HATCHERY AND GENETIC MANAGEMENT PLAN

(HGMP)

Hatchery Program: Fish Restoration Facility

Species or Hatchery Stock: Green River Winter Steelhead

Agency / Operator: Muckleshoot Indian Tribe

Watershed and Region: 09.0001 – Green River (Duwamish)/Puget Sound

Date Submitted: ____

Date Last Updated: July 18, 2014

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

Fish Restoration Facility – Winter Steelhead Program

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

Green River Winter Steelhead (*Oncorhynchus mykiss*) - listed as Threatened in 2007 (72FR26722); reaffirmed by five-year status review completed August 15, 2011 (76FR50448)

1.3) Responsible organization and individuals

Name (and title):	Dennis Moore, Fish Enhancement Manager Hugo Hernandez, Green River Team Leader
Agency or Tribe:	Muckleshoot Indian Tribe
Address:	39015- 172nd Ave SE Auburn, WA 98092
Telephone:	(253) 876-3286
Fax:	(253) 931-0752
Email:	Dennis.Moore@muckleshoot.nsn.us Hugo.Hernandez@muckleshoot.nsn.us

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

Tacoma Water: The Tacoma Water Headworks adult fish trap and haul facility near RM 60.9 will be used initially or on a supplemental basis as needed for broodstock collection. Tacoma Water will also transport and release juvenile fish produced in the program above Howard Hanson Dam if supplementation of juveniles in the upper watershed is determined to be beneficial.

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

Funding source: Muckleshoot Indian Tribe and Bureau of Indian Affairs
Staffing level and annual O&M: TBD

1.5) **Location(s) of hatchery and associated facilities**.

This facility will be constructed at a future date to be determined. The Fish Restoration Facility (FRF) site is located on the left bank of the Green River near RM 60. The Tacoma Water adult fish trap and haul is located at RM 60.9.

1.6) Type of program.

Integrated Harvest

1.7) Purpose (Goal) of program.

Mitigation. The goal of the Fish Restoration Facility winter steelhead program is to provide harvest opportunities to help mitigate for lost production related to the construction and operation of Howard Hanson and Tacoma Water dams. The progam may also assist in restoring steelhead to the upper Green River watershed, depending on the status of future fish passage facility construction at the USACE Howard Hanson Dam and related investigations.

Note: The Muckleshoot Indian Tribe reserves the right to discontinue current production; modify the current production level; or to change species reared to meet the needs and policy direction of the Tribe in consultation with their co-manager and with appropriate federal agencies to ensure compliance with the ESA.

1.8) Justification for the program.

The program will be operated to provide fish for harvest while minimizing adverse effects on listed fish species using measures listed in Section 1.10.2. The Fish Restoration Facility (FRF) steelhead program is needed to help mitigate the impacts of lost natural fish production due to past and ongoing land and natural resource use including water diversion, reservoir and flood control dams and operations.

Salmon and steelhead harvest is essential to the culture and well-being of the Muckleshoot Indian Tribe. The harvest of fish from this hatchery program is an essential part of the Tribe's federally-recognized fishing rights reserved in the Treaties of Medicine Creek and Point Elliott. The role of 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. So long as watersheds are unable to maintain self-sustaining and abundant salmonid populations, hatchery programs will be needed to replace lost natural production, and provide meaningful harvest opportunities in fulfillment of promises made in the Treaties and the Tribe's fishing rights as affirmed by the U.S. v. Washington proceedings.

Natural production of steelhead in the Green-Duwamish watershed is diminished by the extensive loss and degradation of habitat. The City of Tacoma constructed a dam on the Green River at River Mile 61 in 1911 to divert water for municipal and industrial use. This dam blocked all migrating fish and diminished streamflows downstream. In 1962, the U.S. Army Corps of Engineers (USACE) completed Howard Hanson Dam (HHD) near RM 64 for flood control, water supply, and flow augmentation. HHD is an impassable barrier to fish migration, blocking approximately 100 miles of potential anadromous fish habitat. Reservoir and water diversion operations alter the natural flow regime and aquatic habitat. An adult fish trap and haul facility was completed in 2005 at the Tacoma Water dam, however, upstream fish passage awaits construction of juvenile fish passage facilities at HHD. Reservoir storage was expanded in 2006 through the

USACE-Tacoma Additional Water Storage Project.

The lower two-thirds of the Green-Duwamish basin is dominated by urban, commercial, residential, port, and industrial land uses, while the upper third is managed for timber production. Total impervious surface area in 2006 was estimated at 38% of the basin area below Howard Hanson Dam (NWIFC 2012). The prospects for restoring significant areas of properly functioning habitat and natural ecosystem processes in this basin are limited. Ninety-eight percent of the historic estuary has been lost to development, and sediment and water quality in the current estuarine habitat is poor. Intertidal and marine shorelines are lined with artificial structures, while levees and revetments confine the lower 30 river miles and much of the middle river. Green River temperatures exceed lethal levels for salmonids at times as a result of inadequate riparian vegetation and loss of groundwater inflows. These and other factors continue to degrade or eliminate habitat and natural processes needed to support the life history of salmonids, reducing the abundance and productivity of natural populations in the watershed.

Together with Green River minimum instream flow provisions, the Fish Restoration Facility (FRF) is a central element of the 1995 settlement agreement between the Muckleshoot Indian Tribe and the City of Tacoma regarding its water supply operations in the Green/Duwamish River System. The FRF program will replace the former role of the Tribe's Keta Creek Hatchery with regard to steelhead production in the Green River. Green River winter steelhead fry reared at the Keta Creek Hatchery were planted in the upper watershed above Howard Hanson Dam between 1987 and 1998 (see Section 10.3). These plants have been discontinued until after the USACE completes a juvenile fish passage facility at HHD and it is evaluated. After expending over $100 million on the project, completion of downstream fish passage facilities was halted by the USACE due to cost considerations.

The Biological Opinion prepared by NMFS for the 2001Tacoma Water Habitat Conservation Plan (HCP) identified the possible planting of hatchery juveniles in the upper river as a covered activity in the City's Incidental Take Permit, if found to be beneficial to restoration. The HCP includes a commitment to fund a fish restoration facility to rear salmonids and to provide transport and release of juvenile steelhead and other species into the upper watershed from the facility (HCP Measure HCM 2-05). This facility will be subject to the necessary regulatory processes independent of any incidental take permit granted to Tacoma Water. Chinook, coho, and steelhead from the facility would be used to restore and enhance populations in the Green River and serve as the source of juvenile outplants to the upper watershed for (1) monitoring and evaluation of fish passage at HHD; (2) to accelerate natural rebuilding; and/or (3) to supplement adult returns to address short term declines in adult escapement.

1.9 List of program "Performance Standards".

See section 1.10 below.

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

1.10.1) “Performance Indicators” addressing benefits.

Performance Standard	Performance Indicator	Monitoring & Evaluation
Hatchery operations support implementation of U.S. v. Washington and help sustain Muckleshoot tribal fisheries guaranteed through the Treaties of Point Elliot and Medicine Creek.	Contribute to a meaningful harvest for sport, tribal and commercial fisheries	Survival and contribution to fisheries will be estimated for each brood year released.
Program contributes to mitigation for habitat loss and degradation required in all areas of the watershed.	This program provides partial mitigation for lost fish due to fish passage issues at Howard Hanson Dam and impacts of municipal water diversion per the 1995 Green River Agreement between MIT and the City of Tacoma.	Survival and contribution to fisheries and spawning grounds will be estimated for each brood year released
Program addresses ESA responsibilities	Program is allowed to continue harvest Section 4(d)	HGMP updated and re-submitted to NOAA with significant changes or under permit agreement.
Fish produced for harvest are produced and released in a manner enabling effective harvest, as described in all applicable fisheries management plans, while avoiding overharvest of non-target species	Externally-marked hatchery fish enable mark-selective fisheries, which can reduce directed harvest mortality on wild fish.	Harvests and hatchery returns are monitored by agencies to provide up-to-date information
The hatchery program uses standard scientific procedures to evaluate various aspects of artificial propagation	Apply monitoring standards in the hatchery: food conversion rates, growth trajectories, mark/tag rate error, weight distribution (CV).	Annual run timing, age and sex composition and return timing data are collected.

