HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Keta Creek Complex
Species or Hatchery Stock:	Green River Coho - Yearlings
Agency/Operator:	Muckleshoot Indian Tribe and Suquamish Indian Tribal Coop
Watershed and Region:	09.0001 – Green River (Puget Sound)
Date Submitted:	
Date Last Updated:	June 22, 2017

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SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

Keta Creek Complex-Yearling Coho Program

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

Green River Coho Salmon – *Oncorhynchus kisutch*

1.3) Responsible organization and individuals

Keta Creek Complex Operations Lead Staff:

Name (and title): Hugo Hernandez – Green River Enhancement Team Leader
Sean Hildebrandt, Biologist
Agency or Tribe: Muckleshoot Indian Tribe
Address: 39015 172nd Ave.SE Auburn, WA 98092
Telephone: (253) 876-3286
Fax: (253) 931-0572
Email: Hugo.Hernandez@muckleshoot.nsn.us
Email: Sean.Hildebrandt@muckleshoot.nsn.us

Elliott Bay Net Pens Operation Lead Staff:

Name (and title): Mike Huff, Biologist
Agency or Tribe: Suquamish Tribe
Address: P.O. Box 498, Suquamish, WA 98392
Telephone: (360) 394-8440
Fax: (360) 598-1974
Email: mhuff@suquamish.nsn.us

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

Washington Department of Fish and Wildlife – fingerling transfers from Soos Creek to Keta Creek Complex, and yearlings to Elliott Bay Net Pens
Tacoma Water – broodstock collection assistance at Green River headworks trap

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

Funding Source: Muckleshoot Tribe, Suquamish Tribe, and BIA
Staffing: 5 permanent staff and up to 15 seasonal staff
O&M – Approximately $500,000

The above information applies cumulatively for Keta Creek Complex and is not broken out by specific program.

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

Keta Creek Complex: RM 1.1 on Crisp Creek (WRIA 09.0013), tributary of Green River (WRIA 09.0001) entering at RM 40.1; Elliott Bay Tribal Net Pens: Elliott Bay in Puget Sound immediately north of Pier 70, Seattle (WRIA 9.0072); Potential supplemental rearing facility: Green River near RM 60.5

1.6) Type of program.

Integrated Harvest

1.7) Purpose (Goal) of program

Augmentation. The goal of this program is to provide harvest opportunities for tribal, commercial, and recreational fishers.

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 Keta Creek Complex coho yearling program is intended to produce 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 under this 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 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 the extensive loss and degradation of habitat in this basin. 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. In 1962, the U.S. Army Corps of Engineers completed Howard Hanson Dam (HHD) near RM 64 for flood control and other purposes. HHD is an impassable barrier to fish migration, blocking approximately 100 miles of potential anadromous fish habitat. Flood control and spring reservoir storage operations at the HHD and water diversion operations significantly alter the river's natural flow regime. 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 (HHD) (NWIFC 2012). Stormwater runoff is associated with high pre-spawning mortality in coho salmon, and this effect is predicted to occur over a large extent in Central Puget Sound (Feist et al., 2011; Spromberg and Scholz 2011) including the Green-Duwamish basin. Municipal and other groundwater withdrawals have depleted streamflows in the tributaries of the Soos Creek subbasin by as much as 70 to 90 percent (NHC, 2005). Water temperatures in the lower Green River have exceeded lethal levels for salmonids at times and riparian areas are shade deficient, particularly along the lower mainstem (Coffin et al., 2011). Ninety-eight percent of the historic estuary has been lost to development, and sediment and water quality in the 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. These and other factors continue to degrade or eliminate habitat and natural processes needed to support the life history of coho salmon, reducing the abundance and productivity of natural populations in the watershed. The prospects for restoring sufficient areas of properly functioning habitat and natural ecosystem processes in this basin are limited.

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 opportunity in fulfillment of promises made in the Treaties and the Tribe's fishing rights as affirmed by the U.S. v. Washington proceedings. The coho yearling program will be operated to minimize adverse effects on listed fish by releasing fish at a size, location, and time that will reduce spatial and temporal interactions with listed fish, by preventing the spread, introduction or amplification of pathogens that might affect the health of listed fish, and by insuring that hatchery facilities are in compliance with screening criteria, state water rights, and water quality (NPDES) permit requirements.

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 (US v Washington) and sustain Muckleshoot tribal fisheries guaranteed through the Treaties of Point Elliott and Medicine Creek.	Contributes 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 co-management and tribal trust responsibility mandates and treaty rights per 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 (Future Brood Document process).
Releases are marked to provide biological and stock management information, and program evaluation.	Of the 2,050,000 coho smolts released, all are mass marked (adipose-fin clips), and at least 100,000 of these are coded-wire tagged. Mass marked adult returns provide data on catch contribution, 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.

