HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Photo: Courtesy of the hatchery staff and HEAT Unit.

Hatchery Program:	Soos Creek (Green River) Hatchery Summer Steelhead Program (Segregated)
Species or Hatchery Stock:	Summer Steelhead (*Oncorhynchus mykiss*) Early Summer Hatchery Stock
Agency/Operator:	Washington Department of Fish and Wildlife
Watershed and Region:	Duwamish/Green River, Puget Sound
Date Submitted:	
Date Last Updated:	October 29, 2015

Executive Summary

ESA Permit Status:
On March 31, 2004, the Washington Department of Fish and Wildlife (WDFW) submitted a Hatchery Genetic Management Plan (HGMP) for Soos Creek Hatchery early summer steelhead program as part of a joint state/tribal hatchery resource plan for consideration under Limit 6 of the 4(d) rule. In a letter from NOAA Fisheries dated August 4, 2004, the co-managers were informed that NOAA Fisheries anticipated completing a draft Environmental Impact Statement (EIS) by the summer of 2005. NOAA noted that "A final EIS may then be completed by winter 2005-2006, after which time NOAA Fisheries will release ESA 4(d) Rule determinations for the hatchery plans." The letter concluded by stating that "Your work on these hatchery plans is important, and will substantially contribute to on-going salmon recovery efforts within the region." The WDFW provided updated HGMPs to NOAA Fisheries in August 2005.

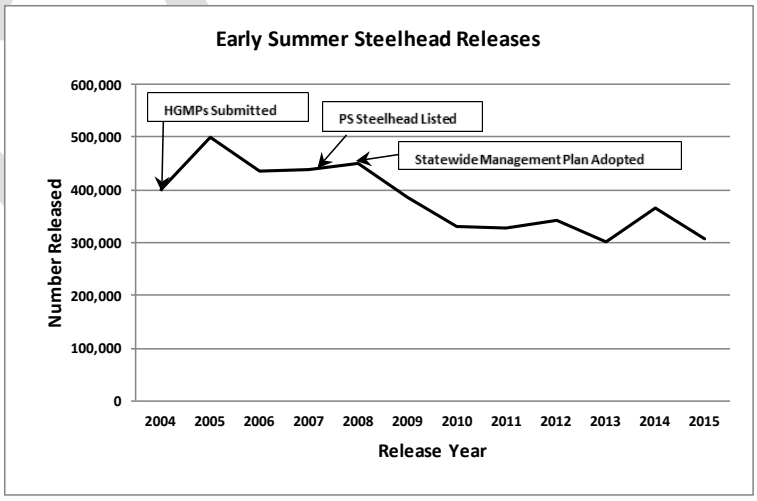
The co-managers are now re-submitting an HGMP for the Green Basin hatchery early summer steelhead program to further update the description of the program and incorporate new information and analyses.

The Puget Sound steelhead Distinct Population Segment (DPS) is listed as "Threatened" under the ESA, however, Green basin hatchery early summer steelhead are not included in the ESA-listing. The Puget Sound Technical Recovery Team has preliminarily delineated one Demographically Independent Population of native winter steelhead in the Green River.

Early Summer Steelhead - Additional Risk Reduction Measures:
The co-managers have implemented substantial additional risk reduction measures for early summer hatchery steelhead programs since the HGMPs were first submitted in 2004. The risk reduction measures were developed around the principles and recommendations of the co-managers' Resource Management Plans.

Across the Puget Sound Distinct Population Segment (DPS), these risk reduction measures include:

- >12% reduction in hatchery releases of early summer steelhead;
- >13% reduction in release locations;
- Elimination of cross-basin transfers, off-station releases, adult recycling, and fry releases into anadromous waters;
- Volitional smolt releases to minimize wild fish interactions;
- Hatchery broodstock collection by February 15th to enhance separation between hatchery and wild fish;
- Establishment of a network of wild stock gene banks; and
- Genetic monitoring of hatchery strays to natural spawning areas.



The developments of new genetic analysis techniques since July 2013 (Warheit, 2014) has provided significant new information to evaluate and, as necessary, modify hatchery programs.

Green River Basin Hatchery Early Summer Steelhead Program:
The purpose of the program is to produce Green River basin early summer steelhead for sustainable recreational and tribal fisheries. Program fish will be produced at the Soos Creek Hatchery, located on Soos Creek, a tributary to the Green River, and Icy Creek Pond, located on Icy Creek tributary to the Green River. The program will release 100,000 yearling smolts into the Green River basin annually.

The early summer hatchery program in the Green River basin is designed to take into account potential risks of artificial propagation on listed species while still providing for some harvest by treaty tribes and recreational fisheries. Efforts to minimize potential risks of artificial propagation are described below. Likewise, to protect against overutilization of wild steelhead whose abundances have declined from historical levels, the NMFS Biological Opinion established a 4.2% limit of the aggregate average harvest rate of wild steelhead in five basins: Skagit River, Snohomish River, Green River, Puyallup River, and Nisqually River. The factors driving the declining abundance of wild steelhead, however, have not been similarly restricted, including: 1) the present and increasing threat of destruction, modification and curtailment of wild steelhead freshwater, estuarine, and marine habitat; 2) predation and potentially disease, and 3) the inadequate existing regulatory mechanisms to protect wild steelhead habitat. The current harvest restriction severely limits the opportunities for both treaty and non-treaty fisheries on natural-origin steelhead. The lack of adequate habitat protection and restoration places an unacceptable disparate burden on hatchery programs, the exercise of the tribes' treaty-secured rights, limits recreational fishing opportunities, and fails to conserve steelhead. The potential risks of this hatchery program are minimal compared to the risks of failed steelhead habitat protection and restoration measures.

The program will be operated as a "segregated" program with the intent for the hatchery population to represent a distinct population that is reproductively isolated from naturally-spawning populations. Segregation will be achieved operationally by using only adult hatchery-origin early summer steelhead (distinguished by an adipose fin-clip) returning to the Soos Creek and Icy Creek traps, and by operating the program in a manner to limit gene flow to the wild population. Specific risk- reduction measures that have been implemented since 2004 for this program include:

- > 50% reduction in release locations relative to 2003-2004 (from four to two).
- Hatchery traps now remain open through March 15 (or later as conditions allow) to provide the opportunity for all adult hatchery-origin fish to return to the hatcheries to reduce straying,
- All eggs are taken from hatchery-origin fish returning with a goal to collect the program prior to January 31st but no later than February 15th to maintain the temporal separation in spawn-timing between hatchery- and natural-origin steelhead, and
- Eggs are mainly collected from broodstock returning to Soos Creek or Icy Creek hatcheries to promote fidelity of homing to the hatcheries.
- The early winter program is being eliminated so all marked fish will be known to originate from the summer program

The genetic impact from this segregated hatchery program on natural-origin steelhead will be assessed through measures of introgression and the proportion of effective hatchery contribution derived directly from DNA, based on periodic tissue sampling of key demographic/tributary groups, and linked to other harvest and habitat actions in a Total Viability Analysis (TVA) that considers the effects on all viability parameters from "All H" actions. These performance indicators are estimated using genetic samples collected from the natural populations and hatchery-origin fish straying to natural spawning areas. Given the above improvements and more direct measures of introgression and gene flow, the revised hatchery program should result in significant reductions in genetic impacts on natural-origin populations provided other factors affecting productivity remain neutral. Environmental and ecological effects that could contribute to the decline of steelhead viability are being addressed in ongoing monitoring efforts (smolt trapping, estuarine and nearshore marine monitoring done for more than 12 consecutive years) and new monitoring efforts (e.g. Salish Sea Marine Survival Project with the co-managers and 15 other agencies and entities, SeaGrant juvenile fish monitoring project, new zooplankton monitoring, etc). Risk control

measures are also in place to address other potential hazards including ecological interactions, disease transmission, and facility effects.

An integrated TVA is needed to assess the risks of the proposed hatchery program relative to other risk factors and to develop management actions that are likely to lead to recovery. As noted by the Puget Sound Technical Recovery Team (2003), "Considering the effects of one factor at a time (e.g. harvest, habitat, or hatchery management actions) on salmon population characteristics is more tractable from a technical standpoint, but such estimates of effects are sure to be wrong in most instances. Managers [are asked] to consider suites of habitat, harvest, and hatchery actions together, especially with a view towards how these factors interact..." The WDFW and Treaty tribes are now developing analytical tools to complete this task.

Harvest:
WDFW and Tribal co-managers (Muckleshoot Tribe and the Suquamish Tribe) prepare an annual Fisheries Management Plan for the harvest of Green River steelhead produced from this program (Muckleshoot Tribe et al., 2015). Returning early summer steelhead adults provide for limited tribal commercial and subsistence use and provide a localized recreational sport fishery, mostly from June through December each year. Tribal fisheries include net and hook and line fisheries, generally from June through December. The sport fishery directed at hatchery-origin adults for the 2014 season was open the first Saturday in June, within selected stream reaches, and was open until January 31, with retention of two hatchery-origin steelhead over 20 inches allowed per day (WDFW Sport Fishing Rules 2014/2015).

Monitoring, Evaluation, and Adaptive Management:
WDFW together with Muckleshoot Tibe conducts annual spawning ground surveys in the Green River mainstem and selected tributaries. Survey data are used to track annual trends in natural population abundance and spatial distribution. WDFW is also implementing a genetic monitoring program to measure the proportion effective hatchery contribution and genetic introgression between segregated hatchery steelhead and wild populations in the Puget Sound DPS. These monitoring programs will provide input data to a TVA model that will provide information to adaptively manage the early summer hatchery programs relative to other "All-H Actions" and viability parameters.

1 SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1 Name of hatchery or program.

Green River Summer Steelhead Program (Soos Creek Hatchery and Icy Creek Rearing Pond).

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

Green River (early summer stock) Steelhead (*Oncorhynchus mykiss*).

Not ESA-Listed – Early summer hatchery stock perpetuated in the Green River system is not considered part of the Puget Sound Distinct Population Segment (DPS), for Puget Sound Steelhead listed as *Threatened* under the ESA (National Marine Fisheries Service, May 11, 2007).

1.3 Responsible organization and individuals

Hatchery Operations Staff Lead Contact

Name (and title): Brodie Antipa, Region 4-South Operations and Hatchery Reform Manager
Agency or Tribe: Washington Department of Fish and Wildlife
Address: 13030 Auburn Black Diamond Rd, Auburn WA 98092
Telephone: (253) 931-3928
Fax: (253) 833-2805
Email: Brodie.Antipa@dfw.wa.gov

Fish Management Staff Lead Contact

Name (and title): Aaron Bosworth, Region 4 District Biologist
Agency or Tribe: Washington Department of Fish and Wildlife
Address: 16018 Mill Creek Blvd, Mill Creek WA 98012
Telephone: 425-775-1311 ext. 102
Fax: (425) 338-1066
Email: Aaron.Bosworth@dfw.wa.gov

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

The **Muckleshoot Indian Tribe (MIT)**, **Suquamish Tribe** and WDFW prepare an annual fishery management plan for the harvest of Green River system winter and summer steelhead from hatchery programs.

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

Facility	Funding Sources	Operational Information (FY 2013)[a]
Soos Creek Hatchery	Puget Sound Recreational Enhancement (PSRE) Fund; Wildlife Fund – State DJ-Federal; Local	FTEs = 4.44 Annual operating cost (dollars) $418,922
Icy Creek Rearing Pond	PSRE fund	Full time equivalent staff – 0.88 Annual operating cost (dollars) - $86,128

[a] The above information for annual operating cost applies to all species produced at these facilities.

1.5 Location(s) of hatchery and associated facilities.

Table 1.5.1: Location of culturing phases, by facility.

Facility	Culturing Phase	Location
Soos Creek Hatchery	Broodstock collection, spawning, incubation, rearing and release.	Big Soos Creek (WRIA 09.0072) at RM 1, tributary to the Green River (WRIA 09.0001) at RM 33.5.
Icy Creek Rearing Pond	Broodstock collection, rearing and release.	Icy Creek (WRIA 09.0125), tributary to the Green River (WRIA 09.0001) at RM 48.3.

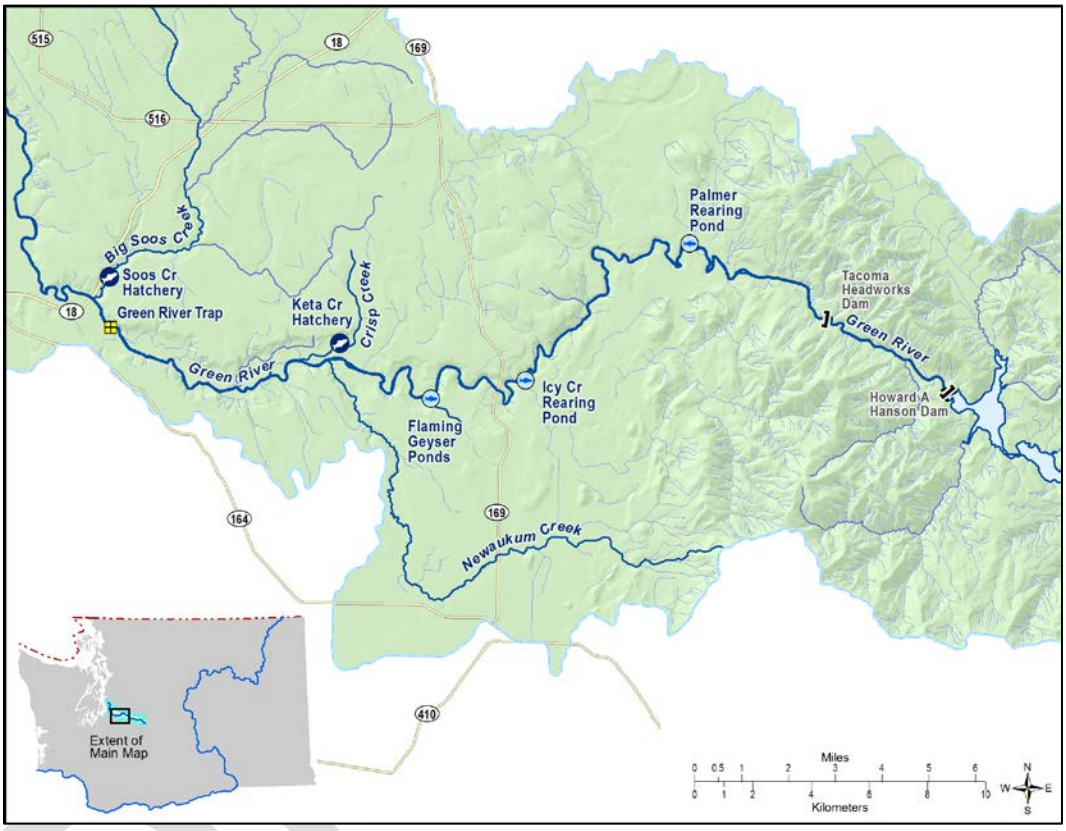


Figure 1.5.1 Map of Soos Creek Hatchery and Associated Juvenile Production and Adult Broodstock Trapping, Rearing, Acclimation and Release Sites. Source: WDFW GIS Unit, 2015.