1.10.2) "Performance Indicators" addressing risks.

Performance Standard	Performance Indicator	Monitoring & Evaluation
Minimize impacts and/or interactions to ESA listed fish.	Hatchery smolts are released in July at a time and condition that fosters rapid migration downstream at average target size of 5 fish per pound.	Monitor size, number and date of release. Fish health documented. Behavior and condition monitored for migration readiness. Mass marking allows monitoring of migration timing, rate, and behavior of juvenile releases through capture of downstream migrants at the WDFW juvenile trap on the Green River.
Artificial production facilities are operated in compliance with all applicable fish health guidelines, facility operation standards and protocols including Co-managers Fish Health Policy	Prevent the introduction, amplification or spread of fish pathogens that might negatively affect the health of both hatchery and naturally reproducing stocks and to produce healthy smolts that will contribute to program goals.	Pathologists from NWIFC monitor programs monthly. Exams performed at each life stage may include tests for virus, bacteria, parasites, and/or pathological changes, as needed.
Ensure hatchery operations comply with state and federal water quality and quantity standards through proper environmental monitoring.	NPDES permit compliance. State water rights permit compliance.	Flow and discharge reported in monthly NPDES reports. Water usage monitored.
Water withdrawals and diversion structures for hatchery facility will not adversely affect natural populations or impact juveniles.	Hatchery intake screen structures will meet federal guidelines. Surface water withdrawn for hatchery water supply will avoid diminishing instream flows.	Periodic inspections will be made to assess barrier and intake structure compliance. Water usage and effects on streamflows in the FRF reach are monitored.
Releases are sufficiently marked to allow statistically significant evaluation of program contribution to natural production, and to evaluate effects of the program on the local natural population	Percentage of total hatchery releases are identifiable as hatchery-origin fish. Mass-mark (adipose-fin clip, CWT) production fish to identify them from naturally-produced fish.	Annual estimates of mass-mark rate of all hatchery releases. Returning fish encountered are examined for the fin-mark upon hatchery return and on the spawning ground. Numbers of estimated hatchery (marked) and natural (unmarked) are recorded annually.
Fish collected for broodstock are taken throughout the return or spawning period in proportions approximating the timing and age distribution of population from which broodstock is taken	Collection of broodstock is done randomly throughout the entire return period.	Annual run timing, age and sex composition and return timing data are collected.
Hatchery operations comply with ESA responsibilities.	Approved HGMP	Identified in HGMP and Biological Opinion for hatchery operations.

1.11) Expected size of program.

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

The program will require up to 150 males and 150 females to reach the full release goal. In no case however, will this program, together with the Soos Creek Hatchery winter steelhead conservation program, remove more than 20 percent of the total returning adult population of natural origin winter-run Green River steelhead in any single year for use as broodstock.

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

Table 1.11.2.1. Proposed annual release levels life stage, and location for FRF steelhead. Note: Alternative release levels, life stage, and release locations as shown below will ultimately depend on Howard Hanson Dam juvenile fish passage facilities and related assessments.

Alternative A- With Effective Juvenile Passage at Howard Hanson Dam

Life Stage	Release Location	Annual Release Level
Fry	Green River watershed upstream of Howard Hanson Dam in streams including Sunday, Snow, Smay, McCain, Friday, Intake, Tacoma, Canton, Gale, and Charley creeks, North Fork Green River, and the Green River mainstem.	Up to 280,000
Smolt	On site at the Fish Restoration Facility, Green River near RM 60	Up to 70,000

Alternative B – Without Effective Juvenile Passage at Howard Hanson Dam

Life Stage	Release Location	Annual Release Level
Smolt	On- site at the Fish Restoration Facility -Green River near RM 60	Up to 350,000

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

N/A

1.13) Date program started (years in operation), or is expected to start.
Facility not constructed yet, target date to be determined.

1.14) Expected duration of program.

Indefinite

1.15) Watersheds targeted by program.

Green River – 09.0001, specifically areas below and potentially above the Howard Hanson Dam at RM 64.

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

Expansion of the program at WDFW Soos Creek Hatchery: this option was rejected due to capacity constraints, and an increased risk of loss within the hatchery when relying on a single facility for production. Large scale ecosystem restoration including dam removal combined with restoration of properly functioning floodplain, stream channel, water quality, and forest landscape and estuary conditions and natural processes and sole reliance on natural production was considered but rejected as infeasible given the level of existing development and human population in the basin. Expansion of the MIT Keta Creek Hatchery Complex was considered but rejected due to limited water supply and space. Additionally, should fish passage at Howard Hanson Dam be constructed and determined to be effective, the uppermost incubation and release locations planned for the FRF would foster dispersal of returning adults in a large portion of the watershed accessible to the species, more efficiently increasing population spatial structure compared to the other locations.

SECTION 2. PROGRAM EFFECTS ON 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.

This HGMP is being submitted to the NOAA Fisheries for ESA consultation and take prohibition exemption under ESA section 4(d).

2.2) Provide descriptions, status, and projected take actions and levels for 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.

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, as well as twenty-six artificial propagation programs (Ford 2011). 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).

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

Puget Sound Steelhead *(Oncorhynchus mykiss*), were 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, in streams in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington, bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive), as well as the Green River natural and Hamma Hamma winter-run steelhead hatchery stocks.

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 *(see definitions in "Attachment 1")***.**

Puget Sound Chinook ESU, Duwamish-Green River fall Chinook (*O. tshawytscha):* 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). Recent escapement levels (2003-2011) have averaged 1,860 for natural spawners in the Green/Duwamish DIP. During this same time period, the population has shown declining trend (SaSI, WDFW 2012). The Puget Sound Chinook Harvest Plan (PSIT and WDFW 2010a) set natural-origin-recruit spawner low abundance threshold of 1,800 and an upper management threshold of 5,800 for the Green River fall Chinook. The NMFS refers to a critical threshold of 835 and a viable threshold of 5,523 for this population in their evaluation of the Harvest Plan (NMFS 2011). Between 2000 and 2011, Green River fall Chinook naturally spawning escapements have remained above critical threshold levels except in 2009 and 2011. The levels have been at or above viable thresholds in 7 of these last twelve years. *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. 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.

Green River steelhead, Puget Sound steelhead DPS (*O. mykiss):* Steelhead counts in the Green River have declined steadily since the 1980s and most sharply since 2005. The PSSTRT population viability analyses indicate the majority of steelhead populations in the Puget Sound DPS are at moderate to high levels of extinction risk. The extinction risk appears to be especially high for the Central and Southern Sound MPG. 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 and process variance of 0.001, we can be 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 we are highly uncertain about the precise level of risk (Ford 2011). The Co-managers developed critical and viable threshold values for annual spawning escapement in each management unit (MU) as part of the 'Puget Sound Steelhead Management Plan' (PSIT and WDFW 2010b). The PSSTRT may develop thresholds for each DIP in the future. The Comanagers' critical and viable thresholds for the Green River population were set at 250 and 1000 (PSIT and WDFW 2010b).

