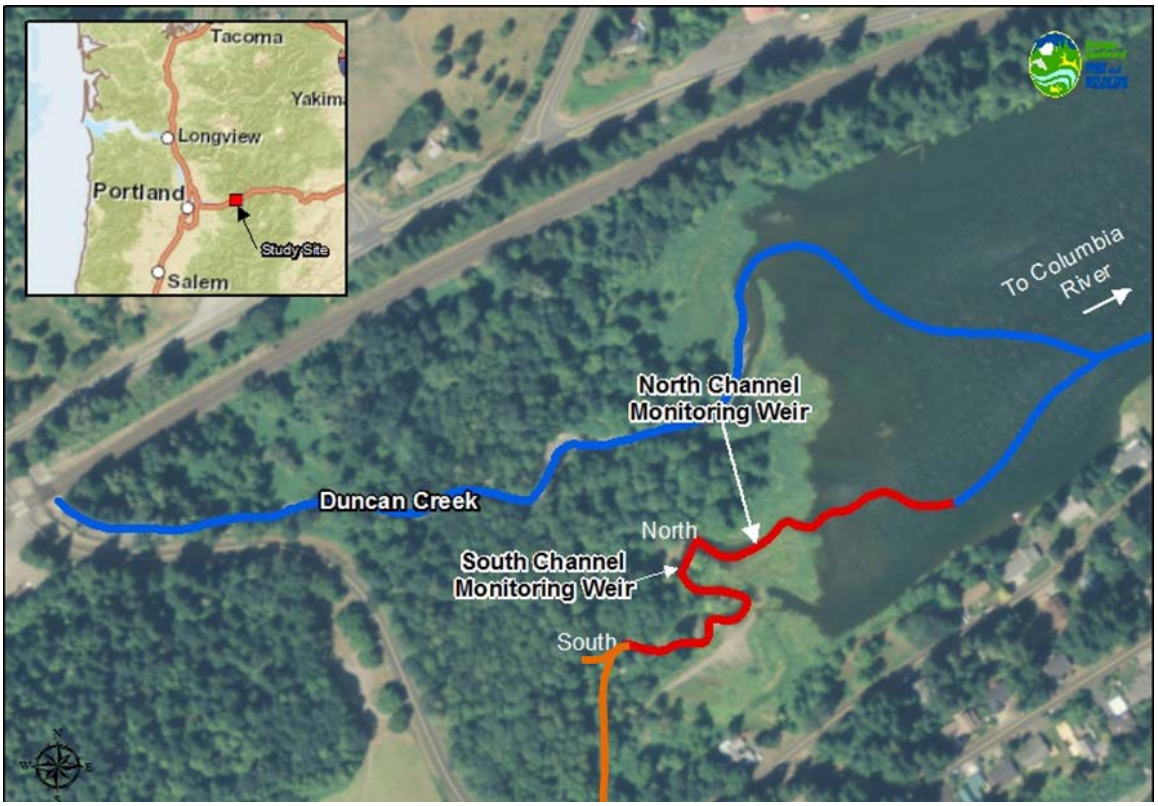

Figure 5.3.1: Aerial view of Duncan Creek and the renovated spawning channels (photo taken during summer months with lake present). The blue line represents Duncan Creek's location during fall/winter/spring when the lake is not present. The red line represents the channel configuration after the 2008 work and the orange line represents the work in 2011 that extended the spawning channel.

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

Washougal Hatchery. Eggs from an individual female will be placed in a single tray in the vertical stack incubators. This allows the survival of offspring produced from each female used in the recovery program to be evaluated. Water chillers and flex hoses have been installed at the hatchery to enable thermal-marking while the eggs are incubating.

Table 5.4.2: Incubation vessels available, Vancouver Hatchery.

Type	Units (number)	Size			Flow (gpm)	Volume (cu.ft.)	Loading (eggs/unit)
		Length	Width	Depth			
Shallow Troughs (5 cells/trough)	48 Shallow Troughs	15-ft	1-ft	0.6-ft	7	9	20,000

Vancouver Hatchery. Eyed-eggs will be transferred from Washougal Hatchery into shallow concrete troughs for final incubation and rearing. Average water temperature is 51°F.

