HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Grays River Chum (Integrated)
Species or Hatchery Stock:	Chum (*Oncorhynchus keta*) Grays River Stock
Agency/Operator:	Washington Department of Fish and Wildlife
Watershed and Region:	Grays River Sub-basin/ Columbia River Estuary Province
Date Submitted:	
Date Last Updated:	September 25, 2014

Executive Summary

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

The purpose of the program is to produce Grays River Basin origin chum salmon to preserve genetic diversity within the Columbia River Coastal Chum population and provide escapement to the watershed. Program fish will be produced at the Grays River Hatchery, located on the West Fork (WF) Grays River (WRIA 25.0131). The program will annually release up to 400,000 fry in the Grays River.

This chum HGMP is built around the principles and recommendations of the Hatchery Scientific Review Group (HSRG). These principles and recommendations represent the best science available for operating hatchery facilities consistent with the conservation of salmonid species. The program will be operated as a "integrated type" program as defined by the HSRG. An "integrated" program is one in which natural-origin adults are used in the hatchery broodstock. Integration is achieved by focusing broodstock collection effort in areas with known low hatchery-origin spawner abundance. Broodstock are collected via hook and line sampling in the WF Grays River, at/near the mouth of Crazy Johnson Creek, (late-October through November). All fish released through this hatchery program have been 100% mass-marked (thermal otolith-mark) since the program was initiated in 1998.

Columbia River chum are listed as "Threatened" under the ESA, and includes the Grays River artificial propagation program (NMFS 2014 - 79FR20802).

Broodstock Collection:
The broodstock is derived from chum salmon adults collected via hook and line sampling in the WF Grays River, from the mouth of Crazy Johnson Creek (WRIA 25.0139) to its confluence with the mainstem Grays River (approximately 0.8 RKm), and the lower 0.1RKm of Crazy Johnson Creek. The current egg-take goal for this program is up to 400,000 at Grays River Hatchery, and includes production for the Oregon Department of Fish and Wildlife (ODFW) program at Big Creek Hatchery (Astoria OR); approximately 155 adult pairs are collected. Adults captured in surplus of broodstock needs are released to spawn naturally.

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

Monitoring and Evaluation:
The RM&E plan for this program is based on the framework developed under the Integrated Status and Trend Monitoring (ISTM) program. It'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.

Operation and Maintenance of Hatchery Facilities:
Grays River Hatchery has water rights to divert water at a rate of 11 cfs from the WF Grays River from a well and an unnamed non fish-bearing creek. The return water systems operate under a National Pollutant Discharge Elimination System (NPDES) permit.

1 SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1 Name of hatchery or program.

Grays River Hatchery Chum Program

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

Grays River chum salmon (*Oncorhynchus keta*)

ESA Status: reaffirmed "*Threatened*" by five-year status review, completed August 15, 2011 (76 FR 50448).

1.3 Responsible organization and individuals

Hatchery Operations Staff Lead Contact

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Fish Management Staff Lead Contact

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

Bonneville Power Administration (BPA) – beginning in brood year 2009, funding for this program was secured from the BPA under project #2008-710-00.

Oregon Department of Fish and Wildlife (ODFW)

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

Funding Sources	Operation Information
BPA	Full time equivalent staff – 3.2
	Annual operating cost (dollars) - $414,537

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

1.5 Location(s) of hatchery and associated facilities.

Broodstock Source: Grays River Chum

Table 1.5.1: Location of culturing phases, by facility.

Facility	Culturing Phase	Location
In-River	Broodstock collection (via hook and line)	Crazy Johnson Cr. (WRIA 25.0139); tributary to WF Grays R. (WRIA 25.0131) at RKm 0.8; tributary to the Grays R. (WRIA 25.0093) at RKm 20.9; tributary to the Columbia R. at RKm 37.0, Lower Columbia River, Washington.

Grays River Hatchery	Adult Holding/ Spawning; Incubation; Rearing	West Fork Grays River (WRIA 25.0) at RKm 3.2; tributary to the Grays River (WRIA 25.0093) at RKm 20.9; tributary to the Columbia River at RKm 37.0, Lower Columbia River, Washington

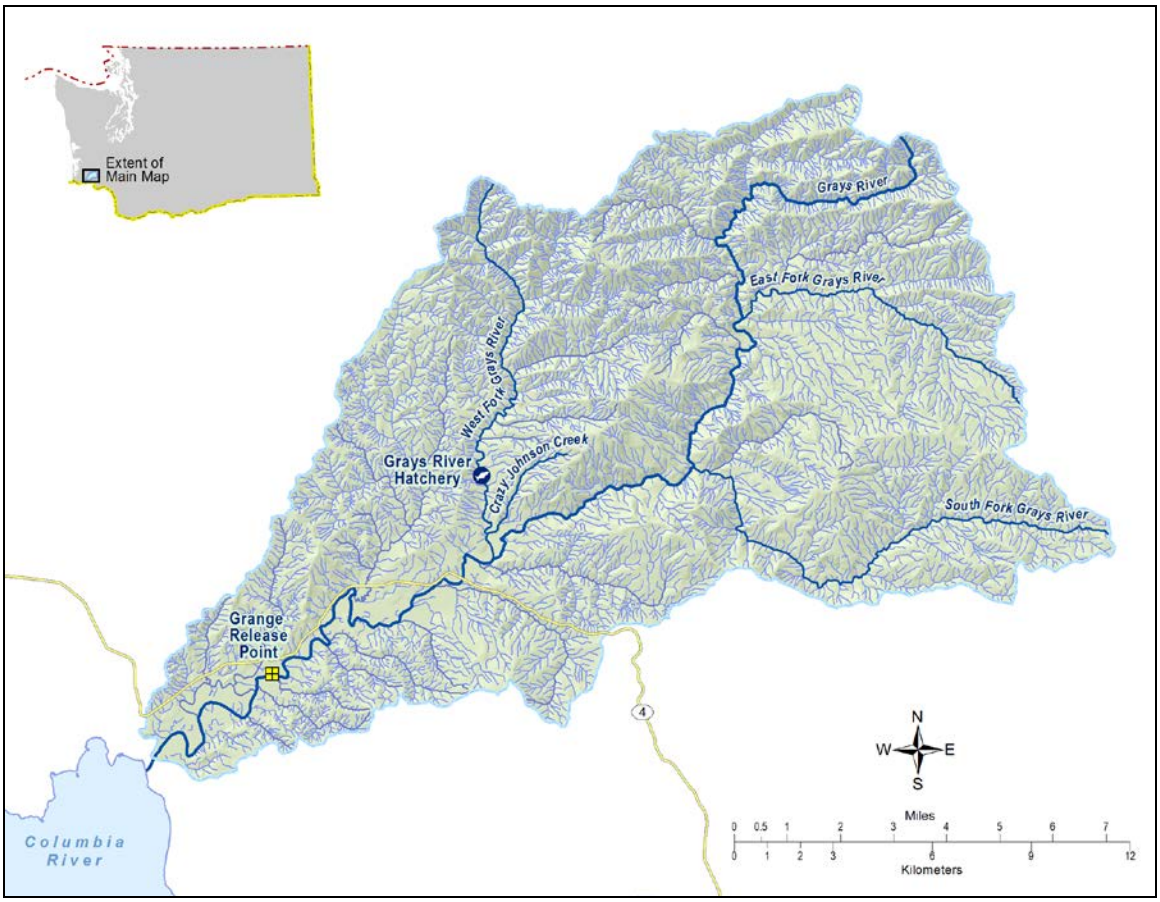

Figure 1.5.1: Map of Grays River Hatchery and release site, Grays River watershed. Source: WDFW GIS 2014.

1.6 Type of program.

Integrated Recovery

1.7 Purpose (Goal) of program.

Mitigation/Augmentation/Restoration. The goal of this program is to provide escapement to the watershed, while minimizing impacts to natural-origin listed salmonids and steelhead.

The goal of the chum salmon enhancement program at Grays River Hatchery is to preserve genetic diversity within the Columbia River Coastal chum population, and provide a source for reintroduction into other potential spawning sites in the Columbia River Coastal zone. The proposed integrated strategy for this program is based on WDFW's assessment of the genetic characteristics of the hatchery and local natural population, the current and anticipated productivity of the habitat used by the populations, the potential for successfully implementing an isolated program, and NMFS' listing determination (August 15, 2011 76 FR 50448).

In addition, this facility provides up to 150,000 eyed-eggs for the ODFW production at Big Creek Hatchery, near Astoria OR.

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. WDFW protects listed fish and provides harvest opportunity on hatchery fish through the Lower Columbia River- *Fish Management and Evaluation Plan* (FMEP) (WDFW 2001). The Mitchell Act programs are intended to support Northwest fishing economies – particularly coastal and Native American -- that have relied on Columbia River production both before and after dam construction. Catches of hatchery fish sustain the economies of local communities while keeping incidental mortalities of ESA-Listed fish at approved levels.

The BPA began funding the Grays River chum enhancement program in 2009 in response to Reasonable and Prudent Actions (RPAs) identified in the Federal Columbia River Power System (FCRPS) 2008 Biological Opinion (NMFS 2008), specifically RPA 42, sub-action 42.10: "fund assessment of habitat potential, development of reintroduction strategies, and implementation of pilot supplementation projects in selected Lower Columbia River tributaries below Bonneville Dam." It was modeled on and developed under the guiding standards of chum supplementation programs implemented in the Puget Sound and Hood Canal (WDFW and PNPTT 2000). The loss of the Gorley Creek artificial spawning channel to a winter freshet in 1998 increased the chum extinction risk by reducing the available high quality protected spawning and incubation area in the basin to approximately half of Crazy Johnson Creek (BPA memo 2009). WDFW believes that supplementation should continue until other spawning sites outside Crazy Johnson Creek are restored and proven successful.

To minimize impact on listed fish by the Grays River Hatchery Chum 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 the Grays River chum program.

Potential Hazard	HGMP Reference	Risk Aversion Measures
Water Withdrawal	4.1	Water rights are formalized through trust water right from the Department of Ecology. Monitoring and measurement of water usage is reported in monthly NPDES reports.
Intake Screening	4.1	The intake screens are in compliance with state and federal guidelines (NMFS 1995, 1996), but do not meet the current *Anadromous Salmonid Passage Facility Design Criteria* (NMFS 2011). Structures have been assessed, and changes have been proposed (Mitchell Act Intake and Fish Passage Study Report 2003).
Effluent Discharge	4.1	This facility operates under the "*Upland Fin-Fish Hatching and Rearing*" *National Pollution Discharge Elimination System* (NPDES) administered by the Washington Department of Ecology (WDOE) - WAG 13-1010.
Broodstock Collection & Adult Passage	7.9	All fish are mass marked prior to release. Broodstock collection and sorting procedures can quickly identify listed non-target listed fish, and if encountered, released per protocol to minimize impact as determined by WDFW Region 5 staff.
Disease Transmission	7.9, 10.11	The *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006) and the *Fish Health Policy in the Columbia Basin* details hatchery practices and operations designed to stop the introduction and/or spread of any diseases within the Columbia Basin. Also, *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries* (Fish Health Policy Chapter 5, IHOT 1995).

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

1.9 List of program "Performance Standards".

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

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

1.10.1 "Performance Indicators" addressing benefits.

Table 1.10.1.1: "Performance Indicators" addressing benefits.