1.6 Type of program.

Segregated Harvest.

1.7 Purpose (Goal) of program.

Harvest Augmentation.

1.8 Justification for the program.

The NMFS Biological Opinion established a 4.2% limit on the aggregate average harvest rate of wild steelhead in five basins: Skagit River, Snohomish River, Green River, Puyallup River, and Nisqually River. This severely limits the opportunities for treaty tribe harvest and recreational fisheries.

The harvest of hatchery fish under this program is an essential part of the Tribe's federally – recognized treaty fishing rights. The role of this and other hatchery programs associated with treaty-reserved fishing rights is to support four basic values recognized by the Federal courts: (1)

resource conservation, (2) ceremonial, religious, and spiritual values, (3) subsistence values, and (4) commercial values. The natural production of steelhead in the Green-Duwamish watershed has been diminished by the extensive loss and degradation of habitat. Hatchery production is needed to replace lost natural production and provide meaningful harvest opportunity in fulfillment of the Indian Tribe's treaty fishing rights as affirmed by U.S. v. Washington proceedings.

Historically, tributary spawning in the Green-Duwamish accounted for up to 55% in 1984 of the total wild escapement to the basin. The five-year average of tributary contribution dropped from 40% in 1987 to 22%-34% from 1998-2013. Since 2005 this average has remained at or below 11%. This decline is due in large part to habitat degradation in the two main tributaries, Soos and Newaukum Creeks.

In addition to habitat loss and degradation, high parasite loads (Nanophyetus) in the Green-Duwamish Basin severely limit the potential for natural production at self-sustaining and harvestable levels.

See Section 3.4 in this HGMP for links to habitat protection and recovery processes.

The purpose of the program is to produce Green River (early summer stock) steelhead for sustainable fisheries (Magnuson/Stevens Act), for harvest in terminal recreational fisheries and to fulfill Treaty Indian fishing right entitlements (*U.S. v Washington*).

To minimize impacts on listed fish from facilities operations: the following Risk Aversions are included in further sections of this HGMP (**Table 1.8.1**):

Table 1.8.1: Summary of risk aversion measures for the Soos Creek summer steelhead program.

Potential Hazard	HGMP Reference	Risk Aversion Measures
Water Withdrawal	4.2	Surface water rights are formalized through trust water right #S1-21122. Spring water rights at Soos are formalized though trust water right #S1-000382CL. Monitoring and measurement of water usage is reported in monthly National Pollution Discharge Elimination System (NPDES) reports.
Intake Screening	4.2	Intake screens at the Soos Creek Hatchery are in compliance with state and federal guidelines (NMFS 1995, 1996), but do not meet the current Anadromous Salmonid Passage Facility Design criteria (NMFS 2011a). The 2012 budget provided WDFW with funding to replace/renovate the existing intake to meet current fish passage and screening requirements.
Effluent Discharge	4.2	This facility operates under the "Upland Fin-Fish Hatching and Rearing" NPDES permit administered by the Washington Department of Ecology (DOE) - WAG 13 – 3014 (Soos) and WAG 13 – 3013 (Icy).
Broodstock Management & Adult Passage	2.2.2, 2.2.3,7.9	Summer steelhead voluntarily enter an instream trap at Soos Creek and off channel trap at Icy Creek between June and February. Fish for broodstock are selected from the run using adipose clipped stock only. While adult Chinook are present during this time, both traps are operated to collect Chinook broodstock for the various Green River Chinook programs regardless of steelhead trapping. .
Disease Transmission	7.7, 9.2.7	*The Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006) details hatchery practices and operations designed to stop the introduction and/or spread of any diseases.

Competition & Predation	2.2.3, 10.11	Fish are released as smolts between April and May to foster rapid migration to marine waters and to allow juvenile listed fish to grow to a size that reduces the potential for predation.

1.9 List of program "Performance Standards".

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

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**
3.1.1 Program contributes to fulfilling tribal trust responsibility mandate and treaty rights as described in applicable agreements (*U.S. v Washington*).	Contributes to co-manager harvest.	Participate in annual coordination between co-managers to identify and report on issues of interest, coordinate management, and review programs (FBD process and annual fisheries management plans).
3.1.2 Program contributes to mitigation requirements.	Number of fish released by program, returning, or caught, applicable to given mitigation requirements.	Annually estimate survival and contribution to fisheries for each brood year released. This program provides mitigation for lost fish production due to development within the Green River system and contributes to sport and tribal fisheries.
3.1.3 Program addresses ESA responsibilities.	Program complies with Federal ESA-listed fish take authorizations for harvest and hatchery actions.	HGMP updated and re-submitted to NOAA with significant changes or under permit agreement.
3.2.1 Fish produced for harvest are propagated and released in a manner enabling effective harvest, as described in all applicable fisheries management plans, while adequately minimizing by-catch of non-target species.	Annual number of fish produced by program caught in all fisheries, including estimates of fish released.	Annually mass-mark hatchery steelhead releases to differentiate hatchery from natural-origin fish and record estimates of mark rate. The external mark enables mark-selective fisheries, which can reduce directed harvest mortality on natural-origin fish. Agencies monitor harvests and hatchery returns to provide up-to-date information. Estimate survival and contribution to fisheries for each brood year released.
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 (Tipping 2001). Release type (forced, volitional, or direct).	Monitor fish condition in the hatchery throughout all rearing stages. Annually monitor and report size, number, and date of release.

3.5.6 The number of adults returning to the hatchery that exceeds broodstock needs is declining.	Program is properly sized to meet harvest objectives; program fish are fully utilized in target fisheries.	Monitor harvests and hatchery returns throughout the run.
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 (CVs).	Collect annual run timing, age and sex composition data upon adult return. Annually monitor and report growth rates, mark rate and size at release and release dates.
3.8.3 Non-monetary societal benefits for which the program is designed are achieved.	Contributes to cultural and recreational benefits to the general population. Also contributes cultural, ceremonial and subsistence (C&S), and recreational benefits for PNW Native Americans. Surplus (food-grade quality) fish provides contributions to local charitable organizations. Recreational fishery angler days, length of season, number of licenses purchased.	Assess annual harvest of hatchery fish based on Catch Record Card (CRC) estimates. Annually record and report number of surplus fish donated to local charitable organizations.

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 and hatchery management actions. Monitor juvenile hatchery fish size, number, date of release and mass-mark quality; monitor contribution of hatchery adult fish to fisheries and hatchery escapement.
3.2.1 Fish produced for harvest are produced and released in a manner enabling effective harvest, as described in all applicable fisheries management plans, while adequately minimizing by-catch of non-target species.	Annual number of fish produced by this program caught in all fisheries, including estimates of fish released	Annually mass-mark (adipose fin-clip) juvenile steelhead releases to differentiate hatchery- from natural-origin fish, and record estimates of mark rate. The external mark enables state agencies to initiate mark-selective fisheries, which can reduce directed harvest mortality on natural-origin fish.

		Harvest is regulated to meet appropriate biological assessment criteria. Agencies monitor harvests and hatchery escapements to provide up-to-date information.
3.4.3 Life history characteristics of the natural population do not change as a result of this hatchery program.	Life history patterns of juvenile and adult NOR are stable.	Spawn timing of the natural population is performed by conducting redd surveys, and smolt size, production and outmigration timing are monitored via smolt trapping data.
3.5.1 Patterns of genetic variation within and among natural populations do not change significantly as a result of artificial production.	Within and between populations, genetic structure is not significantly affected by artificial production.	Conduct genetic monitoring of the hatchery and natural populations (see HGMP section 11.1).
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 - broodstock-separated timing of earlier hatchery fish from later natural-origin spawners to minimize potential spawning overlap.	All hatchery production is identifiable in some manner (fin-marks, tags, etc.). Segregated program - only marked hatchery fish are used for broodstock purposes; fish are spawned before January 31. Collect annual run timing, origin, and age and sex composition data. Examine returning fish for the fin-mark at the hatchery. Annually monitor 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.	Watershed –specific introgression rates of the natural spawning populations.	Collect tissues for DNA analysis from key demographic/tributary groups in each watershed subbasin sample and refine DNA analysis to better understand the genetic composition of steelhead DIPs and monitor for signals of hybridization with hatchery fish. Input introgression data to TVA analysis and attempt to scale programs accordingly.
3.5.4 Juveniles are released on-station, or after sufficient acclimation to maximize homing ability to intended return locations.	Fish are reared and released on-station	Annually monitor and report release (information location, method, and age class) in (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 report size, number, date of release and release type.
3.5.6 The number of adults returning to the hatchery that exceeds broodstock needs is	Program is sized appropriately for harvest goals. Numbers of surplus hatchery	Annually monitor and report numbers of adults returning to the hatchery, broodstock collected,

declining.	returns are calculated annually.	and surplus returns.
3.7.1 Hatchery facilities are operated in compliance with all applicable fish health guidelines and facility operation standards and protocols (IHOT, PNFHPC, the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006), INAD, MDFWP).	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. 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).
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. WDOE water rights permit compliance.	Flow and discharge reported in monthly NPDES reports.
3.7.3 Water withdrawals and in-stream water diversion structures for artificial production facility operation will not prevent access to natural spawning areas, affect spawning behavior of natural populations, or impact juvenile rearing environment.	Water withdrawals compared to NMFS, USFWS and WDFW applicable passage and screening criteria for juveniles and adults.	Barrier and intake structure compliance assessed and needed fixes are prioritized.
3.7.4 Releases do not introduce pathogens not already existing in the local populations, and do not significantly increase the levels of existing pathogens. Follow the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006).	Necropsies of fish to assess health, nutritional status, and culture conditions.	WDFW Fish Health Section inspects adult broodstock yearly for pathogens and monitor juvenile fish on a monthly basis to assess health and detect potential disease problems. As necessary, WDFW's Fish Health Section recommends remedial or preventative measures to prevent or treat disease, with administration of therapeutic and prophylactic treatments as deemed necessary. 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	At spawning, lots of up to 60 adult

	for pathogens and parasites.	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).
3.7.5 Any distribution of carcasses or other products for nutrient enhancement is accomplished in compliance with appropriate disease control regulations and guidelines, including State, Tribal and Federal carcass distribution guidelines.	All applicable fish disease policies are followed. See HGMP sections 7.5 and 7.8.	Conduct controls of specific fish pathogens through eggs/fish movements in accordance to the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006). Record and report disposition of carcasses in the WDFW Hatcheries Headquarters Database
3.7.6 Adult broodstock collection operation does not significantly alter spatial and temporal distribution of any naturally-produced population.	Spatial and temporal spawning distribution of natural populations above and below weir/trap currently compared to historic distribution.	Trap is checked regularly. When natural-origin steelhead are mixed in with hatchery fish, they are safely returned to the river.
3.7.7 Weir/trap 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.	Trap checked regularly. Annually monitor and report abundances and observations of natural-origin and hatchery-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.	Hatchery smolt release size and time are monitored to quantify/minimize predation effects on naturally-produced listed fish (Sharpe et al. 2008, Pflug et al. 2013) (see also HGMP section 2.2.3). No predation data available for watershed.

1.11 Expected size of program.

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

Up to 100 pairs collected annually.

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

Table 1.11.2.1: Annual release levels, by site.

Life Stage	Release Location	Annual Release Level
Yearlings	Soos Creek (WRIA 09.0072)	50,000
	Icy Creek (WRIA 09.0125)	50,000
	Total Releases (Green River System)	**100,000**

1.12 Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels.

Due to a lack of coded-wire tag (CWT) studies and limitations that not all fish can be accounted for as being harvested or as back-to-rack counts, smolt-to-adult survival rates (SAR) are likely underestimated. Based on the average smolt-to-adult survival of 0.89% for brood years 1999-2010 and a program release goal of 50,000 yearlings, the estimated adult production (goal) level would be 445 (see HGMP section 3.3.1) and 890 with increased release goal of 100,000.

Table 1.12.1: Green River system hatchery summer steelhead escapement 2004-2015.

Return Year	Soos Creek Hatchery	Palmer Ponds Hatchery	Icy Creek Ponds
2004	133	0	NA
2005	665	112	NA
2006	212	3	NA
2007	185	101	NA
2008	147	58	NA
2009	247	101	NA
2010	156	Discontinued	NA
2011	115		NA
2012	107		NA
2013	174		21
2014	228		38
2015	149		15
Average	**210**	**63**	**25**

Source: WDFW Hatcheries Headquarters Database 2015

[a] Broodstock was supplied from Reiter Ponds (WRIA 7) prior to 2001, so no adult trapping occurred in this system.

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

The summer steelhead program in the Green River system was initiated in the 1960s. Releases from Palmer Ponds ran from 1969 through 2009. Trapping, incubation, hatching and early rearing phases began at Soos Creek Hatchery in 2002 and the releases from Icy Creek Rearing Pond began in 1999 and broodstock trapping in 2012. Releases from Flaming Geyser ran on and off from 2004 to 2010.

1.14 Expected duration of program.

Ongoing.

1.15 Watersheds targeted by program.

Duwamish/Green River (WRIA 09.0001).

