HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Fish Restoration Facility
Species or Hatchery Stock:	Green River Coho
Agency/Operator:	Muckleshoot Indian Tribe
Watershed and Region:	09.0001 – Green River (Puget Sound)
Date Submitted:	
Date Last Updated:	July 21, 2014

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.
Fish Restoration Facility

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

Green River Coho Salmon – *Oncorhynchus kisutch*

1.3) Responsible organization and individuals

Name (and title): Dennis Moore – Fish Enhancement Manager
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Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

Tacoma Water - The Tacoma Headworks trap and haul facility near RM 60.9 will be used to collect initial and supplemental adults for broodstock. Tacoma Water will also transport and release juvenile fish produced in the program above HHD 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.

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

1.6) Type of program.

Integrated Harvest

1.7) Purpose (Goal) of program

Mitigation. The goal of this program is to provide harvest opportunity to help mitigate lost production related to the construction and operation of Howard Hanson and Tacoma

Water dams, and to assist in the potential restoration of coho salmon in the upper Green River watershed after verification of effective fish passage through the dam and reservoir.

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. Salmon harvest is essential to the culture and well-being of the Muckleshoot Indian Tribe. The harvest of fish supplemented by this program is an essential part of the Muckleshoot Indian Tribe's federally-recognized treaty fishing rights reserved by the Treaties of Medicine Creek and Point Elliott. 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 coho salmon throughout the Green-Duwamish watershed has been diminished by extensive habitat loss and degradation (see Section 3.4 below). So long as watersheds are unable to maintain abundant self-sustaining salmonid populations, hatchery programs will be needed to mitigate and replace lost natural production and provide meaningful harvest opportunity in fulfillment of the Tribe's treaty fishing rights as affirmed by the U.S. v. Washington proceedings. Mitigation is required for lost natural production throughout the watershed.

Natural production of coho salmon in the Green-Duwamish watershed is diminished by extensive habitat loss and degradation. The City of Tacoma constructed a diversion 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 majority of the lower half of the Green-Duwamish basin is dominated by urban, commercial, residential, and industrial land uses. The prospects for restoring significant areas of properly functioning habitat and natural ecosystem processes in this landscape 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 far exceed state water quality standards and at times exceed lethal levels for salmonids as a

result of inadequate riparian vegetation and reduced groundwater inflows. These and many other factors continue to degrade habitat and limit natural processes needed to support the life history of salmonids, reducing the abundance and productivity of natural populations in the watershed.

This program will replace the former role of the Tribe's Keta Creek Hatchery with regard to coho production in the Green River. Coho from Keta Creek Hatchery were planted in the upper watershed above Howard Hanson Dam between 1984 and 2005 (see Section 10.3). Together with Green River minimum instream flow provisions, the fish restoration facility is a central element of the 1995 settlement Agreement between the Muckleshoot Indian Tribe and the City of Tacoma regarding the City's water supply operations in the Green/Duwamish River System.

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.

Table 1.10.1.1. Performance standards, indicators, and monitoring and evaluation addressing benefits.

Performance Standard	Performance Indicator	Monitoring & Evaluation
Hatchery operations support Puget Sound Salmon Management Plan (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 fulfilling tribal trust responsibility mandates and treaty rights as described in applicable agreements	Coordination with WDFW and other tribal governments.	Participate in meetings between the co-managers to identify and report on issues of interest, coordinate management, and review programs (FBD process).
Releases are marked to provide biological and stock management information, and program evaluation.	Of the 600,000 released, all will be marked (adipose-fin clip with 50,000 also receiving a coded-wire tag). Mass marked adult returns provide data on catch contribution from timing, total survival, migration patterns, and straying to other watersheds.	Returning fish are sampled throughout their return for length, sex, mass marks and coded-wire tags.
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

1.10.2) "Performance Indicators" addressing risks.

Table 1.10.1.2 Performance standards, indicators, and monitoring and evaluation addressing risks.