5.5 Rearing facilities.

Table 5.5.1: Rearing facilities available, Washougal Hatchery.

Pond Type	Units (No.)	Volume (cu.ft)	Size			Flow (gpm)	Max. Flow Index	Max. Density Index
			Length (ft.)	Width (ft.)	Depth (ft.)			
Concrete Raceways	12	4,800	80	20.0	3.0	265	2.69	0.17
Concrete Raceways	12	8,300	135	17.5	3.5	320	2.10	0.068
Concrete Rearing Pond	1	85,500	475	40	4.5	11,000	2.26	0.26

Washougal Hatchery. Chum fry for this program were reared at Washougal Hatchery in fiberglass deep troughs next to the concrete raceways during brood years 2001-2013. The water supply was plumbed into a water manifold from the concrete raceways to provide flow to individual troughs.

Vancouver Hatchery. Fry will be reared at Vancouver Hatchery, in concrete troughs beginning with the 2014 brood (see **Table 5.4.1**).

Duncan Creek spawning channels. See HGMP section 5.3.

5.6 Acclimation/release facilities.

Duncan Creek/Below Bonneville: Two options exist for rearing and releasing artificially-produced fry from either the re-introduction or the salvage programs:

1. Fry will be reared to size at the hatchery and then transported to the appropriate sites for release (see HGMP section 10.1).
2. Unfed or fed fry produced under a salvage-plan will be transported to rearing locations at Hardy, Hamilton, and Duncan creeks. In each of these locations, it may be possible construct facilities to hold and rear juveniles in seep areas. If this approach is used, bird netting will be stretched over rearing sites to help prevent losses from avian predators. Prior to fry introduction, the rearing areas will be seined and/or electroshocked to remove any potential predators. This option may increase homing fidelity since the fry will have additional time to imprint to their rearing locations. However, to date no acclimation sites have been used or constructed for this program.

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.
- Broodstock collection is checked daily for program and listed fish.
- 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.

Vancouver Trout Hatchery. No impact to listed natural fish.

Duncan Creek spawning Channels:

- Spawning area is located in a spring channel, and therefore protected from extreme environmental variation.
- Log barriers were placed in fall 2003 to protect the spawning channels from high water events in Duncan Creek, which would have changed the substrate composition in the spawning areas.
- Gravel composition and conditions are monitored for favorable spawning and incubation.
- Environmental factors (water velocity and other water quality measures) are monitored from adult spawning to fry emigration.

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 the mainstem Columbia River spawning areas from Bonneville Dam downstream to approximately Multnomah Falls, and from adult chum returning to Duncan and Hamilton creeks. Annual broodstock collection totals will vary, dependent upon implementation and degree of a salvage plan. Estimated broodstock needs under different degrees of the salvage plan (see HGMP section 1.7).

6.2 Supporting information.

6.2.1 History.

The 120-foot-long Duncan Creek Dam was constructed in the early-1960s, and was modified a few years later to include a culvert for fish passage. Chum had a difficult time locating the passage, and the number of the salmon returning upstream of the dam to spawn dropped dramatically. Prior to dam construction, peak annual chum counts in Duncan Creek were approximately 500 fish; after dam construction, the numbers quickly dropped to one or two fish every few years. The dam was modified in 2000, through the cooperation with local landowners, WDFW, and the Lower Columbia Fish Recovery Board.

The Duncan Creek Project has two goals: 1) reintroduction of chum salmon into Duncan Creek by providing off-channel high-quality spawning and incubation areas, and 2) to simultaneously evaluate natural recolonization and a supplementation strategy where adults are collected and spawned artificially at a hatchery.

For supplementation, eggs are incubated and the fry reared at Washougal Hatchery for release into Duncan Creek. Four criteria are used to evaluate the success of this program: 1) the egg-to-fry survival rates in the renovated channels, 2) the survival of the eggs and fry used in the artificial rearing program in Duncan Creek, 3) the survival and spawning ground distribution of adult chum salmon produced from the spawning channels and the artificial rearing program, and 4) the straying rate of non-program chum salmon into Duncan Creek.