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

Alternative 1: *Reduce number of summer steelhead released* as a measure to decrease genetic and ecological risks to natural-origin steelhead. The Co-Managers did not pursue this alternative because : 1) program is projected to meet standards; and 2) this alternative would not meet enhancement or harvest objectives for the program and would not meet the goals of either Co-Manager, including providing recreational, cultural and subsistence, ceremonial, religious, commercial and non-commercial benefits, nor be compatible with Treaty Indian fishing rights (*U.S. v Washington*) or the Magnuson/Stevens Act for sustainable fisheries. Operation of early summer steelhead program proposes discontinuation of Green River early winter steelhead program, so risk of overlap with naturally produced winter steelhead is reduced.

Alternative 2: Discontinue the program. The Co-Managers did not pursue this alternative because: 1) program is projected to meet standards; and 2) this alternative would not meet enhancement or harvest objectives for the program and would not meet the goals of either co-Manager, which include providing recreational, cultural and subsistence, ceremonial, religious, commercial and non-commercial benefits, nor be compatible with Treaty Indian fishing rights (*U.S. v Washington*) or the Magnuson/Stevens Act for sustainable fisheries. Operation of early summer steelhead program proposes discontinuation of Green River early winter steelhead program, so risk of overlap with naturally produced winter steelhead is reduced.

Alternative 3: Replace segregated program with an integrated program. There are no in-basin native summer populations with which to integrate.

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.

The Palmer Ponds summer steelhead HGMP (now Soos Creek) was previously submitted to NOAA Fisheries in 2005, but was not acted on at that time. This HGMP is submitted to NOAA Fisheries for ESA consultation, and determination regarding compliance of the plan with ESA Limit 6 of the 4(d) rule criteria for joint state/tribal hatchery resource management plans affecting listed species.

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.

None directly.

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

Puget Sound 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 (76FR50448). The Puget Sound Chinook salmon ESU is composed of 31 historically quasi-independent populations, of which 22 are believed to be extant currently. The ESU includes all naturally-spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Strait of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington (Ford 2011), as well as twenty-seven artificial propagation programs (NMFS 2013 78FR38270). In the Duwamish/ Green River basin, the Technical Recovery Team (TRT) has identified one demographically independent population (DIP) (Duwamish/ Green River Chinook) (Ruckelshaus et al. 2006).

Puget Sound steelhead *(Oncorhynchus mykiss*): Listed as *Threatened* under the ESA on May 11, 2007 (72FR26722); reaffirmed *Threatened* by five-year status review, completed August 15, 2011 (76FR50448). The DPS includes all naturally spawned anadromous winter-run and summer-run *O. mykiss* (steelhead) populations, below natural migration barriers in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington. This DPS is bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive) (Ford 2011). Also includes steelhead from six artificial propagation programs: Green

River Natural; White River Winter Steelhead Supplementation; Hood Canal Steelhead Supplementation Off-station Projects in the Dewatto, Skokomish, and Duckabush Rivers; and the Lower Elwha Fish Hatchery Wild Steelhead Recovery (NMFS 2013 78FR38270). In the Duwamish/ Green River basin, the TRT has preliminarily delineated one demographically independent population (DIP) of winter steelhead; (Green River), no native summer run populations were identified in the basin (PSSTRT 2013).

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

Soos Creek (Green/Duwamish) Hatchery fall Chinook in the Puget Sound Chinook ESU. NMFS (1999) considered this stock to be in the ESU, but not essential for recovery. The stock was designated Category 2a, as the hatchery population is derived from a native, local population (SSHAG 2003). The NMFS subsequently listed hatchery production in the Green because these hatchery stocks are not significantly divergent from naturally-spawning fish in the watershed (70 FR 37160. June 28, 2005; NMFS SHIEER 2004, NMFS 2005).

Green/ Duwamish fall Chinook in the Puget Sound Chinook ESU. Recent escapement levels (2005-2012) have averaged 1,547 for natural spawners in the Green/Duwamish DIP. During this same time period, the population has shown declining trend (SaSI, WDFW 2012).

Puget Sound Chinook salmon: Updated Risk Summary. All Puget Sound Chinook populations are well below the TRT planning range for recovery escapement levels. Most populations are also consistently below the spawner recruit levels identified by the TRT as consistent with recovery. Across the ESU, most populations have declined in abundance somewhat since the last status review in 2005, and trends since 1995 are mostly flat. Several of the risk factors identified by Good et al. (2005) and Judge (2011) are also still present, including high fractions of hatchery fish in many populations and widespread loss and degradation of habitat. Many of the habitat and hatchery actions identified in the Puget Sound Chinook recovery plan are expected to take years or decades to be implemented and to produce significant improvements in natural population attributes, and these trends are consistent with these expectations. Overall, the new information on abundance, productivity, spatial structure and diversity since the 2005 review does not indicate a change in the biological risk category since the time of the last BRT status review.

See Soos Creek Fall Chinook HGMP for Viability Criteria.

Green River steelhead in the Puget Sound steelhead DPS. The number of natural-origin winter steelhead has increased in the last five years. From a low point in 2008-2009 of 304 spawners, the number of spawners increased to 1,657 in 2015. Ford (2011) used spawner data collected through 2008 and concluded the following: "Steelhead counts in the Green River have declined steadily since the 1980's and most sharply since 2005. The estimated probability that this steelhead population would decline to 10% of its current estimated abundance (i.e., to 45 fish) is high—about 90% within 80 years. With an estimated mean population growth rate of -0.042 ($\lambda = 0.959$) and process variance of 0.001, NOAA was highly confident ($P < 0.05$) that a 90% decline in this population will not occur within the next 20 years, and that a 99% decline will not occur within the next 45 years. However, beyond the next 50 years NOAA was highly uncertain about the precise level of risk." Based on a preliminary intrinsic potential estimate by the PSSTRT (2013), the capacity for winter steelhead is between 1,977 and 39,537 in the Green River Basin.

*Puget Sound steelhead: Updated Risk Summary***.** The number of winter steelhead spawners has increased for many populations in Puget Sound since 2009. The number of spawners for 16 Puget Sound winter steelhead populations, relative to the average number of spawners for each population in the four year period up to the listing in 2007, increased from an average of 53% in 2009 to 141% in 2013, (Fig.2.2.2.1).These recent, short-term increases in spawners are a positive

development, but do not negate the long-term risks facing Puget Sound steelhead DPS. Using spawner data collected through 2008 or 2009, Ford (2011) concluded that the status of the listed Puget Sound steelhead DPS has not changed substantially since the 2007 listing, and that steelhead in the Puget Sound DPS remain at risk of extinction throughout all or a significant portion of their range in the foreseeable future, but are not currently in danger of imminent extinction.

Table 2.2.2.1: Interim DIP abundance goals for steelhead in Puget Sound, based on a four-year average. Abundance goals for summer-run fish (italics) are still under review. QET, quasi extinction threshold; SAS, smolt to adult survival.

Population Basin				Quasi Extinction Threshold	Low Abundance	Viable	Capacity
Population Name	Area km^2	Mean Elevation (m)	Total Stream Length (m)		1% SAS	5% SAS	20% SAS
Green River	1,444	463	834,472	69	1,977	9,884	39,537
Puget DPS Total				**1,462**	**30,449**	**153,194**	**613,662**

Source: Hard et al. 2014.

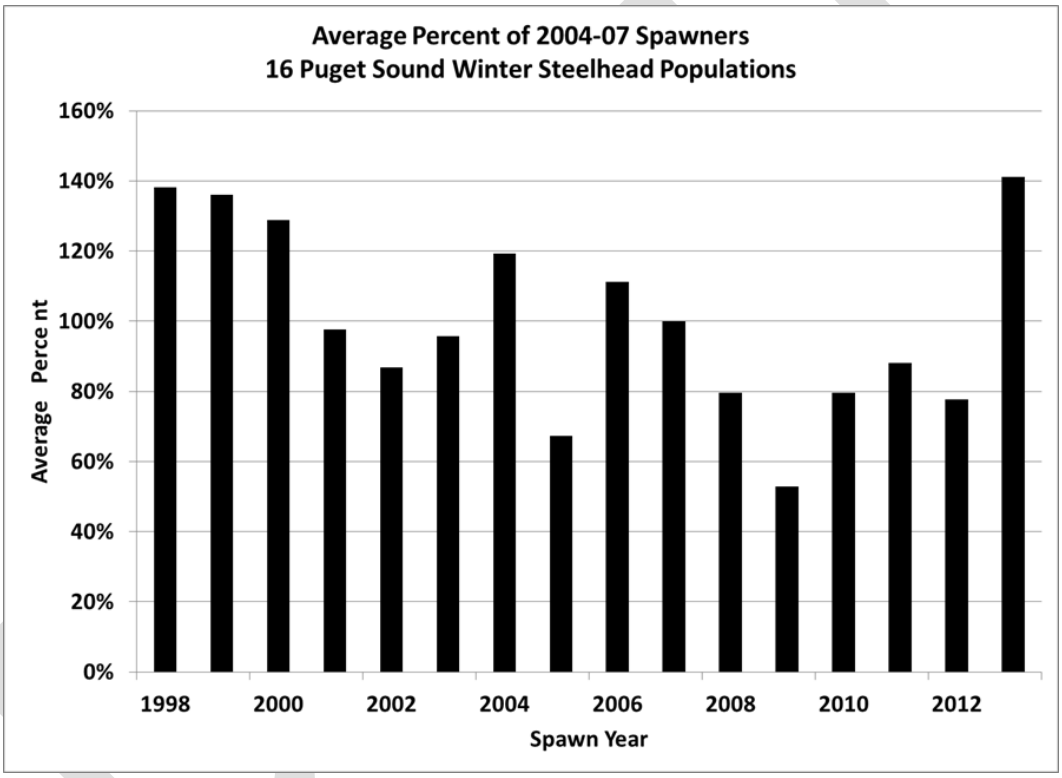


Figure 2.2.2.1: Average percent of 2004-2007 spawners for 16 Puget Sound winter steelhead populations.

- 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 Soos Creek Fall Chinook HGMP for Chinook Productivity Data.

Green River steelhead (*Oncorhynchus mykiss*): WDFW natural-origin smolt monitoring activity occurs on this system.

Table 2.2.2.2: Abundance estimates, 95% confidence intervals, and coefficient of variation (CV) for natural-origin steelhead smolts rearing above the Green River juvenile trap, migration years 2009-2013.

Trap Year[a]	Abundance	95% C.I.		CV
		Lower	Upper	
2009	26,174	10,151	42,198	19.4%
2010	71,710	49,317	94,103	15.9%

Source: Topping and Zimmerman 2013.
[a] 2011 to 2013 data currently unavailable.

Table 2.2.2.3: Estimates of exponential trend in the natural logarithm (ln) of natural spawners (lambda) for winter-run populations of steelhead in the Puget Sound DPS over the entire data series (1985 – 2009; last data point is 2001) (95% CI).

Population	1985-2009	1995-2009
Green River winter-run	0.992 (0.969 - 1.016)	0.953 (0.892 - 1.019)

Source: Ford 2011. These are based on analyses reported by Ford (2011) that are not necessarily agreed to by WDFW and the Muckleshoot and Suquamish Tribes.

- Provide the most recent 12 year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.

See Soos Creek Fall Chinook HGMP for Chinook Escapement Data.

Table 2.2.2.4: Green (Duwamish) River wild winter steelhead spawning escapement 2003-2015.

Return Year	Escapement
2003/2004	2,359
2004/2005	1,298
2005/2006	1,955
2006/2007	1,452
2007/2008	833
2008/2009	304
2009/2010	423
2010/2011	855
2011/2012	392
2012/2013	656
2013/2014	997
2014/2015	1,657
Average	**1,098**

Source: (WDFW SCoRE, 2015). Data are total escapement estimates based on cumulative redd counts in all mainstem spawning areas and in index reaches in Soos and Newaukum creeks totaling 12 miles. Does not include wild brood collected for hatchery program.

- 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.

See Soos Creek Fall Chinook HGMP for Chinook estimates.

Green River (Duwamish) steelhead (*Oncorhynchus mykiss*): The early summer hatchery program in the Green River basin is designed to take into account potential risks of artificial

propagation on listed species while still providing for some harvest by treaty tribes and recreational fisheries. Risk to natural winter steelhead production was taken into account in proposing to discontinue the early winter steelhead program. Efforts to minimize potential risks of artificial propagation are described below. Likewise, to protect against overutilization of wild steelhead whose abundances have declined from historical levels, the NMFS Biological Opinion established a 4.2% limit of the aggregate average harvest rate of wild steelhead in five basins: Skagit River, Snohomish River, Green River, Puyallup River, and Nisqually River. The factors driving the declining abundance of wild steelhead, however, have not been similarly restricted, including: 1) the present and increasing threat of destruction, modification and curtailment of wild steelhead freshwater, estuarine, and marine habitat; 2) predation and potentially disease, and 3) the inadequate existing regulatory mechanisms to protect wild steelhead habitat. The current harvest restriction severely limits the opportunities for both treaty and non-treaty fisheries on wild steelhead. The lack of adequate habitat protection and restoration places an unacceptable disparate burden on hatchery programs, the exercise of the tribes' treaty-secured rights, limits recreational fishing opportunities, and fails to conserve steelhead. The potential risks of this hatchery program, therefore, have to be considered in the context of failure to implement steelhead habitat protection and restoration measures commensurate with those measures imposed on steelhead hatchery and harvest programs that result in diminished fishing opportunities.

An integrated Total Viability Analysis (TVA) is needed to assess the risks of the proposed hatchery program relative to other risk factors and to develop management actions that are likely to lead to recovery. As noted by the Puget Sound Technical Recovery Team (2003), "Considering the effects of one factor at a time (e.g. harvest, habitat, or hatchery management actions) on salmon population characteristics is more tractable from a technical standpoint, but such estimates of effects are sure to be wrong in most instances. Managers [are asked] to consider suites of habitat, harvest, and hatchery actions together, especially with a view towards how these factors interact..." Rather than simplistic single sector analysis and management actions, our challenge is to develop a suite of integrated recovery actions that lead to increased production and viability of wild steelhead. The WDFW and Treaty tribes are now developing analytical tools to initiate this task.