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 are released at a time that fosters rapid migration downstream at an average size of 140 mm. In addition, almost half of the yearlings reared are transferred to Elliott Bay Net Pens for release in saltwater.	Monitor and record size, number and date of release. Fish 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 affect the health of both hatchery and naturally reproducing stocks and produce healthy smolts that contribute to program goals.	Pathologists from NWIFC monitor programs monthly. Exams performed at each life stage may include tests for virus, bacteria, parasites nutritional status and culture conditions, 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.	Discharge water quality tested for monthly NPDES reports. Water usage is monitored.
Water withdrawals and in-stream water diversion structures for hatchery facility will not affect listed populations.	Hatchery intake screen structures meet federal guidelines	Barrier and intake structure compliance assessed and any needed fixes are prioritized.
Implement measures for broodstock management to maintain genetic integrity and diversity.	Broodstock are collected throughout the spawning run in proportion to timing, age, and sex composition of return.	Annual run timing, age, and sex composition and return timing data are collected to adhere to best management practices.
Hatchery operations comply with ESA responsibilities.	Approved HGMP	Identified in HGMP and Biological Opinion for hatchery operations.

1.11) Expected size of program.

The proposed maximum program size includes a future release goal of up to 2,050,000 yearling coho smolts. The current facility capacity is up to 1.55 million coho yearlings, and the program release level at present is approximately 1 million. As noted above, the Muckleshoot Indian Tribe reserves the right to discontinue current production; modify the current production level; or 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.

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

A total program release goal of up to 2,050,00 coho smolts will require collection of up to 3,500 adults (1,400 pairs) collected from Crisp Creek, and approximately another 800 adults collected at the WDFW Soos Creek Hatchery for juveniles transferred to the Keta Creek Complex for the Elliott Bay Net Pen releases. (See Soos Creek Coho HGMP for adults required for transfers from Soos Creek Hatchery to the tribe.)

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

Table 1.11.2 Maximum annual releases by life stage and location.

Life Stage	Release Location	Annual Release Level
Yearling	Crisp Creek (River Mile 1.1)	1,000,000
	Green River (River Mile 60.5)	50,000*
	Elliott Bay Tribal Net Pens	1,000,000**

** does not include releases from future Fish Restoration Facility*

*** The current net pen capacity is 480,000*

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

Table 1.12.1. Coho escapement levels (including jacks) returning to the hatchery from 1999 through 2010. Data source: Muckleshoot Indian Tribe

Brood Year	Escapement
1999	2418
2000	7756
2001	7778
2002	1286
2003	3044

2004	1177
2005	3841
2006	1078
2007	2353
2008	3349
2009	1494
2010	3263

Table 1.12.2. Program performance with estimated smolt-to-adult survival rates.

Brood Year	Keta Complex Survival	Elliott Bay Net Pen Survival
1996	2.5%	2.7%
1997	12.1%	9.5%
1998	10.2%	7.2%
1999	10.7%	9.4%
2000	6.4%	5.8%
2001	10.3%	10.4%
2002	Data unavailable	8.4%
2003	7.5%	3.7%
2004	9.6%	6.4%
2005	8.7%	7.8%
2006	6.3%	5.1%
2007	1.0%	1.7%
2008	6.5%	4.7%

Data Source: Pacific States Marine Fisheries Commission (PSMFC) Regional Mark Information System (RMIS) web site: (http://www.rmpc.org). Information current as of January 30, 2013.

Table 1.12.2. Recent average distribution of annual harvest mortality for the years 2005-2011.

Alaska	Canada	Oregon	WA ocean	Pre- terminal net & troll	PS sport	Terminal net	Escapement
0.000	0.026	0.002	0.028	0.023	0.113	0.550	0.257

Data Source: Pacific States Marine Fisheries Commission's (PSMFC) Regional Mark Information System (RMIS) web site: (http://www.rmpc.org). Information current as of January 30, 2013.

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

Crisp Creek releases – 1975
Elliott Bay Tribal Net Pens – 1993
Supplemental rearing facility at RM 60.5 – expected start of operation unknown

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 rejected due to capacity constraints, and an increased risk of loss within the hatchery when relying on a single facility for production. Potential alternative actions to produce comparable coho salmon abundance for harvest are limited. Reliance on natural production to attain program goals is infeasible given the extent of habitat loss and degradation over a large proportion of the historic coho salmon distribution in the watershed. Existing urban development, altered stream hydrology, contaminated runoff, high land costs, and conflicting water and land uses limit the opportunities to protect and restore sufficient areas of properly functioning habitat and natural processes, and for these reasons this approach is not being proposed.

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS

2.1) List all ESA permits or authorizations in hand for the hatchery program.

This HGMP is being submitted to NOAA Fisheries for ESA consultation, and determination regarding compliance of the plan with ESA section 4(d) rule criteria for joint state/tribal hatchery resource management plans affecting listed Chinook salmon and steelhead.

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) <u>Status of NMFS ESA-listed salmonid population(s) affected by the program.</u>

- **Describe the status of the listed natural population(s) relative to "critical" and "viable" population thresholds**

Puget Sound Chinook ESU, Green-Duwamish 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 those 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 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 Co-managers' 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 Creek). MIT currently traps juveniles on Soos Creek 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. 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 juvenile migrant Chinook (sub-yearling) in the Green River above and below WDFW juvenile trap (Rkm 55), and in Soos Creek 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, WDFW 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. *(Include estimates of juvenile habitat seeding relative to capacity or natural fish densities, if available).*

Table 2.2.2.6. Mainstem 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. 2011.