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

returning to natural spawning areas.	natural production index areas.	
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) at the hatchery and on the spawning grounds; monitor and report numbers of estimated hatchery (marked) and natural (unmarked) fish. The goal is 200 samples per year from each of the primary spawning reaches (Hillson 2013).
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 (mid-October through November). Collect annual run timing, age and sex composition and spawning escapement timing data. Adhere to WDFW spawning guidelines (Seidel 1983; HSRG 2009).
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/tag rate error, weight distribution (CV).	Collect annual run timing, age and sex composition data upon adult return. 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 of hatchery releases. Examine returning fish encountered for the mass-mark at the hatchery and on the spawning ground. Annually record and report numbers of estimated hatchery (marked) and natural (unmarked). The goal is 200 samples per year from each of the primary spawning reaches (Hillson 2013).
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 data, survival-to-release rates, and date of release. Examine returning fish for the mass-mark (thermal otolith-marks) at broodstock collection

		points and on the spawning grounds. Annually record and report numbers of estimated hatchery (marked) and natural (unmarked). The goal is 200 samples per year from each of the primary spawning reaches (Hillson 2013).
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.	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, tags, thermal otolith-mark etc.). Collect annual run timing, origin, and age and sex composition data. Examine returning fish for the mass-mark (otolith-mark) at broodstock collection points and on the spawning grounds. Annually record and report numbers of estimated hatchery (marked) and natural (unmarked).
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 has met HSRG standards for pHOS for all years. See also HGMP section 7.5.
3.5.4 Juveniles are released after sufficient acclimation to maximize homing ability to intended return locations.	Location of release (on-station, acclimation pond, direct plant). Release type (forced, volitional or direct stream release).	Annually record and report release information, including location, method (direct) and age class in hatchery data systems (WDFW Hatcheries Headquarters Database).
3.5.5 Juveniles are released at fully-smolted stage.	Level of smoltification at release. Release type (forced, volitional or direct).	Annually monitor and record size, number, mark type, date of release 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 Washington State*).	Annual reports indicating levels of compliance with applicable standards and criteria. Periodic audits indicating level of compliance with applicable standards and criteria.	Pathologists from WDFW's Fish Health Section monitor program monthly. Exams performed at each life stage may include tests for virus, bacteria, parasites and/or pathological changes, as needed. See also **Attachment 1** for pre-release Fish Health History. The program is operated consistent with the *Salmonid Disease Control Policy of the*

		Fisheries Co-Managers of Washington State (WDFW and WWTIT 1998, updated 2006), *Fish Health Policy in the Columbia Basin*, and *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 report (see HGMP section 4.2).
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 (see HGMP section 4.2).
3.7.4 Releases do not introduce pathogens not already existing in the local populations, and do not significantly increase the levels of existing pathogens. Follow the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, revised 2006).	Necropsies of fish to assess health, nutritional status, and culture conditions.	DFW Fish Health Section inspect adult broodstock yearly for pathogens and monitor juvenile fish on a monthly basis to assess health and detect potential disease problems. A fish health database will be maintained to identify trends in fish health and disease and implement fish health management plans based on findings.
	Release and/or transfer exams for pathogens and parasites.	Examine fish 1 to 6 weeks prior to transfer or release, in accordance with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006).
	Inspection of adult broodstock for pathogens and parasites.	At spawning, lots of 60 adult broodstock are examined for pathogens.
	Inspection of off-station fish/eggs prior to transfer to hatchery for pathogens and parasites.	Controls of specific fish pathogens through eggs/fish movements are conducted in accordance to the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006).
3.7.6 Adult broodstock collection operation does not significantly alter spatial and temporal	Spatial and temporal spawning distribution of natural populations above and below	Trap is checked regularly. Non-target listed fish, when encountered, are returned to the

distribution of any naturally-produced population.	broodstock collection site is currently compared to historic distribution.	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).

Approximately 155 adult pairs would be needed to achieve the maximum potential egg-take goal of 400,000 (FBD 2014) for both the on-station and ODFW programs. This is based on an average fecundity of 2,700 eggs/female, and a pre-spawning mortality of 5%.

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.

Age Class	Max. No.	Size (fpp)	Release Date	Location	Major Watershed
Fed Fry	400,000	300*	April	Grays River	Grays-Elochoman

Source: Future Brood Document 2014.
* Size range 250-450 fpp (FBD 2014).

This program provides up to 150,000 eyed-eggs for the ODFW production at Big Creek Hatchery, near Astoria OR. These are included in maximum egg-take goal of the FBD and not additive.

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: Preliminary estimates of fry-to-adults survival (SAR) for Grays River hatchery-origin chum salmon fry from returns to the Grays River Basin, brood years 2001-2012.

Return Year	Number Spawned	Fry Released	Adults Produced	SAR
2001	276	305,185	269	0.09
2002	328	398,000	651	0.16
2003	305	537,000	183	0.05
2004	304	321,000	239	0.07
2005	132	155,501	149	0.10
2006	117	129,457	165	0.13

2007	134	147,609	1,230[a]	0.83[a]
2008	87	102,914	14[a]	0.01[a]
2009	108	122,505	14[a]	0.01[a]
2010	287	250,003	N/a	N/a
2011	293	199,842	N/a	N/a
2012	219	159,682	N/a	N/a

Source: Table 15 in Hillson 2013.
N/a = data not available yet.
[a] Incomplete return data for brood years 2007-09.

There are currently no Columbia River commercial fisheries which target chum. A rule change in 2013 made it illegal to land any chum salmon in the LCR. 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).

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

This facility began operations in 1961. The chum program began in 1998.

1.14 Expected duration of program.

Program is on-going, with no plans for termination. The collection of chum salmon broodstock from the Grays River will continue until significant habitat improvements have stabilized the dynamic river-flow patterns that currently exist in the basin. In addition, the program is intended to mitigate impacts to the population from broodstock collections to provide eggs for RSIs, juveniles or adults to be used for reintroduction/enhancement programs in nearby basins in the future, *e.g.* Skamokawa and Elochoman rivers.

1.15 Watersheds targeted by program.

Grays Sub-Basin/ Grays River (WRIA 25.0093)/ Southwest Washington DPS/ Columbia River Estuary Province.

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

1.16.1 Brief Overview of Key Issues.

The Grays River Hatchery has a water supply problem brought on by decades of environmental impacts associated with habitat degradation due to logging, road building, and the associated problems with very heavy rainfall in most winter seasons. An assessment and evaluation of the main intake was completed in 2010, which determined that the upper watershed is unstable and to expect bed load movement for the next 100 years. The passage and screening at this facility is also out of compliance and difficult to solve.

1.16.2 Potential Alternatives to the Current Program

Alternative 1: *Eliminate the program and allow chum to spawn naturally in the Grays River without hatchery intervention*: This action would reduce potential interaction with natural populations and eliminate potential impacts on other ESA-listed species. This action was not followed because of the dynamic instability of the basin. Heavy rainfall in the fall/winter may cause the Grays River to change its course, and scour or fill large portions of its water course.

Alternative 2: Create a protected spawning area in the Grays River basin for chum salmon. Scoping and design projects have been funded by both the BPA and the Salmon Recovery Funding Board (SRFB) in the basin. There is currently a project funded under the SRFB to finalize plans for a spawning channel located in the lower WF Grays River (downstream of the hatchery but upstream of Crazy Johnson Creek). However, funding hasn't been allocated for construction yet. A comprehensive evaluation and monitoring effort will need to be carried out to

ensure that this area can act as a key spawning and incubation refugia for Grays River chum ending the necessity for this hatchery program.

Alternative 3: Shift the program to Beaver Creek Hatchery on the Elochoman River. The Grays River Hatchery needs significant capital investment to solve the water quality, and intake compliance issues. WDFW is currently evaluating options which may include moving the entire production to Beaver Creek Hatchery (see *Reform Investment 1*).

1.16.3 Potential Reforms and Investments

Reform/Investment 1: *Water quality and intake improvements*. The Grays River Hatchery needs significant capital investment to solve the water quality, and intake compliance issues. These would likely require a change in the intake from the upstream gravity system to a pump system that would not de-water the facility during the summer. Further action would be required to solve the bed load build up that threatens the facility on most winter heavy storm periods.

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 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).

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).

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 Lower Columbia River (LCR) Chinook Evolutionarily Significant Unit (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.

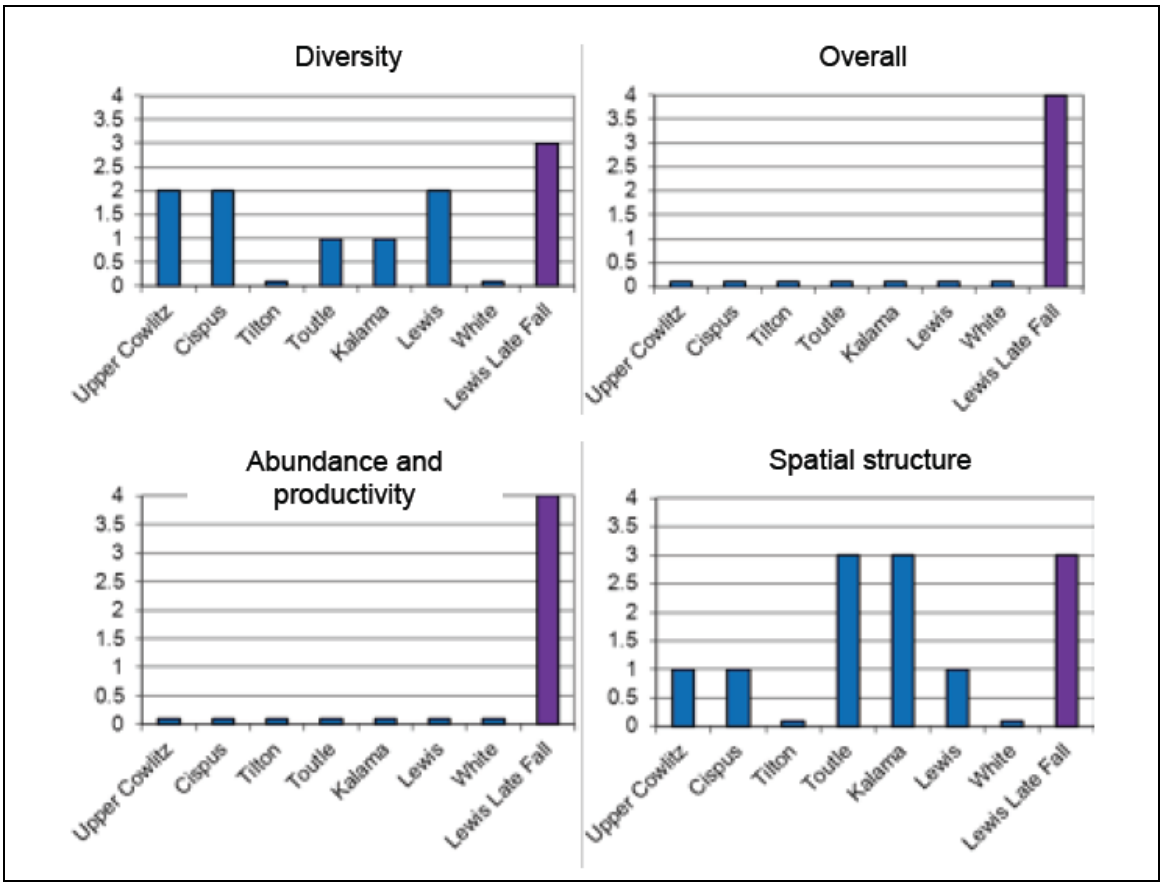

Figure 2.2.2.1: Current status of Washington lower Columbia River spring Chinook and late fall-run (bright) Chinook salmon populations for the Viable Salmonid Population (VSP) parameters and overall population risk. (LCFRB Recovery Plan 2010, chapter 6). A population score of zero indicates a population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

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.