- Provide the most recent 12 year (e.g. 2000-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. *Indicate the source of these data.*

Table 2.2.2.1. Puget Sound Chinook population average productivity for five-year intervals measured as recruits per spawner (R/S) and spawners per spawner (S/S).

Brood Years	1982-1986		1987-1991		1992-1996		1997-2001		2002-2006		Trend	
Populations	**R/S**	**S/S**	**R/S**	**S/S**	**R/S**	**S/S**	**R/S**	**S/S**	**R/S**	**S/S**	**R/S**	**S/S**
Green/Duwamish	*4.69*	*1.18*	*1.34*	*0.23*	*3.1*	*0.53*	*3.58*	*0.73*	*3.12*	*0.29*	*-0.09*	*-0.13*
ESU	*9.57*	*2.19*	*5.05*	*0.96*	*3.01*	*1.24*	*2.70*	*1.19*	*1.67*	*0.67*	*-1.81*	*-0.28*

Source Data: Ford et al. 2011

Table 2.2.2.2. Short and long term population trend and growth rate estimates for the Puget Sound Chinook ESU populations.

Regions and Populations	Years	Trend Natural Spawners w/Cl	Hatchery Fish Success = 0 Lambda w/Cl	p>1	Hatchery Fish Success = 1 Lambda w/Cl	p>1
Green River Fall Run	1995-2009	0.952 (0.851 - 1.065)	1.003 (0.274 - 3.67)	0.51	0.835 (0.3 - 2.324)	0.13
	1968-2009	1.01 (0.981 - 1.039)	0.994 (0.892 - 1.108)	0.45	0.799 (0.716 - 0.89)	0.00

Source Data: Ford et al. 2011

Table 2.2.2.3. Abundance of migrant Chinook sub-yearlings in the Green River above and below WDFW juvenile trap (Rkm 55), and above the Soos Creek Hatchery rack.
Source: Topping et al. 2011.

Trap Year	Above Trap			Below Trap			Soos Creek			Total Abundance
	Redds	Deposition	Abundance	Redds	Deposition	Abundance	Females	Deposition	Abundance	
2000	1,625	7,312,500	475,207	826	3,717,000	241,551	1,616	7,272,000	275,125	991,883
2001	3,064	1,378,800	809,616	936	4,212,000	247,324	1,580	7,110,000	275,000	1,331,940
2002	2,711	12,199,500	584,151	480	2,160,000	103,428	995	4,477,500	275,000	962,579
2003	3,772	16,974,000	449,956	2,314	10,413,000	276,034	1,239	5,575,500	275,000	1,000,990
2004	3,124	14,058,000	236,650	1,038	4,671,000	78,631	720	3,240,000	54,542	369,823
2005	4,769	21,460,500	470,334	827	3,721,500	80,561	623	2,803,500	61,442	612,337
2006	1,553	6,988,500	99,796	82	369,000	5,269	598	2,691,000	38,428	143,493
2007	3,170	14,265,000	127,491	883	3,973,500	35,512	313	1,408,500	12,588	175,591
2008	2,435	10,957,500	400,763	438	1,971,000	72,088	676	304,200	111,259	584,110
2009	2,107	94,810,500	196,118	282	1,269,000	26,248	504	2,268,000	46,911	269,277
2010	218	981,000	55,547	57	256,500	14,524	759	3,415,500	193,395	263,466

Source: Topping et al. 2011

Table 2.2.2.4. Abundance estimates, 95% confidence intervals, and coefficient of variation (CV) for natural-origin steelhead smolts rearing above the Green River juvenile out-migrant trap (RKm 55), migration years 2000-2010.

Trap Year	Abundance	95% C.I.		CV
		Lower	Upper	
2000	14,529	-----	-----	-----
2001	53,077	-----	-----	-----
2002	12,612	-----	-----	-----
2003	n/a	-----	-----	-----
2004	n/a	-----	-----	-----
2005	n/a	-----	-----	-----
2006	16,748	-----	-----	-----
2007	2,285	-----	-----	-----
2008	n/a	-----	-----	-----
2009	26,174	10,151	42,198	19.4%
2010	71,710	49,317	94,103	15.9%

Source: (Topping and Zimmerman 2011).

Table 2.2.2.5. Exp. Steelhead Population Trend ln (natural spawners, 95% CI)

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

Source Data: Ford et al. 2011

- Provide the most recent 12 year (e.g. 2000-2011) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.

Table 2.2.2.6. Green River and Soos Creek summer/fall Chinook total natural spawners,

Year	Natural-Origin Spawners	Hatchery-Origin Spawners	Total Spawners*	Passed Above Soos Creek Weir***
2000	NA	NA	4,473**	2,419
2001	NA	NA	6,473**	3,623
2002	NA	NA	7,564**	3,401
2003	2,613	3,251	5,864	1,516
2004	2,922	5,025	7,947	1,134
2005	1,109	1,414	2,523	1,160
2006	2,516	3,274	5,790	1,564
2007	1,832	2,469	4,301	1,556
2008	3,825	2,146	5,971	1,053
2009	164	524	688	1,669
2010	839	1,253	2,092	1,504
2011	459	534	993	478
2012	1,629	1,462	3,091	1,217

Source: Aaron Bosworth, WDFW 2013 and SaSI 2013.
*Escapement estimates listed include all HOR and NOR fish spawning naturally in the mainstem Green River and Newaukum Creek.

**Standardization of redd -based spawner survey methodology has resulted in revised estimates for years prior to 2003.

***Not included in mainstem Green River spawner count.

Table 2.2.2.7. Green (Duwamish) River natural winter steelhead spawning escapement 2000-2011 based on redd counts conducted from mid-March to mid-June.

Return Year	Escapement
1999/2000	1,705
2000/2001	1,402
2001/2002	1,068
2002/2003	1,612
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
Average	**1,321**

Source: (Aaron Bosworth, WDFW District Biologist, 2012). Data are system escapement estimates based on cumulative redd counts in all mainstem spawning areas and in index reaches in Soos and Newaukum creeks totaling 12 miles. Data do not include wild brood collected for hatchery program. These data reflect a partial estimate as total escapement is unknown and would include any early timed winter hatchery or natural origin steelhead spawning prior to mid-March, and steelhead spawning outside the tributary index areas.

- Provide the most recent 12 year (e.g. 2000-2011) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

Table 2.2.2.8. Puget Sound Chinook average natural (natural-origin and hatchery) and natural-origin only spawners and percent hatchery contributions for five year intervals. Spawning abundance averages are geometric means and hatchery contribution averages are arithmetic, see data source for further explanation.

Return Years	1990-1994			1995-1999			2000-2004			2005-2009		
Populations	Nat	%	NOR	Nat	%	NOR	Nat	%	NOR	Nat	%	NOR
Green-Duwamish	5,239	56%	2,214	6,792	68%	2,007	6,335	37%	3,921	3,077	56%	1,288
ESU	23,938	75%	17,905	27,392	63%	17,245	43,192	72%	31,294	34,486	69%	23,938

Data Source: Ford et al. 2011

Green River (Duwamish) steelhead (*Oncorhynchus mykiss*): The actual contribution level of hatchery winter run steelhead spawners in the Green River is unknown. Due to timing differences between early Chambers winter stock and Skamania summer stock steelhead and the majority of the existing wild winter stocks (late February -June), interaction on the spawning grounds is unclear.

2.2.3) <u>Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of NMFS listed fish in the target area, and provide estimated annual levels of take</u> (see "Attachment 1" for definition of "take")**.**

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

Broodstock Collection, Handling, and Holding: Most Soos Creek/Green River Chinook broodstock trapping ends by the time that wild winter steelhead enter the system making it highly unlikely for encounters or effects. Summer steelhead (both hatchery and natural origin) may be encountered in the adult holding pond during Chinook broodstock collection. Natural origin summer steelhead may be encountered but are returned back to stream. The natural origin summer steelhead in this system is believed to be of non-native origins (SaSI 2002).