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) <u>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.</u>

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

Broodstock Collection, Handling, and Holding: Broodstock for this program are collected at the WDFW Soos Creek Hatchery, the Keta Creek Complex, and a small proportion from the Tacoma Water headworks trap**.** Adult returns to the Keta Creek Complex volitionally enter a trap located in the hatchery outlet channel to Crisp Creek. The on-station broodstock is integrated by including NORs collected at the Tacoma Water headworks trap on the Green River at river mile 60.9. Coho broodstock collection at all facilities in the watershed takes place between October and December, overlapping the latter part of the Chinook run. Chinook salmon are collected as broodstock at Soos Creek Hatchery concurrently with coho salmon during this overlap period, and take effects on listed species at the hatchery are addressed in WDFW's Soos Creek Hatchery Coho and Fall Chinook HGMPs. There are no naturally-spawning Chinook or steelhead in Crisp Creek, and no take effects for listed fish are expected during broodstock collection, handling, and holding at the tribal facility.

Broodstock Spawning/Pathology Sampling: No listed salmonids in the Duwamish-Green River system will be affected by coho salmon 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. Also please see Soos Creek Coho HGMP submitted by WDFW.

Rearing Program: NWIFC pathologists monitor fish health each month at Keta Creek Complex, and during the final saltwater rearing phase at the Elliott Bay Net Pens. Releases of coho yearlings into the Duwamish-Green River system are consistent with Co-Managers Washington Fish Health Policy (NWIFC and WDFW 2006) protocols and standards to minimize the risks of fish disease pathogen transfer and amplification risk for 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 is 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. This program is 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: The Keta Creek Complex hatchery coho program has no monitoring activities that would adversely affect ESA listed species.

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. 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: Almost half of the yearlings reared at the Keta Creek Complex are transferred to Elliott Bay Net Pens for release in saltwater, eliminating the risk of interactions between these fish and listed species in freshwater. Elliott Bay Net Pen coho are reared and released in a manner to minimize potential negative impacts on listed fish populations, and are released from deeper water where Chinook juveniles are not expected (see Section 10.11). The remaining coho yearlings are released on- site into Crisp Creek which enters the Green River at RM 40.1.

Predation: Marine Environment. 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 coho yearling 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 the program is 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 OBJECTIVES

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

The program is 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 also 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.

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.

The program supports harvest objectives by providing treaty and non-treaty harvest opportunity for coho salmon in the Green River and in Puget Sound and other marine waters. Hatchery escapement is the primary harvest management unit for Green River coho. Natural coho in the Green River are a secondary management unit. The following table shows fisheries contributions from the Keta Complex coho yearling program for brood years 1997-2008. The percent adult survival rate represents the proportion (%) of recovered Keta Creek coho harvested in each fishery.

Table 3.3.1.1 Keta Creek Complex coho fishery contributions (CWT recoveries) for BY 1997- 2008

Total CWT Released		**Total CWT Recovered**	**Smolt-to-Adult Survival**
622,928		46,206	7.42%
Non -WA Fishery	**Agency**	**Number of CWT Recovered**	**Percent Adult Survival Rate**
Adults			
All	CDFO	748	1.62
All	ODFW	146	0.32
Washington State Fishery			
10-Ocean Troll	WDFW	54	0.12
15-Treat Troll	WDFW	532	1.15
23-PS Net	WDFW	17,439	37.85
41-Ocean Sport-Charter	WDFW	329	0.71
42-Ocean Sport-Private	WDFW	912	1.98
45-PS Sport	WDFW	4,548	9.87
46-Freshwater Sport	WDFW	234	0.51
50-Hatchery Escapement	WDFW	15,760	34.20
62-Test Fishery Seine	WDFW	2	0.00
50-Hatchery Escapement	NIFC	5,374	11.66
	Total	**46,078**	**100**
Jacks			
23-PS Net	WDFW	12	0.03
45-PS Sport	WDFW	20	0.04
50-Hatchery Escapement	WDFW	80	0.17

50-Hatchery Escapement	NIFC	16	0.03
	Total	**128**	**0.28**

Data source: RMIS data base

The estimated total incidental harvest rate is consistent with a management target of less than 5% of catch on non-target species.

3.4) Relationship to habitat protection and recovery strategies.

The hatchery coho yearling program provides treaty and non-treaty harvest opportunity in light of habitat loss and degradation limiting natural production in the Green Duwamish River basin (WRIA 9) streams and Puget Sound. Howard Hanson Dam near river mile 64 is an impassable barrier to fish migration and prevents natural production of salmonids into over 100 miles of stream habitat in the upper Green River watershed. This federally-owned dam currently lacks fish passage facilities. Plans to construct a safe downstream passage outlet are on hold due to a lack of federal funds. The survival rates associated with any future juvenile fish passage at the dam are uncertain. Project feasibility studies associated with additional water storage initiated in 2006 predicted in-reservoir migration delay and reduced fish guidance efficiency with increasing spring water storage (Dilley and Wunderlich, 1992 and 1993). The majority of the lower half of the accessible basin is highly developed, channelized, and/or industrialized. Ninety eight percent of the historic estuary has been lost to development. Riprap and other structures line the intertidal and marine shorelines, along with levees and revetments in the middle and lower river. Agriculture and urban development have degraded the hydrology, water quality, floodplain, channel diversity, and riparian areas of most lowland streams, reducing the potential for natural production over much of the historic coho distribution. Toxic stormwater runoff from developed lands and roads is associated with high pre-spawning mortality in coho salmon, and this effect is predicted over a large extent in Central Puget Sound (Feist et al., 2011; Spromberg and Scholz 2011). Water temperatures in the lower Green River have exceeded lethal levels for salmonids at times and riparian areas are shade deficient, particularly along the lower mainstem (Coffin et al., 2011). 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 in WRIA 9 by tribal, state, local and federal governments to try to protect and improve instream flows, water quality, fish passage, near-shore, riparian 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. A number of habitat restoration actions were initiated under the 2001 Tacoma Water Green River Habitat Conservation Plan in the upper river, and a Superfund cleanup plan is being developed to address toxic contamination of Duwamish River sediments. The net cumulative effect of these activities is uncertain, and salmon habitat was reported to be in continued decline since the adoption of the Puget Sound Chinook Recovery Plan (M. Judge, 2011).