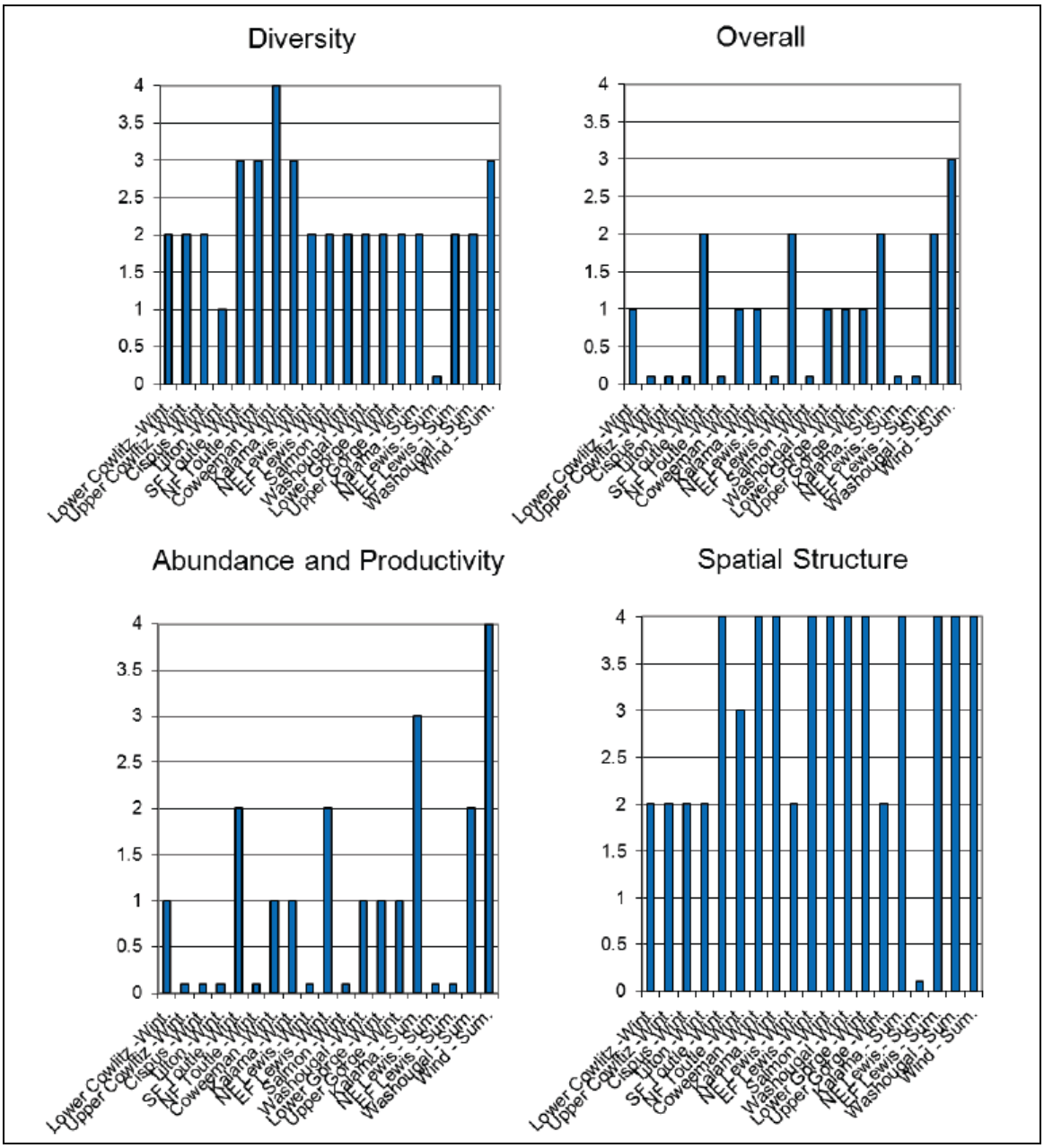

Figure 2.2.2.2: Current status of Washington LCR steelhead populations for the VSP parameters and overall population risk. (LCFRB 2010 Recovery Plan, chapter 6). A population score of zero indicates a population extirpated or nearly so, a score of 1 is high risk, 2 is moderate risk, 3 is low risk ("viable") 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, Lewis River Type-N and Type-S Coho programs, Fish First Wild Coho and Type-N Coho programs, Syverson Project Type-N Coho Program, and Washougal Hatchery Type-N Coho Program (NMFS 2014 - 79FR20802).

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

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

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

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

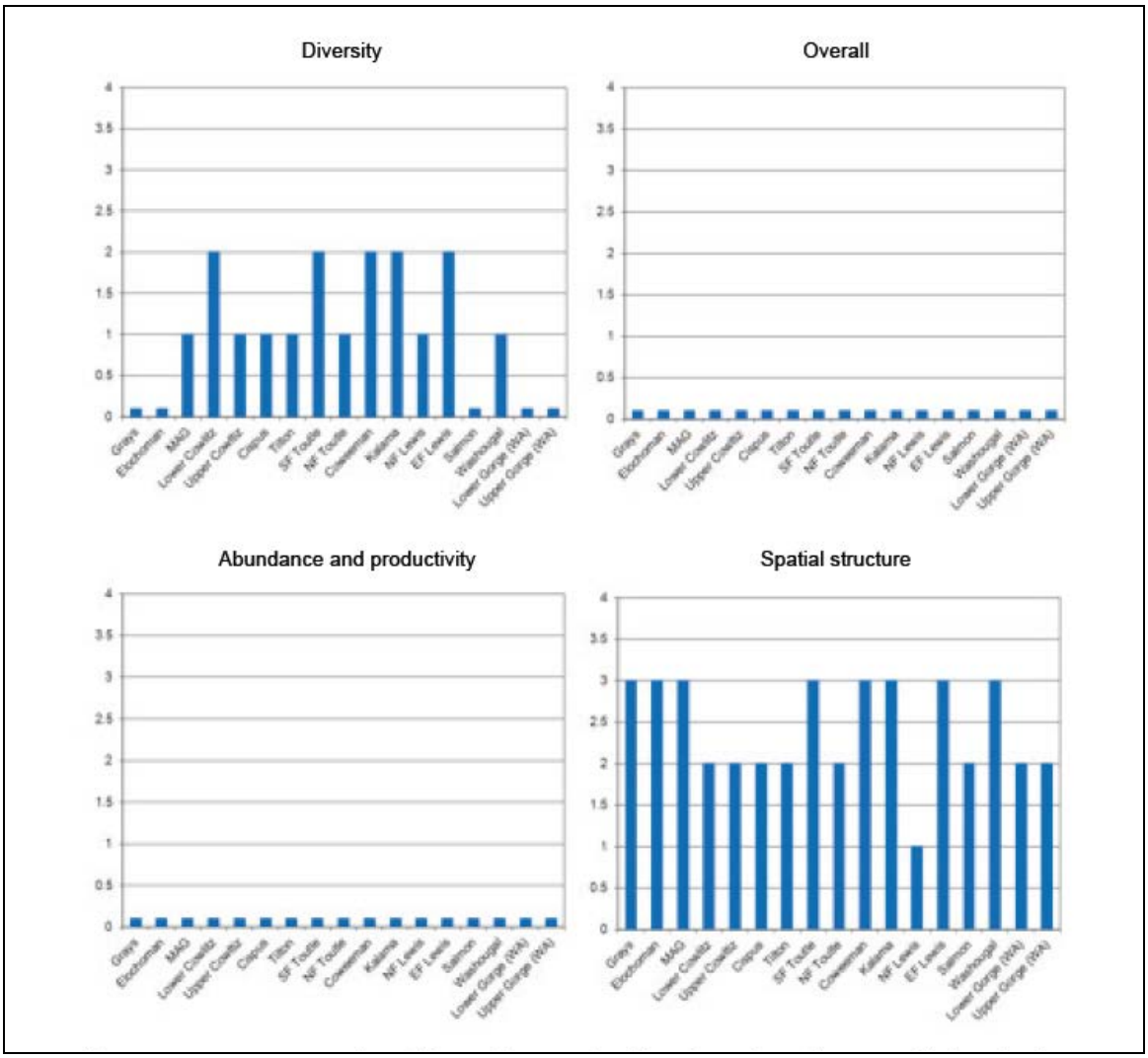

Figure 2.2.2.3: Current status of Washington LCR coho populations for the VSP parameters and overall population risk. (LCFRB 2010 recovery plan, chapter 6). A population score of zero indicates a population extirpated or nearly so, a score of 1 is high risk, 2 is moderate risk, 3 is low risk ("viable")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

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

Status: The LCFRB completed a revision recovery plan in 2010 that includes Washington populations of Columbia River chum salmon. This plan includes an assessment of the current status of Columbia River chum populations, which relied and built on the viability criteria developed by the WLC-TRT (McElhany et al. 2006) and an earlier evaluation of Oregon WLC populations (McElhany et al. 2007). This evaluation assessed the status of populations with regard to the VSP parameters of abundance, productivity, spatial structure, and diversity (McElhany et al. 2000). The result of this analysis is shown in **Figure 2.2.2.4**. The analysis indicated 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.

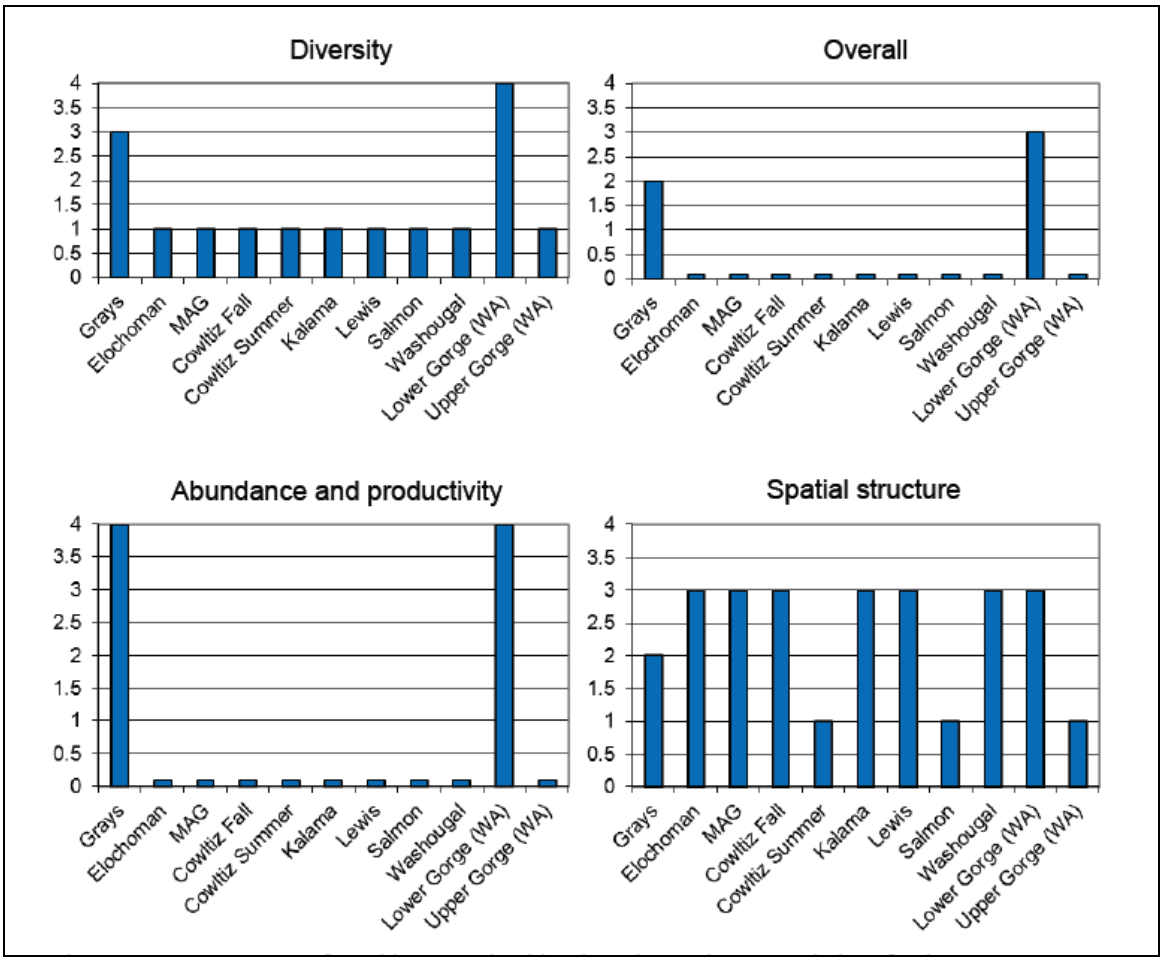

Figure 2.2.2.4: Current status of Washington CR chum populations for the VSP parameters and overall population risk. (LCFRB 2010 Recovery Plan, Chapter 6). A population score of zero indicates a population extirpated or nearly so, a score of 1 is high risk, 2 is moderate risk, 3 is low risk ("viable")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

See HGMP section 11.1 for planned M&E.