Analyses of a single hatchery parameter or application of a universal standard is unlikely to lead to an informed decision regarding the potential risk of a hatchery program or to the identification of appropriate management actions. We used two analyses to evaluate the potential genetic effects of the early summer steelhead programs on wild steelhead. The analyses are complementary - they use multiple sources of information and address multiple questions.

1) Genetic Introgression. Introgression results from hybridization between hatchery and wild individuals. We used an analysis of genetic introgression to address the question "How have past early summer hatchery program practices affected the genetic characteristics of wild steelhead?" Since our analysis relies on tissue samples from natural-origin steelhead collected in the Green River, it provides a direct measure of the cumulative effects of the early summer hatchery program. However, it may also reflect some practices that have now ended (e.g., off-station plants, recycling of returning adults.

2) Proportion Effective Hatchery Contribution. The proportion effective hatchery contribution (PEHC) is the proportion of natural spawners that are genetically derived from the early summer hatchery program and includes both hatchery-wild hybrids and pure natural-origin hatchery-lineage fish. We estimated the PEHC from an analysis of the genetic ancestry of tissue samples from natural-origin steelhead from the Green River (Warheit 2014). Since the PEHC includes pure hatchery-lineage fish that have the potential to generate hybrid offspring, it addresses a broader question than would genetic introgression alone: "How may early summer hatchery program practices affect the potential for genetic introgression. Like the analysis of introgression, PEHC relies on

tissue samples from natural-origin steelhead collected in the Green River, and provides a direct measure of the effects of the early summer hatchery program.

Introgression from the early summer steelhead program was evident in the Green River Winter population with the PEHC for previous hatchery practices at 0.01. The estimated PEHC for the proposed programs is 0.02 Several key assumptions and uncertainties of the analyses are discussed briefly below (see Warheit 2014 for a more detailed discussion):

1) Uncertainty in Estimates. Although we report most statistics as point estimates, the estimates have variance associated with sampling the population and measuring biological attributes. Because of variability inherent in natural systems, and our sampling programs, we can expect substantial inter-annual variability in our point estimates, even if the true value is constant.

2) Effects of Variations in Population Abundance. Our projections for the proposed program assume that the abundance of the natural-origin population remains constant relative to when the samples were taken. Increases in population abundance will result in lower values of introgression, PEHC, and gene flow even if the hatchery programs do not change. Conversely, decreases in population abundance will result in higher values of introgression, PEHC, and gene flow than projected.

3) Time Lags. The effects of changes in hatchery programs may not be evident for 2-5 years after the changes have been made. This time lag reflects: a) the multiple years of ocean residence between smolt release and the return of adult fish; b) the multiple ages at return for adult steelhead; and c) the presence of hatchery-wild hybrids from previous generations that can continue to contribute to the genetic characteristics of the population.

4) Neutral Markers. The genetic analysis was based on SNP loci that were presumably neutral to natural selection. These markers were used to categorized fish as pure early summer hatchery lineage, wild lineage, and hybrid between the hatchery and wild lineages. If a hatchery program is terminated, the amount of time it takes a wild population to purge itself of alleles that categorize a fish as being a hatchery or hybrid fish is a function of the frequency of the alleles and the effective size of the wild population.

Proportion Effective Hatchery Contribution. We estimated the PEHC from the early summer hatchery program from a genetic analysis of juvenile and adult steelhead (Warheit 2014). The PEHC was estimated as 0.01 from an analysis of 173 samples from adults collected in 2004 and 2013 and smolts collected in 2007 and 2008. The estimated PEHC reflects the previous hatchery practices that affected the juvenile and adult fish in the years when the samples were collected. The average number of hatchery summer steelhead smolts released was 73,112 (**Table 2.2.2.5**). We projected the PEHC for the proposed program of 100,000 smolts by multiplying the base PEHC (0.01) by the proposed increase to the base smolt releases (137%) to obtain a projected PEHC of 0.014 for the proposed program.

Table 2.2.2.5. Genetic samples and associated hatchery releases of summer steelhead into the Green River.

Sample	Life Stage	Sample Collection Year	Primary Spawn Year	Primary Release Year	Releases
Green	Adult	2004	2001	1998	61,396
Green	Smolt	2007	2006	2003	59,883
Green	Smolt	2008	2007	2004	74,605
Green	Adult	2013	2010	2007	96,564

Source: Ken Warheit, WDFW Genetics Lab, 2015.

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

Broodstock Collection: Natural-origin steelhead encountered at the Soos Creek weir are identified by presence of an adipose fin and returned to stream immediately. The trapping facility at Icy Creek is a hatchery outlet-only with little or no incentive for listed fish to voluntarily enter. Broodstock collection of summer steelhead takes place between June and February. Only hatchery identified (missing adipose fin) adults are used for broodstock. While adult Chinook are present during this time, traps are operated to collect Chinook broodstock for the various Green River Chinook programs. Listed Chinook may enter the trap at Icy Creek, but it is unlikely due to the small size of the outlet creek. Wild winter steelhead are not observed during the summer steelhead broodstock collection period. No take of listed fish has been reported in the summer-run steelhead hatchery broodstock collection activity.

Broodstock Spawning/Pathology Sampling: Only hatchery identified steelhead (adipose fin-clip only) are spawned at Soos Creek summer steelhead program. Spawned or fresh pond mortality females (up to 100 total) may be kidney/spleen sampled for thorough pathogen screening per the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington* (WDFW and WWTIT 1998, updated 2006).

Rearing Program: Only hatchery origin steelhead are reared for this program. Listed fish are not reared in this program.

Residualism:
Rearing and release strategies are key components to minimizing risks from hatchery programs on outmigrating salmonids. Ideally, hatchery steelhead are released when fish are smolting to encourage rapid outmigration to minimize the opportunity for predation or residualism risks (Fuss et al. 1999 and Snow et al. 2013) of hatchery fish on natural outmigrants. Studies conducted on predation risks to natural-origin Chinook (Sharpe et al. 2008) and steelhead (Naman and Sharpe 2012; Pflug et al. 2013) have shown predation risks to be minimal. Short outmigrating travel times have also been shown to minimize opportunity for negative interactions (nine days Moore et al. 2013 Puget Sound wide; 16.4 days Goetz et al. 2014, Green River).

Based on 30 years of staff observations and the studies conducted to evaluate predation and residualization risks, the current protocol as described incorporates the following risk aversion factors into best practices to reduce risks to ESA-listed populations while meeting management goals.

- FISH UNIFORMITY: Monitor population uniformity of hatchery steelhead through CVs and condition factors prior to release to ensure release criteria are met (uniform size, condition, etc).
- FISH SIZE: Release groups will meet the minimum size criteria of 10 fpp established by Tipping 2001.
- RELEASE TIMING: Releases of hatchery smolts will occur on or after April 15 to minimize predation risks on out-migrating natural-origin listed fry in the freshwater system so long as the first two criteria of fish uniformity and fish size (Tynan 2012 analysis-unpublished; Iverson and Missildine 2013 unpublished).
- VOLITIONAL RELEASE: Releases of hatchery smolts will be volitional to minimize residualization risks.
    - Volitional release will begin after April 15 when steelhead display cues of outward physical signs and behaviors of active smoltification, such as loss of parr marks, banding of tail, actively cruising pond edges, inflow, and outflow areas.
    - Hatchery Staff will pull screens to provide the opportunity for steelhead smolts ready to emigrate to leave the pond(s) or raceway(s).

- Steelhead that have not volitionally left the holding area by the end of the release period (approximately one month (Fuss 1999; Tipping 2001) will be transferred to non-anadromous lakes for angling opportunities.

For more information on predation and competition risks see HGMP 2.2.3 *Competition/Niche-Displacement* and *Predation* sections below.

Operation of Hatchery Facilities: Potential facility operation impacts on listed fish include; water withdrawal, hatchery effluent, and intake compliance or barrier blockages. The intake screens at Soos Creek are in compliance with state and federal guidelines (NMFS 1995, 1996), but do not meet the current *Anadromous Salmonid Passage Facility Design* criteria (NMFS 2011a). Monitoring and maintenance of hatchery facilities is conducted regularly. Effluent at outfall areas is rapidly diluted with main stem flows and operation is within permitted guidelines (see HGMP sections 4.1 and 4.2). All permit requirements are followed in order to minimize the potential indirect 'Take" associated with the operations of these facilities. No take of listed fish is reported by staff during the normal operation of the hatchery.

Genetic Introgression: Genetic introgression may occur if hatchery adults spawn in the wild with both temporal and spatial separation of hatchery and wild steelhead playing a role in the amount of potential impact. Run timing for wild winter steelhead stocks in Puget Sound systems range from November to June with the current existing peak spawn time in most populations from mid-April through May (SaSI, WDFW 2012). Where native summer steelhead stocks are present, run timing occurs from April to December with peak spawn time believed to be approximately one month earlier than the winter stock (SaSI, WDFW 2012). There are no historic native summer steelhead populations in the Green/ Duwamish system (PSSTRT 2013).

Plants to various locations in the system occurred in the past, but have been eliminated and program fish are currently released on-station (100% mass marked) and with no out of basin transfers. This reduces overlap potential and straying incidences. The natural-origin winter run steelhead spawning generally occurs from early March to early June.

The expected gene flow rate can be much lower than the "stray" rate. In a well-run segregated program, the level of gene flow should be quite low for three reasons: 1) the numbers of hatchery-origin fish that have escaped harvest should be low compared to the number of natural-origin fish present; 2) the reproductive success of the hatchery-origin fish can be expected to be low (Leider et al. 1990; Kostow et al. 2003; McLean et al. 2003; McLean et al. 2004); and 3) spawning overlap may be low (Scott and Gill 2008).

Operational changes were implemented in 2009 to remove hatchery fish, including adults trapped above broodstock needs. These will not be re-cycled for additional sport opportunities and trapping facilities will continue removing hatchery fish until March 15 or later as conditions allow. Additionally, the early winter program is proposed to be terminated which will reduce opportunities to accidentally incorporate winter-run adipose-marked fish into the summer program broodstock.

Disease Transmission: Interactions between hatchery reared and naturally produced populations may be a source of pathogen and disease transmission although there is little evidence showing that diseases are transmitted from hatchery fish to natural-origin fish (Steward and Bjornn 1990). WDFW conducts fish disease examinations to ensure minimal disease transmission and to prevent the introduction and/or spread of any fish diseases. Fish health-monitoring efforts include fish health examinations and virus sampling, abnormal fish loss investigations, and pre-transfer and pre-liberation inspections. All activities are done in accordance with guidelines developed under the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006).

Competition/Niche-Displacement: Freshwater carrying capacity may be compromised if hatchery steelhead smolts planted or those produced naturally from hatchery spawners competitively

displace or compete with wild fish in their natural rearing habitats. Smolts from on station releases in large river systems travel rapidly – migration rates of approximately 20 river miles per day have been observed with steelhead smolts released in the Cowlitz River (Harza 1999). Interactions with listed salmonids in the estuarine and nearshore environment are likely to be limited. Telemetry studies indicate that steelhead migrate out of the Puget Sound quickly, with an average travel time of approximately 9 days to the Strait of Juan de Fuca (Moore et al. 2013, Moore et al. 2010, Goetz et al. 2008).

Predation: Steelhead released from hatchery programs are unlikely to prey upon listed species of salmonids, but the magnitude of predation will depend upon the characteristic of the listed population of salmonids, the habitat in which the population occurs, and the characteristics of the hatchery program (e.g., release time, release location, number released, and size of fish released). Based stomach fullness, most steelhead smolts do not begin to feed extensively until about a week after release (Cannamela 1993). Recent WDFW research (Sharpe et al. 2008) has shown that the predation risks from hatchery steelhead smolt releases are minimal on smaller prey fish and that most sub-yearling Chinook have already emigrated or grown large enough to reduce or eliminate their susceptibility to predation when hatchery steelhead are released. Based on a study in the Skagit basin, Pflug et al. (2013) showed that hatchery steelhead smolts did not prey on wild steelhead juveniles.

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

No listed steelhead are targeted for this segregated program (see also the Green River Native winter-late steelhead HGMP for listed steelhead take). Wild steelhead may be inadvertently handled and released from trapping facilities but operational protocols are in place to return these adults back to stream as quickly as possible when and where they occur. Inadvertent mortality on all listed fish encountered at these trapping sites and returned back to stream is estimated to be 0-1 fish yearly. In almost all years, staff has reported this as none.

Timing for summer steelhead and Chinook collection overlaps, but unmarked Chinook are retained at the hatchery for the integrated program regardless of summer steelhead collection (also see Soos Creek Chinook HGMP). Bull trout or wild steelhead may be inadvertently handled during trapping at these facilities, but operational protocols are in place to return these adults back to stream as quickly as possible when and where they occur. Inadvertent mortality on all listed fish encountered at these trapping sites and returned back to stream is estimated to be 0-1 fish yearly. In most years the staff has reported none.

- 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).

See comments above.

- 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.

Any additional mortality from these activities, above what is anticipated and described above, would be communicated to WDFW Fish Program and NOAA staff for additional guidance.

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 HGMP is a component of the co-managers comprehensive resource management plan for Puget Sound steelhead.

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

The program is implemented in accordance with the legislatively-mandated *Puget Sound Recreational Fish Enhancement* Program.

The program is implemented in accordance with the legislatively-mandated *Puget Sound Recreational Fish Enhancement* Program.

Future Brood Document (FBD): Hatchery salmon and steelhead production levels are detailed in the annual Future Brood Document, which is 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). The FBD is coordinated between WDFW, the Northwest Indian Fisheries Commission (NWIFC) representing Puget Sound and coastal treaty tribes, eastern Washington treaty tribes, and Federal fish hatcheries. Hatchery production by volunteers, schools, and Regional Fisheries Enhancement Groups are represented by WDFW.

WDFW hatcheries operate under *U.S. v Washington* that provides the legal framework for coordinating these programs, defining artificial production objectives, and maintaining treaty-fishing rights through the court-ordered *Puget Sound Salmon Management Plan* (PSSMP 1985). This co-management process requires that both the State of Washington and the relevant Puget Sound Tribe(s) develop program goals and objectives and agree on the function, purpose and release strategies of all hatchery programs.