Performance Standard	Performance Indicator	Monitoring & Evaluation
Minimize impacts and/or interactions to ESA listed fish.	Hatchery juveniles (smolts) are released at a time that fosters rapid migration downstream at an average size of 140 mm.	Monitor size, number and date of releaseFish health documented. Behavior and physical condition monitored for migration readiness. Mass marking allows monitoring of migration timing, rate, and behavior of coho released through capture of downstream migrating fish at the WDFW juvenile outmigrant 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 facility 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.	Water quality sampling results, flow and discharge reported in monthly NPDES reports as required.
Water withdrawals and diversion structures for hatchery facility will not affect natural populations or impact juveniles.	Hatchery intake screen structures will meet federal guidelines.	Barrier and intake structure compliance will be adhered to. Water usage is monitored.
Hatchery operations comply with ESA responsibilities.	Approved HGMP	Identified in HGMP and Biological Opinion for hatchery operations.
Implement measures for broodstock management to maintain genetic integrity and diversity.	Broodstock are collected throughout the run in proportion to timing, age, and sex composition of return.	Annual run timing, age, and sex composition and return timing data are collected adhere to best management practices.

1.11) **Expected size of program.**

600,000

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

600 Adults

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

Note: Fish release levels, life stage, and location will ultimately depend on the status of planned downstream fish passage facilities at the USACE Howard Hanson Dam and related assessments.

Table 1.11.2.1.
Alternative A- With Effective Juvenile Passage at Howard Hanson Dam

Life Stage	Release Location	Annual Release Level
Fry	Upper 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 500,000
Smolt	On site at the Fish Restoration Facility, Green River near RM 60	Up to 100,000

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 600,000

1.12) Current program performance, including estimated smolt-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.
TBD (facility not constructed yet, target date not yet determined)

1.14) Expected duration of program.
Indefinite

1.15) Watersheds targeted by program.
Green River (09.0001)

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 was considered but 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. Expansion of the MIT Keta Creek Hatchery Complex was considered but rejected due to limited water supply and space. Large scale watershed restoration sufficient to meet program goals including dam removal; restoration of natural ecosystem processes; and natural floodplain, stream

channel, wetlands, land cover, and estuary conditions was considered infeasible.

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.

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

None

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

Puget Sound Chinook ESU, Duwamish/Green River Chinook (*O. 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).

Puget Sound Steelhead DPS, Green River (*O. 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, 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. In the Duwamish/Green River basin, the TRT has preliminarily delineated one demographically independent population (DIP) of winter steelhead; (Green River), no summer run populations were identified in the basin (PSSTRT 2011).

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**

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. Across the ESU, most populations have declined in abundance somewhat since the last status review in 2005, and trends since 1995 are mostly flat. Many of the actions identified in the Puget Sound Chinook recovery plan are expected to take years or decades to be implemented, and to potentially 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.

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 Comanagers 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. 2000-2011) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.**

Green/Duwamish fall Chinook: WDFW conducts smolt monitoring with a trap at RM 34.5 (upstream of Soos Cr). MIT currently traps juveniles on Soos Cr at RM 1.0 above the hatchery.

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. 2010

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. 2010

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

Duwamish-Green River steelhead:

Note: WDFW natural-origin smolt monitoring activity occurs on this system.

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 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. 2010.

- 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, 2000-2012.

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 here include all HOR and NOR fish spawning naturally in the mainstem Green River and Newaukum Creek.

**Standardization of the 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 River (Duwamish) steelhead wild winter steelhead spawning escapement 2000-2011.

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, District Biologist, 2012). 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. 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.

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. 2010

Green River (Duwamish) steelhead (*Oncorhynchus mykiss*): The 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 a majority of the existing wild winter stocks (being later February – June), interaction on the spawning grounds is unclear.

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

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

Broodstock Collection, Handling, and Holding: Much of the detail of this hatchery program will be determined once the decision is made to build the facility. It is assumed that broodstock would initially be collected from the Tacoma Water headworks trap on the Green River at river mile 60.9. Coho broodstock collection takes place between October and December, overlapping the latter part of the Chinook run. Chinook may enter the trap facilities during coho collection and experience stress due to short term confinement (e.g., up to 24 hours) in the facilities and mechanical sorting back to the river.