The monitoring portion of the Duncan M&E includes documenting and monitoring the physical attributes of the channels. These physical attributes include, but are not limited to, gravel composition, sedimentation load, dissolved oxygen (DO) levels, vertical hydraulic gradients and water temperatures in the hyporheic zone, and flow.

Reintroduction/Salvage Programs. The Bonneville chum population is believed to originate entirely from natural production. Eyed-eggs of non-local origin had been introduced into the Hamilton Creek Spring Channel with no apparent increase in adult production. No non-local hatchery introductions have been made into Hardy and Duncan creeks.

6.2.2 Annual size.

Reintroduction Program. The goal is to use a minimum of 35 pairs (per Schroder 2000), and up to 280 pairs of adult chum salmon may be collected from the mainstem Columbia River, focusing on the Ives Island area, for either use as broodstock or released directly into the Duncan Creek spawning channel.

Salvage Program. Up to 120 adult pairs are collected from the mainstem Columbia River, focusing on the Ives Island area, and transported to Washougal Hatchery for artificial spawning and rearing.

6.2.3 .Past and proposed level of natural fish in broodstock.

The ideal level of natural fish in the broodstock is 100%. However, since returning adults are otolith-marked and not mass-marked, the proportion will be unknown until after spawning.

Table 6.2.3.1: Preliminary estimates of origin contributions (pNOB, pHOB-Hatchery and pHOB-Channels) of broodstock spawned at Washougal Hatchery into the spawning channels, 2001-20012.

Brood Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
# Hatchery Spawners	47	169	74	0	20	56	0	0	22	40	62	51
pHoB (Hatchery-origin)	0.0%	0.0%	0.0%	---	11.4%	2.0%	---	---	0.0%	0.0%	0.0%	0.0%
pHoB (Channel-origin)	0.0%	0.0%	0.0%	---	0.0%	0.0%	---	---	0.0%	2.7%	12.5%	0.0%
pHoB (combined)	0.0%	0.0%	0.0%	---	11.4%	2.0%	---	---	0.0%	2.7%	12.5%	0.0%
pNoB	100.0%	100.0%	100.0%	---	88.6%	98.0%	---	---	100.0%	97.3%	87.5%	100.0%

Brood Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
# Channel Spawners	43	65	54	69	46	63	36	42	49	69	154	50
pHoB (Hatchery-origin)	0.0%	0.0%	0.0%	0.0%	2.2%	0.0%	0.0%	3.0%	0.0%	0.0%	0.0%	0.0%
pHoB (Channel-origin)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	11.5%	11.4%	16.9%	19.4%	22.9%	9.0%
pHoB (combined)	0.0%	0.0%	0.0%	0.0%	2.2%	0.0%	11.5%	14.4%	16.9%	19.4%	22.9%	9.0%
pNoB	100.0%	100.0%	100.0%	100.0%	97.8%	100.0%	88.5%	85.6%	83.1%	80.6%	77.1%	91.0%

Source: Hillson 2014 in prep.

Table 6.2.3.2: Estimates of PNI, by brood year and strategy, Duncan Creek Chum Project, 2001-2012.

Brood Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Hatchey broodstock	100.0%	100.0%	100.0%	na	96.5%	100.0%	na	na	96.7%	100.0%	100.0%	100.0%
Channels broodstock	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.5%	98.1%	97.7%	97.9%	96.9%	99.4%
Combined	100.0%	100.0%	100.0%	100.0%	98.3%	100.0%	99.5%	95.7%	97.2%	99.0%	98.6%	99.5%

Source: Hillson 2014 in prep.

6.2.4 Genetic or ecological differences.

There are no known genotypic, phenotypic, or behavioral differences between the natural spawning and fish collected for brood stock. Small et al (2011) assessed the genetic structure in Lower Columbia River chum salmon to guide and support recovery. Chum genetic variation showed strong eco-regional structure in the Columbia River and its tributaries. Gene flow was greatest within eco-region, and minimal among eco-regions.