Equilibrium and Future Brood Document (EBD and FBD): The PSSMP defines the EBD as the annual expression of the equilibrium brood document as it pertains to the coming year's run of salmon and describes the standard mode of operation for existing facilities/functions, associated with fish culture activities. The EBD provide descriptions of facilities, species propagated, and fishery management, hatchery production, broodstock management, eggtake, rearing, and release goals for each facility. While it does not include all of the requirements of the EBD, the Future Brood Document (FBD) is currently used as a pre-season planning document for EBD fish hatchery production reporting information in Washington State for the upcoming brood stock collection and fish rearing season (July 1 –June 30). The FBD is coordinated between WDFW, Puget Sound and coastal treaty tribes, the Northwest Indian Fisheries Commission (NWIFC), eastern Washington treaty tribes, and Federal fish hatcheries. Hatchery production by volunteers, schools, and Regional Fisheries Enhancement Groups are represented by WDFW.

See also HGMP section 3.1.

3.3 Relationship to harvest objectives.

WDFW general harvest goals are to provide fishing opportunities consistent with the mandate of the agency for restoration and recovery of wild indigenous salmonid runs, the Pacific Salmon Treaty, the *Puget Sound Salmon Management Plan*, the *Statewide Steelhead Management Plan*, annual fisheries management plans, *U.S. v Washington*, and other state, federal, and international legal obligations. The Muckleshoot and Suquamish Tribes along with WDFW prepare an annual

fishery management plan for the harvest of Green/Duwamish River system summer and winter steelhead released from hatchery programs. To minimize impacts on listed fish, the tribal net fishery for hatchery steelhead from this program has typically ended no later than the first week of January (WDFW et al. 2008 to present).

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.

Harvest on targeted hatchery fish: Duwamish-Green system programs benefits the in-river recreational fishery and the Muckleshoot and Suquamish tribes commercial and subsistence fisheries. Watershed Resource Management Plans (RMPs), when developed, will manage maximum harvest impacts to listed steelhead in the system. As the Green River winter sport harvest season ends by February 1, and summer begins the first Saturday in June (WDFW Sport Fishing Rules 2014/2015), most of the incidental catch and release may be prior to significant amounts of the wild winter run being present in the system.

Table 3.3.1.1: Green River system Hatchery Summer Steelhead Harvest 2001-2012.

Return Year[a]	Smolt Release[a]	Freshwater Sport[b]	Tribal Harvest	Hatchery Return	Smolt-to-Adult Contribution %
2001	60,249	576	157	54	1.31%
2002	65,273	199	166	126	0.75%
2003	65,860	675	60	23	1.15%
2004	101,137	352	50	133	0.53%
2005	59,883	182	47	777	1.68%
2006	74,608	196	110	215	0.70%
2007	157,463	282	129	286	0.44%
2008	96,841	263	89	205	0.58%
2009	123,864	335	89	348	0.62%
2010	82,080	231	106	156	0.60%
2011	109,600	394	133	115	0.59%
2012	55,609	836	237	107	1.70%
Average	**87,706**	**377**	**114**	**212**	**0.89%**

Sources: WDFW Catch Record Card (CRC) Database 2012, WDFW Hatcheries Headquarters Database 2013.

[a] Smolt releases made two years earlier in the spring (Release years = 1999 to 2010). Catch may include fish caught during the return year and early the following year.

[b] 2- or 3-salt returns cannot be broken out and is the total of the Green River system.

Incidental impact on non-targeted wild steelhead: Implementation of selective-fishing rules which requires the release of all wild, unmarked steelhead in Puget Sound began in the 1990s. This has reduced natural origin steelhead harvest statewide to approximately 1% of the catch. Non-targeted natural origin steelhead may be hooked and released with an unknown impact for most streams and direct studies have not been done in this system. Nelson et al. (2005) showed catch and release mortalities of 1.4% to 5.8% in 1999 and 2000 respectively on steelhead caught in recreational fisheries on the Chilliwack River in British Columbia. This study also showed no indication of increased mortality on fish that had been caught released multiple times. A hook and line mortality study conducted in the Samish River on winter-run steelhead also showed similar results to this, although it indicated that there may be a negative relationship between a fish being caught in a sport fishery and its survival to out migration as kelts (Ashbrook et al. in press). Taylor and Barnhart (1999) determined that summer steelhead caught and released in the Mad and Trinity Rivers of California had a 9.5% mortality rate, with 83% of the mortalities occurring

at water temperatures of 21°C or greater. This study also showed no indication of increased mortality on fish that had been caught released multiple times. As such hooking mortality associated with recreational sport harvest is generally believed to be less than 10% of fish hooked and released.

3.4 Relationship to habitat protection and recovery strategies.

The hatchery steelhead program provides treaty and non-treaty harvest opportunity in light of habitat loss and degradation limiting natural production in the Green-Duwamish River basin (WRIA 9) streams and Puget Sound. Howard Hanson Dam near river mile 64 is an impassable barrier to fish migration and prevents natural production of salmonids into over 100 miles of stream habitat in the upper Green River watershed. This federally owned dam currently lacks fish passage facilities and plans to construct a safe downstream passage outlet are on hold due to high costs and a lack of federal funds. The fish passage efficiency and survival associated with potential future juvenile fish passage at the dam are uncertain due to anticipated budget constraints and predicted in-reservoir migration delay. The majority of the lower half of the accessible basin is highly developed, channelized, and/or industrialized. Ninety eight percent of the historic estuary has been lost to development. Riprap and other structures line the intertidal and marine shorelines, along with levees and revetments in the middle and lower river. Agriculture and urban development have degraded the hydrology, water quality, floodplain, channel diversity, and riparian areas of most lowland streams, reducing the potential for natural production over much of the historic salmonid distribution. Water temperatures in the Green River routinely exceed the Washington State water quality standards and have exceeded lethal levels for salmonids at times due to inadequate shade (Coffin, C. et al., 2011). These and other factors have degraded or eliminated habitat and the natural habitat processes important for salmonids, reducing the abundance and productivity of the natural populations in the watershed.

Efforts continue in WRIA 9 by tribal, state, local and federal governments to try to protect and improve instream flows, water quality, fish passage, near shore, riparian floodplain habitats, and where possible, the underlying natural ecosystem processes that create and maintain salmonid habitat. Unfortunately, the resulting net habitat change to date is not yet positive. Habitat loss and degradation has continued despite efforts at restoration (Judge, M.M. 2011).

King County is lead entity for the WRIA 9 salmon recovery planning group, a coalition of local governments and stakeholders. The WRIA 9 Salmon Habitat Plan (August, 2005) outlined projects and programs focusing on habitat limitations in the Duwamish Estuary, middle and lower river, and nearshore marine areas, and spawning habitat in the middle and lower river (see also http://www.rco.wa.gov/salmon_recovery/lead_entities.shtml).

The Army Corps of Engineers' Ecosystem Restoration Program has funded projects intended to improve habitat conditions for salmon in the basin, unfortunately, at the same time, other Corps' programs and projects continue to negatively affect salmon and salmon habitat. The non-governmental Mid-Puget Sound Regional Enhancement Group works to implement habitat restoration projects in cooperation with other entities to benefit salmonids in the system. A number of habitat restoration actions were initiated under the 2001 Tacoma Water Green River Habitat Conservation Plan in the upper river, and a Superfund cleanup plan is being developed to address toxic contamination of Duwamish River Sediments. The net cumulative effect of these activities is uncertain, and salmon habitat was reported to be in continued decline since the adoption of the Puget Sound Chinook Recovery Plan (M. Judge, 2011).

Salmon Recovery Funding Board (SRFB): Composed of five citizens appointed by the Governor and five state agency directors, the Board provides grant funds to protect or restore salmon habitat and assist related activities. It works closely with local watershed groups known as lead entities (see below). SRFB has helped finance over 500 projects. The Board supports salmon recovery by funding habitat protection and restoration projects. It also supports related programs and activities that produce sustainable and measurable benefits for fish and their habitat.

Regional Fisheries Enhancement Groups (*RFEGs*)*:* Several citizen based groups in conjunction with local governments work on habitat actions to benefit both listed and non-listed stock in the system including the Mid Puget Sound Regional Enhancement Group.

Puget Sound Partnership Action Plan: An ESU-wide recovery planning effort is being undertaken by the Puget Sound Partnership, a collaborative group dedicated to restoring salmon and steelhead throughout Puget Sound (online at http://www.pugetsoundpartnership.org).

State of Our Watersheds: Individual member Tribes have worked with the NWIFC and SSHIAP to create the State of Our Watersheds report. This document examines key indicators of habitat quality and quantity across more than 20 watersheds in western Washington that lie within tribal Usual and Accustomed fishing areas as defined by *U.S. vs. Washington* (1974). The Green River habitat section can be found under the Muckleshoot chapter at http://maps.nwifc.org:8080/sow2012/.

3.5 Ecological interactions.

(1) *Salmonid and non-salmonid fishes or other species that could negatively impact the program.* Negative impacts by fishes and other species on the Soos Creek Hatchery summer steelhead program could occur directly through predation on program fish, or indirectly through food resource competition, genetic effects, or other ecological interactions. In particular, fishes and other species could negatively impact steelhead survival rates through predation on newly released, emigrating juvenile fish in the freshwater and marine areas. Certain avian and mammalian species may also prey on juvenile steelhead while the fish are rearing at the hatchery site, if these species are not excluded from the rearing areas. Species that could negatively impact juvenile steelhead through predation include the following:

- Avian predators, including mergansers, cormorants, belted kingfishers, great blue herons, and green herons
- Mammalian predators, including mink, river otters, harbor seals, and sea lions
- Cutthroat trout

Rearing and migrating juvenile and adult steelhead originating through the program may also serve as prey for large, mammalian predators in marine areas, nearshore marine areas and in the Green River and Soos Creek to the detriment of population abundance and the program's success in harvest augmentation. Species that may negatively impact program fish through predation may include:

- Orcas
- Sea lions
- Harbor seals
- River otters

(2) *Salmonid and non-salmonid fishes or other species that could be negatively impacted by the program (focus is on listed and candidate salmonid species).*

- Puget Sound Chinook
- Puget Sound steelhead
- Puget Sound bull trout

(3) *Salmonid and non-salmonid fishes or other species that could positively impact the program.* Fish species that could positively impact the program may include trout and other salmonid species present in the Green River watershed through natural production. Juvenile fish of these species may serve as prey items for the steelhead during their downstream migration in freshwater and into the marine area. Decaying carcasses of spawned adult fish may contribute nutrients that increase productivity in the watershed, providing food resources for the emigrating steelhead. Salmonid adults that return to the creek and any seeding efforts using adult salmon carcasses may provide a source of nutrients and stimulate stream productivity.

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 salmon have been found to elevate stream productivity through several pathways, including: 1) the releases of nutrients from decaying carcasses has been observed to stimulate primary productivity (Wipfli et al. 1998); 2) the decaying carcasses have been found to enrich the food base of aquatic invertebrates (Mathisen et al. 1988); and 3) juvenile salmonids have been observed to feed directly on the carcasses (Bilby et al. 1996). Addition of nutrients has been observed to increase the production of salmonids (Slaney and Ward 1993; Slaney et al. 2003; Ward et al. 2003).

(4) *Salmonid and non-salmonid fishes or other species that could be positively impacted by the program.* The steelhead program could positively impact freshwater and marine fish species that prey on juvenile fish. Nutrients provided by decaying steelhead carcasses might also benefit fish in freshwater. These species include:

- Northern pikeminnow
- Cutthroat trout
- Bull trout
- Chinook salmon
- Coho salmon
- Pacific staghorn sculpin
- Numerous marine pelagic fish species

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 available at Soos Creek Hatchery and Icy Creek Rearing Pond.

Facility	Water Source	Water Right		Available Water Flow	Water Temp. (F°)	Usage	Limitations
		Record/Cert. No.	Permit No.				
Soos Creek Hatchery	Unnamed spring	S1-000382CL	----	0.71 cfs	47	Adult holding, incubation, early-rearing	Available in small volume
	Big Soos Creek (surface)	S1-000449CL	-----	2.64 cfs	32-70	Adult holding	Excessive pathogen loads
		S1-21122C WRIS	-----	5.0 cfs			
		S1-*19055C WRIS/ 09667	14011	30.0 cfs			
Icy Creek rearing pond	Icy Creek	S1-22710C WRIS	-----	20.0 cfs	45-48	Rearing, acclimation, release	No limitations

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

Soos Creek Hatchery: Is supplied by surface water from Soos Creek. Water is withdrawn via four pumps at the hatchery site, which have the ability to produce up to 13,500 gallons per minute (gpm). In addition, a small spring water supply (50 gpm) can be utilized in the incubation building. Soos Creek responds quickly to heavy rainfall and is prone to rapid fluctuations. Heavy bed loads and winter floods are increasingly common due to extensive watershed development. In 2012, the Legislature passed a jobs creation bill that provided WDFW with funding for hatchery capital improvements at Soos Creek. These projects include replacing the water distribution tower and main supply lines to the tower (see **Table 5.8.1**).

The facility is supplied with surface water from Soos Creek. Water rights are regulated through permit # S1-21122. Spring water withdrawal is regulated through permit #S1-00382CL.

Icy Creek Rearing Pond: Consists of an earthen pond, which is gravity-fed with spring water. The spring water quality is excellent, but flows vary with the season from a low of 2.2cfs in the late fall to 13cfs in the late spring. Water usage is regulated under permit #S1-22710.

Table 4.1.2. Record of NPDES permit compliance at Soos Creek Hatchery and Icy Creek Rearing Pond.

Facility/ Permit #	Reports Submitted Y/N			Last Inspection Date	Violations Last 5 yrs (2010-2014)	Corrective Actions Y/N	Meets Compliance Y/N
	Monthly	Qtrly	Annual				
Soos Creek WAG13-3014	Y	Y	Y	1/10/2012	0	N	Y
Icy Creek WAG13-3013	Y	Y	Y	1/10/2012	0	N	Y

Source: Ann West, WDFW Hatcheries Headquarters Database 2015.

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.

Soos Creek Hatchery: The hatchery water intake structure is in compliance with state and federal guidelines (NMFS 1995, 1996), but does not meet the current Anadromous Salmonid Passage Facility Design criteria (NMFS 2011a). The 2012 budget provided WDFW with funding to replace/renovate the existing intake to meet current fish passage and screening requirements.