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

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

Source: Hillson 2013

See also **Table 1.12.1**.

Table 2.2.2.6: 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	90,97	5,077	3,976	-----	38,917
2009	61,140	62,83	3,761	2,576	-----	29,718
2010	-----	-----	-----	-----	-----	49,171
2011	-----	-----	-----	-----	-----	43,831

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

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

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

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

Source: Joe Hymer, WDFW Annual Database 2012

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

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

Source: Ron Roler, WDFW Natural Spawn Progress Reports 2012.
* Estimates of total adult and jack fall Chinook. May include fish put upstream of hatchery weirs.

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

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

Source: WDFW Data 2012

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

Location	Coweeman	SF Toutle	NF Toutle/ Green	Kalama	EF Lewis	Washougal
WDFW Escapement Goal	**1,064**	**1,058**	**NA**	**1,000**	**1,243**	**520**
LCSRP Abundance Target	**500**	**600**	**600**	**600**	**500**	**350**
2000	530	490	----	921	NA	NA
2001	384	348	----	1,042	377	216
2002	298	640	----	1,495	292	286
2003	460	1,510	----	1,815	532	764
2004	722	1,212	----	2,400	1,298	1,114
2005	370	520	388	1,856	246	320
2006	372	656	892	1,724	458	524
2007	384	548	565	1,050	448	632
2008	722	412	650	776	548	732
2009	602	498	699	1,044	688	418
2010	528	274	508	961	336	232
2011	408	210	416	622	308	204
3-year average	**513**	**327**	**541**	**876**	**444**	**285**
5-year average	**529**	**388**	**568**	**891**	**466**	**444**
10-year average	**487**	**648**	***588**	**1,374**	**515**	**523**

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

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

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

Source: WDFW Data 2012.
* Preliminary estimates.

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

Location	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Crazy Johnson Creek	---	---	1,051	1,418	3,819	870	1,093	996	865	2,304	3,475
WF Grays River	---	---	6,970	1,407	1,377	1,902	793	1,130	1,814	5,996	2,817
Mainstem Grays River	---	---	5,696	1,379	1,510	1,227	721	750	3,701	2,509	1,717
I-205 area	3,160	2,932	2,324	923	869	576	644	1,154	2,148	4,912	2,586
Multnomah area	1,627	1,174	733	214	321	148	31	106	458	647	120
St Cloud area	---	220	126	97	180	3	1	29	126	343	1
Horsetail area	---	---	115	13	65	25	36	6	54	119	92
Ives area[a]	4,344	808	357	288	466	132	295	171	214	162	230
Duncan Creek[b]	13	16	2	7	42	9	2	26	48	85	4
Hardy Creek	343	413	52	74	109	12	3	46	175	157	75
Hamilton Creek	1,000	435	497	178	251	133	118	142	404	542	352
Hamilton Spring Channel	794	386	220	88	227	47	114	94	190	325	137
Grays return[c]	12,041	16,974	14,020	4,336	6,824	4,133	2,695	2,984	6,667	11,104	8,229
I-205 to Bonneville return	11,280	6,384	4,427	1,882	2,531	1,086	1,244	1,773	3,818	7,291	3,597
Sum	34,602	29,742	36,590	12,304	18,591	10,303	7,790	9,407	20,682	36,496	23,432

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 2012, which were done by a subtraction method.

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

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

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

Chum salmon in the Grays River have been identified as a "primary" population (LCFRB 2010, NOAA 2013). The proportion of effective hatchery-origin spawners (pHOS) should be less than 30% of the naturally spawning population for this integrated program per HSRG guidelines (2009). See HGMP section 11.1 for planned M&E.

Table 2.2.2.13: Preliminary estimates of origin contributions (pNOS and pHOS) in the three primary spawning reaches, Grays River fall chum, brood years 1998-2012.

	Brood Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Crazy	pNoS	100.0%	100.0%	100.0%	96.4%	94.5%	95.0%	100.0%	94.3%	96.1%	96.3%	90.7%	97.1%	97.4%	92.6%	96.8%
Johnson	pHoS	0.0%	0.0%	0.0%	3.6%	5.5%	5.0%	0.0%	5.7%	3.9%	3.7%	9.3%	2.9%	2.6%	7.4%	3.2%
West Fork	pNoS	100.0%	100.0%	100.0%	87.5%	83.6%	91.8%	96.9%	82.9%	82.0%	94.8%	91.4%	96.0%	93.9%	93.4%	96.3%
Grays	pHoS	0.0%	0.0%	0.0%	12.5%	16.4%	8.2%	3.1%	17.1%	18.0%	5.2%	8.6%	4.0%	6.1%	6.6%	3.7%
Mainstem	pNoS	100.0%	100.0%	100.0%	85.7%	95.8%	93.5%	93.8%	93.7%	95.7%	95.9%	94.9%	96.6%	95.5%	92.3%	99.3%
Grays	pHoS	0.0%	0.0%	0.0%	14.3%	4.2%	6.5%	6.2%	6.3%	4.3%	4.1%	5.1%	3.4%	4.5%	7.7%	0.7%
Combined	pNoS	100.0%	100.0%	100.0%	89.5%	89.6%	93.3%	95.9%	90.3%	93.1%	95.5%	92.1%	96.5%	95.3%	93.0%	97.2%
	pHoS	0.0%	0.0%	0.0%	10.5%	10.4%	6.7%	4.1%	9.7%	6.9%	4.5%	7.9%	3.5%	4.7%	7.0%	2.8%

Source: Table 17 in Hillson 2013.

2.2.3 <u>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.</u>

- 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: Chum salmon enter the Grays River system from mid-October through November. Spawning peaks in November. Broodstock have been primarily collected using hook

and line gear from the West Fork Grays River throughout November (see HGMP section 5.1). Any chum volunteering to the hatchery trap are released. The 2001-2012 estimated overall average pHOS is 6.3% (Hillson 2013). See **Table 6.2.3.1** for the annually reported values.

See "take" tables at the end of this document.

Genetic introgression: Broodstock for this program was initiated from local chum salmon. 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 natural stock in the sub-basin. Straying rates are extremely low. Indirect take from genetic introgression is unknown.

Rearing Program:
Operation of Hatchery Facilities: Facility operation impacts include water withdrawal, effluent, and intake compliance. Effluent at outfall areas is rapidly diluted with mainstem flows and operation is within permitted NPDES guidelines (see HGMP sections 4.1 and 4.2). Indirect take from this operation 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:
Hatchery Production/Density-Dependent Effects: 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. Fish are released as active smolts that will emigrate in order to minimize the effect of the release. Indirect take from density dependent effects is unknown.

Potential Grays River chum predation and competition effects on listed salmonids and eulachon: The proposed annual production goal for this program is 250,000 fry. WDFW chum recovery projects recommend that fed fry be reared to 50 - 55 mm in fork length, before release. Such fry will likely realize significant survival advantages without suffering any loss in their osmo-regulatory capacity (Hillson 2013). The goal is to release chum fry at around 300 fpp (60 mm fl); newly emerged chum fry migrate immediately to marine areas, and range in size from 32- 41 mm (Salo 1991). Due to lack of opportunity, size and life history traits, predation impact on natural-origin salmonids would be low.

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

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

Source: Todd Hillson, WDFW, unpublished data.

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

Monitoring:
Associated monitoring Activities: 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 collected and encountered during broodstock collection activities.

Brood Year	Spawned	Holding Mortality	Surplus
1998	93	Unk	0
1999	95	Unk	0
2000	174	Unk	0
2001	276	Unk	0
2002	328	Unk	0
2003	305	Unk	0
2004	304	Unk	0
2005	132	Unk	0
2006	117	Unk	0
2007	134	Unk	0
2008	87	Unk	0
2009	108	0	0
2010	287	14	0
2011	293	0	0
2012	219	0	0

Source: Todd Hillson, WDFW, unpublished data

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

Table 2.2.3.2: Projected Annual Take Levels for Listed Fish by Life Stage.

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. 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 a representative sample of carcass. No eggs, fry, or smolts will be subjected to this type of take.
Collect for Transport:	Up to 310 adults may be needed for broodstock.
Capture, Handle, Tag/Mark/Tissue Sample and Release:	*Adults.* Up to 200 additional adults may be captured for broodstock but not be suitable (already spawned or in very poor condition). Adults collected in excess of broodstock needs will be released to continue their spawning activities. *Juveniles.* See RM&E section for details of juvenile handling.
Removal:	*Adults.* Up to 310 adult fish may be removed for artificial spawning.
Intentional Lethal Take:	*Egg/Fry*: At spawning, five eggs from each female will not be fertilized. These eggs will be allowed to water-harden before being weighed. All artificially-produced fish from this recovery project will receive thermal otolith-marks. Up to four different marks may be applied depending upon the size of the project and the number of release locations chosen. Samples are 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. *Adult*: Up to 310 adult fish may be sacrificed for artificial spawning.
Unintentional Lethal Take:	*Egg/Fry*: "Take" can range from 0 up to 5,000 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. *Adults*: Pre-spawning mortalities are estimated to be 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.

The range of values in **Table 2.2.3.2** are based on the assumption that fish in a hatchery situation are not "observed or harassed" during typical operations (e.g., when eggs are shocked, picked, and fry are ponded). The same approach was taken for the other types of takes except for the unintentional lethal takes. Clearly, some mortalities will occur in hatchery operations that are

above and beyond what might be expected: eggs inadvertently lost during spawning operations; fry accidentally killed during transport; etc. Finally, the ranges primarily represent different levels of intervention.

See "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 being 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.

This program has developed capture, handling and holding protocols to broodstock collection methods (hook and line and trapping). These protocols will be reviewed annually by the WDFW in consultation with NOAA Fisheries, in order to minimize "take" of listed fish.

3 SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

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

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

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

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

Descriptions of these policies and excerpts are shown below:

Policies/Plans – Key Excerpts

Hatchery and Fishery Reform Policy: Washington Department of Fish and Wildlife Commission Policy C-3619. WDFW adopted the Hatchery and Fishery Reform Policy C-3619 in 2009. Its purpose is to advance the conservation and recovery of wild salmon and steelhead by promoting and guiding the implementation of hatchery reform. The intent of hatchery reform is to improve hatchery effectiveness, ensure compatibility between hatchery production and salmon recovery plans and rebuilding programs, and support sustainable fisheries. WDFW Policy C-3619 works to promote the conservation and recovery of wild salmon and steelhead and provide fishery-related

benefits by establishing clear goals for each state hatchery, conducting scientifically defensible-operations, and using informed decision making to improve management. It is recognized that many state operated hatcheries are subject to provisions under *U.S. v Washington* (1974) and *U.S. v Oregon* and that hatchery reform actions must be done in close coordination with tribal co-managers. Washington Fish and Wildlife Commission Policy: POL-C3619.

Guidelines from the policy include:

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

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

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

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

Lower Columbia River Chum Salmon Reintroduction/Enhancement Plan (*LCRCREP*)*:* This document is a work in progress. It will follow the framework established in the *Summer Chum Salmon Conservation Initiative*. The overarching goal is to improve the VSP parameters for Lower Columbia River chum salmon by reestablishing populations in historical usage areas or enhancing existing populations that have persisted at low abundance levels. This will be accomplished by using one or more of the following strategies: 1) releases of fed-fry from hatcheries, 2) releases of unfed-fry from RSIs or 3) adult releases into spawning channels. Regardless of the strategy(s) used, the source population will be from a genetically appropriate stock (Small *et al*, 2011). Reintroduction or enhancement releases will phased to take advantage of habitat restoration activities in basins as they occur or are planned.