6.2.5 Reasons for choosing.

Reintroduction program. Chum salmon propagated through this program represent an indigenous Lower Gorge population that is the target of the chum salvage operation. This stock is one of two known historical populations of Columbia River chum salmon that have persisted, and they are genetically distinct from the Grays River Population.

Using chum salmon native to the Bonneville area for broodstock in Duncan Creek also reduces the risk of catastrophic loss since the renovated spawning habitat in Duncan Creek will provide the fish with protected spawning areas. Moreover this tactic will help alleviate: 1) high egg retention rates; 2) superimposition of redds; and 3) pre-spawning mortality in low-flow years. In addition, it will protect this portion of the Lower Gorge chum population from destruction if natural spawning areas become completely dewatered due to weather conditions or flow manipulations. Also, using the hatchery for spawning, incubation, and rearing should provide egg-to-smolt survival rates of 90% or higher.

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.

Only local brood stock will be used. To preserve the temporal integrity of the run, broodstock collection will span the months of November and December. A minimum of 35 pairs will be

collected for each release site 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 (early-November through December) using beach seines and adult traps on tributaries (see HGMP section 5.1). Originally, females included in the direct-adult supplementation program need to be in good condition, show no signs of redd digging activity, and have a firm belly indicating a complete egg-mass. To be used in either program, males need to be at least in fair condition and produce milt when checked for ripeness. Due to declining returns of chum returning to spawning areas nearing Bonneville Dam, beginning in 2006, females that showed signs of digging but were estimated to still have >75% of their eggs could be retained for hatchery broodstock (Hillson 2011).

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. An example of weekly collection goals for a season total of 100 pairs (200 adults) are provided in **Table 7.2.1**. This method insures that adults are collected over the entire run period and that the majority of adults are collected when the run is expected to be at its largest point.

Table 7.2.1: Weekly Broodstock Collection Goals to Produce a Season Total of 100 Pairs.

Week	% of Season Total	# of Adults needed
1	5	10
2	15	30
3	30	60
4	30	60
5	15	30
6	5	10

Mainstem seining locations include the Ives Island, Horsetail, Multnomah and St. Cloud areas. To maximize the likelihood of capturing females that met the criteria for inclusion in the supplementation program, all spawning areas are seined twice a week once chum salmon presence was expected.

Seines were set on foot or by boat, depending on flow conditions and water depths. Start and stop points for each area were designated in 2003 and have remained consistent to the extent that flow and river levels allow.

7.3 Identity.

Lower Gorge chum are present at the start of broodstock collection. Hatchery chum have been present in the adult population since 2004, with the return of three-year old adults from the 2001 brood at Washougal Hatchery. While these fish are thermally-marked for identification, this mark is cryptic and these fish cannot be distinguished in the field. Chum produced during brood years 2009-2012 for the reintroduction program were also adipose fin-clipped.

Biological sampling of each adult used for broodstock includes scale, pathogen, DNA and GSI samples (otoliths).

7.4 Proposed number to be collected:

7.4.1 Program goal (assuming 1:1 sex ratio for adults):

See HGMP section 6.2.2.

7.4.2 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 origin and sex, Washougal Hatchery chum programs.

Brood Year	Duncan Creek		
	Egg-Take	Females	Males
2002	244,156	93	89
2003	87,486	36	38
2004	-----	-----	-----
2005	24.830	9	11
2006	63,132	28	28
2007	None due to funding reductions		
2008	None due to funding reductions		
2009	26,733	11	11
2010	56,007	18	20
2011	79,424	33	32
2012	63,240	24	27

Source: Hillson 2011, WDFW Hatcheries Headquarters Database 2014.

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

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

7.6 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. Adults collected to spawn naturally in the Duncan Creek Channels are held and transported in a tube, then released into the channels above weirs.

7.7 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 (as per Disease Policy). 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.

7.8 Disposition of carcasses.

All carcasses (spawned and un-spawned) from the hatchery portions of either program will either be disposed of by the contracted fish buyer, or used for nutrient enhancement in the Washougal River watershed. In Duncan Creek, carcasses will be removed from the creek to reduce disease concerns. However, they will be left in the Duncan Creek riparian area for ecosystem benefits.

7.9 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.