Monitoring and reporting of effluent discharge results have been in compliance with NPDES permit number WAG 13-3014 (see **Table 4.2.1**). The 2012 Legislature provided WDFW with funding to build a new two-bay pollution abatement pond system.

Icy Creek Rearing Pond: Due to its extremely steep stream gradient, no natural-origin anadromous salmonid population has used the watershed upstream of the Icy Creek Rearing Pond water intake. A permanent trap was installed in 2012 at Icy Creek below the hatchery facility to trap and remove marked hatchery-origin Chinook and steelhead, and to release any stray unmarked, presumably natural-origin Chinook salmon and steelhead back into the Green River. The Icy Creek facility is operated to ensure that hatchery effluent is not detrimental to downstream aquatic life by meeting or exceeding applicable NPDES Permit standards (see **Table 4.2.1**).

These facilities operate under the "Upland Fin-Fish Hatching and Rearing" National Pollution Discharge Elimination System (NPDES) general permit which conducts effluent monitoring and reporting and operates within the limitations established in its permit administered by the Washington Department of Ecology (DOE), WAG 13-3002. Monthly and annual reports on water quality sampling, use of chemicals at this facility, compliance records are available from DOE.

Discharges from the cleaning treatment system are monitored as follows:

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

5 SECTION 5. FACILITIES

Soos Creek Hatchery is under design and permitting. Permits are expected fall 2015 for Phase I, which includes addressing intake fixes, replacing the main water distribution tower, moving the adult holding area out of the creek and improving the trapping facilities. Upland work for Phase I will occur in 2016 and 2017 and in water work will begin in 2017. Phase 2 is scheduled and is highly placed in the 15-17 capital budget.

5.1 Broodstock collection facilities (or methods).

Soos Creek Hatchery: Broodstock is collected from Soos Creek, adjacent to the Soos Creek Hatchery. Reconditioned kelts may also be utilized for broodstock if local facilities are available. Returning steelhead adults are trapped in an in-stream, run-of-the-river pond framed by two semi-temporary weirs, with a "V"-entry into the lower weir. The trap measures approximately 150' x 200'.

Icy Creek Rearing Pond: A new permanent trap built on Icy Creek began operation in fall 2012. This trap can be used to collect marked hatchery-origin adults homing to the hatchery release site for broodstock or removal from the watershed.

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

Depending on the size of the fish transfer, two tanker trucks (300 and 1,500-gallons), equipped with aerators and oxygen tanks are available for fish transportation.

5.3 Broodstock holding and spawning facilities.

Summer steelhead collected for broodstock are held in the fiberglass raceways within the Soos Creek Hatchery building or the fiberglass circular pond and may be spawned at either location.

Ripe adults not selected for kelt reconditioning are killed and spawned. The adults selected for kelt reconditioning will be live spawned, rehabilitated and reared.

5.4 Incubation facilities.

A portion of the live spawned adults may undergo kelt reconditioning, if local facilities are available, as a backup source for eggs in the future if sufficient volitionally returning adults are not expected to be available.

Table 5.4.1: Incubation vessels available at Soos Creek Hatchery.

Type	Number	Size
Shallow troughs	160	15' x 1' x 4"
Deep troughs	24	Not used for steelhead

Deep troughs are used for incubation for Chinook only, not coho or steelhead.

Funding has been provided to construct a new hatchery/ incubation building outside the 100-year flood plain (see HGMP section 5.8).

There are no incubation facilities at the Icy Creek Rearing Pond.

5.5 Rearing facilities.

Table 5.5.1: Rearing vessels available at Soos Creek Hatchery.

Type	Number	Size
Asphalt lined rearing ponds	3	0..25 acres
Standard concrete raceways	8	10’ x 80’ x 3’
Concrete rearing ponds	8	17.5’ x 95’ x 3’
Fiberglass raceways	12	16’ x 3 x 3’
Fiberglass circular ponds	2	16-ft diameter
Fiberglass circular ponds	6	6-ft diameter
Shallow troughs	160	15' x 1' x 4”
Deep troughs	24	15' x 1.5' x 1'

Soos Creek Hatchery: The ponds and raceways are surrounded by bird netting and otter fences to minimize predation losses.

Table 5.5.2: Rearing vessels available at the Icy Creek Rearing Pond.

Type	Number	Size
Earthen bottom pond	1 (can be split into 2)	0.5 acre

Icy Creek Rearing Pond: The pond is equipped with bird netting and surrounded by electric fences to minimize predation losses.

See **Table 5.8.1** for planned pond renovations/upgrades.

5.6 Acclimation/release facilities.

Soos Creek Hatchery: With exception of initial rearing, summer steelhead are reared on Soos Creek surface water the entire time at the facility and are released directly into the creek.

Icy Creek Rearing Pond: The fish transferred to the Icy Creek Rearing Pond are reared and acclimated on Icy Creek surface water the entire time at the facility (~5 months), then released directly into Icy Creek.

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

Soos Creek Hatchery is subject to flooding during high flow events. This causes the pump intake screens to become clogged frequently due to heavy debris loads. In addition, flood risks limit the use of the eight low-lying, concrete rearing ponds (17.5’ x 95’ x 3’). Flood waters often inundate the lower ponds, which may result in the premature release of the fish. As such these ponds are unusable between November and March. Funding has was provided in 2012 to replace/renovate the existing intake and also construct new ponds necessary for the hatchery to operate properly and in compliance with current requirements (see HGMP section 5.8).

Icy Creek has never had fish loss due to flooding or operational failures.

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.

Soos Creek Hatchery: Listed fish are not reared in this program, but the hatchery stock is protected by risk aversion measures that are currently in place. A member of the hatchery staff is on stand-by at all times to monitor hatchery operations and respond to any unexpected events. The facility is equipped with low water alarms and a back-up generator in case of power loss.

Icy Creek Rearing Pond: This is a satellite facility and an employee is present when needed (primarily feeding times). Water is gravity fed to the pond and there is no need for a back-up generator. As a risk aversion measure the facility is equipped with low water alarms.

Fish rearing practices at both facilities are conducted in compliance with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006). Adherence to artificial propagation, sanitation and disease control practices defined in the policy should reduce the risk of any fish disease or pathogen transfers.

Table 5.8.1: The 2012, the Legislature passed a jobs creation bill that provided WDFW with funding for hatchery capital improvements in addition to our capital budget request. At Soos Creek Hatchery, this allowed for the following improvements (see also HGMP section 4).

Project
Renovate or replace existing intake to meet current fish passage and screening requirements. (PHASE 1)
Construct new hatchery/ incubation building outside the 100 year flood plain. (PHASE 2)
Construct EIGHT new 120' x 20' ponds. (PHASE 2)
Demolish north side ponds and current adult handling facilities. (PHASE 2)
Construct new adult handling facilities and ponds. (PHASE 1)
Construct a new incubation settling pond. (PHASE 2)
Construct new two bay pollution abatement ponds. (PHASE 2)
Replace water distribution tower. (PHASE 2)
Replace main supply line to distribution tower. (PHASE 1)

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.

Adult hatchery (distinguished by an adipose fin-clip), summer steelhead returning to the traps at Soos and Icy creeks until February 15. Early summer stock is used for this hatchery program and is not ESA-listed.

6.2 Supporting information.

6.2.1 History.

Summer steelhead are not considered to have been historically native to the Green River (PSSTRT 2011, SSHAG 2003). The summer steelhead Green River program began in 1969, (HSRG Recommendations 2003), with the early summer hatchery stock established in 1960s from summer-run steelhead populations collected at the Washougal (WRIA 29) and Klickitat (WRIA 30) Rivers. This hatchery stock was widely used throughout Puget Sound, with Reiter Ponds, located on the Skykomish River (WRIA 7), providing eggs for several Puget Sound stations (Crawford 1979, Good et al. 2005), including Soos Creek Hatchery.

Summer-run steelhead were first trapped in the Green River system in 2000, with the goal of developing a locally adapted summer steelhead hatchery broodstock. In 2001, broodstock collection, incubation and early rearing of the fish were relocated from Palmer Ponds to Soos Creek Hatchery, however releases and broodstock trapping (in small numbers) continued at Palmer Ponds until its closure in 2009. In 1999, fish releases begun at Icy Creek Rearing Pond

and since 2012 the facility has also been used to trap broodstock. Flaming Geyser was used as a release site between 2004 and 2010.

Currently adults are trapped at both Soos Creek Hatchery and Icy Creek Rearing Pond.

6.2.2 Annual size.

Up to 100 adult pairs are collected for broodstock. No natural-origin fish are included.

6.2.3 Past and proposed level of natural fish in broodstock.

Prior to the implementation of mass-marking of steelhead by the Washington State Department of Game in 1981, any level of mixing natural fish in the broodstock in the past could not be identified (B. Crawford pers. comm. 2006). Most steelhead programs had volunteer collection sites on small tributary streams in the past, wild stock spawners may not have had a strong incentive to enter those trapping sites.

Currently this summer steelhead program is managed as segregated, which means that the hatchery broodstock is reproductively segregated from naturally spawning populations and is composed entirely of returning hatchery-origin adults identified by a missing adipose fin.

6.2.4 Genetic or ecological differences.

Steelhead collected at the Soos Creek Hatchery and Icy Creek traps are of locally-adapted early summer hatchery-origin (WRIA 28, Lower Columbia DPS) stock and are segregated from the natural-origin winter population both spatially and temporally. The early summer stock hatchery fish typically return from June through Januray (with some as late as February) while their wild winter stock counterparts return from November through June. Peak hatchery spawning occurs in January, while peak natural-origin winter spawning occurs in late-April, with peak wild summer steelhead spawning one-two months earlier. Hatchery steelhead are released as age 1+ smolts, whereas natural-origin steelhead are predominately age 2+ smolts. Out-migration timing for both life history types is similar but is slightly earlier for hatchery component (Fuss et al. 1998).

Historically, the Green River did not contain wild summer steelhead (PSSTRT 2013a). Since the start of the hatchery program, naturally-produced summer steelhead have been present in small numbers in the Green River as a result of some limited spawning of un-harvested fish. No genotypic, phenotypic, or behavioral differences have been noted between these fish and the hatchery stock. DNA collections and analysis has been conducted recently to update genetic makeup of endemic and non-local steelhead stocks in Puget Sound (see HGMP section 2.2.2 for current results).

See also "*Genetic Introgression*" in HGMP section 2.2.3.

6.2.5 Reasons for choosing.

The early summer hatchery steelhead stock was selected for its early arrival and spawn timing (as compared to wild steelhead), availability, and the ability to release one-year smolts (Crawford 1979). This stock has been used statewide to provide fish for recreational and/or tribal harvest with minimal overlap in time and space with natural origin steelhead.

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.

Fish collected for this hatchery program are from the early summer hatchery stock. No natural-origin fish are included in the broodstock. As of the 2008 broodstock, no eggs are collected after February 15. The target of 100% mass marking allows exclusion of natural-origin fish from the hatchery broodstock and selection for earlier maturing fish deepens temporal separation, keeping hatchery and naturally-spawning fish genetically different and maintaining the divergence of the populations. Additionally, the early winter program is proposed to be terminated which will

reduce opportunities to accidentally incorporate winter-run adipose-marked fish into the summer program broodstock.

7 SECTION 7. BROODSTOCK COLLECTION

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

Adults.

7.2 Collection or sampling design.

Summer steelhead broodstock is selected from adults returning, to Soos Creek Hatchery or Icy Creek trap, between June and January. In the past, collected fish were spawned from December through February (in some rare cases into early March). Currently, the earliest ripening fish are utilized for broodstock in order to maintain maximum separation in spawn timing between the early summer and wild winter run fish. If broodstock needs are not met by January 31, fish that returned by this date may be spawned till February 15. Any fish that fail to ripen by this date or those returning after January 31 will be removed from the system. The trap remains open until March for removal of hatchery fish.

7.3 Identity.

All fish released through this hatchery program have been 100% mass-marked (adipose fin-clipped), since the 1985 releases, (brood year 1984).

7.4 Proposed number to be collected:

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

Up to 100 pairs collected for broodstock.

7.4.2 Broodstock collection levels for the last twelve years, or for most recent years available:

Table 7.4.2.1: Sex composition of summer steelhead broodstock spawned at Soos Creek Hatchery.

Brood year	Males	Females
2004	2 + 6	8
2005 [a]	30+ 25	57
2006	55+2	29 + 26
2007 [a]	44	49
2008 [a]	40	48
2009 [a]	37	51
2010	22	24
2011	35	34
2012	24	28
2013	46	46
2014	45+5	60
2015	29+1	33
Average	**37**	**41**

Source: WDFW Hatcheries Headquarters Database 2015.
Note: "+ numbers" indicate live-spawned fish.
[a] Includes Palmer Ponds collection.

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

Fish collected above broodstock needs (surplus) are removed from the system, no recycling occurs. Surplus fish that are of quality for human consumption may be donated to the local tribes or approved charitable organizations, or used for nutrient enhancement.

7.6 Fish transportation and holding methods.

Adults collected at the Icy Creek trap are transferred to Soos Creek hatchery in a 100-gallon tote equipped with oxygen and air-stone. All fish collected for broodstock are held in 16' x 3' x 3' fiberglass raceways or fiberglass circular pond prior to spawning.

7.7 Describe fish health maintenance and sanitation procedures applied.

Standard fish health protocols, as defined in the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006) are adhered to. No antibiotics or formalin treatment is applied.

7.8 Disposition of carcasses.

Food-grade quality carcasses may be distributed to approved charitable organizations and local tribes for ceremonial and subsistence purposes. Nonfood-grade carcasses are used in local streams for nutrient enhancement if approved by the Fish Health Specialist.

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

This program is managed as segregated with the intent to separate hatchery- and natural-origin stocks and as such listed steelhead are not targeted in the hatchery broodstock.