Strategies

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

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

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

See also HGMP section 3.1.

3.3 Relationship to harvest objectives.

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

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

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

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

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

The Columbia River system is currently closed to recreational harvest of chum salmon. Angling for and retaining chum has been closed on the Oregon side of the Columbia River since 1992 and on the Washington side since 1995.

3.4 Relationship to habitat protection and recovery strategies.

This project originated in response to Reasonable and Prudent Actions (RPAs) identified in the Federal Columbia River Power System's 2008 Biological Opinion (NMFS 2008). The Grays River chum enhancement project component of the project is a direct response to RPA #42/42.10 "Columbia River Chum: fund assessment of habitat potential, development of reintroduction strategies, and implementation of pilot supplementation projects in selected Lower Columbia tributaries below Bonneville Dam."

The following processes have included habitat identification problems, priority fixes and evolved as key components to the *Grays-Elochoman Cowlitz Watershed Management Plan WRIA 25/26* (December 9, 2004, adopted July 2006), the *Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan* (LCFRB 2010), and the *Lower Columbia River Salmon and Steelhead ESA Recovery Plan* (Dornbusch and Sihler2013).

Sub-Basin Planning: 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.

Limiting Factors Analysis (LFA): A WRIA 25 LFA was conducted by the Washington State Conservation Commission (Wade 2002). WRIA 25 three sub-basins; Mill/Germany/ Abernathy, Elochoman/Skamokawa, and the Grays. Streams within WRIA 24 were included in the Grays River Sub-basin. The Grays River suffers from severe habitat degradation (siltation, poor water quality). This is the result of widespread ongoing logging in the watershed. Freshwater and estuarine ecosystems have been degraded by past and present human activities that have reduced the habitat quality, quantity, and complexity. The primary land use activities responsible for these include: road building, timber harvesting, agriculture, and rural development. These upslope and riparian activities have increased sediment, altered woody debris availability and recruitment, increased water temperatures, changed runoff patterns, and reduced river flow.

3.5 Ecological interactions.

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

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

(3) *Salmonid and non-salmonid fishes or other species that could positively impact the program.* Multiple programs, coho and steelhead, are released from the Grays River 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 the Grays River Hatchery.

Water Source	Water Right		Available Water Flow	Avg Water Temp. (F)[a]	Usage	Limitations[b]
	Record/Cert. No.	Permit No.				
Unnamed stream (surface)	S2-CV2P754/ 08315	11847	0.25 cfs	NA	Incubation to hatching and rearing	High water temps from mid-July – Sept.; low flows from mid-June – Sept; summertime pathogens
WF Grays River (surface)	S2-CV2P755/ 08312	08270	9.25 cfs	34 – 68	Broodstocking, rearing, acclimation	
Well	G2-21976 CWRIS	-----	1280 gpm	50 - 52	Incubation to eyeing and rearing	Low summertime flows July - Sept.

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

Grays River Hatchery. The facility gets its water from three sources: Grays River, an unnamed Creek, and well water. Most of the water is supplied by gravity flow from a river intake. The unnamed creek through the hatchery grounds is seasonal (dry from early summer to late fall); WDFW has determined that it is a non-fish bearing stream therefore of no impact. It provides 200-300 gpm for incubation. The river intake provides 4,500 to 5,000 gpm of surface water for most of the facility's needs. The well provides approximately 500-600 gpm for incubation and rearing. Water rights were obtained in 1949, 1960 and 1974.

NPDES Permits:
The Grays River Hatchery operates 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).

Discharges from the cleaning treatment system are monitored as follows:

- *Total Suspended Solids* (*TSS*) one to two times per month on composite effluent, maximum effluent and influent samples.
- *Settleable Solids* (*SS*) one to two 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				
Grays River WAG13-1015	Y	Y	Y	9/13/2012	2	N	Y

Source: Ann West, WDFW Hatcheries Headquarters Database 2013.

Table 4.1.3: List of NPDES violations over the last five years (2008-2012).

Month/ Year	Parameter	Sample Type	Result/ Violation	Permit Limit	Comment	Action
May 2011	TSS	Drawdown	237.0 mg/L	100.0 mg/L	Sample taken late at end of drawdown. Pond difficult to clean prior to release. Sediments from heavy rain.	N/A
	TSS	Drawdown	173.2 mg/L	100.0 mg/L		

Source: Ann West, WDFW Hatcheries Headquarters Database 2013
Note: These violations did not result in non-compliance with NPDES permit.

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.

Grays River Hatchery. The intake screens are in compliance with state and federal guidelines (NMFS 1995, 1996), but do not meet the current *Anadromous Salmonid Passage Facility Design criteria* (NMFS 2011). WDFW received a Mitchell Act Grant in 2008 to assess and evaluate a new gravity intake. The assessment and evaluation of the main intake was completed in 2010, which determined that the upper watershed is unstable and to expect bed load movement for the next 100 years. WDFW is currently evaluating options which may include moving production to Beaver Creek Hatchery.

The unnamed creek has an intake and has been determined to be a non-fish bearing, seasonal stream. The stream effluent to the West Fork Grays River is located about 228.6 m (250-yds) upstream of the hatchery effluents; the intake structure from which the facility draws water is approximately the same distance (228.6 m) from the hatchery building itself and from the confluence with the WF Grays River.

5 SECTION 5. FACILITIES

5.1 Broodstock collection facilities (or methods).

Hook and line. Broodstock are primarily collected via hook and line sampling from the West Fork Grays River, from the mouth of Crazy Johnson Creek (WRIA 25.0139), to its confluence with the mainstem Grays River (approximately 0.8 RKm), and the lower 0.1 RKm of Crazy Johnson Creek since 2004 (see **Figure 1.5.1**). Captured adults are inspected and selected fish are placed into perforated, 122-cm long, 25-cm diameter PVC holding/transfer tubes, and placed into a 500 gallon tank mounted on a flatbed truck with supplemental oxygen. The fish are then hauled about 5 km to the Grays River Hatchery where the tubes are placed into one of four small concrete adult holding ponds ("kill bins") at the hatchery. Each tube can hold up to 3 females or 2 males. Sexual maturity is checked on a regular basis and fish are spawned twice a week when available.

Hatchery trap. The trap at Grays River Hatchery operates from September through March to collect broodstock for the on-station coho program (see Grays River Type-N Coho HGMP). Any chum encountered at the hatchery trap are released to spawn naturally.

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

Table 5.2.1: Transportation equipment available, Grays River Hatchery.

Equipment Type	Capacity (gallons)	Supp. Oxygen (y/n)	Temp. Control (y/n)	Norm. Transit Time (minutes)	Chemical(s) Used	Dosage (ppm)
Flatbed truck w/ tank	500	Y	N	10-30 min	None	NA
Tanker truck	1,100	Y	N	n/a	None	NA
Tanker truck	1,100	Y	N	n/a	None	NA

Adults collected for broodstock and juvenile chum releases are transported using the flatbed truck with tank, equipped with supplemental oxygen. This vehicle and tank are assigned to and stationed at Grays River Hatchery. Average transport time from the collection site to Grays River Hatchery is 10 minutes.

Juvenile fish are transported via flatbed truck with tank, for release at the Grange Hall boat ramp at RKm 7.6, below WDFW's juvenile out-migration monitoring site. Average transit time to the release site is 20 minutes.

5.3 Broodstock holding and spawning facilities.

Table 5.3.1: Adult holding/spawning facilities available at Grays River Hatchery.

Ponds (No.)	Pond Type	Volume (cu.ft)	Length (ft.)	Width (ft.)	Depth (ft.)	Available Flow (gpm)
2	Concrete kill bins/holding ponds	81	18	3.0	1.5	200-300

Adults transported to Grays River Hatchery are kept in the holding/transport tubes held in the bottom of the holding pond (two 81 cu-ft concrete "kill bins"), which are supplied with river water at 200-300 gpm. Broodstock are held no longer than one week, during which they are checked for ripeness and spawned accordingly. Ripe fish are killed and bled then transported to the main hatchery building for biological sampling and matrix spawning.

5.4 Incubation facilities.

Table 5.4.1: Incubation vessels available at Grays River Hatchery.

Type	Units (number)	Size	Flow (gpm)	Volume (cu.ft.)	Loading (eggs/unit)
Vertical Stack Tray Units	128 half stacks	24" x 25" x 32"	3-5	10.7	49,000- 70,000
Deep Troughs	2	14' x 16" x 19"	10-15	29.4	100,000-650,000
Shallow Troughs	2	15' x 7" x 12"	6-8	8.70	20,00 -120,000
Freestyle Deep Troughs	4	31" x 20" x 25"	10-15	8.96	100,000-450,000
Intermediate Raceways	2	16' x 24" x 36"	10-50	96.0	N/A
Intermediate Raceways	3	16' x 30" x 32"	10-50	106.8	N/A

Chum eggs for this program are placed on folded Vexar® in the vertical stack tray incubators supplied with well water. River and creek water is also available.

5.5 Rearing facilities.

Table 5.5.1: Rearing facilities available at Grays River Hatchery.

Ponds (No.)	Pond Type	Volume (cu.ft)	Length (ft.)	Width (ft.)	Depth (ft.)	Flow (gpm)	Max. Flow Index	Max. Density Index
10	Concrete Raceways	4,800	80	20	3.0	300	2.0-2.5	n/a
1	Earthen Pond	95,722	n/a	n/a	n/a	4,200	2.10	0.09
2	Concrete holding ponds	12,000	60	40	5.0	450-800	1.950	n/a
2	Intermediate Raceways	96	16	3	2	10-50	1.73	0.30
3	Intermediate Raceways	106.8	16	2.5	2.7	10-50	1.73	0.30

Chum fry are ponded by take into either one side of a divided raceway, or into an intermediate raceway. Fish are fed accordingly, and once takes are matched up by size, are combined into the divided raceway, where they remain until they are released.

5.6 Acclimation/release facilities.

Fish are reared on-station on well water, in standard or intermediate raceways. In April, they are gently seined into a plastic tote, and then transported via flatbed truck approximately 11.3 km (7 miles) to the mainstem Grays River, at the town of Rosburg WA. Fish at the Community Hall boat ramp (located at approximately RKm 7.6) are discharged through a 4" hose into a tidal portion of the river.

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

Grays River Hatchery. Grays River Hatchery has problems with shells of eyed-eggs on well water not breaking down and clogging the vertical tray lid screens. Incubation water from a seasonal unnamed creek adjacent to the hatchery can be used to alleviate this problem.

If river or creek water is needed, flooding and associated debris and sediments chronically affect fish production at this facility. This typically happens during sensitive stages of incubation, which can result in egg loss, but has not yet happened in the history of this program.

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.

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

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

6 SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

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

6.1 Source.

Adults returning to the Grays River. Natural-origin fish incorporation into the broodstock will be maximized to allow for integration of the on-station program by collecting in areas known to have low pHOS based on otolith analysis.

6.2 Supporting information.

6.2.1 History.

The first supplementation broodstock for Grays River was developed in 1996 by the educational co-operative-run Sea Resources Hatchery, located on the Chinook River (WRIA 25.0001) at RKm 6.6, from spawners collected in Willapa Bay tributaries. After the first year, the broodstock was developed from spawners collected from tributaries of the Grays River to promote the native genetic diversity of Grays River spawners (Small et al. 2011).

WDFW's recovery program has used only native Grays River chum salmon for its broodstock since the project's initiation in 1998. The source broodstock originated from adults trapped at Gorley Creek (WRIA 20.0129) and the Grays River. A winter flood event in 1998 altered both Gorley Creek and the course of the mainstem Grays River; as of 2004, most of the broodstock collection has come from the confluence of Crazy Johnson Creek (WRIA 25.0139), now a small tributary to the West Fork Grays River at RKm 0.8.