- 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.

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.

Fish used for broodstock will be collected from the spawning grounds and at traps in a random fashion throughout the duration of the spawning run (early-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 spawning 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 and they are semelparous. Two-year-old males have been observed in some chum populations but they are very rare. In any case, broodstock males with different ages of maturity will be used in an equivalent fashion and in proportion to their occurrence in the population.

8.3 Fertilization.

In a 3x3 mating, nine separate egg lots are created, 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 Vertical 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.

The factorial mating scheme described in HGMP section 8.2 allows each fish chosen as broodstock to make a genetic contribution and therefore maintain genetic diversity.

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.

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

Brood Year	% Survival Rate	
	Green-to-Eyed	Eyed-to-Ponding
2002	92.5	98.3
2003	93.7	95.2
2004	----	----
2005	90.1	97.0
2006	92.0	97.8
2007	----	----
2008	----	----

2009	97.6	97.3
2010	98.8	99.0
2011	95.3	99.0
2012	93.3	99.9

Source: Hillson 2011, WDFW hatchery records.

Duncan Creek Spawning Channels. The renovated spawning channels at Duncan Creek should produce egg-to-fry survival rates of 30-50%. The overall estimated egg-to-fry survival from adults released into the Duncan Creek spawning channel has been greater than 60% (pers. communication Todd Hillson, 2014).

9.1.2 Cause for, and disposition of surplus egg takes.

There are no constraints, other than incubation space, on numbers to be released from this Conservation/Recovery program. Therefore, all eggs taken for either program will be incubated, reared and released.

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 incubated in their own Heath tray. Average fecundity is 3,000 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 (see **Table 9.2.3.1**), 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 eggs are water hardened in iodophor for 60 minutes in the tray before incubation being moved to the incubation racks.

All eggs at the Washougal Hatchery are incubated on water from spring-fed Bob Creek; water temperature range 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 8.0 to 10.0 ppm. The eyed-eggs are placed into incubator trays supplied with folded Vexar®.

At Vancouver Hatchery, eggs are incubated in shallow troughs with water from Columbia Springs.

All hatchery-reared fish released under this program have been thermally otolith-marked via methods described in Volk et al. (1990, 1994 and 1999) through brood year 2013. The bar codes are determined and a schedule established for chilled water applications by personnel in the WDFW Otolith Lab.

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. Eyed-eggs were placed into 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 will prevent yolk sac malformations.
- 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, Duncan Creek chum at Washougal Hatchery.

Brood Year	Survival Rates (%)
2002	98.1
2003	97.4
2004	------
2005	92.5
2006	95.7
2007	------
2008	------
2009	99.2
2010	97.2
2011	99.0
2012	98.4

Source: Hillson 2011, WDFW hatchery records.

The objective at is to achieve at least a 95% survival rate during the rearing period.

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 for chum reared at Washougal and Vancouver hatcheries are less than one-half pound of fish per gpm during rearing, approximately 26,000 fry per trough.

9.2.3 Fish rearing conditions

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

Month	Average Water Temperature (ºF)		
	Washougal R.	Bob Creek	Boyle Creek
January	39.3	43.2	42.2
February	42.1	44.5	44.3
March	43.4	45.0	46.0
April	45.6	47.1	47.2
May	50.6	49.1	50.8
June	54.1	50.5	51.2
July	61.4	56.9	59.1
August	60.8	58.2	58.7
September	56.8	56.0	56.1
October	47.5	48.0	48.5
November	44.1	45.0	45.2
December	38.7	43.2	42.3
Average	**48.7**	**48.9**	**49.3**

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 a combination of river and spring 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.

Chum reared at Washougal Hatchery were also adipose fin-clipped from brood years 2009-2012, in addition to the otolith thermal mark. Chum fry are clipped in early-May, when fish are 250 fpp.

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, Washougal Hatchery chum fry.

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
Week 9	1.325	310	1.345	306	1.224	365	1.295	345
Week 10	1.543	225	1.523	236	1.467	277	1.455	258

Source: WDFW hatchery records 2014.