Details of the FRF hatchery steelhead program will be determined once the decision is made to build the facility. The broodstock collection program planned for the FRF facility is expected to be capable of collecting 100% of the adult steelhead return, but the trapping facility has not yet been designed. Tacoma Water has an adult trap and haul facility approximately a mile upstream that could provide broodstock to the hatchery on an initial or supplemental basis.

Entrainment effects: The water source for the FRF has not yet been developed. If screens are needed, they will be constructed to meet applicable NMFS guidelines.

Predation/Competition: The release date of juvenile fish for the program can influence the likelihood that listed species are encountered or are of a size small enough to be consumed. Extensive studies of the migration timing of naturally produced juvenile Chinook and steelhead in Puget Sound have been conducted in the Green River and other streams (e.g., Seiler et al., 1998-2002). Although distinct differences are evident in the timing of Chinook migration between watersheds, several general patterns emerge:

1) Emigration occurs over a prolonged period, beginning soon after enough emergence (typically January) and continuing at least until July;
2) Two broad peaks in migration are often present during the January through July time period; an early season peak (typically in March) comprised of relatively small Chinook salmon (40-45 mm), and a second peak in mid-May to June comprised of larger Chinook salmon;

Steelhead fry from the FRF that may rear above HHD are expected to have a slightly later migration timing than their natural counterparts because of the cooler conditions in the

upper watershed. Smolts released at the FRF are also expected to lag behind steelhead from the lower watershed for a similar reason. The release timing (July) for the hatchery smolts may reduce the likelihood for interaction with the majority of natural origin juvenile Chinook and steelhead rearing and emigrating each year.

FRF steelhead releases may compete with wild steelhead and fall Chinook for food and space in the freshwater, estuarine, and marine environment through both direct and indirect means. The risk of competition in freshwater will be minimized by feeding transfer diets (higher salt content) and release strategies that promote rapid seaward migration including close monitoring of smolt condition prior to release. Early marine life competition between the hatchery and wild juveniles is unknown.

Predation- Freshwater Environment: A report by WDFW indicates extremely small levels of predation by hatchery steelhead on listed Chinook as observed in several rivers including the Green River (WRIA 9), Deschutes River (WRIA 13), Coweeman River and the Kalama River in WRIA 27 (Sharpe et al. 2008). In general, steelhead released from hatchery programs may prey upon listed salmonids, however the magnitude of predation will depend upon the characteristics of the listed population; the habitat in which the population occurs; and the release timing, location, size, and number released. While the site-specific nature of predation and few empirical studies make it difficult to predict the predation effects of any individual hatchery program, WDFW (2005) describes a number of risk factors affecting the potential for significant predation by hatchery coho and steelhead releases. These are discussed below to characterize the level of predation risk from steelhead released under this HGMP.

Environmental characteristics: Factors such as water clarity, temperature, channel size and configuration, and discharge are among those that can influence the likelihood that predation will occur. The SIWG (1984) concluded that the potential for predation is greatest in small streams with flow and turbidity conditions conducive to high visibility. Smolt releases in this program will occur in the Green River mainstem, a relatively large channel with median streamflows greater than 1,200 cubic feet per second at the hatchery release site (river mile 60) in May. In this program, releases will be made during freshets and elevated turbidity when possible to speed outmigration and reduce potential interaction with listed juveniles.

Relative body size: The potential for hatchery steelhead releases to prey on listed Chinook and steelhead juveniles is limited by the relative size of the steelhead releases and their prey. Salmonid predators typically prey on fish approximately 1/3 or less their length (USFWS 1994). Juvenile Chinook captured in migrant traps in the Green River and other Puget Sound watersheds between 1998 and 2003 had an average length of 40-45 mm or less in February and March, increasing to 82.4 mm by late June (WDFW 2005). The minimum predator length required to consume an average size Chinook juvenile was 153 mm in statistical week 16 (mid-April) increasing to 250 mm by statistical week 26 (late June) assuming that prey are most vulnerable when smaller than 1/3 the length of the predator. To reduce interactions with juvenile Chinook, the FRF

program will delay steelhead smolt releases until July, after a large majority of the Chinook outmigration has past. Smolt size at release will be a minimum of 10 fish per pound, with a target of 5 fish per pound, at an average fork length of approximately 180 mm. In 2000, the average size of Chinook migrants in the Green River was 76.3 mm at the end of June (statistical week 26) when the required minimum predator length was 250 mm. By July, relatively few Chinook migrants would be small enough to be vulnerable to predation by steelhead smolts released in this program (i.e., under 60 mm in length).

Table 2.2.3.1. Average length by statistical week of natural origin juvenile Chinook salmon migrants captured in traps in Puget Sound watersheds. The minimum predator length corresponding to the average length of Chinook migrants, assuming that the prey can be no greater than 1/3 the predator length, are shown in the final row. (NS=not sampled). Source: WDFW 2005.

Watershed	Statistical Week										
	16	17	18	19	20	21	22	23	24	25	26
Skagit [1] 1997-2001	43.2	48.3	50.6	51.7	56.1	59.0	58.0	60.3	61.7	66.5	68.0
Stillaguamish [2] 2001-2002	51.4	53.5	55.7	57.8	60.0	62.1	64.2	66.4	68.5	70.6	72.8
Cedar [3] 1998-2000	54.9	64.2	66.5	70.2	75.3	77.5	80.7	85.5	89.7	99.0	113
Green [4] 2000	52.1	57.2	59.6	63.1	68.1	69.5	NS	79.0	82.4	79.4	76.3
Puyallup [5] 2002	NS	NS	NS	66.2	62.0	70.3	73.7	72.7	78.7	80.0	82.3
Dungeness [6] 1996-1997	NS	NS	NS	NS	NS	NS	NS	NS	77.9	78.8	81.8
All Systems Average Length	50.4	55.8	58.1	61.8	64.3	67.7	69.2	72.8	76.5	79.0	82.4
Minimum Predator Length	153	169	176	187	195	205	210	221	232	239	250

Sources:

[1] Data are from Seiler et al. (1998); Seiler et al. (1999); Seiler et al. (2000); Seiler et al. (2001), and Seiler et al. (2002)..

[2] Data are from regression models presented in Griffith et al. (2001) and Griffith et al. (2003).

[3] Data are from Seiler et al. (2003).

[4] Data are from Seiler et al. (2002).

[5] Data are from Samarin and Sebastian (2002).

[6] Data are from Marlowe et al. (2001).

On average, over 80% of the juvenile Chinook have migrated past the trap after statistical week 23 (usually the first week of June). To reduce the likelihood of substantial temporal overlap with listed juveniles of sizes most vulnerable to predation, this program will delay the release of smolts until July. Yearling steelhead will be released as actively migrating smolts that are known to move seaward rapidly soon after release, limiting the

duration of potential interactions with Chinook and other natural-origin juveniles.