Broodstock Spawning/Pathology Sampling: No listed salmonids in the Duwamish-Green River system will be affected by spawning and pathology sampling activities that are part of this program. Consistent with the Co-managers' Washington Fish Health Policy (NWIFC and WDFW 2006), ovarian fluid and kidney- spleen samples collected from up to 60 coho salmon adults will be evaluated each year for fish pathogen and disease incidence. Fish disease control measures consistent with the policy will be applied to reduce the risk of adverse effects on listed fish populations in the Duwamish-Green River.

Rearing Program: NWIFC pathologists would monitor fish health each month. Releases

of coho yearlings into the Duwamish-Green River system are consistent with Co-Managers Washington Fish Health Policy (NWIFC and WDFW 2006) to eliminate disease risk to listed fish populations in the watershed.

Operation of Hatchery Facilities: Operation of the hatchery physical plant will have none to very minor effects on listed fish in the watershed. Withdrawal of surface water and ground water to supply the hatchery would be screened to avoid entrainment of juvenile salmon, in accordance with NMFS guidelines (NMFS 1995, 1996). Hatchery effluent may alter various properties of the receiving water used by listed and other stocks. These properties include suspended solids, settled solids, temperature, dissolved oxygen, biological oxygen demand, and nutrient. If required, this program would be operated under discharge limitations set by the U.S. Environmental Protection agency limiting the changes and effects of these properties on the receiving water. Hatchery effluent is rapidly diluted at the point of discharge, and effluent quality is maintained within federal and/or state effluent discharge permit guidelines to ensure that downstream aquatic life (including fish) is adequately protected.

Monitoring Activities: No FRF hatchery coho program monitoring activities that would affect listed species are planned at this time.

Predation- Freshwater Environment: Coho 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, the identification of risk factors can assist in hatchery program review. 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 coho 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 coho releases to prey on listed Chinook and steelhead juveniles is limited by the relative size of the coho releases and their prey. Salmonid predators typically prey on fish approximately 1/3 or less their length (USFWS 1994), although coho have been observed to consume juvenile Chinook as large as 46% of their total length (Pearsons et al. 1998). 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). Green River Chinook were larger than the all-system averages by 1.3 mm to 6.7 mm except in the last week of June (Table 2.2.3.1). 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, this program will delay coho smolt releases until the month of May. Smolt size at release will average approximately 140 mm fork length. In 2000, the average size of Chinook migrants was 63.1 mm in early May (statistical week 19) when the required minimum predator length was 187 mm. By early May, relatively few Chinook migrants are smaller than 50 mm in length. Coho fry outplanted above Howard Hanson Dam under Alternative A in this program may also consume Chinook fry as they reach smolt size. The larger size of steelhead juveniles in May is expected to eliminate any risk of predation by hatchery coho smolts on steelhead. Steelhead parr in the Green River typically reach or exceed100 mm in length by mid-April, while natural origin steelhead smolts and hatchery coho smolts are of similar size.

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).

Date of Release: The release date of juvenile fish in the program can influence the likelihood or magnitude of predation on listed species. Coho yearlings will be released in May as actively migrating smolts at approximately 140 mm to avoid and minimize predation on juvenile Chinook. Over half of the Chinook outmigration has occurred by early May (Seiler et al., 2002). As noted above, Chinook migrants are larger in size by May, limiting the potential for predation by coho smolts. Migration timing of juvenile Chinook in the Green River has been documented since 1999 by WDFW in their juvenile migrant trap reports. While some variation exists between years, the general pattern is that Chinook emigration begins soon after emergence (typically January) and continues at least until July. Two broad peaks in migration usually occur, an early peak typically in March consisting of relatively small Chinook salmon (40-45mm), and a second peak of larger Chinook salmon in mid-May to June. 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 May. Yearling hatchery coho 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. The potential for the hatchery coho smolts to predate on steelhead fry is low since most or all would leave freshwater before the onset of steelhead emergence in June.