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 a semi-moist diet with no fines, and fed up to release. Feed brands 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 one-fortieth of fork length of the reared fish. While not calculated, expected fed conversion rates are >0.08. 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).

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).

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. The vacuum/siphon and any tools used are soaked in a PVP-iodine solution for several minutes before using it another trough to prevent disease or pathogen transfer from one raceway to the next.

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.

The most “natural” rearing method chum fry reared in the Duncan Creek spawning channels. Here the fish will experience a natural substrate and will have opportunities to prey on live foods. So-called NATURES rearing systems have yet to be tried and evaluated for chum salmon. However, raceway coloration, overhead covers, and underwater feeders would be elements that could be used to pre-condition chum fry to natural conditions. If funding becomes available, such treatments will be instituted and evaluated because of their potential to increase post-release survival rates.

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.

Juvenile chum will be returned to appropriate release sites (e.g. Hardy, Hamilton, Duncan creeks and the mainstem Columbia near Ives Island) as soon as possible for imprinting. Another option is to rear the juveniles in the tributaries before release.

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)	Release Location	
					Stream	Release Pt (RKm)
Fry	Reintroduction	Up to 150,000	250-400	Apr-May	Duncan Creek (WRIA 28.0296)	Mouth of Duncan Cr 226.1 on Columbia R.
	Reintroduction plus Salvage	up to 400,000	250-400	Apr-May	Mainstem Columbia near Ives Island	~229.0

Source: WDFW Future Brood Document 2014
Note: 200 fpp = ~60 mm fork length (fl).

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

Stream, river, or watercourse: See HGMP section 10.1

Release point: See HGMP section 10.1

Major watershed: See HGMP section 10.1

Basin or Region: Lower Columbia Gorge

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

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

Release Year	Number	Avg Size (fpp)	CV	Date
2004	294,235	355.6	NA	May 8, 19-21
2005	NA	NA	NA	NA
2006	19,578	427.0	9.90	May 11
2007	65,592	313.0	7.10	May 21
2008	None due to funding reductions			
2009	None due to funding reductions			
2010	63,255	213	6.35	May 17
2011	53,267	200.0	7.00	May 25
2012	74,893	297.0	n/a	May 15
2013	58,004	187.0	6.10	May 13

Source: WDFW Headquarters Hatcheries Database 2014.
NA = not available.

10.4 Actual dates of release and description of release protocols.

Release is triggered on fish size, once the average weight of fry in a trough reaches 1.0-1.5 grams (50-55 mm fl). Release is a forced type since fry are trucked from the hatchery and released in mass.

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 30 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).

Fry are currently force-released; release sites do not have acclimation facilities. Acclimation ponds may be built if straying rates are determined to be unacceptable in the future.

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, release site, and mark-type.

Brood Year	Age Class	Mark Type	
		Washougal/Vancouver Hatchery	Duncan Creek Spawning Channel
2002	**Fry**	Otolith (thermal)	-------
2003-2009		Otolith (thermal)	Otolith (strontium)
2009-2012		Otolith (thermal) + AD	Otolith (strontium)
2013		Otolith (thermal)	Otolith (strontium)
2014		Parental Based Tagging (PBT)	Parental Based Tagging (PBT)

Source: Todd Hillson 2014.

All chum fry released from Washougal Hatchery through brood year 2013 were thermally otoliths-marked in the incubators via methods described in Volk et al. (1990, 1994 and 1999). Each release site had a unique mark. Fry produced from naturally-spawning adults in the restored Duncan Creek spawning channels were marked by placing the fish in a diluted strontium bath.

Chum fry reared at Washougal Hatchery from brood years 2009-2012 were adipose fin-clipped in addition to the thermal marking on the otoliths; the 2013 brood should have also been AD+otolith-marked, but grew too slowly, and were released before they reached adequate clipping size. As of brood year 2014, chum fry from both Washougal and Duncan Creek will use PBT to identify origin.

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.

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

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 Fish Health Specialist, who examines the 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.