Early summer stock hatchery fish typically return from June to November, while their natural-origin winter counterparts return from November through June. Peak hatchery spawning takes place in January, while peak natural-origin winter steelhead spawning occurs in late-April. The new collection period takes place earlier than much of the natural-origin winter steelhead escapement seen in the system, and may further accentuate and minimize overlap with current known natural-origin winter steelhead present in the system. This collection timeframe coincides with the timing of the fall Chinook run occurring between August and late October, however, the hatchery operates a fall Chinook program that is managed as integrated and portion of natural-origin Chinook returning to the hatchery are retained for that program regardless of summer steelhead collection. Bull trout are not encountered at these sites. Unmarked fish of any species that are not subject of the collection for the hatchery broodstock would be immediately return back to the stream.

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.

Steelhead for broodstock are selected randomly and based on ripeness on spawn days.

8.2 Males.

All males collected, including jacks, are considered for spawning and are selected randomly on spawn days.

Steelhead males can be live-spawned in low male return years to ensure enough males are available for mating. Live-spawned males are operculum-punched and reused only when necessary, and no more than two times.

Steelhead jacks are not seen at this facility, but may be used at up to 2%, if present.

8.3 Fertilization.

Eggs from each female are collected in a separate container and mixed with milt from one male (pairwise spawning). Eggs mixed with milt are allowed 30-60 seconds for fertilization and then transferred into 5-gallon buckets for transportation to the incubation room.

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.

Listed fish are not used in the broodstock.

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:

Current egg-take goal for the early-summer steelhead program at Soos Creek Hatchery is 400,000 for Soos Creek and Icy Creek releases.

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

Table 9.1.1.1: Egg-to–ponding survival of summer steelhead eggs at Soos Creek Hatchery.

Brood Year	Eggs Collected	Survival Rates (%)	
		Green-to-Eyed Up	Eyed-Up-to-Ponding
2003	36,300	92.0	90.0
2004	28,900	90.0	90.0
2005 [a]	219,500	80.0	90.0
2006	203,500	89.0	90.0
2007 [a]	196,000	75.0	90.0
2008 [a]	207,700	93.0	90.0
2009 [a]	204,000	92.0	90.0
2010	96,000	92.0	90.0
2011	119,300	90.0	90.0
2012	98,500	90.0	90.0
2013	184,000	90.0	90.0
2014	222,000	90.0	90.0
Average	**151,308**	**88.6**	**90.0**

Source: WDFW Hatcheries Headquarters Database 2015, Hatchery Records 2015

[a] Includes Palmer Ponds collection.

9.1.2 Cause for, and disposition of surplus egg takes.

Extra eggs may be collected for this program, to allow for a larger effective gene pool and to offset losses to predation and disease. When additional eggs are taken, the surplus is typically culled at picking or after initial swim up. If losses are too high, then the program goals may not be met.

9.1.3 Loading densities applied during incubation.

Fertilized eggs are placed in baskets and in shallow troughs at 20,000 per basket.

9.1.4 Incubation conditions.

Fertilized eggs are incubated at Soos Creek Hatchery in shallow troughs supplied with spring water at a rate of 8 gpm. Water temperatures are monitored daily and on average range between 47-50°F. Dissolved oxygen is checked as needed.

9.1.5 Ponding.

Initial feeding begins in the shallow troughs when fish are 95% buttoned-up. In May/June, the fry (500 to 1,000 fpp) are moved to the larger fiberglass intermediate raceways. They are transferred to standard concrete 10' x 80' x 4' raceways in June/July.

9.1.6 Fish health maintenance and monitoring.

All fertilized eggs are water hardened in an iodophor solution. Fungus in troughs is controlled by a formalin drip (15-minute every day drip at a target dose of 1,667-ppm formalin), throughout incubation and until just prior to hatching. Once eyed, the eggs are shocked and mortalities are removed. Fry loss is picked daily.

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

Listed fish are not incubated for this program.

9.2 Rearing:

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

Table 9.2.1.1: Fry-to-sub-yearling and sub-yearling-to-smolt survival of summer steelhead at Soos Creek Hatchery, Icy Creek and Flaming Geyser ponds.

Brood Year	Survival Rates (%)			
	Soos Creek		Icy Creek	Flaming Geyser
	Fry-to-Sub-yearling	Sub-yearling-to-Smolt		
2003	87.0	92.0	90.0	100.0
2004	90.0	91.0	90.0	100.0
2005	88.0	89.0	90.0	-----
2006	86.0	95.0	90.0	100.0
2007	85.0	96.0	90.0	100.0
2008	88.0	93.0	90.0	-----
2009	87.0	92.0	95.0	100.0
2010	86.0	90.0	95.0	Discontinued
2011	88.0	90.0	95.0	
2012	80.0	40.0[a]	95.0	
2013	86.0	42.7	99.0	
2014	84.0	56.1	99.0	
Average	**86.3**	**80.6**	**93.2**	

Source: WDFW Hatchery Records 2015.

[a] In 2012 Soos Creek Hatchery experienced a high loss of sub-yearlings due to cold water disease, Ich and Nanophyetus.

Bird and otter predation have been the most significant contributors to fish mortalities. Installation of bird netting and an otter fence have substantially decreased losses. Nanophyetus

has also caused loss in the most recent years for all stocks of juvenile steelhead reared at Soos Creek Hatchery on Green River surface water. Juvenile release groups destined for release from Rearing Ponds are transferred as soon as possible to reduce these losses, as the water supply at Icy Creek is pathogen free spring water.

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

Fish reared at Soos Creek, follow loading parameters set in *Fish Hatchery Management* (Piper et al. 1982) and the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006). In all facilities within the Green River system, densities are kept at or below 3.3 lbs /gpm and 0.5 lbs /cu ft. before the last loading reduction in the fall of the year. Trough maximum loading is 40 lbs at 12 gpm (3.33 lbs/gpm). Tank and raceway maximum loading for early rearing is 132 lbs for the tanks at 40 gpm (3.3 lbs/gpm) and 800 lbs per raceway at 300 gpm (2.66 lbs/gpm). The final maximum loading per raceway is approximately 3200 lbs. at 300 gpm (10.6 lbs/gpm). Once density levels in the fiberglass troughs reach 0.20 lbs fish/gpm, the steelhead are moved to the 10’ x 80’ x 4’ outdoors standard concrete raceways. Flow index (FLI) is monitored monthly for all programs at Soos Creek Hatchery and would not exceed 80% of the allowable loading (Piper et al. 1982). Loadings could be lighter than these, but feeding the population to achieve size consistency is a priority.

9.2.3 Fish rearing conditions.

Soos Creek Hatchery: Additional rearing through the sub-yearling stage occurs in the 10’x80'x4’ raceways or 17.5' x 95' x 4’ concrete rearing ponds or 0.25 acre asphalt ponds supplied with Creek water. Marking takes place in July and August when fish are 100 to150 fpp. Fish for on-station releases are reared in the 0.25 acre rearing ponds until the May release.

All ponds at Soos Creek receive ambient surface water from the creek. Ambient oxygen levels range between 10-12 ppm entering to 8-10 ppm leaving the raceway, depending on ambient air temperature and number of fish in the raceway. Flow index (FLI) is monitored monthly and would not exceeds 80% of the allowable loading (Piper et al. 1982).

Icy Creek Rearing Pond: Depending on the amount of water available, initial rearing vessels used at Soos Creek Hatchery to rear fish for the Icy Creek program receive pathogen-free spring water from a spring adjacent to Soos Creek. Between August and December, a group of around 50,000 marked fish, destined for release at Icy Creek are transferred to the facility’s earthen bottom, supplied with creek water, where they remain until the May release.

Table 9.2.3.1: Monthly average surface water temperature (°F) at Soos Creek.

Month	Soos Creek	Icy Creek
January	41	47
February	41	47
March	45	48
April	49	48
May	51	48
June	56	49
July	58	49
August	58	49
September	56	49
October	50	49
November	43	48
December	41	48

Source: WDFW Hatchery Records 2012.

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: Average size (fpp), by month, of juvenile summer steelhead reared at Soos Creek Hatchery and Icy Creek Rearing Pond.

Month	Soos Creek	Icy Creek
April	800	
May	400	
June	190	
July	55	
August	30	30
September	24	23
October	20	22
November	16	20
December	15	16
January	12	12
February	9	9
March	7	7
April	6	5.5
May	5	

Source: Hatchery Records 2012.

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

See **Table 9.2.4.1** for growth information. 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).

Steelhead are fed a variety of diet formulations including starter, crumbles and pellets of various brands; the feed brand may vary, depending on cost and vendor contacts. Feeding frequencies vary depending on the fish size and water temperature and usually begin at seven feedings/seven days a week, and end at one feeding a day/from two to seven days a week. Feed rates vary from 0.5% to 3% B.W./day. The overall seasonal food conversion rate is approximately 1.1:1.

9.2.7 Fish health monitoring, disease treatment and sanitation procedures.

Fish health is monitored on a daily basis by the hatchery staff and at least monthly by a state Fish Health Specialist (FHS). Hatchery personnel carry out treatments prescribed by the FHS. Procedures are consistent with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006). See also HGMP section 10.9 for WDFW Standard Fish Health Procedures.

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

The migratory state of the release population is determined by fish behavior. Aggressive screen and inflow crowding, leaner condition factors, a more silvery physical appearance, banded tails and loose scales during feeding events are signs of smolt development. ATPase activity is not measured.

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

No "NATURES" type rearing methods are applied through the program.

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.

This program is managed as segregated. Listed steelhead are not included in the hatchery broodstock and are not reared in this program.

Hatchery fish are reared to meet *Statewide Steelhead Rearing and Release Guidelines* (Tipping 2001) to achieve a size and condition factor at the time of releases that represents the best chance for survival in order to meet adult goals. Rearing fish to a yearling smolt stage is mandatory in order to foster out-migration and subsequent survival when the fish vacate the system. Fry or sub-yearlings will not be reared and released from this program in order to eliminate or minimize interactions with listed fish rearing in the system.

All reasonable and prudent measures are employed to minimize rearing and incubation losses. These include the use of high quality spring or well water for incubation, high quality feeds for rearing, rearing densities and loadings that conform to best management practices, frequent fish health inspections and presence of professionally trained personnel to operate facilities. Hatcheries are designed to provide safe and secure rearing environment through the use of alarm systems, backup generators and water re-use pumping systems to prevent catastrophic fish losses.

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, by release site.

Facility	Age Class	Maximum Number	Size (fpp)	Release Date	Release Location
Soos Creek	Yearling	50,000	5.0	April/May	Green River
Icy Creek	Yearling	50,000	5.5	April/May	

Note: Releases from Icy Creek RP and Soos Creek Hatchery began in April 1999 and May 2002, respectively.

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

Stream, river, or watercourse: 1. Soos Creek (WRIA 09.0072)
2. Icy Creek (WRIA 09.0125)

Release point: 1. R.M. 1
2. Approximately 40 yards from the confluence with Green River at RM 48

Major watershed: Duwamish/Green River

Basin or Region: Puget Sound

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

Non-migratory fish will be planted into lakes that are functionally isolated from anadromous accessible freshwater and in compliance with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006).

Table 10.3.1: Actual numbers and sizes of summer steelhead released through the Soos Creek Hatchery program, 2004-2015.

Release Year		Yearling					
	Icy Creek RP	Flaming Geyser Pond	Soos Creek	Palmer Ponds	Sprague Lake[a]	Avg. size (fpp)	CV
2004	23,700	7,245	36,100	7,560	No release	6	8.5
2005	33,120	7,000	34,500	89,843		5	6.6
2006	7,828	-----	41,000	48,013		5	NA
2007	27,300	5,000	37,000	27,264		6	8.9
2008	25,500	3,200	25,700	27,680		6	NA
2009	25,500	-----	32,100	52,000		6	7.9
2010	21,600	10,000	34,009	Discontinued		8	NA
2011	25,000	Discontinued	49,408			7	NA
2012	19,984		60,000			6	NA
2013	-----		30,482			6	NA
2014	24,914		-----		45,823	8[b]	NA
2015	41,600		71,922		No release	10	NA
Average	**25,095**	**6,489**	**41,111**	**42,060**		**7**	**8.0**

Source: WDFW Hatcheries Headquarters Database 2015.

Notes: Releases of early summer steelhead stocks from Palmer Ponds and Flaming Geyser Ponds were discontinued after 2009 and 2012, respectively.

The fork length (fl) of steelhead when weighting 5 fpp is ~210 mm; 6 fpp ~198 mm fl; .7 fpp ~188 mm fl.

[a] In 2014 45,823 yearling smolts were released into Sprague Lake as a one-time extraordinary measure due to a legal Settlement Agreement with Wild Fish Conservancy.

* Not included in average calculations.

10.4 Actual dates of release and description of release protocols.

Table 10.4.1: Actual dates and release methods of summer steelhead released through the Soos Creek Hatchery program.

Release Year	Icy Creek RP	Flaming Geyser	Soos Creek	Palmer Ponds	Sprague Lake	Release Method
2004	5/1-5/3	5/8	4/26	5/1-5/2	No releases	Forced/Volitional
2005	5/3-5/13	5/8	5/1	5/1-5/10		Forced/Volitional
2006	4/1	-----	5/1	5/1-5/16		Forced/Volitional
2007	5/1	5/5	4/20	4/16-5/8		Forced/Volitional
2008	5/5	5/4	5/1	5/1-5/4		Forced/Volitional
2009	5/1	-----	5/1	5/1-5/7		Forced/Volitional
2010	4/23	5/8	5/3	Discontinued		Forced
2011	5/6	Discontinued	5/4			Forced
2012	5/1		5/1			Forced
2013	-----		5/1			Forced
2014	3/24-28		-----		5/12	Forced
2015	4/15-5/8		4/15-5/15		No release	Volitional

Source: WDFW Hatcheries Headquarters Database 2015.

At both release locations, Soos Creek Hatchery and Icy Creek Rearing Pond, fish will be volitionally released for four weeks, starting no earlier than April 15 (under same criteria as stated in HGMP section 2.2.3 - *Residualism*). Fish remaining in the ponds after that time will be considered non-migratory and will be planted into lakes that are functionally isolated from anadromous accessible freshwater.

Soos Creek facility currently does not have the ability to separate fish that do not volitionally out-migrate and *Icy Creek Rearing Pond* currently has the screens open for up to three weeks, or less if all the fish out-migrate, due to constraints on available water and rearing space needed for the next fry. Once the Soos Creek hatchery reconstruction is complete (see **Table 5.8.1**), WDFW will have more options and will likely be able to accommodate a desired prolonged volitional release period of up to one month.