6.2.2 Annual size.

Approximately 155 adult pairs would be needed to achieve the maximum potential egg-take goal of 400,000 (FBD 2014) for both the on-station and ODFW programs. This is based on an average fecundity of 2,700 eggs/female, and a pre-spawning mortality of 5%.

6.2.3 Past and proposed level of natural fish in broodstock.

Initial broodstock came from native fish. The program had used adult chum salmon that returned back to the Grays River Hatchery (brood years 2001-06). This practice resulted in high pHOB values for many of those years. Beginning with brood year 2007, any adult chum that returned to the hatchery trap/rack are excluded from the brood stock. In addition, in the same season broodstock collection efforts were shifted to areas of known low hatchery-origin adults based on otolith (origin) analysis. These two actions have resulted in the desired effect of lowering pHOB to acceptable levels.

Table 6.2.3.1: Preliminary estimates of pNOB, pHOB, pHOS and PNI, Grays River Hatchery chum, brood years 2001-2012.

Brood Year	pNOB[a]	pHOB	pHOS[b]	PNI
2001	36.1	63.9	7.4	83.1
2002	40.6	59.4	10.5	79.4
2003	60.8	39.2	6.7	90.1
2004	87.2	12.8	4.3	95.3
2005	60.2	39.8	9.7	86.1
2006	17.5	82.5	6.8	72.0
2007	94.5	5.5	4.6	95.4
2008	90.8	9.2	8.2	91.7
2009	91.8	8.2	3.5	96.3
2010	92.4	7.6	4.8	95.1
2011	96.5	3.5	6.9	93.3
2012	99.5	0.5	2.6	97.4
Average	**72.3**	**27.7**	**6.3**	**89.6**

Source: Tables 16 and 17 in Hillson 2013.

[a] Broodstock spawned at Grays River Hatchery.

[b] Combined from three spawning reaches: Crazy Johnson Creek, West Fork Grays River, mainstem Grays River.

6.2.4 Genetic or ecological differences.

There are no known genotypic, phenotypic, or behavioral differences between the natural spawning and fish collected for broodstock. (See also HGMP section 6.2.1). Although LCR chum salmon populations are at very low numbers, genetic drift and temporal variation were minor (Small et al. 2006).

6.2.5 Reasons for choosing.

Chum salmon propagated through this program represent indigenous Grays River stock. Grays River chum are one of three remaining viable populations in the lower Columbia River.

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.

- Natural spawners will be integrated into the broodstock to represent the run throughout the season.
- Hatchery program fish are otolith-marked; pHOS is determined by otolith analysis from carcasses recovered during fall stream surveys (Hillson 2013).
- There are no known genotypic, phenotypic, or behavioral differences between either the hatchery stock or natural stock in the sub-basin.
- Holding pond procedures follow IHOT guidelines.
- Other listed fish encountered during the broodstock collection process will be returned directly to the river or passed into the upper watershed, with minimal handling and holding time.
- Any observed mortalities will be reported in the WDFW Hatcheries Headquarters Database.

7 SECTION 7. BROODSTOCK COLLECTION

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

Adults returning to the Grays River.

7.2 Collection or sampling design.

Hook and line. WDFW has collected broodstock via hook and line sampling since brood year 2003. Broodstock collection was accomplished by sight-fishing and then snagging adults using rod and reel from spawning areas with a low percentage of hatchery-origin adults, based on historical otolith decoding data (Hillson 2013). This method that is concentrated around the W.F. Grays River and the confluence of Crazy Johnson Creek is now the primary means of collection (see HGMP section 5.1 and **Figure 1.5.1**).

Sexually mature adult chum are captured from late-October through November in the West Fork and mainstem Grays River. Weekly collection curves used to incorporate broodstock numbers into the overall adult collection are based on previous returns. Numbers can change in-season if the run is determined to be ahead of or behind schedule. High water events that alter run timing can also cause an adjustment to this curve.

Hatchery trap. The trap at Grays River Hatchery is operated from September to March for the on-station coho program (see Grays River Type-N Coho HGMP). Capture efficiency is 100% for fish volunteering to the trap, however, all chum volunteering to trap are released; no program broodstock have been collected at the trap since 2007.

Table 7.2.1: Grays River chum broodstock collected via the hatchery trap and hook and line sampling.

Brood Year	Volunteers to the Hatchery Trap/ Seining		Captured via Hook and Line	
	Adults	Jacks	Adults	Jacks
2002	328	0	0	0
2003	0	0	305	0
2004	0	0	304	0
2005	0	0	132	0
2006	0	0	117	0
2007	0	0	134	0
2008	0	0	87	0
2009	0	0	108	0

2010	0	0	287	0
2011	0	0	293	0
2012	0	0	219	0
2013	0	0	246	0
Average	**328**	**0**	**203**	**0**

Source: WDFW hatchery data 2014.

7.3 Identity.

Only Grays River chum salmon are expected to return to the Grays River; no other chum populations apparently exist in this part of the Lower Columbia.

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 collection by sex and age, and resultant egg-take.

Brood Year	Estimated green Egg-Take	Females		Males	
		Natural-origin	Hatchery-Origin	Natural-origin	Hatchery-Origin
2002	437,517	77	88	42	121
2003	394,655	89	64	91	61
2004	388,457	133	21	132	17
2005	169,622	34	28	42	27
2006	142,012	11	48	9	48
2007	159,587	64	3	63	4
2008	104,651	41	3	38	5
2009	137,258	59	4	40	4
2010	396,265	139	5	127	16
2011	354,235	143	6	141	4
2012	303,366	111	1	107	0

Source: Todd Hillson, WDFW unpublished data.

See **Table 7.2.1** for broodstock source.

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

As mentioned above, adults that return to the hatchery, regardless of origin, have been excluded from being used as broodstock since 2006. Beginning in 2007, any chum salmon found in the hatcheries adult trap are released to spawn naturally. All adults collected via hook and line, in excess of weekly spawning goals (regardless of origin), are also released into the WF Grays River to spawn naturally.

Fish transportation and holding methods.

Adults captured via hook and line sampling are placed in holding/transport tubes until the end of the day's collection activities, and then transported in a 500 gallon tank mounted on a flatbed truck with supplemental oxygen (see HGMP section 5.2). Average transport time from the collection site to Grays River Hatchery is 10 minutes. Broodstock are held in the adult kill bins at Grays River Hatchery until spawning.

7.6 Describe fish health maintenance and sanitation procedures applied.

The adult holding area is separated from all other hatchery operations. Disinfection procedures that prevent pathogen transmission between stocks of fish are implemented during spawning. Spawning implements are rinsed with an iodophor solution, and spawning area and implements are disinfected with iodophor solution at the end the spawning day. Water temperatures in the late-fall are cooler, and no treatments are required to hold adult chum.

7.7 Disposition of carcasses.

Carcasses of chum salmon spawned at Grays River Hatchery will be returned to the watershed for nutrient/productivity enhancement.

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

Proper fish handling techniques are followed. Broodstock are collected throughout the return period. Broodstock collection procedures quickly identify non-target fish encountered; fish not used in the program are released immediately.

In the event of water failure to the holding ponds, fish held in the tubes could be quickly removed from the pond and placed in the nearby Grays River until the water supply to the pond is restored. In addition, the tubes could be moved to nearby raceways or to the earthen pond. If none of those locations are suitable, the fish could be liberated into the river.

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 are checked for spawning readiness based on observed state of ripeness. Once the number of ripe females is determined, an equal number of ripe males are checked and selected. Representative portions of the run are randomly selected. Spawning occurs weekly, over the period, from late-October through December. Spawning activity peaks in mid-November.

8.2 Males.

A factorial mating scheme of either 2x2 or 3x3 is followed whenever possible. The total egg mass of each female is weighed and then divided into the number of aliquots necessary to make the cross. Each aliquot is then fertilized by a different male. Approximately 30 seconds after the eggs and milt have been activated by water, milt from a “back-up” male is added to ensure a high rate of fertilization. This approach is used to ensure that each fish has an opportunity to contribute genetic material to the next generation.

8.3 Fertilization.

Agency spawning guidelines are closely followed (Seidel 1983); protocols are outlined by Schroder (2000) and Hillson (2003). Fertilization follows a 2x2 or 3x3 factorial mating scheme. Eggs from each female are collected separately in dry plastic pails. Each lot of eggs is then poured into a plastic colander that sits on top of another colander that has been lined with a plastic bag. The eggs are gently rotated around the colander to remove excess ovarian fluid, which is retained by the lower colander. The eggs are then weighed to the nearest tenth of a gram on a top loading electronic balance. Depending upon the type of factorial cross being used, two to three aliquots of eggs are then weighed out and placed into new dry plastic pails. A label with the female’s number is placed into each of these pails. A small sub sample of eggs (30 to 100) is then

removed from one of the aliquots and weighed to the nearest hundredth of a gram. The eggs in the sub-sample are then hand counted two times. The data from this sample provides an estimate of the green egg weight of each female (sample weight/egg number = mean green egg weight) and is used to calculate a fecundity estimate. Five of the eggs from the sub-sample are retained and placed in water and allowed to water harden for 24 hours. These eggs are then individually weighed to the nearest mg to provide an estimate of the water-hardened egg weight for each female.

The ovarian fluid captured by the lower colander is then poured back into each egg lot and the pails are stored in a cooler supplied with a 10 cm layer of crushed ice that is covered with some light insulating material. Once all the females in a factorial cross have been processed, milt is extracted from the males. Like the females, each of these fish is wiped dry of water, mucus, and blood before milt is collected in dry 1-liter plastic containers. Each milt sample is labeled and placed into a cooler until all the milt samples have been collected. The cross is made by laying out the pails containing the eggs of the same female into a row. For a three by three cross, nine pails would be laid out, with each row having eggs from the same female and each column having eggs from three different females. Milt from each male is added to one column of pails; at least 5-ccs of milt is added to each pail. Incubation water is poured over the combined gametes and they are gently swirled for 5 to 10 seconds. Milt from a back-up male is added after 20 seconds. The eggs are again gently swirled for approximately five seconds, then allowed to stand for a minute or more, until the micropyles in the eggs have closed. The eggs from each female are placed into a single incubation tray and immersed in an iodophor bath for one hour before being placed into normal incubation water.

Iodophor solution is used as rinse that is applied to hands and spawning implements per spawning. Iodophor foot baths are located at entrance to incubation room. Generally, sixty ovarian fluid and kidney/spleen samples are collected from female spawners to test for the presence of viral pathogens. Unmarked fish not used for integration needs are released upstream of the hatchery.

8.4 Cryopreserved gametes.

Cryopreserved gametes are not used.

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

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

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

9.1 Incubation:

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

Table 9.1.1.1: Numbers of females spawned, estimated egg-take, and survival between milestone stages for chum salmon spawned at Grays River Hatchery, brood years 1998-2012.

Year	# of females spawned	Estimated # of eggs taken	Estimated # of fry released in-basin	% Survival			
				Green to eyed-egg stage	Eyed-egg to ponding	Ponding to release	Green-egg to release
1998-99	47	121,060	102,901	92.6%	98.0%	93.5%	91.0%
1999-00	71	216,775*	134,661	93.1%	98.8%	99.4%	92.0%
2000-01	120	298,428*	202,833	96.1%	98.5%	98.5%	94.5%
2001-02	177	437,432*	305,185	94.8%	98.1%	99.3%	92.8%
2002-03	162	437,517	398,000	94.7%	98.2%	96.5%	93.0%
2003-04	153	394,655	357,000	95.6%	98.3%	96.5%	94.0%
2004-05	154	388,457	321,000	90.6%	96.6%	99.7%	87.4%
2005-06	65	169,622	155,501	94.0%	98.9%	98.6%	93.0%
2006-07	58	142,012	129,457	93.0%	97.4%	95.5%	95.5%
2007-08	67	159,587	147,609	94.4%	98.6%	99.4%	93.1%
2008-09	44	104,651	102,914	na	99.1%	99.4%	98.3%
2009-10	59	137,258	122,505	92.8%	97.1%	99.3%	90.1%
2010-11	146	396,265**	250,003	95.4%	98.3%	96.7%	94.8%
2011-12	152	354,235**	199,842	94.0%	95.9%	96.6%	93.8%
2012-13	113	303,366**	159,682	90.4%	98.2%	98.4%	96.8%

Source: Hillson 2013.