Emergency procedures and disposition of fish would adhere to the protocols and procedures set forth in the Section 7 Permit. If the program were threatened by ecological or mechanical events, the Complex Manager would contact and inform Regional management of the situation. Based on a determination of a partial or complete emergency release of program fish, authorized personnel would pull screens and sumps and fish would be early-released into the Washougal River. No release of fish will occur without a review by WDFW Fish Management and a risk assessment is performed.

In the event of a water system failure, screens would be pulled to allow fish to exit the ponds or in some cases they can be transferred into other rearing vessels to prevent an emergency release. WDFW also has emergency response procedures for providing back-up pumps, transport trucks, etc. in cases of emergency. In cases of severe flooding the screens are not pulled because flood waters rise to the point where they breach the ponds. Past experience has shown that the fish tend to lie on the bottom of the pond during flooding events and only those that are inadvertently swept out are able to leave. Every effort will be made to avoid pre-programmed releases including transfer to alternate facilities. Emergency releases, if necessary and authorized, would be managed by removal of outlet screens and pull sumps of the rearing units. If possible, staff would set up portable pumps to use river water to flush the fish.

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 spawning areas (Ives Island, Horsetail, Multnomah and St Cloud) and at adult traps (Duncan Creek and Hamilton Springs).* A well-designed Jolly-Seber (JS) mark/recapture program provides unbiased estimates of spawners. Bio-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 mainstem Columbia River spawning areas (Ives Island, Horsetail, Multnomah, St Cloud and I-205) and in the tributaries (Duncan, Hamilton and Hardy creeks, and Hamilton Springs channel) provides data to support the live mark/recapture analysis and additional bio-data. To produce unbiased estimates in areas where live tagging is not done (Duncan, Hamilton and Hardy creeks, and the Hamilton Spring Channel), carcasses are used to generate a JS estimate for spawners. Bio-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.

C. *Sampling of adults used for broodstock at Washougal Hatchery and adults released to spawn naturally in the Duncan Creek spawning channel.* Sample 100% of these adults to collect bio-data: scales for aging, sex, size, FL, 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 impacts of the hatchery program, and supports population status analysis.

2. Juvenile related M&E

A. *Operate fence weir and live box traps at the two monitoring weirs in the Duncan Creek spawning channel*. Juvenile monitoring at this location provides data to estimate juvenile abundance which can be paired with adult abundance to estimate the VSP parameter of productivity for chum salmon at this location in the Lower Gorge 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 a double fence weir and live box juvenile out-migrant trap at the mouth of Hamilton Springs channel*. Juvenile monitoring at this location provides a second estimate of juvenile abundance which can be paired with adult abundance to of the VSP productivity parameter for chum salmon in the Lower Gorge 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. In conjunction with adult abundance data, this site provides data allowing for comparisons of productivity between chum salmon spawners with different amounts of "hatchery" influence but similar spawning and incubation conditions.

C. *Operate a rotary screw trap in Hamilton Creek*. Juvenile monitoring at this location provides a third estimate of juvenile abundance which can be paired with adult abundance to provide a productivity estimate (run-of-the-river spawners) for the population and the Lower Gorge strata. In addition, data is collected to measure diversity at this location (juvenile outmigration timing, juvenile size, growth and age data for species with age-0+ out-migrants). In conjunction with adult abundance data, this site provides data allowing comparisons of productivity between chum salmon spawners using protected off-main-channel spawning habitat and run-of-the-river spawners.

D. *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 are 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	Annually estimate survival and contribution for each brood year released.

for lost fish production due to development within the Columbia River Basin.	M&E Activities: 1.A, 1.B, 1.C, 2.A and 2.D
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, 1.C, 2.A, 2.B, 2.C and 2.D
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 (otoliths, PBT) at the hatchery and on the spawning grounds; monitor and report numbers of estimated hatchery (marked) and natural (unmarked) 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.	Monitor fish condition in the facilities throughout all rearing stages. M&E Activities: 1.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 to profile the population. 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, 2.C and 2.D

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 HGMP section 11.1.1). Funding, staffing and support logistics are in place to provide a broodstock collection crew 5 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 Vancouver hatcheries. This level of staffing will allow for the monitoring and evaluation of all activities from the beginning of broodstock collection through the subsequent release of fed-fry.