10.5 Fish transportation procedures, if applicable.

Fish destined for release at Icy Creek (approximately 30 minutes transportation time from Soos Creek Hatchery) are transferred using a 1500-gallon tank equipped with re-circulating pumps.

10.6 Acclimation procedures.

Soos Creek Hatchery: With exception of initial rearing, summer steelhead are reared on Soos Creek surface water the entire time at the facility.

Icy Creek Rearing Pond: Summer steelhead are reared on Icy Creek surface water the entire time at facility.

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

Table 10.7.1: Number and mark type released, by location.

Brood Year	Release		Mark Type
	Soos Creek	Icy Creek	
2015	50,000	50,000	AD-only

Hatchery steelhead released from this program are intended to be 100% adipose-fin clipped. Due to regeneration of a partially clipped adipose fin or fin missed completely, some hatchery adults may return with an adipose fin. WDFW performs Quality Assurance/Quality Control checks to measure the successful clip rate during the marking process. Partial or missed clips are enumerated and recorded annually.

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

Egg-take is carefully managed to minimize the likelihood of collecting surplus eggs or raising surplus fry. Annual fluctuation in survival rates may result in production levels above release goals, and actual release of up to 10% above release goal is acceptable. If fish are available for release in excess of 10% acceptable level, regional staff and NOAA Fisheries will be informed and consulted for proper action to be taken. In the past, fish available over 10% limit were planted, accordingly to the direction of fish management, into lakes for use in non-anadromous programs.

10.9 Fish health certification procedures applied pre-release.

Standard Fish Health Procedures performed at the facility:

- *All fish health monitoring is conducted by a qualified WDFW Fish Health Specialist.*
- *Juvenile fish examinations are conducted at least monthly and more often if necessary*. A representative sample (at the discretion of the fish health specialist) of healthy and moribund fish from each lot is examined.
- *Abnormal levels of fish loss are investigated if they occur.*
- *Fish health status is determined prior to release or transfer to another facility*. The exam may occur during the regular monthly monitoring visit, i.e. within one month of release or transfer.

- *Appropriate actions, including drug or chemical treatments are recommended as necessary*. If a bacterial pathogen requires treatment with antibiotics a drug sensitivity profile is be generated when possible.
- *Findings and results of fish health monitoring are recorded on a standard fish health reporting form and maintained in a fish health database.*
- *Fish culture practices are reviewed as necessary with facility personnel*. Where pertinent; nutrition, water flow and chemistry, loading and density indices, handling, disinfecting procedures and treatments are discussed.

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

Soos Creek Hatchery: During severe flood events the screens are generally not pulled because floodwaters rise to the point where they breach the ponds. Past experience has shown that the fish tend to lie on the bottom of the pond during flooding events and only those that are inadvertently swept out are able to leave.

Icy Creek Rearing Pond: Flooding is not a problem at this facility and no emergency procedures have been developed. During severe drought conditions, fish may be moved to Soos Creek if water and space are available.

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.

WDFW has taken following actions to minimize adverse genetic and ecological effects to listed species resulting from hatchery releases:

- Eliminated transfers of eggs and juveniles between watersheds.
- Eliminated egg-takes after February 15, to keep hatchery and natural populations temporally segregated.
- Eliminated off-station releases where no trapping facilities are available.
- Eliminated recycling fish back into the river for sport fishing opportunities.
- Eliminated fry and sub-yearling releases, and mandatory rearing; release only yearling smolts, which are in migratory condition. This promotes rapid out-migration and thus minimizes the time spent in the river, in order to minimize or eliminate interactions with natural-origin salmonids rearing in the system (*Statewide Steelhead Rearing and Release Guidelines*; Tipping 2001).
- Leave trapping facilities open during the entire return time for adults of the segregated stock.
- Promoted volitional releases to foster rapid seaward migration and limit residualism and freshwater interactions with listed Chinook and steelhead juveniles, bull trout and other naturally-produced salmonids.
- Mass-mark all releases for harvest selection and removal from the system.
- Release fish no earlier than April 15, to allow listed stocks (Chinook, chum and steelhead) and pink salmon, to emigrate out of the system, and/or provide time for additional growth to minimize potential predation.
- Continue monitoring, research and reporting of hatchery smolt migration performance behavior, and interactions with wild fish to assess and adjust, if necessary, hatchery production and release strategies to minimize effects on wild fish.

Hatchery steelhead releases have been 100% mass-marked since 1980s to enable identification during selective harvest, broodstock selection and, most recently, removal from the system.

WDFW continues monitoring, research and reporting of hatchery smolt migration performance behavior, and interactions with natural-origin fish to assess and adjust, if necessary, hatchery production and release strategies to minimize effects on natural-origin fish. WDFW is conducting research on the effects of volitional releases in Upper Columbia basin. This study is not yet fully completed, but preliminary results suggest faster fish migration, and lower rates of residualism when released volitionally (Snow et al. 2013).

With changes already being implemented, WDFW continues monitoring its hatchery programs and the affected watersheds to observe the effects on the populations at the hatcheries and natural spawning grounds.

See also HGMP section 2.2.3.

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 purpose of monitoring is to identify and evaluate the benefits and risks from this hatchery program, elements of which are identified in HGMP section 1.10. The co-managers conduct numerous ongoing monitoring programs, including, catch, escapement, marking, tagging, smolt trapping and fish health testing. The focus of enhanced monitoring and evaluation programs will be on the risks posed by ecological interactions with listed species.

WDFW monitors salmon escapement to the natural spawning areas above and below the hatchery release sites to estimate the number of tagged, untagged, and marked fish escaping each year. This will allow for assessment of the status of the target population and the success of the program in achieving restoration objectives. Also, WDFW will continue to monitor smolt emigration rate post-release, timing of emigration and predation assessment via smolt trapping (Topping and Zimmerman 2011).

WDFW's Wild Salmon Production/Evaluation Unit (WSPE) operates a juvenile out-migrant trap at River Mile 33 above the confluence with Soos Creek. This trap enumerates Chinook, coho, chum, pink, and steelhead, as well as facilitates the collection of biological data on age, size and timing.

From 2006 to 2009, WDFW conducted an acoustic tagging study on out-migrating wild (Goetz et al. 2008) and hatchery winter steelhead to assess freshwater migration pathways, rates and use of estuary, nearshore, and marine habitat by juvenile steelhead. Results are being compiled and will be reported (WDFW pers. comm. October 2011).

Additional research, monitoring and evaluation in the Green River watershed: Table 11.1.1.1 should be considered preliminary as this framework is still under development and subject to change.

Table 11.1.1.1: WDFW Green River steelhead monitoring.

Project	Description
Hatchery Reform Implementation	This project focuses on the implementation of hatchery reform actions called for by the Washington Fish and Wildlife Commission Policy on Hatchery and Fishery Reform. Activities include oversight and implementation of WDFW Hatcheries, spawning ground surveys and weir operations. Additional activities include in-season management of broodstock collection activities at WDFW facilities to implement hatchery reform actions. Deliverables include: development of hatchery

	management plans that will contribute to HGMP updates; estimation of performance metrics for WDFW hatchery programs includes adult run timing, spawn timing, broodstock mortality (including handling and pathology), fecundity, egg mortality rate, sex ratios, and juvenile marking protocols).
Monitoring of Populations of Winter Steelhead	This project will continue to conduct spawning ground (redd) surveys in the Green River and its tributaries that support populations of winter steelhead. *Green River DIP*: Streams surveyed include: sections of the Green River mainstem (WRIA 09.0001) (RM 26 to RM 61), Soos Creek (WRIA 09.0072), Covington Creek (WRIA 09.0083), Jenkins Creek (WRIA 09.0087) and Newaukum Creek (WRIA 09.0114). Surveys will provide data regarding adult abundance and spatial diversity of spawning, which are key VSP (viable salmonid population) parameters.
Monitoring Summer Steelhead Populations	Not currently monitored. No native summer run population is known to occur in the Green River watershed (PSSTRT 2013).
Monitoring of Gene Flow/Introgression from Hatchery Steelhead Populations to Wild Steelhead Populations	WDFW is implementing a genetic monitoring program to measure PEHC and gene flow between segregated hatchery (early winter and early summer stock) steelhead and wild populations in the Puget Sound DPS (see Anderson 2014 for additional information).

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

See HGMP section 11.1.1.

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.

Risk aversion measures will be developed in conjunction with the monitoring and evaluation plans.

12 SECTION 12. RESEARCH

12.1 Objective or purpose.

Research specific to Soos Creek summer steelhead is not currently conducted.

12.2 Cooperating and funding agencies.

Not applicable.

12.3 Principle investigator or project supervisor and staff.

Not applicable.

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

Not applicable.

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

Not applicable.

12.6 Dates or time period in which research activity occurs.

Not applicable.

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

Not applicable.

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

Not applicable.

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

Not applicable.

12.10 Alternative methods to achieve project objectives.

Not applicable.

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

Not applicable.

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

Not applicable.

13 SECTION 13. ATTACHMENTS AND CITATIONS

Araki, H., B.A. Berejikian, M. J. Ford, and M.S. Blouin. 2008. Fitness of hatchery-reared salmonids in the wild. Evol. Appl. 1(2):342-355.

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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 SECTION 15. 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 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..."

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

Green (Duwamish) Bull Trout *(Salvelinus confluentus):* Bull trout were listed as a threatened species in the Coastal-Puget Sound Distinct Population Segment on November 1, 1999 (64 FR 58910). The Green River is considered critical habitat for bull trout and is thought to serve rearing, migration and overwintering purposes (USFWS 2004). Bull trout have been document in the Green River as far upstream as RM 41 in recent years and are consistently reported in the lower Duwamish River. It is unclear whether these fish represent a local spawning population or transients from other systems as there is no information on timing or distribution of spawning in the basin if any occurs (SaSI 2004).

Habitat--The Green River watershed has been heavily impacted by human activities, which include logging, road construction, flood control and municipal water supply diversion dams, agricultural development, river channelization, intensive industrial and residential development, and estuarine dredging and filling. Historically the contribution of the White and Black Rivers which accounted for two-thirds of the flow of the Duwamish would have greatly increased the amount of favorable bull trout habitat in the system. It is unknown if the current habitat can support bull trout, but suitable habitat may still be available in the upper watershed above Howard Hanson Dam. It is not known if bull trout occupied the upper watershed in the past; they do not appear to be present now (Watson and Toth 1994). No bull trout were found during extensive gill net sampling in Howard Hanson reservoir conducted in winter and spring of 2008 by the US Army Corps of Engineers (Fred Goetz, USACE, *pers. comm.).*

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

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

Marbled murrelet (*Brachyramphus marmoratus*) –Threatened [critical habitat designated]
Canada Lynx (*Lynx canadensis*) –Threatened [critical habitat designated]
Gray Wolf (*Canis lupus*) –Threatened
Grizzly bear (*Ursus arctos horribilis*) –Threatened
Northern Spotted owl (*Strix occidentalis caurina*) –Threatened [critical habitat designated]

Candidate Species
Fisher *(Martes pennanti)* – West Coast DPS
North American wolverine *(Gulo gulo luteus)* – contiguous U.S. DPS

Oregon spotted frog *(Rana pretiosa)* [historic]
Yellow-billed cuckoo *(Coccyzus americanus)*
Whitebark pine *(Pinus albicaulis*)

16.1 Analyze effects.

Hatchery activities, including in-river broodstock collection, hatchery trap, and water intake structures may pose a risk to system bull trout populations. Juvenile fish releases from the hatchery provide prey for bull trout occurring in the Green River downstream of the hatchery.

16.2 Actions taken to minimize potential effects.

Trap is checked at least daily. Any bull trout encountered at the trap are immediately returned to the stream. Annual estimates of bull trout encounters through the hatchery activities are recorded and reported. The intake that supplies water from Soos Creek to the hatchery facilities are screened in compliance with current state and federal agency fish protection criteria. Water intake screening and structures are routinely inspected to insure they are operating correctly.

16.3 References

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"Take" Tables

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

Listed species affected: Steelhead *(Oncorhynchus mykiss)*	**ESU/Population:** Puget Sound Steelhead		**Activity:** Green River Early Summer Steelhead Program
Location of hatchery activity: Soos Creek Hatchery, Big Soos Creek (WRIA 09.0072), RM 1	**Dates of activity:** December- May		**Hatchery program operator:** WDFW
Type of Take	**Annual Take of Listed Fish By Life Stage *(Number of Fish)***			
	Egg/Fry	**Juvenile/Smolt**	**Adult**	**Carcass**
Observe or harass a)	-	-	-	-
Collect for transport b)	-	-	-	-
Capture, handle, and release c)	-	-	Up to 5	-
Capture, handle, tag/mark/tissue sample, and release d)	-	-	-	-
Removal (e.g. broodstock) e)	-	-	-	-
Intentional lethal take f)	-	-		-
Unintentional lethal take g)	-	-	-	-
Other Take (specify) h)	-	-	-	-

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 natural origin 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.

Table 2. Estimated listed salmonid take levels of by hatchery activity.

Listed species affected: Fall Chinook *(Oncorhynchus tshawytscha)*	**ESU/Population:** Puget Sound Chinook		**Activity:** Green River Early Summer Steelhead Program	
Location of hatchery activity: Soos Creek Hatchery, Big Soos Creek (WRIA 09.0072) RM 1	**Dates of activity:** December- May		**Hatchery program operator:** WDFW	
Type of Take	**Annual Take of Listed Fish By Life Stage *(Number of Fish)***			
	Egg/Fry	**Juvenile/Smolt**	**Adult**	**Carcass**
Observe or harass a)	-	-	-	-
Collect for transport b)	-	-	-	-
Capture, handle, and release c)	-	-	0	-
Capture, handle, tag/mark/tissue sample, and release d)	-	-	-	-
Removal (e.g. broodstock) e)	-	-	-	-
Intentional lethal take f)	-	-	-	-
Unintentional lethal take g)	-	-	-	-
Other Take (specify) h)	-	-	-	-

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.