Release Location: All smolts released under this HGMP will be made from the FRF site in the Green River near river mile 60 in July. During downstream migration, these smolts will be unlikely to encounter Chinook fry along the river mainstem. As explained above, the level of predation by the hatchery smolt releases will be minimized by releasing the smolts in July after the large majority of the Chinook fry outmigration has past, and when smolt condition and behavior promotes rapid downstream migration to saltwater. Steelhead fry releases under Alternative A would be made in tributaries and the upper mainstem river above Howard Hanson Dam (River Mile 64) following fish passage facility construction and related evaluations. As these steelhead fry releases grow to smolt size, they may predate on natural origin Chinook fry produced by Chinook adults transported upstream of the Tacoma Water and Howard Hanson dams after juvenile fish passage construction. As with future natural origin steelhead juveniles in the upper watershed, the potential for spatial overlap between hatchery steelhead and Chinook juveniles would be greatest in the lower reaches of those tributaries large enough to support Chinook spawning, in the mainstem river above and below the dams, and possibly in the Howard Hanson reservoir. Therefore, to minimize predation impacts on natural Chinook fry, steelhead fry outplanting will target smaller tributaries and stream reaches upstream of areas with potential for Chinook spawning activity. Studies are planned by the USACE to evaluate predation in the reservoir following fish passage construction.

Number Released: This program would release 70,000 smolts and 280,000 fry (Alternative A), or 350,000 smolts (Alternative B). Which alternative is selected will depend on the status of juvenile fish passage facility construction at the USACE Howard Hanson Dam, and fish passage effectiveness based on future evaluations. Completion of a downstream fish passage facility has been delayed for years due to funding. A completion date has not yet been scheduled.

Predation: Marine Environment. As summarized by the HSRG (2004) in their review of predation, juvenile salmonids can spend considerable time in estuaries and nearshore areas before moving to offshore marine areas. Time spent in estuaries by different species varies from days to months, and likely is related to environmental conditions and characteristics of individual estuaries (Simenstad et al. 1982). All five species of Pacific salmon occurred within the Campbell River estuary habitats (Korman et al. 1997), suggesting a potential for intrageneric predation although Macdonald et al. (1987) found that larger fish tended to occupy deeper water in these habitats. Compared to freshwater, there is little evidence that natural origin salmonids are preyed on by hatchery salmonids in marine environments. Diets of juvenile Pacific salmon in the nearshore marine environment are often dominated by invertebrates (e.g.,Shreffler et al. 1992; Simenstad et al.1992; Perry et al. 1996; Moulton 1997; Gray et al. 2002), but may contain fish after the fish grow larger and move offshore (Tadokoro et al. 1996; Landingham et al. 1998), although salmonids have rarely been identified as prey. Although many of these studies used small sample sizes and were not designed to evaluate intrageneric predation, the fact

that virtually all the data collected indicate that salmonids do not feed on other salmonids offshore suggests that this is not an important source of mortality. Further, offshore predation on natural origin salmonids by hatchery smolts may be rare because encounter rates between the two may be low.

Competition/ Niche Displacement: The FRF steelhead program may compete with listed Chinook and steelhead for food and space in the freshwater, estuarine, and marine environment. The risk of juvenile competition in freshwater from smolt production would be minimized by release strategies that promote rapid seaward migration. A NMFS (2013) review of studies conducted in freshwater found that intraspecific rather than interspecific competition is of a greater magnitude due to greater niche overlap within species than between species (e.g., Fraser 1969, Allee 1974, Bisson et al.1988, Flagg et al 2000, Hasegawa and Maekawa 2008). Similarly, other studies suggest that competition among co-occurring salmonid species is minimized by species-specific differences in habitat preference (Hearn 1987, Bisson et. al. 1988, Dolloff and Reeves 1990). Competition between hatchery steelhead smolts and other steelhead and Chinook is not expected to be significant given the late release (July), and rapid outmigration and limited freshwater cohabitation with listed species. The effects of competition between the hatchery and wild juveniles during the early marine life stage are not well known. However, in their review of the status of science concerning interactions between hatchery and natural origin anadromous salmonids, Berejekian et al. (2009) concluded that ecological interactions are regulated by habitat partitioning among species and species-specific estuary resident times.

Disease Effects: The risk of disease transmission to listed fish in the area (Puget Sound) is low. Transmission of hatchery-origin diseases from the hatchery to wild fish in areas where they co-occur is an unlikely event. Although hatchery populations can be considered to be reservoirs for disease pathogens because of their elevated exposure to high rearing densities and stress, there is little evidence to suggest that diseases are routinely transmitted from hatchery to wild fish (Steward and Bjornn 1990). These impacts are addressed by rearing juveniles at lower densities, within widely recognized guidelines, continuing well-developed monitoring, diagnostic, and treatment programs already in place (Co-manager's Fish Health Policy 1998, updated 2006).

Genetic Effects: Several recent studies have found lower relative reproductive success of hatchery steelhead compared to wild steelhead, and declining reproductive success with successive generations of hatchery influence *(Araki et al. 2007 and 2009, Berntson et al. 2011)* although results vary with stock origin and numerous other factors and the mechanisms involved are not well understood. The intent of the FRF steelhead program is to help compensate for reduced productivity and abundance in the Green River system by at least giving a boost to abundance. Increased abundance and occupation of additional habitat (spatial structure for the population should Howard Hanson Dam fish passage be constructed and be successful) will foster viable population parameters that are suffering under the current habitat management regime. Genetic impacts such as reduced reproductive success that may occur will be offset by genetic benefits associated with bolstering the population and preserving genetic diversity. Efforts to better

understand and manage genetic risks of integrated steelhead programs are ongoing in the region, and will help inform the FRF program. A small, wild-capture winter steelhead supplementation program has been conducted intermittently in the Green River in varying forms since 1982, ranging from adult releases and fry plants above HHD to yearling smolt releases from Soos Creek Hatchery. The Soos Creek winter steelhead supplementation yearling program has used unmarked fish for broodstock to minimize impacts to genetic fitness.

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

N/A

- 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).

Projected maximum annual take levels are presented in Table 1 at the back of this document. As noted, take levels that may be associated with certain hatchery program activities are unknown at this time.

- 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.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan (Explain any proposed deviations from the plan or policies.

The development of this and other hatchery HGMPs will be used to develop the Puget Sound Steelhead DPS-wide hatchery plan.

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

- Puget Sound Salmon Management Plan
- Co-Managers Future Brood Document
- Co-Managers Fish Health Policy
- Agreement between the Muckleshoot Indian Tribe and the City of Tacoma Regarding the Green/Duwamish River System (1995)

This hatchery program, and all other anadromous salmon hatchery programs within the Puget Sound Chinook ESU, operates under *U.S v Washington* and the *Puget Sound Salmon Management Plan* (1985) which 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).

Hatchery salmon and steelhead production levels are detailed in the annual *Future Brood Document*. The Future Brood Document (FBD) is a pre-season planning document for fish hatchery production in Washington State for upcoming brood stock collection and fish rearing seasons (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.

3.3) Relationship to harvest objectives.

It is intended that, over the long term, and as the total native winter-run steelhead population that is the focus of the proposed HGMP recovers to a healthy state, the FRF program will contribute to opportunities for treaty and non-treaty harvests in the Green River and adjacent terminal areas.

3.3.1) Describe fisheries benefiting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (2000-2011), if available.

N/A

3.4) Relationship to habitat protection and recovery strategies.

The FRF steelhead program is intended to contribute to 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.

In 1911, the City of Tacoma constructed a diversion dam across the Green River at River Mile 61 to divert water for municipal and industrial needs. This dam blocked all up-stream returning adult salmon. In 1962, the U.S. Army Corps of Engineers (USACE) completed the Howard Hanson Dam (HHD) near RM 64 for flood control, water supply, and flow augmentation purposes. HHD, an impassable barrier to fish migration, prevents natural production of salmonids in over 100 miles of upstream habitat. HHD lacks fish passage facilities. A four mile-long reservoir is refilled during the smolt outmigration period, altering natural spring runoff and confounding migration survival and habitat connectivity. An adult fish trap and haul facility was constructed in 2005 at the Tacoma Water Headworks, however, use of this facility for upstream passage is on hold pending construction of juvenile fish passage facilities at HHD. Reservoir storage at HHD was expanded in 2006 for municipal water supply through the USACE-Tacoma Additional Water Storage Project, exacerbating productivity losses through reservoir inundation, migration delay, and other effects. The FRF program will help to mitigate continued lost

fish production as a result of these dams. Together with Green River instream flow provisions, the Fish Restoration Facility was a key element of the 1995 settlement agreement between the Tribe and the City of Tacoma regarding the Green/Duwamish River System.