Release Location: All coho smolts released under this HGMP will be made from the FRF in the Green River near river mile 60. During downstream migration, these smolts may consume Chinook fry encountered along the river mainstem. As explained above, the level of predation by the hatchery coho smolt releases will be minimized by releasing the smolts in May after the majority of the Chinook fry outmigration, and when smolt condition and behavior promotes rapid downstream migration to saltwater. Coho 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 fry 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 coho juveniles in the upper watershed, the potential for spatial overlap between hatchery coho outplants 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 to the extent that overlap occurs when Chinook juveniles are vulnerable to coho smolt predation. Therefore, to minimize predation impacts on natural Chinook fry, coho fry outplanting will target smaller tributaries and stream reaches upstream of areas with a high potential for Chinook spawning activity.

Number Released: This program would release either 100,000 smolts and 500,000 fry (Alternative A), or 600,000 smolts (Alternative B). Which of these alternatives is selected will depend on the status of juvenile fish passage facility construction at the USACE Howard Hanson Dam, and/or fish passage effectiveness based on future evaluations. (Completion of a downstream fish passage facility has been delayed for several 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. In the event that encounters do occur, the predation risk is expected to be low because after entering the marine environment coho and Chinook generally prey upon fish 1/2 their length or less, and on average consume fish prey less than 1/5 of their length (Brodeur 1991).

Competition/ Niche Displacement: The FRF coho 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). This would tend to limit competition for food and space resources between coho and listed species including juvenile Chinook and steelhead. Competition between hatchery coho smolts and listed species is not expected to be significant given the late release (May), and rapid outmigration and limited freshwater cohabitation with listed species. Hatchery smolts are often larger than natural origin juveniles, and larger fish are usually superior competitors, while natural origin juveniles have the advantage of prior residence when defending territories and resources in streams. 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. While there is some overlap, competition between stray hatchery origin coho and listed Chinook salmon for spawning habitat is

likely minimized by differences in spawn timing, spawning distribution, and preferred microhabitat variables such as water depth, velocity, and substrate size.

Disease Transmission: Hatchery effluent has the potential to transport pathogens from the hatchery water supply to receiving water containing listed and other stocks. Pathogens may also be transmitted by direct contact of infected hatchery fish with other stocks. Although these methods of disease transmission are possible, there is little information showing that pathogens are transferred to naturally produced stocks. This program is operated under the disease prevention and detection guidelines established in the Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State (NWIFC and WDFW 1998, 2006). These practices are expected to minimize this risk for both listed and other stocks.

- **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).**

  See take tables at the end of this document.

- **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 projected take that would exceed the estimates given in this HGMP would be communicated to NOAA staff for additional guidance.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT

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.

The program is intended to be consistent with hatchery program guidelines in the co-managers' Puget Sound hatchery resource management plan (WDFW and PSTT 2004), and is aligned with the WDFW Future Brood Document. The program is intended to be consistent with the Washington state co-managers Salmonid Disease Policy that identifies Fish Health Management Zones, eggs and fish transfer policies, and guidelines designed to limit the spread of fish pathogens between and in watersheds (NWIFC and WDFW 1998, 2006).

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

This program operates under and is consistent with several court orders and agreements. These include U.S. v. Washington Boldt decision, and subsequent orders including the Puget Sound Salmon Management Plan (PSSMP), Comprehensive Management Plan for Puget Sound Chinook: Hatchery Management and Harvest Management components. The PSSMP requires that WDFW and Puget Sound tribe develop Equilibrium Broodstock Documents agreeing on program goals, objectives, function, and release strategies of all hatchery programs. The Future Brood Document is a detailed listing of annual production goals that is reviewed and updated each spring and finalized in July. The Current Brood Document reflects actual production relative to the annual production goals. It is developed in the spring after eggs are collected.

This program is included in the Agreement between the Muckleshoot Indian Tribe and the City of Tacoma Regarding the Green/Duwamish River System (1995).