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 Keta Creek Complex hatchery yearling 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.

The Keta Creek complex operates on surface water from Crisp Creek and on groundwater spring sources. Crisp Creek itself is fed by groundwater recharge and springs that discharge to the creek. Water yield is naturally limited and varies by season. Water reuse capacity was recently added to the hatchery to accommodate potential program level increases. Water quality in Crisp Creek source meets most of Washington State's Class A standards, which are the current standards that apply to the creek. Available water quality data collected indicate that Crisp Creek meets State water quality standards for temperature, turbidity, dissolved oxygen, and pH. The supplemental rearing and acclimation facility site will rely on groundwater. The water source for the net pens is Elliott Bay. Maximum current velocity is 0.5 knots, and water sampling indicates that water quality is suitable for rearing.

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.

The Keta Creek Complex operates under NPDES Permit No. WAG-130020 with surface water usage regulated under permits S1-23839C, S1-24508C, S1- 22503C, and S1-22989C. The hatchery water intake structure is in compliance with NOAA Fisheries screening criteria (NMFS 1995, 1996). Water intake screening and structures are inspected several times each week to insure they are operating correctly. Anadromous fish are not present upstream of the adult trap on Crisp Creek. The Elliott Bay Net Pens are operated under a separate NPDES permit (Permit No. WAG-13200, facility no. WAG-13002) and dives are routinely conducted to check for any excess feed on the bottom of the net. To date, no waste accumulation has been observed under the net (Mike Huff, *personal communication*). A future supplemental rearing and release site to be located near RM 60 will comply with all Federal and State guidelines and permits when operational.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

At the Keta Creek Complex, broodstock are collected from Crisp Creek with an instream weir trap and a fish ladder that leads to three off-channel adult holding ponds.

Unmarked coho adults used for the program are collected at the Tacoma Water Headworks Trap and Haul Facility. Also see WDFW Soos Creek HGMP for details of broodstocking adults for coho juveniles that are transferred to the Keta Creek Complex program.

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

Fish are transported from Keta Creek Complex to the Elliott Bay Net Pens via WDFW fish hauling trucks with 1500 gallon tank capacity. Within the Keta Creek Complex, a 500 gallon tank on flatbed truck is used to transfer fish from the Keta Creek Hatchery to the Crisp rearing ponds. A 1000 gallon tanker truck is used to haul surplus fish to out-planting sites in the watershed. All fish transport containers are equipped with oxygen and aeration.

5.3) Broodstock holding and spawning facilities.

Broodstock are held in three 12' by 85' adult off-channel holding ponds until the fish are ripe and ready to be spawned. Each holding pond is outfitted with a crowder and a brail. The brail basket delivers the fish to a table and an electrical anesthesia basket. Upon anesthesia, fish are sorted based on ripeness and/or species then spawned. Non-selected fish are returned to the adult holding ponds or to the creek. Adults are spawned in a covered spawning area adjacent to the adult ponds. Completed in 2016, these new broodstock holding facilities replaced a former in-channel holding area.

5.4) Incubation facilities.

The incubation facilities consist of Heath trays (vertical incubators) and deep troughs.

5.5) Rearing facilities.

Rearing facilities consist of four 10' by 100' raceways, two 96' by 200' concrete ponds, 36 intermediate circulars 15' in diameter, five intermediate rearing tanks and six 4' by 40'rearing tanks. Elliott Bay Net Pens currently consists of one floating metal spar system that forms a rectangular net structure 125 feet by 50 feet by 25 feet deep, and is held in place by offshore anchors. The existing net pen structure is in need of replacement. Because the present net pen capacity is only 480,000 yearlings, the facility would require enlargement to meet the goal of 1 M smolts for this release location. The pens are used between March and June for final rearing of coho smolts. The netting is

removed when not in use.

5.6) Acclimation/release facilities.

Keta Creek Complex coho yearling on station releases are made directly into Crisp Creek. Coho yearlings transferred for final rearing to the Elliott Bay Net Pens are released directly from the pens into Puget Sound. See section 5.5 for facility description.

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.

The hatchery is equipped with a backup generator and adequate fuel supply in the event of a power outage. A caretaker lives on site to enable quick responses that occur outside of normal working hours. The final back-up for all facilities is direct release in case of complete loss of water supply.