11.2 Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from monitoring and evaluation activities.

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 and the Monitoring and Evaluation Plan for the Duncan Creek Chum Salmon Re-introduction Program. Research will be directed at determining whether this salvage/recovery/re-introduction program is successfully maintaining or increasing chum salmon abundance in the mainstem Columbia River, Hardy and Hamilton creeks and introducing a new self-sustaining population of chum salmon into Duncan Creek**.**

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 2013-2013: Washougal Hatchery chum.

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	INOC DATE
								OF	**POOL**	**K/S**	**POOL**	**fry/visc /other**	**pools**			
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					11/28/12
WASHOUGAL	DUNCAN CR	CHUM	11/07/12	NEV	Sent frozen	AD	1127-9/10	1	1	4	2					11/28/12
WASHOUGAL	COLUMBIA R/ VANCOUVER	CHUM	11/21/12	NEV	Sent frozen, I-205 collection site	AD	1127-11/12	10	2	20	4					11/28/12
WASHOUGAL	IVE'S CR	CHUM	11/7,11/14	NEV	Sent frozen	AD	1127-13/14	6	2	14	4					11/28/12
WASHOUGAL	DUNCAN CR	CHUM	11/28/12	NEV		AD	1129-4/5	11	2	22	4					11/30/12
WASHOUGAL	I-205, WASHOUGAL R	CHUM	11/30/12	NEV	Samples previously frozen	AD	1212-5/6	14	3	28	6					12/12/12
WASHOUGAL	I-205, WASHOUGAL R	CHUM	12/07/12	NEV	Samples previously frozen	AD	1212-7/8	17	4	33	8					12/12/12
WASHOUGAL	I-205, WASHOUGAL R	CHUM	12/11/12	NEV		AD	1212-9/10	3	1	7	2					12/12/12
WASHOUGAL	DUNCAN CR	CHUM	11/15/13	NEV		AD	1121-1/2	3	1	6	2					11/21/13
WASHOUGAL	DUNCAN CR	CHUM	11/20/13	**Virus +**	1121-4; 1+/2PLS	AD	1121-3/4	5	1	10	2					11/21/13
WASHOUGAL	I-205	CHUM	11/22/13	NEV		AD	1206-7/8	8	2	16	4					12/06/13
WASHOUGAL	I-205	CHUM	11/27/13	NEV		AD	1206-1/2	6	2	12	4					12/06/13
WASHOUGAL	DUNCAN CR	CHUM	11/27/13	NEV		AD	1206-3/4	6	2	12	4					12/06/13
WASHOUGAL	WASHOUGAL R	NCOHO	12/03/13	NEV		AD	1204-4/5	60	12	60	12					12/04/13
WASHOUGAL	DUNCAN CR	CHUM	12/04/13	NEV		AD	1206-5/6	7	2	15	4					12/06/13
WASHOUGAL	I-205	CHUM	12/06/13	NEV		AD	1212-1/2	18	4	35	8					12/13/13
WASHOUGAL	DUNCAN CR	CHUM	12/11/13	NEV		AD	1212-3/4	2	1	4	2					12/13/13

Note: For coho and Chinook data, see respective HGMPs.

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" Tables

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

Listed species affected:	**ESU/Population:**	**Activity:**
Chum (*Oncorhynchus keta*) Chinook (*Oncorhynchus tshawytscha*) Steelhead *(Oncorhynchus mykiss*) Coho (*Oncorhynchus kisutch*)	Columbia River Chum Lower Columbia River Chinook Lower Columbia River Steelhead Lower Columbia River Coho	Washougal (Duncan Cr) Chum Reintroduction Program
Location of hatchery activity: Washougal Hatchery, Washougal River (WRIA 28.0159) at RKm 22.0	**Dates of activity:** November-January	**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

Note: See supplemental "Take" tables, to be submitted to NMFS.

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.

Instructions:

1. *An entry for a fish to be taken should be in the take category that describes the greatest impact.*
2. *Each take to be entered in the table should be in one take category only (there should not be more than one entry for the same sampling event).*
3. *If an individual fish is to be taken more than once on separate occasions, each take must be entered in the take table.*