The hatchery resource management plan (WDFW and PSTT 2004) identifies interim goals for hatcheries. The plan describes operating procedures for salmon and steelhead hatcheries in Puget Sound and their role in achieving the Co-managers' resource management goals. Both tribal and WDFW hatcheries are covered describing benefits and risks to protecting ESA listed Puget Sound Chinook and steelhead.

3.3) Relationship to harvest objectives

Coho salmon returns are harvested from early September to mid -November, with minimal incidental harvest on the later returning fall Chinook salmon and early returning steelhead. To assure that the incidental harvest rate remains low on Chinook in its fishery, the tribe conducts annual clearance test fisheries near the end of the management period

for Chinook salmon to confirm that coho are in sufficient abundance and non-target species (i.e., Chinook) is in low abundance. These clearance test fisheries have been in place the past 25 years. Recently, the co-managers prepared an updated Harvest Management Plan for Puget Sound Chinook salmon. The Plan states specific objectives for harvest of the 15 Puget Sound management units, the technical bases for the objectives, and procedures for their implementation. The Plan assures that the survival and recovery of the Puget Sound ESU for Chinook will not be impeded by fisheries-related mortality. The Plan was submitted and NMFS (NOAA Fisheries) reached a finding, based on the conditions stated in the 4(d) rule, that fisheries-related take in Washington waters is exempt from prohibition under Section 9 of the ESA**.**

3.3.1) Describe fisheries benefitting 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 coho 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 juvenile fish passage facilities. A four mile-long reservoir is refilled during the smolt outmigration period, altering natural spring runoff and reducing outmigration 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 is on hold pending construction of downstream 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.

The 2001 Tacoma Water Habitat Conservation Plan (HCP) includes a commitment to fund a fish restoration facility to rear salmonids and to provide transport and release of juvenile coho and other species into the upper watershed from the facility (HCP Measure HCM 2-05). Coho 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 coho above the dam; and/or (3) to supplement adult returns in the Green River to address short term declines in adult escapement. Coho 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. 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 the natural habitat processes important for coho and other salmon, reducing the abundance and productivity of the natural population 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. 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 coho 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 coho 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 coho 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 coho through predation include mergansers, cormorants, belted kingfishers, great blue herons, and green herons; and mammalian predators including mink, river otters, harbor seals, and sea lions, as well as cutthroat trout. Migrating adult coho produced by the program may also serve as prey for mammals in marine areas, nearshore marine areas and in the Green River to the detriment of population abundance and harvest augmentation. Species that may negatively impact adult program fish through predation may include orcas, sea lions, harbor seals and 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).* Listed species potentially negatively impacted include Puget Sound Chinook and Puget Sound steelhead. Hatchery fish can interact with the listed species through competition and predation (Fresh 1997). Important considerations include the type of species reared, fish size at time of release, number of fish released and location(s) of program releases. Coho are released on-station in May at approximately 140 mm. Over half of the Chinook outmigration has occurred by this time (Seiler et al., 2002). In addition, Chinook migrants are larger in size by May. Release of smolts from a potential supplemental rearing facility near river mile 60 would also occur in May to avoid predation on outmigrating Chinook. The risk of juvenile competition and predation in freshwater is minimized by release strategies that promote rapid seaward migration. Almost half of the yearlings reared at the Keta Creek Complex are transferred to Elliott Bay net pens for release in saltwater, minimizing negative interactions with listed species in freshwater. Delayed release (late May or early to mid-June) from the net pens is intended to limit interaction with Chinook juveniles but may still result in an undetermined amount of predation on Chinook juveniles in nearshore or marine waters. Salmonid predation is generally thought to be greatest when the prey is 1/3 or less the length of predator species (USFWS 1994). Assuming the "1/3 size rule" in this instance, the program hatchery release in freshwater is well below the 188 mm plus size considered to promote predation on the natural Chinook during time of release. Natural steelhead outmigrants are similar in size to the hatchery coho releases.