Fish rearing is conducted in compliance with the co-managers Fish Health Policy (WDFW and WWTIT 1998, updated 2006). Adherence to artificial propagation, sanitation and disease control practices defined in the policy should reduce the risk of fish disease pathogen transfers.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

6.1) Source.

This stock originated from adults trapped in the Green River.

6.2) Supporting information.

6.2.1) History.

All coho used in the Keta Creek Complex program including juveniles transferred from the Soos Creek Hatchery have originated from the Green River. Some additional stocks were occasionally imported in the early days of hatchery operation at Soos Creek but their contribution was not significant. In 1975, the WDFW began the coho rearing program at Crisp ponds with juvenile transfers from the Soos Creek Hatchery. The ponds were taken over by the Muckleshoot Tribe in 1992.

6.2.2) Annual size.

The total maximum program release goal of up to 2.05 million coho smolts will require about 3,500 adults (1,400 adult pairs) collected from Crisp Creek, and approximately another 800 adults collected at the WDFW Soos Creek Hatchery for juveniles that are transferred to the Keta Creek Complex for the Elliott Bay Net Pen releases. (See Soos Creek Coho HGMP for adults required for transfers from Soos Creek Hatchery to the tribe.)

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

Approximately 5% of the broodstock used at Keta Creek Complex are from un-marked adults collected at the Tacoma Public Utilities trap and haul facility on the Green River. Efforts are being made to increase NORs in the broodstock at Soos Creek Hatchery. Past levels of natural origin fish in the broodstock are unknown.

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.

N/A

SECTION 7. BROODSTOCK COLLECTION

Note: Please refer to WDFW Soos Creek HGMP for information regarding broodstock collection for coho that are transferred from Soos Creek Hatchery to Keta Creek facilities.

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

Adults

7.2) Collection or sampling design.

Broodstock taken at the Keta Creek Complex are collected from adults returning to Crisp Creek trap throughout the entire run. Returns occur between late October and early December with peak spawning in November. Adults are not passed above the hatchery trap. Adults returning to the Tacoma Water Trap and Haul Facility enter a fish ladder that terminates in a sorting system where fish are selected for the program (un-marked) or passed back to the river (marked fish).

7.3) Identity.

Releases are mass marked with an adipose fin clip to allow identification of hatchery origin fish. Unmarked adult coho are incorporated into the spawning population.

7.4) Proposed number to be collected:

7.4.1) Program goal:

The maximum program release goal of up to 2.05 million yearling smolts will require about 3,500 adults (1,400 pairs) collected from Crisp Creek, and approximately another 800 adults collected at the WDFW Soos Creek Hatchery for juveniles that are transferred to the Keta Creek Complex for the Elliott Bay Net Pen releases. (See Soos Creek Coho HGMP for adults required for transfers from Soos Creek Hatchery to the tribe.) These numbers assume a1.5:1.0 male to female sex ratio at the hatchery rack.

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

Please refer to WDFW Soos Creek HGMP for information regarding broodstock collection for coho that are transferred from Soos Creek Hatchery to Keta Creek facilities.

Table 7.4.2.1. Keta Creek Complex coho broodstock collection.

Year	Adults Females	Adults Males	Jacks	Eggs
2007	56	58		124,450

2008	69	70		208,250
2009	106	106	2	241,360
2010	135	133	5	324,500
2011	235	237	12	476,000

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

Un-spawned adults are donated to tribal members (small quantity) and the rest are either sold to a carcass buyer for processing, or are outplanted live or transported as carcasses to watershed streams for nutrient enrichment.

7.6) Fish transportation and holding methods.

Unmarked adults from the Tacoma Water headworks trap and haul facility are transported in tank trucks equipped with oxygen supply. Fish are held in rearing tanks until ripe before spawning at Keta Creek Hatchery. Surplus adults are also transported in tanker trucks for release into watershed streams.

7.7) Describe fish health maintenance and sanitation procedures applied.

Standard fish health protocols are utilized, as defined in the current Co-manager Fish Health Policy (1998, 2006).

7.8) Disposition of carcasses.

Spawned fish are either donated to tribal members or sold to a carcass buyer. A small portion of the adult pond mortality is utilized for stream nutrient enhancement purposes.

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.

N/A

SECTION 8. MATING

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

8.1) Selection method.

Hatchery Origin Return (HOR) adults, males and females are chosen randomly from ripe fish. Matings are 1:1. To represent the total run of fish, adults are taken for spawning from the beginning, middle and end of the run. Unmarked adults from the Tacoma Water headworks fish trap are paired with hatchery adults for spawning.

8.2) Males.

Males are selected randomly from ripe fish. To ensure that the eggs are fertilized in the event that a male is not fully ripe or does not produce enough sperm, another male's gametes are used as a backup. If present, about 1% of males used are jacks.

8.3) Fertilization.

The eggs from one female are collected in a bucket and are fertilized with the sperm of one male and the mix is allowed to sit for 30 to 60 seconds. If the male is not fully ripe, another male is used. The fertilized eggs from four separate buckets are consolidated into one bucket and mixed gently (this also ensures fertilization of all eggs in case of weak sperm from any given male). The next step is the water hardening phase for one hour in buffered iodine 1:100 solution, after which the eggs go into the hatchery for incubation.

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.

N/A

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.