Green River Chinook, coho, and steelhead fry reared at the Keta Creek Hatchery were outplanted in the late 1980s through the mid-2000s above HHD in an effort to utilize the rearing capacity of the upper watershed streams. Upper watershed plants have been discontinued while the USACE worked to plan and construct safe downstream fish passage facility at HHD, however, downstream fish passage construction has been delayed by the USACE due to costs.

The 2001 Tacoma Water Habitat Conservation Plan (HCP) for the Green River water supply operations includes the commitment to fund a fish restoration facility to rear salmonids and to provide transport and release of juvenile steelhead and other species into the upper watershed from the facility (HCP Measure HCM 2-05). Steelhead from the facility would be used to restore and enhance this population in the Green River and serve as the source of juvenile outplants to the upper watershed for (1) monitoring and evaluation; (2) to accelerate the natural rebuilding of steelhead above the dam; and/or (3) to supplement adult returns in the Green River to address short term declines in adult escapement. Steelhead releases above HHD will be made only after a period of testing to verify safe passage through the dam and reservoir. The Fish Restoration Facility will be subject to the necessary regulatory processes separate from any Tacoma Water Incidental Take Permit.

The majority of the lower half of the accessible basin is highly developed, channelized, and/or industrialized (NWIFC 2012). 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 extensive urban development have degraded the hydrology, water quality, floodplain, channel diversity, and riparian areas of most lowland streams in WRIA 9. Water temperatures in the Green River have exceeded lethal levels for salmonids at times due to inadequate shade. These and other factors have degraded or eliminated habitat and natural habitat processes important for salmonids, reducing the abundance and productivity of natural populations in the watershed. Efforts continue by tribal, state, local and federal governments to try to protect and improve instream flows, water quality, fish passage, near-shore, riparian and floodplain habitats, and where possible, the underlying natural ecosystem processes that create and maintain salmon habitat.

King County is the 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 River transition zone; rearing habitat in the estuary, middle and lower river, and nearshore marine areas, and spawning habitat in the middle and lower river. The Salmon Recovery Funding Board is composed of citizens appointed by the Governor and

five state agency directors that provides grant funds to protect or restore salmon habitat and to assist related activities in the basin. 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. 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).

Member Tribes have worked with the NWIFC and SSHIAP to create the State of Our Watersheds report (NWIFC 2012). 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* (Boldt decision). 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 FRF 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 night herons
- Mammalian predators, including mink, river otters, harbor seals, and sea lions
- Cutthroat trout

Rearing and migrating 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 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).* Co-occurring natural salmon and steelhead populations could be negatively impacted by program fish including the Gree/Duwamish River populations of the listed species Puget Sound Chinook and winter steelhead. Other Puget Sound Chinook ESU populations and steelhead DPS populations may also be indirectly affected in nearshore and marine environments.

(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 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 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 steehead program could positively impact freshwater and marine fish species that prey on juvenile fish. Nutrients provided by decaying carcasses might also benefit fish in freshwater. These species include:

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

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.

Water supply for the FRF will consist of wells and/or Green River surface water between 2 cfs to a maximum of 35 cfs. Water quality is expected to be excellent.

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.

Water intake facilities will meet current NOAA Fisheries screening criteria and effluent quality and monitoring will comply with the terms of any required NPDES permit. Water withdrawal for the FRF will be non-consumptive and in compliance with state water right conditions. When Green River instream flows at the USGS Palmer Gage No. 12106700 (at RM 60.3) are less than the State of Washington's instream flow required as a condition of the City of Tacoma's Second Diversion Water Right plus the amount of surface water withdrawn to the hatchery, water will be pumped to the FRF from the Green River at the FRF site and discharged from FRF site in order to avoid impacts on spawning and incubation of any anadromous fish species, including listed steelhead or Chinook, in the bypass reach between the intake or point of withdrawal for the FRF surface water supply and the surface water discharge from the FRF into the Green River.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

Initially, broodstock will be trucked from the Tacoma Water trap and haul facility (1 mile away from the FRF). Later, fish will be collected at the FRF adult fishway.

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

Adult fish will transported via tanker truck.

5.3) Broodstock holding and spawning facilities.

Broodstock facilities for steelhead at the Fish Restoration Facility will be sized to handle up to 300 fish.

5.4) Incubation facilities.

Facility details to be determined.

5.5) Rearing facilities.
Facility details to be determined.

5.6) Acclimation/release facilities.
Facility details to be determined.

5.7) Describe operational difficulties or disasters that led to significant fish mortality.
N/a

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.

Take of listed steelhead are unlikely to occur as a result of the physical operation of the program for broodstock collection, and while the steelhead are under propagation. At the Fish Restoration Facility, alarm systems will be in place to reduce the risk of catastrophic loss of the propagated population. Fish rearing will be conducted in compliance with the Co-managers Fish Health Policy Adherence to artificial propagation, sanitation and disease control practices defined in the policy reduced the risk of fish disease pathogen transfer to listed natural-origin steelhead.

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.
Green River native stock. Adult steelhead will be collected primarily from the Tacoma Headworks trap, and potentially hook and line, representing the extant, Duwamish/Green River native population delineated by the Puget Sound Steelhead TRT (Myers et al. 2014).

6.2) Supporting information.

6.2.1) History.

See WDFW Soos Creek Hatchery steelhead HGMP

6.2.2) Annual size.

Up to 300 adults (150 females; 150 males).

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

See above

6.2.4) Genetic or ecological differences.

None known

6.2.5) Reasons for choosing.

Local indigenous stock

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

Broodstock will be selected randomly from adult returns over the full extent of the return timing. In no case however, will this program, together with the Soos Creek Hatchery winter steelhead conservation program, remove more than 20 percent of the total returning adult population of natural origin winter-run Green River steelhead in any single year for use as broodstock.

SECTION 7. BROODSTOCK COLLECTION

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

7.2) Collection or sampling design.

Broodstock will be selected randomly from adult returns over the full extent of the return timing.

7.3) Identity.
TBD

7.4) Proposed number to be collected:

7.4.1) Program goal (assuming 1:1 sex ratio for adults): 300

7.4.2) Broodstock collection levels for the last twelve years (e.g. 2000-2011), or for most recent years available:
N/A

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

Adult fish surplus to hatchery program needs will be released back in the river.

7.6) Fish transportation and holding methods.

Fish transferred from the Tacoma trap and haul will be transported by tanker truck and held until ready to spawn.

7.7) Describe fish health maintenance and sanitation procedures applied.

Standard fish health protocols, as defined in the Co-manager Fish Health Policy are adhered to.

7.8) Disposition of carcasses.
As appropriate, carcasses will be used for nutrient enrichment, donated, or sold to a carcass buyer.

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.

TBD

SECTION 8. MATING

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

8.1) Selection method.

Females will be chosen randomly from ripe fish. Adult steelhead exceeding program requirements will be released to spawn naturally in the Green River.

8.2) Males.

See 8.1 and 8.3

8.3) Fertilization.

Matings will be 1:1, but if a male killed for spawning is not fully ripe or has very little sperm, another male is used to assure fertilization of the eggs. The eggs from 1 female are collected in a bucket. The sperm from one male, or two, is expressed directly onto the eggs and mixed gently. If a second male is used, adding its sperm will wait until after the sperm from the 1st male has had 30 seconds with the eggs before adding it (to avoid sperm competition). The mix is allowed to sit for no less than 30 seconds and then pooled in a common bucket with other eggs.