(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 for coho during their downstream migration in freshwater and into the marine area. Salmonid adults that return to watershed streams and any seeding efforts using adult salmon carcasses may provide a source of nutrients and stimulate stream productivity. Carcasses from returning adult salmon may 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).

(4) *Salmonid and non-salmonid fishes or other species that could be positively impacted by the program.* The coho program could positively impact freshwater and marine fish species that prey on adult and juvenile fish. These species include: Southern Resident Killer Whale/Orca, Northern pikeminnow, cutthroat trout, bull trout, steelhead, Pacific staghorn sculpin, and numerous marine pelagic fish species. Nutrients provided by decaying coho carcasses might also benefit fish and aquatic invertebrates in freshwater, as well as fish, bird, invertebrate, and mammal species that feed on carcasses directly. The hatchery releases will also provide forage for avian predators, including gulls, mergansers, cormorants, belted kingfishers, great blue herons and night herons. Mammals that benefit from migrating fingerlings and adults include river otters, harbor seals, sea lions and orcas.

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.

Wells and/or Green River surface water between 2 cfs to a maximum of 35 cfs. Water quality is expected to be excellent.

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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.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

Initially, broodstock will be trucked from the TPU trap and haul facility one mile away from the Fish Restoration Facility. If warranted, we will collect fish at the Fish Restoration Facility adult handling facility.

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 coho at the Fish Restoration Facility will be sized to handle up to 600 fish

5.4) Incubation facilities.

Facility details to be determined

5.5) Rearing facilities.

Facility details to be determined

5.5) 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 Chinook salmon and steelhead trout are unlikely to occur as a result of the physical operation of the program. 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 (1998, updated 2006). Adherence to artificial propagation, sanitation and disease control practices defined in the policy reduces the risk of fish disease pathogen transfer to listed natural-origin Chinook salmon and steelhead.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

6.1) Source.

Green River indigenous coho stock.

6.2) Supporting information.

6.2.1) History.

The origin of this stock is the Green River. Some additional coho stocks were occasionally imported in the early days of the hatchery operation but their contribution was not significant.

6.2.2) Annual size.

This program will require about 600 adults

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

See 6.2.2 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.

SECTION 7. BROODSTOCK COLLECTION

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

Adults

7.2) Collection or sampling design.
TBD

7.3) Identity.
TBD

7.4) Proposed number to be collected:

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

A total of 600 adults are needed for the production goals.

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

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

Un-spawned adults will be donated to tribal members (small quantity) with the rest sold to a fish carcass buyer for processing.

7.6) Fish transportation and holding methods.

If adults from the TPU trap and haul facility are used they will be transported in tanker trucks equipped with oxygen supply and held until ready to spawn.

7.7) Describe fish health maintenance and sanitation procedures applied.

Standard fish health protocol is utilized as defined in the current Co-manager Fish Health Policy

7.8) Disposition of carcasses.

Spawned fish are either donated to tribal members 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.

TBD

8.2) Males.

TBD

8.3) Fertilization.

TBD

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.

TBD

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.

N/A

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

N/A

9.1.3) Loading densities applied during incubation.

Eggs will be eyed in vertical incubators (heath trays) at about 7,000 to 7,500 eggs per tray, or TBD.

9.1.4) Incubation conditions.

N/A

9.1.5) Ponding.

Ponding will take place when the fry are about 95% buttoned-up.

9.1.6) Fish health maintenance and monitoring.

TBD

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 smolt) for the most recent twelve years (1988-99), or for years dependable data are available..

N/A

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

TBD

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.

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.

Fish will be monitored on a daily basis for health concerns and inspected monthly by the Olympia Fish Health Center (NWIFC).

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

Not available

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.

(N/A)

SECTION 10. RELEASE

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

10.1) Fish release levels.

With effective juvenile passage at HHD: 500,000 Fry
100,000 Yearling

Without effective juvenile passage at HHD: 600,000 Yearling

10.2) Specific location(s) of proposed release(s).
Stream, river, or watercourse:

Release Point	RM 60 or TBD in upper watershed
Major Watershed	Green River
Basin or Region:	Puget Sound

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

TBD.