The egg take required to meet the maximum production goal is up to 2.6 million, not including additional eggs taken for the 600,000 finglerlings transferred from the WDFW Soos Creek Hatchery.

From green to the eye-up stage, the egg survival rate is about 80 to 90%. From eyed egg to ponding, the survival rate is 80 to 85%.

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

N/A

9.1.3) Loading densities applied during incubation.

Eggs are eyed in vertical incubators (Heath trays) at about 7,000 to 7,500 eggs per tray.

9.1.4) Incubation conditions.

Eggs are hatched with vexar substrate using Crisp Creek water mixed with Keta spring water.

9.1.5) Ponding.

Ponding takes place when the fry are about 95% buttoned-up. The timing of the ponding occurs around mid January to mid February depending on water temperatures.

9.1.6) Fish health maintenance and monitoring.

In order to control any fungus outbreak in the incubators, a 15 minutes formalin drip at 100 parts per million (ppm) is routinely conducted every other day, until the eggs are ready to hatch. Dead eggs are removed with the aid of a "Jen-sorter" power egg picker, as well as hand-picked as needed.

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 (2000-2011), or for years dependable data are available.

The mortality rate from fry to fingerling is about 5%. Fingerling to smolt mortality varies year to year from 5% up to about 20%, mainly from predators**.** Mortality during extended marine net pen rearing has ranged from .01% to 2.6%.

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

Goals established by the US Fish and Wildlife Service (Piper, 1982) are adhered to. Densities in the coho rearing ponds range from 0.44 to 0.57 lbs/ft^3. Elliott Bay net pen loading densities do not exceed 0.3 lbs/ft^{3}at grow-out.

9.2.3) Fish rearing conditions

Fish are transferred to ponds where feeding begins in the first week of August. Spring fed base flow in Crisp Creek provides about 5 c.f.s. to the ponds with typical flows during rearing ranging between 5 and 10 c.f.s. In that range, oxygen levels remain above 7.5 ppm and the water turnover rate is 5.8 hours to 2.9 hours at 2.5 c.f.s. per pond and 5.0 c.f.s. per pond, respectively. The Elliott Bay Net Pens are checked and fish are fed daily. A mortality dive occurs twice weekly or more to observe fish behavior, check for any uneaten food below pens, and repair predator net damage.

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.

At the Keta Creek Complex, coho are placed in the ponds in August at about 70-80 fish per pound (fpp). In mid-September 100,000 fish at 45-55 fpp are coded wire tagged (CWT). Fish are volitionally released into Crisp Creek starting the first week of May at 12-14 fpp. During the rearing period, fish are sampled once a month to determine the total biomass and make necessary changes to the percentage to body weight fed per day. Monthly growth data is recorded. At the Elliott Bay Net Pens, the gain in biomass over the 3-month rearing period ranges from 182 to 260 percent.

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

Not available.

9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (*average program performance*).

Depending on water temperature and size of fish, average percent body weight fed per day ranges from 0.5% and 3.0%. Fish are fed a dry diet throughout the rearing period. A specialized diet (Freshwater Transfer) is fed for the last 6 weeks of rearing before release. At the Elliott Bay Net Pens, coho started with Skretting 2.5 mm Nutra Transfer saltwater diet then switched to 2.5 mm Trout AB converted 1.2 pounds of food to 1.0 pound of fish. In the past several years, a dry diet using Biovita has resulted in a typical conversion of 0.8 to 1.

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

Fish are monitored on a daily basis for health concerns and inspected monthly by the Olympia Fish Health Center (NWIFC). Monthly monitoring exams include an evaluation of rearing conditions and lethal sampling of small numbers of juveniles to assess fish health status and to detect any pathogens of concern. Results are reported to hatchery managers along with recommendations for improving or maintaining fish health. In the event of disease, fish pathologists are available to diagnose problems and provide treatment recommendations. NWIFC pathologists work with hatchery crews to ensure the proper use of drugs and chemicals for treatment. Similarly, NWIFC pathologists monitor fish health at the saltwater net pens and sample fish mortalities and live fish.

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.

Not applicable at the Keta Creek Complex. The Elliott Bay Net Pens allow natural prey to be carried into the net for utilization by the coho yearlings.

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.

Coho yearlings: 1,000,000 into Crisp Creek
Coho yearlings: 1,000,000 into Elliott Bay from the Elliott Bay Net Pens
Coho yearlings: 50,000 in the Green River (from potential supplemental rearing site)

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

Table 10.2.1. Locations of proposed coho yearling releases.

	Keta Creek Complex	**Elliott Bay Net Pens**	**Supplemental Rearing Facility** *(potential)*
Stream, river, or watercourse	Crisp Creek (09.0113)	Elliott Bay	Green River (09.001)
Release Point	RM 1.1 on Crisp Creek, tributary to the Green River at RM 40.1	Near Pier 70 at Seattle waterfront	RM 60.5
Major Watershed	Green River WRIA 9	Green River WRIA 9	Green River WRIA 9
Basin or Region	Puget Sound	Puget Sound	Puget Sound

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

Table 10.3.1. Numbers and size of coho released from the Keta Creek Complex (2000 to 2012).