8.4) Cryopreserved gametes.

N/A

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.

At the Fish Restoration Facility, 1:1 mating will be utilized to maximize the number of spawners incorporated in the gene pool and to ensure an effective breeding population equivalent to the number of adult fish collected and retained for spawning. Adults will be selected randomly from the entire run. Unless evidence suggests that genetic diversity in this steelhead population is low, the use of a factorial mating scheme is not recommended for this program at this time. This is in recognition of the trade-off between increased relatedness among the fish the hatchery produces (creating families of half-siblings which increases the risk of inbreeding and the loss of genetic diversity at the same time) and reducing other risks to genetic diversity by crossing each fish with several others (Adrien Spidle, NWIFC, pers. comm).

SECTION 9. INCUBATION AND REARING -

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

9.1) Incubation:

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

TBD

9.1.2) Cause for, and disposition of surplus egg takes.

TBD

9.1.3) Loading densities applied during incubation.

Steelhead eggs will be incubated from the eyed stage to hatch-out in Heath Techna style trays loaded at a maximum of 7,000 eggs per tray, or TBD depending on facilities.

9.1.4) Incubation conditions.

The eggs will receive ground and/or surface water from the Green River. The eggs and alevins will be checked weekly or more often as needed for silt and or other problems.

9.1.5) Ponding.

Fry will be ponded at buttoned stage.

9.1.6) Fish health maintenance and monitoring.

Fish health services are provided by the Northwest Indian Fisheries Commission's Olympia Fish Health Center pathologists.

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.

N/A

9.2) Rearing:

9.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolts) for the most recent twelve years (2000-11), or for years dependable data are available.

N/A

9.2.2) Density and loading criteria (goals and actual levels).
Density in rearing tanks will not exceed 0.8 pounds fish/cubic feet.

9.2.3) Fish rearing conditions
TBD

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.
TBD

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

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*).
TBD

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

Preventative care will promoted through routine health monitoring. NWIFC pathologists will conduct fish health exams at the Fish Restoration Facility on a monthly or more frequent basis from the time fish "swim-up" until they are released. Monthly exams include an evaluation of rearing conditions, as well as, lethal sampling of small numbers of juvenile fish to assess fish health status of the population and to detect pathogens of concern. The results are reported to hatchery managers along with any recommendations for improving or maintaining fish health. The entire health history for this stock will bmaintained in a relational database called AquaDoc.

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

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

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.

Yearling smolts will be released at a target size of 5 fish per pound (minimum 10 fpp) to maximize survival, but if due to colder water temperatures and late egg takes (May/June), they may be released at a smaller size similar to natural origin smolts observed in the Green and neighboring White River system (See HGMP section 10.1 also).

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, dates, target size at release and location. Release location may vary depending on the availability of juvenile fish passage facilities and the results of fish passage effectiveness monitoring at HHD.

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Alternative A- With Effective Juvenile Passage at Howard Hanson Dam				
Fed Fry	280,000	150 – 200	July	Upper Watershed Above HHD
Smolt	70,000	5-10	July	Fish Restoration Facility (RM 60)
Alternative B – Without Effective Juvenile Passage at Howard Hanson Dam				
Smolt	350,000	5- 10	July	Fish Restoration Facility (RM 60)

Table 10.1.2. Green River wild steelhead smolt lengths and weights. Smolt lengths were obtained from WDFW juvenile trap reports (2000 – 2006 Green River Juvenile Salmonid Production Evaluations, Volkhardt, G., Fleischer, L., Topping, P., Kishomoto, L.). An average weight was calculated by applying a 0.9 condition factor (K) to the average length.

Year	Avg. Length	Cal. Avg. Wt./ffp
2000	176	9.2
2001	167	11.0
2002	173	9.8
2003	148	15.6
2004	153	14.1
2005	151	14.6
2006	145	16.5
Total Avg.	**159**	**12.6**

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

Basin or Region: Puget Sound

River: Green River 9.0001

A. Alternative A (With Effective Juvenile Passage at Howard Hanson Dam)

Fish will be released in the Green River watershed upstream of Howard Hanson Dam at RM 64 in these tributary streams depending on access conditions: Sunday, Snow, Smay, McCain, Friday, Intake, Tacoma, Canton, Gale, and Charley creeks; North Fork Green River; and the Green River mainstem.

B. Alternative B (Without Effective Juvenile Passage at Howard Hanson Dam)

Fish will be released from the FRF facility on the Green River mainstem at RM 60

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

Table 10.3.1. Past fingerling releases of native origin Green River Winter Steelhead above Howard Hanson Dam.

Release year	Eggs/ Unfed Fry	Avg size	Fry	Avg size	Fingerling	Avg size	Yearling	Avg size
1987					41,360			
1988					45,965			
1989					47,190			
1990					32,562			
1991					51,404			
1992					32,656			
1993					57,193			
1994					55,107			
1995					77,422			
1996					15,729			
1997					75,137			
1998					43,439			
Average								

10.4) Actual dates of release and description of release protocols.

TBD

10.5) Fish transportation procedures, if applicable.

TBD

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

TBD

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

TBD

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

N/A

10.9) Fish health certification procedures applied pre-release.

As stated for egg incubation, the NWIFC fish health lab provides pathologists who certify all fish healthy before release. Monthly fish health monitoring exams, as described in section **9.2.7**, are conducted by a fish pathologist from the Northwest Indian Fisheries Commission up until the time of release. Fish are usually examined within 2 weeks of their scheduled release. The exam includes an assessment of mortality rate, fish behavior, general condition of the fish, and rearing conditions. A necropsy is performed on representative fish from the population, including moribund and dead fish if these are available. An attempt is made to determine factors contributing to mortality. Parasites are routinely screened for by microscopic examination of gills and skin scrapes. Bacterial or viral assays may be conducted at the discretion of the pathologist if there is evidence of an infectious disease problem. Depending upon the findings of the exam, a recommendation will be made to either release the fish as planned, or if necessary, to take appropriate management actions prior to release.

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

Fish will be released directly into the Green River or its tributaries.

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.

Given the potential risks associated with hatchery programs (see Section 3.5), steelhead would be reared and released in a manner to minimize potential negative impacts on listed populations.

FRF program steelhead smolt releases will consist of yearlings. Volitional release practices will be employed to promote rapid seaward migration and minimize delay in freshwater, limiting interactions with listed Chinook and other steelhead. Culture measures will include feeding a salt-enriched "transfer" diet the last six weeks prior to release to further promote smoltification and the desire to migrate quickly to saltwater and minimize predation in freshwater on listed fish species. Steelhead juveniles will be visually monitored for smolting characteristics and behavior to ensure release at a fully smolted stage. Coefficient of variation (CV) for length at release will be monitored to ensure that an average CV value of 10.0% or less is achieved to confirm the likelihood that most fish are ready to migrate (Fuss and Ashbrook 1995).

Both fry and smolt releases will occur in July after the vast majority of Chinook juveniles have migrated from freshwater.

The risk of disease transmission to wild salmonids in the area (Puget Sound) is low. Transmission of hatchery-origin diseases from the hatchery to wild fish in areas where they co-occur is an unlikely event. Although hatchery populations can be considered to be reservoirs for disease pathogens because of their elevated exposure to high rearing densities and stress, there is little evidence to suggest that diseases are routinely

transmitted from hatchery to wild fish (Steward and Bjornn 1990). These impacts are addressed by rearing fish at lower densities, within widely recognized guidelines, continuing well-developed monitoring, diagnostic, and treatment programs already in place (Co-manager's Fish Health Policy, WDFW and WWTIT 1998, updated 2006).