* Beginning with BY 1999 and continuing through BY 2001, a portion of each year's fry were transferred to the Sea Resources Hatchery on the Chinook River for rearing and in-basin releases.

** Beginning with BY 2010 and continuing through BY 2012, a portion of each year's egg-take were transferred to ODFW's Big Creek Hatchery to complete incubation and rearing for in-basin releases.

In addition, this program ships up to 150,000 eyed-eggs to ODFW in December/January to support their chum re-introduction program at Big Creek Hatchery, near Astoria OR.

Table 9.1.1.2: Eyed-eggs shipped to ODFW's Big River Hatchery.

Brood Year	Eggs Transferred
2010	106,960
2011	123,686
2012	132,193
2013	103,368

Source: WDFW Hatcheries Headquarters Database 2014.

9.1.2 Cause for, and disposition of surplus egg takes.

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

9.1.3 Loading densities applied during incubation.

Eggs placed in the stack incubators for hatching; eggs from one female are placed in an individual tray. Loading densities do not exceed 3,500 eggs/tray.

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.

After weighing and shocking, eyed-eggs are placed in trays with a Vexar® substrate. Eyed-eggs on well water have experienced difficulty in shells not breaking down during hatching, which can plug receptacles. If this condition occurs, eggs can be incubated on water from the seasonal unnamed creek adjacent to the hatchery. Flow rate through the trays is 4 gpm; well water temperatures are a constant 51°F (**Table 9.1.4.1**). Daily formalin treatments (15 minutes per day at 470 ml per minute) are applied until just before hatching (minimum of five days) to prevent *Sparolegnia* spp. growth. Dissolved oxygen is a little higher for the creek water, but ranges around 9-11 ppm. Siltation may be controlled with rodding, however, well water is silt-free, and very little silt is collected when the small amount of creek water is used. Creek water is not used during flood events.

Table 9.14.1: Monthly average well water temperature (°F) at Grays River Hatchery.

Month	Average Water Temperature (ºF)
November	51.0
December	50.6
January	50.3
February	49.8
March	50.6
April	51.2

Source: WDFW hatchery data 2014.

Grays River chum are not externally marked because fry are too small, and would likely experience high mortality rates during clipping. Instead, eggs receive a thermally-induced otolith mark during incubation. Chillers are used to lower water temperature to create otolith marks (Volk et al 1990). This mark can only be detected if the fish is recovered as a carcass, lethally sampled, or was part of the broodstock and the otolith is removed and processed.

Table 9.1.4.2: Number of eyed-eggs thermally otolith-marked, by brood year, Grays River Hatchery chum program.

Brood Year	Eyed-Eggs
2003	414,329
2004	377,290
2005	351,942
2006	159,445
2007	132,071
2008	150,650
2009	104,458
2010	127,375
2011	378,037
2012	332,981
2013	274,243
2014	290,136

Source: WDFW hatchery data 2014.

9.1.1 Ponding.

Fry are inspected at 800 TUs to determine the width of the yolk still visible. Chum are ponded when 100% buttoned up, at KD ~1.9, generally March/April. They are reared in the raceways supplied with well water.

9.1.2 Fish health maintenance and monitoring.

Fish health is continuously monitored in compliance with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006). Staff conducts daily inspection, visual monitoring and sampling through eyed-egg and fry stages. As soon as potential problems are seen, these concerns are immediately communicated to the WDFW fish health specialist. In addition, Fish Health specialists conduct inspections monthly. Potential problems are managed promptly to limit mortality and reduce possible disease transmission. Disease treatment varies with the pathogen encountered, but is generally antibiotic in nature for bacterial infections and bath or drip treatments with chemotheraputants for external infections.

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

9.1.3 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.
- Egg loading densities in each tray are relatively low ensuring that adequate water exchange can occur.
- IHOT and WDFW fish health guidelines followed.
- Multiple units are used in incubators.
- Splash curtains can isolate incubators.
- Temperature, dissolved oxygen, and flow are monitored.
- Dead eggs are discarded in a manner that prevents disease transmission.

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.

See **Table 9.1.1.1**.

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), and the WDFW *Fish Health Manual* (2010). IHOT standards are followed for water quality, alarm systems, predator control measures to provide the necessary security for the cultured stock, loading and density.

The fish are reared using the loading densities recommended by Piper et al. 1982. Each raceway can hold a maximum of 73,000 fry at the end of the rearing period. Our loading density goal for Grays River Hatchery is to try to rear the fish at less than one-half a pound of fish per gallon per minute for the majority of their rearing period.

9.2.3 Fish rearing conditions

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

Fish are reared on a combination of well water and river water. Temperature, dissolved oxygen (DO) and pond turn-over rate are monitored and recorded daily during fish rearing. The rearing water at Grays River averages around 10°C (50°F) (**Table 4.1.1**); flow into each raceway can vary between 946 to 1,325 liters/min (250 to 350 gpm). Ponds are vacuum-cleaned regularly to remove settleable solids, unused feed and feces. All ponds are broom-cleaned as needed and pressure-washed between broods. Predator netting over the rearing ponds and raceways minimize predation.

Surface water temperature from the Grays River ranges from 41 to 60°F (**Table 9.2.3.1)**. Well water temperatures average 51°F (**Table 9.1.4.1**)

Table 9.2.3.1: Monthly average surface water temperature (°F) at Grays River Hatchery.

Month	Average Water Temperature (ºF)
January	42
February	43
March	43
April	46
May	51
June	52
July	59
August	60
September	56
October	49
November	47
December	41

Source: WDFW hatchery records 2014.

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.

Table 9.2.4.1: Monthly fish growth information by length (mm), weight (fpp), condition factor and growth rate, of Grays River Hatchery chum collected during rearing.

Rearing Period	Length (mm)	Weight (fpp)	Growth Rate
February	25-30	1,200	n/a
March	30-40	500	0.583
April	40-60	300	0.400

Source: WDFW Hatchery Records 2014.

Growth samples were taken from each rearing area on a once-a-week basis to estimate mean body weight values for each group of reared fish. These values were used to adjust the daily ration of food provided to the fish. Growth rates (changes in length or body weight/day) for each group fish averaged around 0.4 mm and 27 mg per day. No formal assessments were made of the energy reserves the fish possessed at the time of their release. One of cultural goals in this project is to release fed fry with condition factors that range from 0.68 to 1.0. Fish with condition factors greater than one may be obese and not as able to migrate or escape predation as those in a slightly slimmer condition.

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

See HGMP section 9.2.4. No energy reserve data available.

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*).

Fish are given variety of starter diet formulations, including a semi-moist diet with no fines; pellet size never exceeds $^{1}/_{40}$ fork length. The food brand used may vary, depending on cost and vendor contracts. Feeding frequencies varies depending on the fish size and water temperature. Once the fish are actively feeding, they receive a daily ration of 3% B.W. throughout the day, at least once every hour, and ceases two to three days prior to release (Hillson 2013). The overall season feed conversion ratio has averaged approximately 0.55:1.0 (1,200-525 fpp) to 0.70:1.0 (<525 fpp to release).

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

Monitoring. 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), and the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006). 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. Blood is checked for signs of anemia or other pathogens. Additional tests for virus or parasites are done if warranted (see **Attachment 1** for 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.

Sanitation. All eggs brought to the facility are surface-disinfected with iodophor (as per disease policy). All equipment (nets, tanks, boots, etc.) is disinfected with iodophor between different fish/egg lots. Mortalities are collected and disposed of at a landfill. Fish Health and/or treatment reports are kept on file (see **Attachment 1** for Fish Health monitoring history).

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

Gill ATPase activity is not measured. Chum salmon fry are physiologically able to move directly into seawater at emergence.

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

Not applicable.

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

See HGMP sections 5.8, 6.3, 7.9 and 9.1.7.

10 SECTION 10. RELEASE

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

10.1 Proposed fish release levels.

Table 10.1.1: Proposed release levels (maximum number).

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Fry	400,000	250-450	April	Grays-Elochoman

Source: WDFW Future Brood Document 2014
Note: 300 fpp = 60 mm fork length (fl); 350 fpp = 57 mm fl; 450 fpp = 53 mm fl

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

Stream, river, or watercourse: WF Grays River (WRIA 25.0131)
Release point: RKm 7.6 (see HGMP section 5.5)
Major watershed: Grays-Elochoman
Basin or Region: Columbia River Estuary

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

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

Release Year	Number	Avg Size (fpp)	CV	Date
2002	305,185	315.0	3.02	March 12, 28; April 11
2003	398,000	300.0	3.50	April; 1, 8
2004	357,000	302.5	7.03	March 16, 22, 31; April 7, 12, 28
2005	321,000	337.5	4.95	March 25, 30
2006	155,501	302.7	6.17	March 21; April 6, 18
2007	129,427	298.5	4.40	April 2, 6
2008	147,609	485.0	8.77	March 29
2009	102,914	262.0	n/a	April 30
2010	122,527	300.0	n/a	April 1-30
2011	250,000	385.0	n/a	April 1-28
2012	206,000	312.0	5.65	April 5, 12
2013	157,800	337.5	n/a	March 21, April 10

Source: WDFW Hatcheries Headquarters Database 2014, WDFW hatchery data.
Note: 300 fpp = 60 mm fork length (fl); 350 fpp = 57 mm fl; 450 fpp = 53 mm fl

10.4 Actual dates of release and description of release protocols.

Fed fry are released between mid-March and mid-April. All releases will occur after dark, and on a falling tide to protect the fish from in-stream predation and expedite their movement toward the Columbia estuary. The fish are not fed for at least 24-hrs prior to a release to minimize handling stress.

Hatchery staff use a stick-seine to gently concentrate the fish into a small portion of their raceway. Fish are dip-netted into either a 200-gallon tote box or 1,000-gallon tanker truck filled with well water. The tote is lined with a fine mesh (3.125 mm) knotless nylon net, and oxygenated with air stones and sealed with a lid. The tanker truck is also supplied with air stones. The fish are then hauled approximately 11.3 km (7 miles) to the mainstem Grays River, in the town of Rosburg WA. Fish at the Community Hall boat ramp (located at approximately RKm 7.6) are discharged through a 4” hose into a tidal portion of the river, below chum spawning areas.

Per WDFW release protocols, temperature is monitored in the tank and tempering is performed at the release site if the difference between the tank and the release water is greater than 7ºF. There have not been any problems with elevated temperatures during hauling.

See **Table 10.3.1** for actual release dates.

10.5 Fish transportation procedures, if applicable.

See HGMP section 10.4. Transport time averages 20 minutes.

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

To reduce hatchery acclimation, fish are completely reared on well water at Grays River Hatchery, then transported by truck to the Community Hall boat ramp (RKm 7.6) on the Grays River for direct release to the tidal portion of the lower river (see also HGMP section 10.4).

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

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

Brood Year	Mark Type and Proportion
2001	Otolith – Thermal, 100%
2002	Otolith – Thermal, 100%
2003	Otolith – Thermal, 100%
2004	Otolith – Thermal, 100%
2005	Otolith – Thermal, 100%
2006	Otolith – Thermal, 100%
2007	Otolith – Thermal, 100%
2008	Otolith – Thermal, 100%
2009	Otolith – Thermal, 100%
2010	Otolith – Thermal, 100%
2011	Otolith – Thermal, 100%
2012	Otolith – Thermal, 100%

Source: WDFW hatchery data.

Grays River chum fry are released with their otoliths thermally-marked, using methods described in Volk et al. 1990, Volk et al. 1994, Schroder et al. 1996, and Volk et al. 1999. The distinctive marks allows identification of facility origin, brood year, and release locations and strategies to evaluate effects on fry-to-adult survival.