Release Year	**Brood Year**	**Yearlings**	**Average Size** (fpp)	**Release Dates**	**Tag Code**	**Brood Source**
2000	1998	194,180	17	5/2	210224	Big Soos Cr
2001	1999	195,000	12.1	5/7-10	210197	Big Soos Cr
2002	2000	345,085	10	5/6-10	210335	Big Soos Cr
2003	2001	290,000	15	5/1-7	210424	Big Soos Cr
2004	2002	280,000	17	5/3-10	n/a	Big Soos Cr
2005	2003	239,550	14	5/4	210578	Big Soos Cr
2006	2004	160,000	12	5/4-9	210636	Big Soos Cr
2007	2005	177,000	12	5/5-14	210432	Big Soos Cr
2008	2006	153,200	13	5/5-18	210721	Big Soos Cr
2009	2007	297,000 94,000	14 14	5/5-15 5/5-15	210794 210794	Big Soos Cr Crisp Cr
2010	2008	140,420 157,180	13 13	5/1-14 5/1-14	210830 210829	Big Soos Cr Crisp Cr
2011	2009	217,413 196,587	16.5 16.5	5/5-14 5/5-14	210890 210891	Big Soos Cr Crisp Cr /TPU trap
2012	2010	64,400 185,000	14 14	5/6-17 5/6-17	210988 210989	Big Soos Cr Crisp Cr / TPU trap
Average		**260,463**	**14**			

Table 10.3.2. Annual numbers and sizes of coho released from the Elliott Bay Net Pens (2000 to 2012).

Release Year	Start of saltwater rearing - Release date	Number released	Number CWT	Fish size (fpp)
2000	2/28 - 6/2	456,139	46,984	7.8
2001	3/5- 6/10	366,252	44,656	6.6
2002	3/4 - 5/21	279,809	48,323	9.0
2003	3/10 - 5/25	430,121	39,812	8.9
2004	3/9 - 6/2	297,393	49,730	7.0
2005	3/14 - 5/24	448,174	50,164	12.9
2006	2/21 - 6/13	307,653	51,447	8.4
2007	3/13 - 6/12	398,642	51,143	6.2
2008	data not available			
2009				
2010	3/16 - 5/14	401,267	47,592	10.0
2011	3/1 - 5/11	423,127	53,415	9.0
2012	2/27 - 5/22	379,538	50,601	10.0

Data source: Mike Huff, Suquamish Tribe Fisheries. Draft Elliott Bay Net Pen Project 2012 report.

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

See Tables 10.3.1 and 10.3.2 above for actual release dates. From Crisp Creek, coho are typically released during the first or second week of May, when fish behavior and appearance in the ponds indicate smolt migration readiness, i.e. crowding the screens, circling the pond, and silvery coloration. Since 2006, a Smith-Root tunnel fish counter is used as a replacement to the lower dam boards to allow the fish to be volitionally released and counted. Over the course of a week, the dam boards are pulled to lower the pond 5 inches a day to encourage the few remaining fish to pass through the counters. The Elliott Bay Net Pens have a zippered panel on the side that is un-zipped and the fish are allowed to swim out.

10.5) Fish transportation procedures, if applicable.

For saltwater rearing at the Elliott Bay Net Pens, coho are transported from the Crisp Creek Ponds at the Keta Creek Complex in WDFW transport trucks. While in the truck they are vaccinated against Vibriosis. The coho are transferred out to the net pens in a transport barge equipped with air stones and saltwater is pumped in to displace the freshwater the coho have been transported in.

10.6) Acclimation procedures

Fish reared at the future supplemental rearing facility in the Green River near RM 60 will be volitionally released on site after 2-3 months of acclimation/imprinting.

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

The Keta Creek Complex coho on-station releases are all adipose-clipped and 50,000 smolts are also coded-wire tagged. Another 50,000, or an average of 11% of the coho released from Elliott Bay Net Pens are coded-wire tagged (with a different code), and all are adipose-clipped. It is anticipated that additional numbers of fish will be coded-wire tagged when the program level increases to the proposed maximum production level. Marking protocol for the supplemental rearing 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.

The coho are inspected and certified as specified by the Pacific Northwest Fish Health Protection Committee (Co-Managers Agreement). For the net pen operation, NWIFC pathologists test a 60 fish sample on the day of saltwater transfer, and samples 60 fish before their release. Data is reported in standard fish health report format.

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

Fish will be released directly into Crisp Creek or the Green River. The net pen nets can be opened to release fish if a water quality problem (such as noxious algae) were to occur.

10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.

The coho yearling salmon are reared and released in a manner to minimize potential negative impacts on listed salmonid populations. These measures include 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, thereby minimizing interactions in freshwater with listed fish. Yearling coho are reared for an extended period and released from the Elliot Bay Net Pens in late May or mid-June (as late as possible) to minimize the impact on migrating Chinook.

Coho releases made on-station in Crisp Creek are released as actively migrating smolts in May at an average fork length of 140 mm. The proposed smolts-only production release approach, the lower middle watershed release location, and May release timing minimize

the likelihood for substantial temporal and spatial overlap with listed juvenile fish of a size vulnerable to predation. Hatchery coho yearlings released as smolts have been shown to exit freshwater areas and move seaward rapidly after release, limiting the duration of any interactions with natural-origin fish. Over half of the natural-origin Chinook outmigration has occurred by the proposed May release time (Seiler et al, 2002). Juvenile outmigrant trapping data collected by WDFW (Seiler et al. 2002; 2003) indicates that natural-origin Chinook salmon emigrating in May in the Green River have grown to a body size that makes them less vulnerable to predation by hatchery yearling coho in freshwater areas where the species may interact. Release of smolts from the supplemental rearing facility would also occur in May to minimize the risk of predation on outmigrating Chinook salmon.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

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

See table 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.