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

Monitoring and Evaluation of Performance Indicators are briefly described in Section 1.10.

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.

This information is described in Section 1.9 and 1.10.

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

Program funding is subject to annual evaluation and support from Northwest Indian Fisheries Commission, and other sources.

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.

N/A

SECTION 12. RESEARCH

The Tribe is not currently engaged in formal research involving this program; however, we coordinate with WDFW who is currently engaged in juvenile salmon studies on the Green River, and will coordinate as appropriate with USACE and/or Tacoma Water in future research and monitoring activities regarding future fish passage at HHD.

12.1) Objective or purpose.
12.2) Cooperating and funding agencies.
12.3) Principle investigator or project supervisor and staff.
12.4) Status of stock, particularly the group affected by project, if different than the stock(s) described in Section 2.
12.5) Techniques: include capture methods, drugs, samples collected, tags applied.
12.6) Dates or time period in which research activity occurs.
12.7) Care and maintenance of live fish or eggs, holding duration, transport methods.
12.8) Expected type and effects of take and potential for injury or mortality.
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).
12.10) Alternative methods to achieve project objectives.
12.11) List species similar or related to the threatened species; provide number and causes of mortality related to this research project.
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.

SECTION 13. ATTACHMENTS AND CITATIONS

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SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

"I hereby certify that the foregoing information 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."
By submitting this material the Muckleshoot Indian Tribe is not conceding the application of the ESA to its hatchery operations. This information is primarily submitted to facilitate the ability of the NMFS to carry out it's duties under ESA consistent with the government to government relationship between the Muckleshoot Indian Tribe and the United States.
Name, Title, and Signature of Applicant:

Dennis Moore – Fish Enhancement Manager

Certified by_____ Date:_____

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

Listed species affected: Chinook Salmon (*O. tshawytscha*) **ESU/Population:** Puget Sound/Green Duwamish Fall Chinook
Activity: Fish Restoration Facility Chinook Program

Location of hatchery activity: Green River near RM 60 **Dates of activity:** August- July

Hatchery program operator: Muckleshoot Indian Tribe

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)	-	-	10	-
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.

Instructions:

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

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

Listed species affected: Steelhead (*O. mykiss*) **ESU/Population:** Puget Sound DIP/Green Duwamish winter steelhead
Activity: Fish Restoration Facility Steelhead Program

Location of hatchery activity: Green River RM 60 **Dates of activity:** Year round

Hatchery program operator: Muckleshoot Indian Tribe

Type of Take	**Annual Take of Listed Fish By Life Stage *(Number of Fish)***			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)	-	-	Up to 800	-
Collect for transport b)	-	-	Up to 300	-
Capture, handle, and release c)	-	-	Up to 500	-
Capture, handle, tag/mark/tissue sample, and release d)	-	-	Up to 300	-
Removal (e.g. broodstock) e)	-	-	Up to 300	-
Intentional lethal take f)	-	-	Up to 300	-
Unintentional lethal take g)	-	-	Up to 300	-
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.

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

ADDENDUM A. PROGRAM EFFECTS ON OTHER (AQUATIC OR TERRESTRIAL) ESA-LISTED POPULATIONS.

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.

This HGMP is being submitted for ESA consultation and take prohibition exemption under ESA section 4(d).

15.2) 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). However, the USFWS does not consider the watershed to be a core area for bull trout in Puget Sound (USFWS 2004), and no distinct population has been delineated for the Green River. Bull trout have been documented 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). The Tacoma Water Headworks adult fish trap at RM 61 has been operated by Tacoma Water on a limited basis for various purposes since 2007 and bull trout have not been encountered during trap operations (Greg Volkhardt, Tacoma Water, pers. comm.).

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. Water temperatures and habitat conditions in the lower basin are often unsuitable for this species. 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). More recently, 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 (Fred Goetz, USACE, *pers. comm.).*

Several listed and candidate species are found in King County.

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*)

15.3) Analyze effects.

Hatchery activities, including broodstock collection, hatchery trap, water discharges, and water intake structures may pose a risk to bull trout populations or individuals. However, risk to bull trout populations from the FRF program is expected to be low as no records of bull trout observations have been reported in the Green River in the vicinity of the FRF.

Hatchery activities associated with the FRF program will include broodstock collection at the FRF facility in a fishway ladder or other adult collection facility, and at the Tacoma Headworks adult fish trap in the Green River. Bull trout have not been encountered at the Tacoma Headworks adult fish trap or observed near the trap (Greg Volkhardt, Tacoma Water, pers. comm.).

FRF hatchery surface water intake structures may pose a risk to any bull trout that might be encountered at these facilities, however the risk will be low as they will be screened in compliance with appropriate NMFS and USFWS protection criteria.

Water discharges from the hatchery may affect water quality in the Green River, however, the risk of water quality degradation affecting the health of bull trout would be low given that hatchery operations will comply with NPDES permit and monitoring requirements and will avoid or limit adverse effects on water quality.

The FRF will operate on surface water from the Green River and/or groundwater sources. Water withdrawals will be non-consumptive, and will not exceed the rates authorized by the state. The risk to bull trout from water withdrawals is low as the water supplied to the hatchery will be non-consumptive and will also be returned to the river at the point where it is withdrawn during low flow periods to minimize impacts to instream flows.

Hatchery operations may introduce or spread fish pathogens that might pose a risk to the health of any bull trout that may occur in the creek. However, this risk would be low as hatchery facilities and fish culture practices are operated in compliance with all applicable fish health

guidelines, facility operation standards, and protocols, including routine monitoring and testing for pathogens.

Juvenile fish releases from the hatchery could provide prey for any bull trout occurring in the Green River downstream of the hatchery.

15.4) Actions taken to minimize potential effects.

Broodstock collection facilities would be checked at least daily when operating. Any bull trout encountered would immediately be returned safely to the stream. Any bull trout encounters would be recorded and reported to USFWS.

Water intake structures will be screened in compliance with appropriate NMFS and USFWS fish protection criteria to protect any bull trout juveniles or adults that may approach these facilities. Water intake screening and structures will be inspected several times each week to insure they are operating correctly. Any bull trout encountered at the water intake facilities would be returned immediately to the Green River, and reported to USFWS.

Water withdrawals will be non-consumptive and limited to the rates authorized by existing state water rights certificates. During low flows, water will be pumped back to the point of withdrawal to maintain adequate flows in any bypass reach.

Program facilities will be operated in compliance with all applicable fish health guidelines, facility operation standards and protocols including the Co-managers Fish Health Policy (NWIFC and WDFW, 2006) to prevent the introduction or spreading of fish pathogens including routine monitoring and testing for pathogens.

15.5) References

USFWS (U.S. Fish and Wildlife Service). 2004. Draft recovery plan for the coastal-Puget Sound distinct population segment of bull trout (*Salvelinus confluentus*). Volume I (of II): Puget Sound management unit. Portland, Oregon. 389 + xvii pp.

USFWS (U.S. Fish and Wildlife Service). 2008. Bull trout (*Salvelinus confluentus*) 5-year review: Summary and evaluation. U.S. Fish and Wildlife Service. Portland, Oregon. 55 pp.

WDFW (Washington State Department of Fish and Wildlife). 2004. Washington State salmonid stock inventory bull trout/ Dolly Varden. Washington State Department of Fish and Wildlife. Olympia, Washington.

Watson, G. and Toth, S. 1994. Limiting factors analysis for salmonid fish stocks in the Plum Creek habitat conservation plan (HCP) area. December 14, 1994 draft of fish limiting factors analysis.