Table 10.3.1. Past coho fry releases made above Howard Hanson Dam 1984 - 2005. No releases have been made after 2005. Releases following 1989 were made from the Keta Creek Hatchery.

Release Year	Fry	Release Year	Fry
1984	**2,035,714**	**1995**	431,982
1985	**1,003,690**	**1996**	489,636
1986	**1,361,610**	**1997**	495,272
1987	**1,273,500**	**1998**	581,976
1988	**1,763,600**	**1999**	470,986
1989	**1,805,807**	**2000**	559,625
1990	**1,361,389**	**2001**	494,760
1991	**1,028,157**	**2002**	495,600
1992	**933,222**	**2003**	648,240
1993	**1,550,333**	**2004**	497,726
1994	947,812	**2005**	546,450

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

TBD

10.5) **Fish transportation procedures, if applicable.**

N/A

10.6) Acclimation procedures

N/A

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

Marking protocol for the Fish Restoration Facility fish is yet to be determined

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.

Fish will be inspected and certified as dictated by the Pacific Northwest Fish Health Protection Committee (Co-Managers Agreement).

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), coho are reared and released in a manner to minimize risk of competition and predation to listed juvenile fish. For yearling smolt releases, these measures include (1) delaying the release until May after the peak of Chinook outmigration has occurred; (2) feeding a "transfer" diet the last six weeks prior to release to improve physical and biological processes relating to smoltification and the desire to migrate quickly to saltwater: and (3) monitoring fish behavior and physical condition to confirm smolt migration readiness. Following completion of fish passage facilities and related evaluations, fry releases made into the upper watershed (Alternative A) will minimize risk of competition and predation with listed juveniles by targeting release sites in smaller tributaries or areas upstream of known or likely Chinook spawning activity.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

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

This information is described in Section 1.9 and 1.10.

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

Currently, CWT tagging is used to calculate the hatchery program's contribution rates to harvest, including contribution of hatchery fish to harvest in terminal target fisheries. CWT tagged fish are sampled in all fisheries and in the escapement to the hatchery rack. Fish tickets are used to quantify terminal tribal harvest. The mass marking of coho salmon and continued juvenile migrant trapping will facilitate monitoring of the migration timing, rate, and behavior of yearling coho smolts post-release through the capture of downstream migrating fish at the WDFW juvenile outmigrant trap at RM 33 on the Green River. Please refer to Monitoring and Evaluations column in the tables in Section 1.10 for further information concerning plans and methods.

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

The ability to estimate such indicators will be determined by implementation plans, budgets, and assessment priorities. Program funding is subject to annual evaluation and support from WDFW, Northwest Indian Fisheries Commission, Bureau of Indian Affairs, and other sources. However, at present we anticipate that funding, staffing and support logistics will be available to implement all or most of the monitoring and evaluation activities shown in the tables in Section 1.10.

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 Tribe is not conceding the application of ESA to its hatchery operations. This information is primarily submitted to facilitate the ability of NOAA Fisheries to carry out its duties under the ESA consistent with the government to government relationship between the Muckleshoot 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 **ESU/Population**: Puget Sound Chinook- Green River **Activity:** Fish Restoration Facility Coho Program				
Location of hatchery activity: Green-Duwamish River near 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)	-	-	-	-
Collect for transport b)	-	-	-	-
Capture, handle, and release c)	-	-	-	-
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 **ESU/Population**: Puget Sound DIP- Green River **Activity:** Fish Restoration Facility Coho Program				
Location of hatchery activity Green-Duwamish R near 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)	-	-	-	-
Collect for transport b)	-	-	-	-
Capture, handle, and release c)	-	-	-	-
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 sep

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

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

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). 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. 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. It is unclear whether the bull trout observed represent local-origin fish 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 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 discharges will comply with NPDES permit and monitoring if required, employ discharge water treatment facilities and water quality best management practices to avoid or minimize 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 at the trap 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 current NMFS and USFWS fish protection criteria. 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

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