Currently, CWT tagging is used to calculate the hatchery program's contribution rates to harvest and escapement, 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. Mass marking of coho salmon allows monitoring of the migration timing, rate, and behavior of yearling coho post-release through 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

Research related to the coho yearling program is not being conducted at this time.

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:** Keta Creek Complex Coho Yearling Program				
Location of hatchery activity: Crisp Creek/Elliott Bay/Green-Duwamish R. **Dates of activity:** Year round **Hatchery program operator:** Muckleshoot Tribe and Suquamish 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)	-	-	10	-
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:** Keta Creek Complex Coho Yearling Program

Location of hatchery activity: Crisp Creek/Elliott Bay/Green-Duwamish R. **Dates of activity:** Year round **Hatchery program operator:** Muckleshoot Tribe and Suquamish 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)	-	100	10	-
Capture, handle, tag/mark/tissue sample, and release d)	-	-	-	-
Removal (e.g. broodstock) e)	-	-	-	-
Intentional lethal take f)	-	-	-	-
Unintentional lethal take g)	-	100	10	-
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. (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). However, 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). No bull trout have been documented in Crisp Creek nor have any been encountered at the Keta/Crisp Creek trap or any other hatchery facilities since the hatchery began operations in 1975.

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 in the Green Duwamish can support bull trout. While water temperatures in the lower basin are often unsuitable for this species, however it is possible that some suitable habitat may still be available the upper watershed above Howard Hanson Dam. It is not known if bull trout occupied the upper watershed in the past; they do not appear to be present now (Watson and Toth 1994). 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; however the hatchery operations and facilities for this program do not fall within the critical habitat for any of these species. As a result, no effects are anticipated for these species.

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

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

Candidate Species
Fisher *(Martes pennanti)* – West Coast DPS
North American wolverine *(Gulo gulo luteus)* – contiguous U.S. DPS
Oregon spotted frog *(Rana pretiosa)* [historic]
Yellow-billed cuckoo *(Coccyzus americanus)*
Whitebark pine *(Pinus albicaulis*)

15.3) Analyze effects.

Hatchery activities, including broodstock collection at the Green River at the Tacoma Headworks adult fish trap (typically 25 pair of unmarked/natural origin coho), broodstock collection at the Soos Creek hatchery weir and at the Keta Creek hatchery weir on Crisp Creek; water withdrawals, water discharges, and hatchery water intake structures may pose a risk to any bull trout that might be in proximity to these facilities. However, the risk to bull trout populations is expected to be low as bull trout are not documented in Crisp Creek nor have any been encountered at the Keta/Crisp Creek trap or any other hatchery facilities since the hatchery began operations in 1975.

Bull trout have not been encountered at the Tacoma Headworks adult fish trap or reported to be observed in the vicinity of the trap. The trap has been operated by Tacoma Water on a limited basis for various purposes since 2007. Fish collections conducted in 2008 and 2009 at the Tacoma Water Headworks Adult Trap for the period from mid- September to mid- November for which tables documenting fish species, number, origin, and disposition of fish were prepared show that no bull trout were collected (Greg Volkhardt, Tacoma Water, unpublished data). Risk

to bull trout related to the collection of coho broodstock at Soos Creek is addressed in WDFW's Soos Creek Coho HGMP.

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

The Keta Creek complex operates on surface water from Crisp Creek and on groundwater spring sources. Water withdrawals from Crisp Creek and from tributary springs to Crisp Creek are non-consumptive, and do not exceed the rates authorized by existing state water rights certificates. The risk to bull trout from water withdrawals is low as the water supplied to the hatchery is non consumptive and returns to the Creek a very short distance from where it is withdrawn, and continuous streamflow is maintained in the Crisp Creek channel between the intakes.

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.

The Keta Creek Complex broodstock collection facilities on Crisp Creek are checked at least once daily when operating. In the event that bull trout are encountered at the Keta Creek complex hatchery weir/trap, they would immediately be returned to Crisp Creek. Any bull trout encountered in the broodstock collection facility will be recorded and reported to USFWS.

Hatchery operations comply with NPDES permit and water quality monitoring requirements to avoid or limit adverse effects on water quality.

Water withdrawals from Crisp Creek are non-consumptive and limited to the rates authorized by existing state water rights certificates. Surface flow will be retained in the Crisp Creek channel between the intakes to maintain the health of the creek.

The two intake structures that supply water from Crisp Creek to the rearing ponds and tanks are screened in compliance with current state and federal agency fish protection criteria. Water intake screening and structures are 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 Crisp Creek, and reported to USFWS.

Program facilities are 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

Northwest Indian Fisheries Commission (NWIFC) and Washington State Department of Fish and Wildlife (WDFW). 2006. Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State. Washington Department of Fish and Wildlife and Western Washington Treaty Indian Tribes, Olympia Washington.

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