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

The program guidelines for annual broodstock/egg-take collection are managed to prevent any surpluses, and maintained within the ±5% guideline. In the event of surplus >10%, WDFW Regional Managers will, in accordance with regional policy and guidelines set forth in management plans/agreements and ESA permits and after consultation with NMFS, instruct hatchery staff for disposition of the surplus. Pending discussion, fish can be transferred, released, or destroyed.

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

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

Hatchery staff will make every attempt to keep the fish alive and healthy throughout the entire rearing-release cycle; all appropriate resource managers from the Complex level to the Federal level will be informed of the actions taken.

Adult Holding: Broodstock are held in the concrete kill bins at the Grays River Hatchery prior to spawning. The kill bins are supplied by gravity-fed Grays River water; any disruption to the water supply to the ponds would be detected by an alarm system. The hatchery staff would have at least three rescue options.

1) Depending upon stream conditions, pumps could be placed into Grays River until the water supply to the pond is restored.
2) The pumps could be placed in nearby raceways or to the earthen pond.
3) If none of the above locations are suitable, the fish could be released into the river.

Spawning and incubation-to-fry stage: In the event of a failure to the well pump that disrupts the water flow to the units:

1) If the eggs have not hatched, each Vertical tray would be de-watered and the eggs can be kept moist for up to 24 hours or longer, until replacement pumps can be installed or the line repaired.
2) If that is not possible, water from the auxiliary (unnamed) creek or river water can be used.
3) If all water lines are ruptured, egg trays could be carried out to the rearing raceways or earthen pond and supplied with gently moving water at those locations.

Rearing: In the event that well water flow is disrupted, some of the fish could be converted to river or creek water, if it is available. If all water supplies are disrupted, fry can be maintained by supplying each raceway with air stones that are fed by cylinders of compressed air, or (depending upon conditions in the river and time of year) the fish could be released into the Grays River.

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 production and release of only fed fry through fish culture and release practices fosters rapid seaward migration with minimal delay in the rivers, limiting interactions with naturally-produced fry.
- Hatchery fish returning during the time of year when chum are present are under heavy selective harvest. Sections of the West Fork and mainstem Grays rivers are closed to fishing when chum are present.
- 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.

- WDFW fish health and operational concerns for Grays River Hatchery programs are communicated to WDFW Region 5 staff for any risk management or needed treatment. See also HGMP section 9.7.

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 goal of the Grays River Chum Salmon Enhancement Program is to preserve genetic diversity within the Columbia River Coastal chum population, and provide a source for reintroduction into other potential spawning sites in the Columbia River Coastal zone. The program was modeled on, and developed under the guiding standards of chum salmon supplementation programs implemented in the Puget Sound and Hood Canal (WDFW and Point no Point Treaty Tribes 2000). Hatchery-produced chum otoliths are thermally marked to enable identification of project-origin adults during carcass recovery on the spawning grounds. The goal of otolith sampling for natural spawners each year has been 200 samples representatively collected from each of the primary spawning reaches in the Grays and West Fork Grays rivers and Crazy Johnson Creek (Hillson 2013).

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. *Spawning ground surveys in the Grays River, its tributaries and other Coastal Strata streams (Chinook, Skamokawa and Elochoman rivers, Mill, Abernathy and Germany creeks).* To produce unbiased estimates in these areas a mark/recapture protocol using carcasses is used to generate a Jolly-Seber estimate for spawners when abundance allows. Biological data collected to support assumption testing of JS analysis (scales for aging, sex, size and condition) in addition to tissue samples collected for genetic origin (PBT) and stock-analysis and potentially a genetic mark recapture 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. *Sampling of adults used for broodstock at Grays River Hatchery and any adults released to spawn naturally in spawning channels (none currently, but work is underway to create one off the WF Grays in 2-3 years).* Sample 100% of these adults to collect biological data: scales for aging, sex, size, fork lengths, weights (hatchery broodstock only) and condition, collect tissue samples for genetic origin (PBT) and stock-analysis. This sampling provides data needed to annually profile VSP parameters (adult abundance, diversity and adult spatial distribution), estimate annual rates of pNOB, pHOS and PNI, detect/track trends, measure/detect influence of the hatchery program, and supports population status analysis.
2. **Juvenile related M&E**
   A. *Operate a rotary screw trap in Crazy Johnson Creek.* Estimates of juvenile abundance at this location can be paired with adult abundance data to generate

productivity estimate for chum and other salmonids spawning in a naturally occurring protected groundwater-feed off-main-channel spawning area in the Coastal Strata. In addition, data is collected to measure diversity for multiple salmonid species at this location (juvenile outmigration timing, juvenile size, growth and age data for species with age-0+ outmigrants).

B. *Operate a rotary screw trap in in the mainstem Grays River*. The juvenile abundance estimates from this location, in conjunction with adult abundance data and juvenile outmigrant monitoring estimates from Crazy Johnson Creek, can be used to generate estimates of productivity for chum and other salmonids spawning in run-of-the-river spawning habitat in the Coastal Strata. In addition, data is collected to measure diversity for multiple salmonid species at this location (juvenile outmigration timing, juvenile size, growth and age data for species with age-0+ outmigrants).

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

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

Performance Standard	Addressed by M&E Activities included in this HGMP
3.1.2 Program contributes to mitigation requirements. Program provides mitigation for lost fish production due to development within the Columbia River Basin.	Annually estimate survival and contribution for each brood year released. M&E activities: 1.A and 1.B
3.1.3 Program addresses ESA responsibilities.	Natural populations are monitored annually to assess trends and compare with goals. M&E activities: 1.A and 1.B
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 and 1.B
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) 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 and 1.B
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 and 1.B
3.5.5 Juveniles are released at fully-smolted stage to benefit juvenile to adult survival rates, and reduce the likelihood for residualism and negative ecological interactions with natural-origin fish.	Annually monitor and record size, number, and date of release. M&E activity: 2.B
3.6.1 The hatchery program uses standard scientific procedures to evaluate various	Collect annual run timing, age and sex composition data

aspects of artificial propagation.	upon adult return. M&E activities: 1.A and 1.B
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, 2.A, 2.B and 2.C

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

Except for a risk involving genetic introgression, all other aspects of the M&E outlined in HGMP section 1.10 are currently funded (see 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 Grays River Hatchery. This level of staffing will allow for the monitoring and evaluation of all activities from the beginning of brood stock collection through the subsequent release of 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. Research will be directed at determining whether this program is successfully maintaining or increasing chum salmon abundance in the Grays River system.

12.2 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).

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

Not applicable.

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

Not applicable.

12.5 Dates or time period in which research activity occurs.

Not applicable.

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

Not applicable.

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

Not applicable.

12.8 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.

12.9 Alternative methods to achieve project objectives.

Not applicable.

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

Not applicable.

12.11 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 2005-2006 through 2012-2013: Grays River Hatchery.

Hatchery/ Collection Site	Stock	Species	Date Sampled	Results	Comments	Life Stage	Sample number	Number of fish sampled						ID	Cell Line	Inoc Date
								OF	pools	K/S	pools	fry/visc	pools			
GRAYS R	GRAYS R	CHUM	11/09/05	NEV		AD	1109-11/12	12	3	12	3					
GRAYS R	GRAYS R	CHUM	11/16/05	NEV	frozen on 11/18, thawed on 11/21 & proc'd	AD	1118-3/4	40	8	39	8					
GRAYS R	GRAYS R	CHUM	11/22/05	NEV		AD	1122-11/12	11	3	25	5					
GRAYS R	GRAYS R	CHUM	11/15/06	NEV		AD	1116-1/2	29	6	29	6					
GRAYS R	GRAYS R	CHUM	11/21/06	NEV		AD	1122-1/2	28	6	28	6					
GRAYS R	GRAYS R	CHUM	11/07/07	NEV		AD	1108-5/6	23	5	23	5					
GRAYS R	GRAYS R	CHUM	11/15/07	NEV		AD	1115-19/20	20	4	20	4					
GRAYS R	GRAYS R	CHUM	11/27/07	NEV		AD	1127-13/14	10	2	10	2					
GRAYS	GRAYS R	CHUM	11/18/08	NEV		AD	1118-18/19	16	4	35	7					
GRAYS	GRAYS R	CHUM	11/20/08	NEV		AD	1121-1/2	21	5	39	10					
GRAYS	GRAYS R	CHUM	11/25/08	NEV		AD	1125-9	5	1							
GRAYS	GRAYS R	CHUM	11/05/09	NEV	OF: F1-5 → 21-24, F&M: 1-5 → 21-24	AD	1105-10/11	24	5	48	10					
GRAYS	GRAYS R	CHUM	11/05/09	NEV	OF: F1-5 → 21-24, F&M: 1-5 → 21-24	AD	1105-10/11	24	5	48	10					
GRAYS	GRAYS R	CHUM	11/10/09	NEV	#25-29, 30-34, 35-39	AD	1110-20/21	15	3	30	6					
GRAYS	GRAYS R	CHUM	11/10/09	NEV	#25-29, 30-34, 35-39	AD	1110-20/21	15	3	30	6					
GRAYS	GRAYS R	CHUM	11/17/09	NEV		AD	1117-15	20	4							
GRAYS	GRAYS R	CHUM	11/17/09	NEV		AD	1117-15	20	4							
GRAYS	GRAYS R	CHUM	11/02/10	NEV		AD	1102-11/12	12	3	18	4					
GRAYS	GRAYS R	CHUM	11/08/10	NEV		AD	1109-7/8	33	7	33	9					
GRAYS	GRAYS R	CHUM	11/10/10	NEV		AD	1110-5	59	12							
GRAYS	GRAYS R	CHUM	11/02/11	NEV	6 pools female, 5 pools male	AD	1103-3/4	28	6	52	11					
GRAYS	GRAYS R	CHUM	11/07/11	NEV		AD	1108-1/2	25	5	8	2					
GRAYS	GRAYS R	CHUM	11/09/11	NEV		AD	1110-7	25	5							
GRAYS	GRAYS R	CHUM	11/17/11	NEV		AD	1118-3	60	12							
GRAYS	GRAYS R	CHUM	11/22/11	NEV		AD	1123-3	13	3							
GRAYS	GRAYS R	CHUM	11/06/12	NEV		AD	1107-5/6	41	9	60	12					
GRAYS	GRAYS R	CHUM	11/15/12	NEV		AD	1116-1	60	12							

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

Attachment 2: Fish health summaries: Grays River Hatchery, October 1, 2009 through March 31, 2009 to October 1, 2012 through March 31, 2013.

Grays River Hatchery Chum

Adults:
2011 Chum
One hundred and one ovarian fluid and 60 kidney/spleen samples were collected from spawning adults and tested for regulated viral pathogens. No virus was detected.

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 listed and candidate species are found in Cowlitz, Clark and Skamania Counties; 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.

"No effect" for the following listed species:

Bull trout (*Salvelinus confluentus*) – Threatened (Critical Habitat Designated)
Marbled murrelet (*Brachyramphus marmoratus*) –Threatened (Critical Habitat Designated)
Columbian White-Tailed deer (*Odocoileus virginianus leucurus*) – Endangered
Northern Spotted owl (*Strix occidentalis caurina*) –Threatened (Critical Habitat Designated)

Candidate Species:
(Cathlamet) Mazama pocket gopher (*Thomomys mazama* ssp. *louiei*) [historic]
Streaked horned lark (*Eremophila alpestris strigata*)

15.3 Analyze effects.

Not applicable.

15.4 Actions taken to minimize potential effects.

Program fish 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:**
Chinook (*Oncorhynchus tshawytscha*) Steelhead *(Oncorhynchus mykiss*) Chum (*Oncorhynchus keta*) Coho (*Oncorhynchus kisutch*)	Lower Columbia River Chinook Lower Columbia River Steelhead Columbia River Chum Lower Columbia River Coho	Grays River Chum Program
Location of hatchery activity: Grays River Hatchery: West Fork Grays River , RKm 3.2	**Dates of activity:** September-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.*